Offline User Manual

Release 22909

Offline Group

May 16, 2014

CONTENTS

1 Introduction **3**
- 1.1 Intended Audience . . . 3
- 1.2 Document Organization . . . 3
- 1.3 Contributing . . . 3
- 1.4 Building Documentation . . . 3
- 1.5 Typographical Conventions . . . 4

2 Quick Start **5**
- 2.1 Offline Infrastructure . . . 5
- 2.2 Installation and Working with the Source Code . . . 5
- 2.3 Offline Framework . . . 6
- 2.4 Data Model . . . 6
- 2.5 Detector Description . . . 6
- 2.6 Kinematic Generators . . . 6
- 2.7 Detector Simulation . . . 6
- 2.8 Quick Start with Truth Information . . . 6
- 2.9 Electronics Simulation . . . 8
- 2.10 Trigger Simulation . . . 8
- 2.11 Readout . . . 8
- 2.12 Event Display . . . 9
- 2.13 Reconstruction . . . 11
- 2.14 Database . . . 11

3 Analysis Basics **13**
- 3.1 Introduction . . . 13
- 3.2 Daya Bay Data Files . . . 13
- 3.3 NuWa Basics . . . 32
- 3.4 NuWa Recipes . . . 33
- 3.5 Cheat Sheets . . . 42
- 3.6 Hands-on Exercises . . . 58

4 Offline Infrastructure **61**
- 4.1 Mailing lists . . . 61
- 4.2 DocDB . . . 61
- 4.3 Wikis . . . 61
- 4.4 Trac bug tracker . . . 61

5 Installation and Working with the Source Code **63**
- 5.1 Using pre-installed release . . . 63
- 5.2 Instalation of a Release . . . 63
- 5.3 Anatomy of a Release . . . 64

5.4 Version Control Your Code . . . 64
5.5 Technical Details of the Installation . . . 65

6 Offline Framework **67**
6.1 Introduction . . . 67
6.2 Framework Components and Interfaces . . . 67
6.3 Common types of Components . . . 68
6.4 Writing your own component . . . 68
6.5 Properties and Configuration . . . 69

7 Data Model **79**
7.1 Overview . . . 79
7.2 Times . . . 80
7.3 Examples of using the Data Model objects . . . 81

8 Data I/O **83**
8.1 Goal . . . 83
8.2 Features . . . 83
8.3 Packages . . . 84
8.4 I/O Related Job Configuration . . . 84
8.5 How the I/O Subsystem Works . . . 84
8.6 Adding New Data Classes . . . 85

9 Detector Description **93**
9.1 Introduction . . . 93
9.2 Conventions . . . 94
9.3 Coordinate System . . . 96
9.4 XML Files . . . 97
9.5 Transient Detector Store . . . 97
9.6 Configuring the Detector Description . . . 97
9.7 PMT Lookups . . . 97
9.8 Visualization . . . 97

10 Kinematic Generators **99**
10.1 Introduction . . . 99
10.2 Generator output . . . 99
10.3 Generator Tools . . . 99
10.4 Generator Packages . . . 99
10.5 Types of GenTools . . . 100
10.6 Configuration . . . 100
10.7 MuonProphet . . . 103

11 Detector Simulation **107**
11.1 Introduction . . . 107
11.2 Configuring DetSim . . . 107
11.3 Truth Information . . . 108
11.4 Truth Parameters . . . 119

12 Electronics Simulation **121**
12.1 Introduction . . . 121
12.2 Algorithms . . . 123
12.3 Tools . . . 123
12.4 Simulation Constant . . . 124

13 Trigger Simulation **127**

13.1 Introduction . . . 127
13.2 Configuration . . . 127
13.3 Current Triggers . . . 128
13.4 Adding a new Trigger . . . 128

14 Readout **131**
14.1 Introduction . . . 131
14.2 ReadoutHeader . . . 131
14.3 SimReadoutHeader . . . 133
14.4 Readout Algorithms . . . 133
14.5 Readout Tools . . . 133

15 Simulation Processing Models **135**
15.1 Introduction . . . 135
15.2 Fifteen . . . 135

16 Reconstruction **145**

17 Database **147**
17.1 Database Interface . . . 147
17.2 Concepts . . . 147
17.3 Running . . . 152
17.4 Accessing Existing Tables . . . 156
17.5 Creating New Tables . . . 162
17.6 Filling Tables . . . 168
17.7 ASCII Flat Files and Catalogues . . . 174
17.8 MySQL Crib . . . 176
17.9 Performance . . . 179

18 Database Maintanence **181**
18.1 Introduction . . . 181
18.2 Building and Running dbmjob . . . 182

19 Bibliography **185**

20 Testing Code With Nose **187**
20.1 Nosetests Introduction . . . 187
20.2 Using Test Attributes . . . 190
20.3 Running Tests Using dybinst . . . 192
20.4 Testing nose plugins . . . 193

21 Standard Operating Procedures **197**
21.1 DB Definitions . . . 198
21.2 DBI Very Briefly . . . 199
21.3 Rules for Code that writes to the Database . . . 204
21.4 Configuring DB Access . . . 206
21.5 DB Table Updating Workflow . . . 214
21.6 Table Specific Instructions . . . 226
21.7 DB Table Writing . . . 228
21.8 DB Table Reading . . . 236
21.9 Debugging unexpected parameters . . . 241
21.10 DB Table Creation . . . 243
21.11 DB Validation . . . 249
21.12 DB Testing . . . 252
21.13 DB Administration . . . 255

21.14 Custom DB Operations . . . 256
21.15 DB Services . . . 267
21.16 DCS tables grouped/ordered by schema . . . 269
21.17 Non DBI access to DBI and other tables . . . 282
21.18 Scraping source databases into *offline_db* . . . 285
21.19 DBI Internals . . . 304
21.20 DBI Overlay Versioning Bug . . . 319
21.21 DBI from C++ . . . 336

22 Admin Operating Procedures for SVN/Trac/MySQL **339**
22.1 Tasks Summary . . . 339
22.2 SVN/Trac . . . 349
22.3 Backups Overview . . . 349
22.4 Monitoring . . . 350
22.5 DbiMonitor package : cron invoked nosetests . . . 352
22.6 Env Repository : Admin Infrastructure Sources . . . 355
22.7 Dybinst : Dayabay Offline Software Installer . . . 358
22.8 Trac+SVN backup/transfer . . . 358
22.9 SSH Setup For Automated transfers . . . 361
22.10 Offline DB Backup . . . 362
22.11 DBSVN : dybaux SVN pre-commit hook . . . 364
22.12 Bitten Debugging . . . 366
22.13 MySQL DB Repair . . . 371

23 NuWa Python API **379**
23.1 DB . . . 379
23.2 DBAUX . . . 389
23.3 DBConf . . . 393
23.4 DBCas . . . 396
23.5 dbsvn - DBI SVN Gatekeeper . . . 397
23.6 DBSRV . . . 401
23.7 DybDbiPre . . . 410
23.8 DybDbi . . . 411
23.9 DybPython . . . 476
23.10 DybPython.Control . . . 476
23.11 DybPython.dbicnf . . . 477
23.12 DbiDataSvc . . . 479
23.13 NonDbi . . . 479
23.14 Scraper . . . 483
23.15 DybTest . . . 494

24 Documentation **497**
24.1 About This Documentation . . . 497
24.2 Todolist . . . 508
24.3 References . . . 509

25 Unrecognized latex commands **511**

26 Indices and tables **513**

Bibliography **515**

Python Module Index **517**

Index **519**

Version 22909

Date May 16, 2014

PDF `OfflineUserManual.pdf` (via reStructuredText and Sphinx)

Old PDF `main.pdf` (direct from latex)

CHAPTER

ONE

INTRODUCTION

1.1 Intended Audience

This manual describes how Daya Bay collaborators can run offine software jobs, extend existing functionality and write novel software components. Despite also being programmers, such individuals are considered "users" of the software. What is not described are internal details of how the offline software works which are not directly pertinent to users.

This document covers the software written to work with the Gaudi framework [1]. Some earlier software was used during the Daya Bay design stage and is documented elsewhere [g4dyb].

1.2 Document Organization

The following chapter contains a one to two page summary or "quick start" for each major element of the offline. You can try to use this chapter to quickly understand the most important aspects of a major offline element or refer back to them later to remind you how to do something.

Each subsequent chapter gives advanced details, describes less used aspects or expand on items for which there is not room in the "quick start" section.

1.3 Contributing

Experts and users are welcome to contribute corrections or additions to this documentation by commiting `.tex` or `.rst` sources. **However:**

> *Ensure latex compiles before committing into dybsvn*

1.4 Building Documentation

To build the plain latex documentation:

```
cd $SITEROOT/dybgaudi/Documentation/OfflineUserManual/tex
make plain      ## alternatively: pdflatex main
```

To build the Sphinx derived latex and html renderings of the documentation some non-standard python packages must first be installed, as described oum:docs. After this the Sphinx documentation can be build with:

[1] See chapter *Offline Framework*.

```
. ~/v/docs/bin/activate     # ~/v/docs path points to where the "docs" virtualpython is created
cd $SITEROOT/dybgaudi/Documentation/OfflineUserManual/tex
make
```

1.5 Typographical Conventions

This is bold text.

CHAPTER

TWO

QUICK START

2.1 Offline Infrastructure

2.2 Installation and Working with the Source Code

2.2.1 Installing a Release

1. Download `dybinst` [1].
2. Run it: `./dybinst RELEASE all`

The `RELEASE` string is `trunk` to get the latest software or `X.Y.Z` for a numbered release. The wiki topic wiki:Category:Offline_Software_Releases documents avilable releases.

2.2.2 Using an existing release

The easiest way to get started is to use a release of the software that someone else has compiled for you. Each cluster maintains a prebuilt release that you can just use. See the wiki topic wiki:Getting_Started_With_Offline_Software for details.

2.2.3 Projects

A project is a directory with a `cmt/project.cmt` file. Projects are located by the `CMTPROJECTPATH` environment variable. This variable is initialized to point at a released set of projects by running:

```
shell> cd /path/to/NuWa-RELEASE
bash> source setup.sh
tcsh> source setup.csh
```

Any directories holding your own projects should then be **prepended** to this colon (":") separated `CMTPROJECTPATH` variable.

2.2.4 Packages

A package is a directory with a `cmt/requirements` file. Packages are located by the `CMTPATH` environment variable which is **automatically** set for you based on `CMTPROJECTPATH`. You should **not** set it by hand.

[1] http://dayabay.ihep.ac.cn/svn/dybsvn/installation/trunk/dybinst/dybinst

2.2.5 Environment

Every package has a setup script that will modify your environment as needed. For example:

```
shell> cd /path/to/NuWa-RELEASE/dybgaudi/DybRelease/cmt/
shell> cmt config  # needed only if no setup.* scripts exist
bash> source setup.sh
tcsh> source setup.csh
```

2.3 Offline Framework

2.4 Data Model

2.5 Detector Description

2.6 Kinematic Generators

2.7 Detector Simulation

2.8 Quick Start with Truth Information

Besides hits, `DetSim`, through the `Historian` package can provide detailed truth information in the form of *particle histories* and *unobservable statistics*. These are briefly described next and in detail later in this chapter.

2.8.1 Particle History

As particles are tracked through the simulation information on where they traveled and what they encountered can be recorded. The particle history is constructed with tracks (`SimTrack` objects) and vertices (`SimVertex` objects). Conceptually, these may mean slightly different things than what one may expect. A vertex is a 4-location when something "interesting" happened. This could be an interaction, a scatter or a boundary crossing. Tracks are then the connection between two vertices.

Because saving all particle history would often produce unmanageably large results rules are applied by the user to specify some fraction of the total to save. This means the track/vertex hierarchy is, in general, truncated.

2.8.2 Unobservable Statistics

One can also collect statistics on unobservable values such as number of photons created, number of photon backscatters, and energy deposited in different ADs. The sum, the square of the sum and the number of times the value is recorded are stored to allow mean and RMS to be calculated. The same type of rules that limit the particle histories can be used to control how these statistics are collected.

2.8.3 Configuring Truth Information

The rules that govern how the particle histories and unobservable statistics are collected are simple logical statements using a C++ like operators and some predefined variables.

Configuring Particle Histories

The hierarchy of the history is built by specifying selection rules for the tracks and the vertices. Only those that pass the rules will be included. By default, only primary tracks are saved. Here are some examples of a track selection:

```
# Make tracks for everything that's not an optical photon:
trackSelection = "pdg != 20022"
# Or, make tracks only for things that start
# in the GD scintillator and have an energy > 1Mev
trackSelection =
  "(MaterialName == '/dd/Materials/GdDopedLS') and (E > 1 MeV)"
```

And, here are some examples of a vertex selection:

```
# Make all vertices.. one vertex per Step.
vertexSelection = "any"
# Make vertices only when a particle crosses a volume boundary:
vertexSelection = "VolumeChanged == 1"
```

As an aside, one particular application of the Particle Histories is to draw a graphical representation of the particles using a package called GraphViz [2]. To do this, put the `DrawHistoryAlg` algorithm in your sequence. This will generate files in your current directory named `tracks_N.dot` and `tracks_and_vertices_N.dot`, where `N` is the event number. These files can be converted to displayable files with GraphViz's dot program.

Configuring Unobservable Statistics

What statistics are collected and when they are collected is controlled by a collection of triples:

1. A name for the statistics for later reference.
2. An algebraic formula of predefined variables defining the value to collect.
3. A rule stating what conditions must be true to allow the collection.

An example of some statistic definitions:

```
stats = [
    ["PhotonsCreated" , "E" , "StepNumber==1 and pdg==20022" ]
   ,["Photon_bounce_radius" , "r" , "pdg==20022 and dAngle > 90" ]
   ,["edep-ad1"  ,"dE"  ,"pdg!=20022 and
      ((MaterialName == '/dd/Materials/LiquidScintillator' or
        MaterialName == '/dd/Materials/GdDopedLS') and AD==1)"  ]
   ]
```

2.8.4 Accessing the resulting truth information

The resulting Truth information is stored in the `SimHeader` object which is typically found at `/Event/Sim/SimHeader` in the event store. It can be retrieved by your algorithm like so:

```
DayaBay::SimHeader* header = 0;
if (exist<DayaBay::SimHeader>(evtSvc(),m_location)) {
   header = get<DayaBay::SimHeader>(m_location);
}
const SimParticleHistory* h = header->particleHistory();
const SimUnobservableStatisticsHeader* h = header->unobservableStatistics();
```

[2] http://graphviz.org

2.9 Electronics Simulation

2.10 Trigger Simulation

The main algorithm in TrigSim, `TsTriggerAlg` has 3 properties which can be specified by the user.

TrigTools `Default` : "TsMultTriggerTool" List of Tools to run.

TrigName `Default` : "TriggerAlg" Name of the main trigger algorithm for bookkeeping.

ElecLocation `Default` : "/Event/Electroincs/ElecHeader" Path of ElecSimHeader in the TES, currently the default is picked up from ElecSimHeader.h

The user can change the properties through the TrigSimConf module as follows:

```
import TrigSim
trigsim = TrigSim.Configure()
import TrigSim.TrigSimConf as TsConf
TsConf.TsTriggerAlg().TrigTools = [ "TsExternalTriggerTool" ]
```

The `TrigTools` property takes a list as an argument allowing multiple triggers to be specified. Once implemented, the user could apply multiple triggers as follows:

```
import TrigSim
trigsim = TrigSim.Configure()
import TrigSim.TrigSimConf as TsConf
TsConf.TsTriggerAlg().TrigTools = [ "TsMultTriggerTool" ,
                                    "TsEsumTriggerTool" ,
                                    "TsCrossTriggerTool" ]
```

2.11 Readout

The default setup for Readout Sim used the `ROsFecReadoutTool` and `ROsFeeReadoutTool` tools to do the FEC and FEE readouts respectivly. The default setup is as follows

```
import ReadoutSim
rosim = ReadoutSim.Configure()
import ReadoutSim.ReadoutSimConf as ROsConf
ROsConf.ROsReadoutAlg().RoTools=["ROsFecReadoutTool","ROsFeeReadoutTool"]
ROsConf.ROsFeeReadoutTool().AdcTool="ROsFeeAdcPeakOnlyTool"
ROsConf.ROsFeeReadoutTool().TdcTool="ROsFeeTdcTool"
```

where the Fee will be read out using the tools specified via the `TdcTool` and `AdcTool` properties. Currently the only alternate readout tool is the `ROsFeeAdcMultiTool` which readout the cycles specified in the `ReadoutCycles` relative to the readout window start. The selection and configuration of this alternate tool is

```
ROsConf.ROsFeeReadoutTool().AdcTool="ROsFeeAdcMultiTool"
ROsConf.ROsFeeAdcMultiTool().ReadoutCycles=[0,4,8]
```

2.12 Event Display

2.12.1 A Plain Event Display: EvtDsp

A plain event display module, EvtDsp, is available for users. It makes use of the basic graphic features of the "ROOT" package to show the charge and time distributions of an event within one plot. One example is shown in Fig. *fig:evtdsp*. A lot of features of ROOT are immediately available, like "save as" a postscript file. All PMTs are projected to a 2-D plain. Each PMT is represented by a filled circle. The radii of them characterize the relative charge differences. The colors of them show the times of them, i.e. the red indicates the smallest time and the blue indicates the largest time.

Simple Mode

One can use a default simple algorithm to invoke the EvtDsp module. The charge and time of the first hit of each channel will be shown. Once setting up the nuwa environment, the following commands can be used to show events.

```
shell> nuwa.py -n -1 -m EvtDsp DayaBayDataFile.data
shell> nuwa.py --dbconf "offline_db" -n -1 -m "EvtDsp -C" DayaBayDataFile.data
shell> nuwa.py -n -1 -m "EvtDsp -S" DayaBaySimulatedFile.root
```

where the first one, by default, will show the raw information, i.e. delta ADC (ADC-preADC) and TDC distributions from ReadoutHeader, the second one will show calibrated result, CalibReadoutHeader, in PE and ns, as seen in Fig. *fig:evtdsp* and the last line is for SimHeader, i.e. information is directly extracted from MC truth.

A simple readouts grouping was implemented. Readouts with delta trigger times within $2\mu s$ are considered as one event and shown together. But an event only allows one readout for one detector. For example a very close retrigger after an energetic muon in the same AD will start a new event. This algorithm also works for calibReadout and simHeader.

Advance Mode

One can also directly call the Gaudi Tool, EvtDsp, and plot the charges and times calculated in a different manner. In the simple mode, no selection is applied to select hits, however this is not the best choice in some cases, for example, some hits' times are out of the physically allowed window, like the blue hit in the inner water shield in Fig. *fig:evtdsp* seems like a noise hit. One can also make a selection in an analysis algorithm to show only a fraction of interesting events or have a different event grouping algorithm. To use this feature one need to follow the standard Gaudi procedure to locate a tool "EvtDsp" first, i.e., add use EvtDsp module in cmt requirements file

```
use EvtDsp v*  Visualization
```

then get access to this tool

```
#include "EvtDsp/IEvtDsp.h"

IEvtDsp* m_evtDsp
StatusCode sc = toolSvc()->retrieveTool("EvtDsp","EvtDsp",m_evtDsp);
```

After this three simple interfaces are available and they can be plugged into anywhere of a user code.

```
/// Plot AD
virtual StatusCode plotAD(DayaBay::Detector det,
                          double chrg[8][24],       double time[8][24],
                          const char* chrgunit = 0, const char* timeunit = 0,
                          const char* info = 0 ) = 0;

/// Plot pool
```

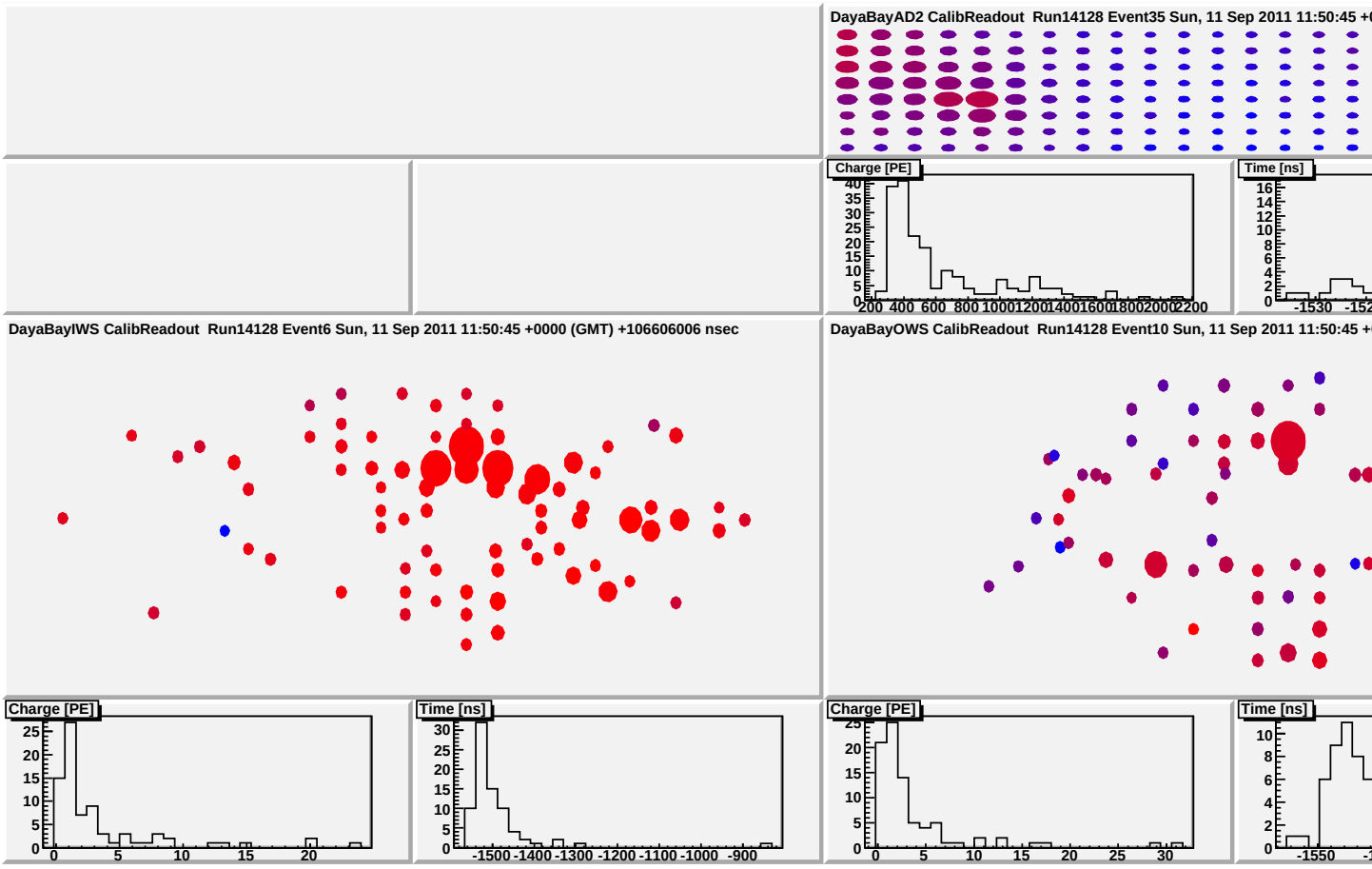


Figure 2.1: **fig:evtdsp**

A snapshot for EvtDsp for a muon event which passed outer and inner water pool and struck AD No. 2, while AD No. 1 was quiet. The time and charge patterns of the AD and water pool hits are clearly seen.

```
virtual StatusCode plotPool(DayaBay::Detector det,
                            double chrg[9][24][2],  double time[9][24][2],
                            const char* chrgunit = 0, const char* timeunit = 0,
                            const char* info = 0 ) =0;

/// A pause method for user. After this all displayed stuff will be flushed.
virtual StatusCode pause() = 0;
```

where for AD, chrg and time are arrays indexed by ring-1 and column-1, while for water pool, chrg and time arrays are indexed by wall-1,spot-1 and inward.

2.13 Reconstruction

2.14 Database

The content of this quickstart has been migrated to oum:sop/

CHAPTER

THREE

ANALYSIS BASICS

3.1 Introduction

This guide will help you analyze Daya Bay data. It contains a short description of the Daya Bay data and analysis software, called NuWa. It is not a detailed technical manual. In this document you can learn how to:

- Open a data file and see what it contains [Sec. *Opening data files*]
- Draw histograms of the data in the file [Sec. *Histogramming data*]
- Use NuWa to do more detailed calculations with the data [Sec. *NuWa Basics*]
- Write your own NuWa analysis module [Sec. *Change an Existing Job Module*]
- Write your own NuWa analysis algorithm [Sec. *Write a Python analysis Algorithm*]
- Select events using *tags* [Sec. *Tag Events in a NuWa File*]
- Add your own data variables to the data file [Sec. *Add Variables to a NuWa File*]
- Filter data based on data path or tag [Sec. *Copy Data Paths to a New File*]

A set of cheat-sheets are included. These give short descriptions of the data and other NuWa features.

3.2 Daya Bay Data Files

Daya Bay uses ROOT files for data analysis. Basic analysis can be done with these files using only the ROOT program (http://root.cern.ch). For more complex analysis, see the Section *NuWa Basics* on using NuWa. If you do not have ROOT installed on your computer, you can access it on the computer clusters as part of the NuWa software (Sec. *Loading the NuWa software*).

3.2.1 Opening data files

Daya Bay data files can be opened using the ROOT program,

```
shell> root
root[0] TFile f("recon.NoTag.0002049.Physics.DayaBay.SFO-1._0001.root");
root[1] TBrowser b;
root[1] b.BrowseObject(&f);
```

The ROOT browser window will display the contents of the file, as shown in Fig. *fig:tesbrowser*. Event data is found under the path `/Event`, as summarized in Table *Standard paths for Event Data*. A section on each data type is included in this document. Simulated data files may include additional data paths containing "truth" information. A complete list of data paths are given in Sec. *Data File Contents*.

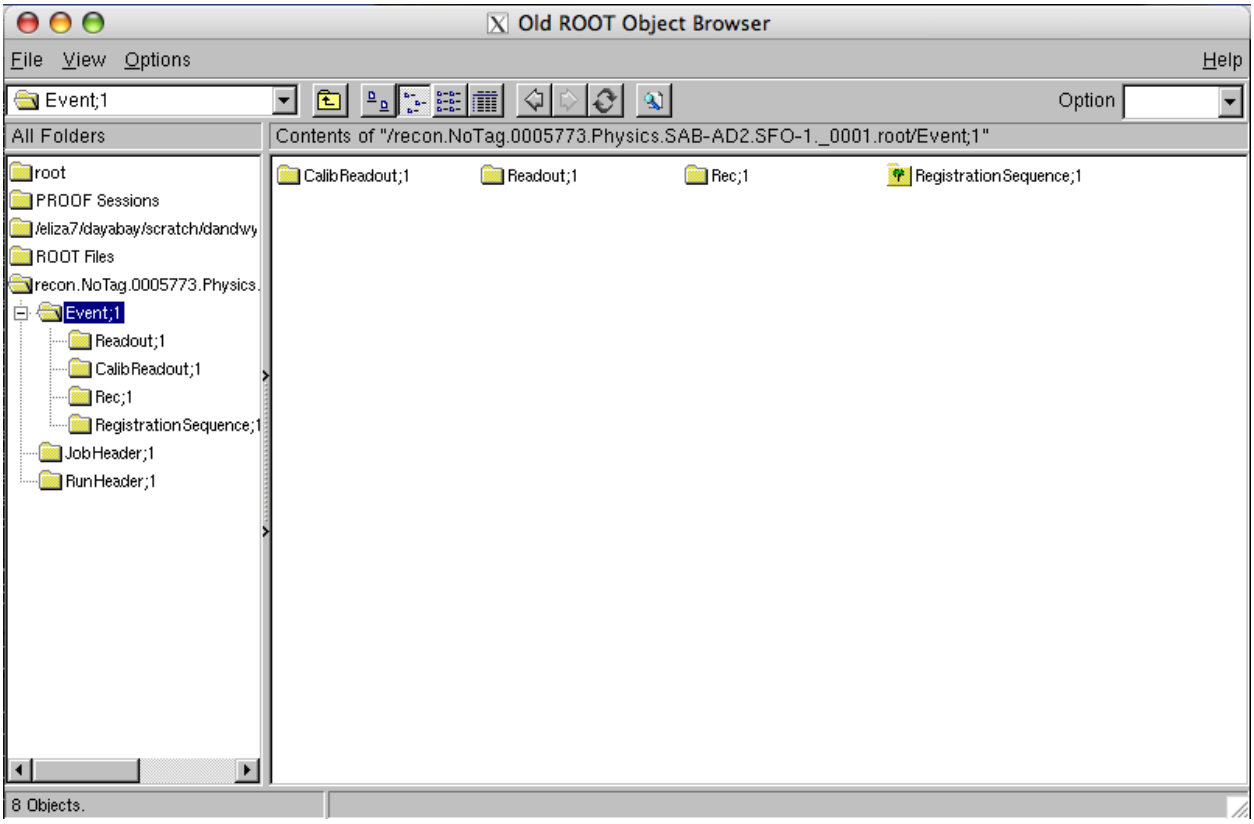


Figure 3.1: **fig:tesbrowser**
Data File Contents

Table 3.1: Standard paths for Event Data

	Real and Simulated Data	
/Event/Readout	Raw data produced by the experiment	Sec. *Raw DAQ Data*
/Event/CalibReadout	Calibrated times and charges of PMT and RPC hits	Sec. *Calibrated Data*
/Event/Rec	Reconstructed vertex and track data	Sec. *Reconstructed Data*
	Simulated Data Only	
/Event/Gen	True initial position and momenta of simulated particles	
/Event/Sim	Simulated track, interactions, and PMT/RPC hits (Geant)	
/Event/Elec	Simulated signals in the electronics system	
/Event/Trig	Simulated signals in the trigger system	
/Event/SimReadout	Simulated raw data	

A set of standard data ROOT files will be maintained on the clusters. The file prefix is used to identify the contents of the file, as shown in Table *Standard NuWa Event Data files*. The location of these files on each cluster are listed in Section *Standard Data Files*.

Table 3.2: Standard NuWa Event Data files

File Prefix	Readout	CalibReadout	Rec	Coinc	Spall	Simulation Truth (Gen,"Sim")
daq.	yes					optional
calib.	optional	yes				optional
recon.	some events	some events	yes			optional
coinc.	some events	some events	some events	yes		optional
spall.	some events	some events	some events		yes	optional

Each data paths in the ROOT file contains ROOT trees. You can directly access a ROOT tree,

```
root[0] TFile f("recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root");
root[1] TTree* AdSimple = (TTree*)f.Get("/Event/Rec/AdSimple");
```

The next section gives examples of working with these ROOT Trees. See the ROOT User's Guide for more details on working with Trees, http://root.cern.ch/download/doc/12Trees.pdf.

3.2.2 Histogramming data

Data can be histogrammed by selecting items in the TBrowser, or by using the Draw() function of the tree. For example, Figure *fig:reconbrowser* shows the data contained in a reconstructed event.

The Draw() function allows the addition of selection cuts. For example, we can draw the reconstructed energy for all events where the reconstruction was successful by selecting events with energyStatus==1 and energy < 15 MeV,

```
root[2] AdSimple->Draw("energy","energyStatus==1 && energy<15");
```

Two- and three-dimensional histograms can be drawn by separating the variables with a colon. The third colz argument will use a color scale for a two- dimensional histogram. Fig. *fig:reconhists* shows the resulting histograms.

```
root[3] AdSimple->Draw("z:sqrt(x*x+y*y)","positionStatus==1","colz");
```

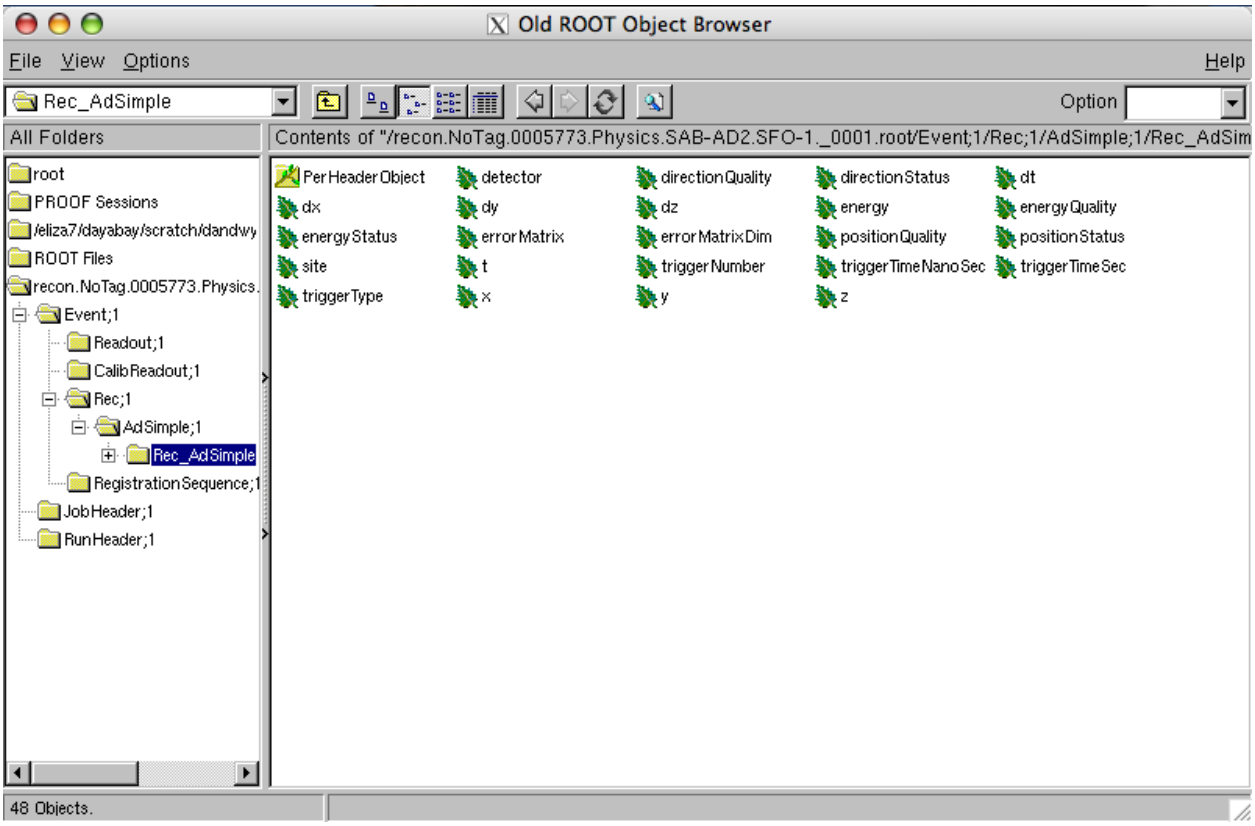


Figure 3.2: **fig:reconbrowser**
Example Reconstructed Data

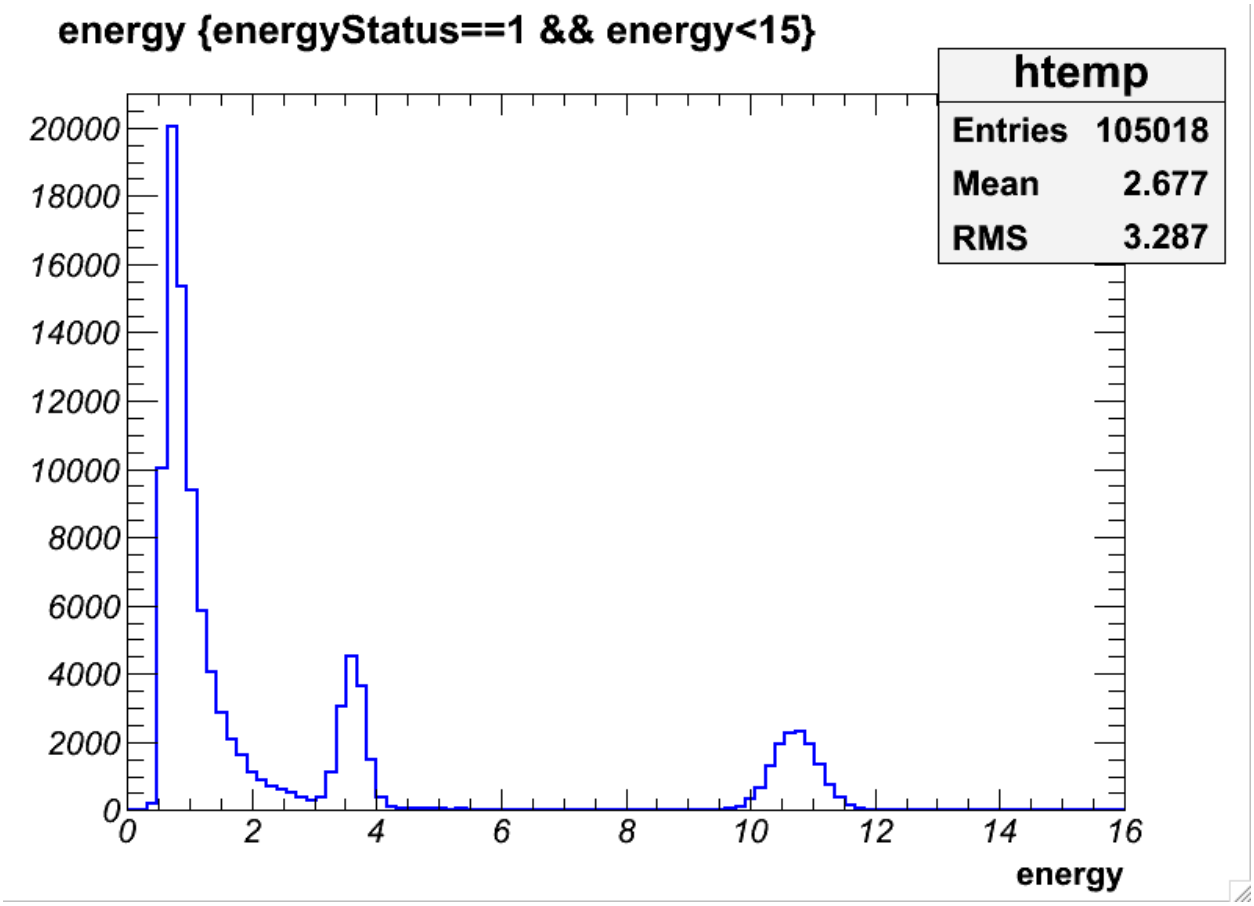


Figure 3.3: **fig:reconhists**

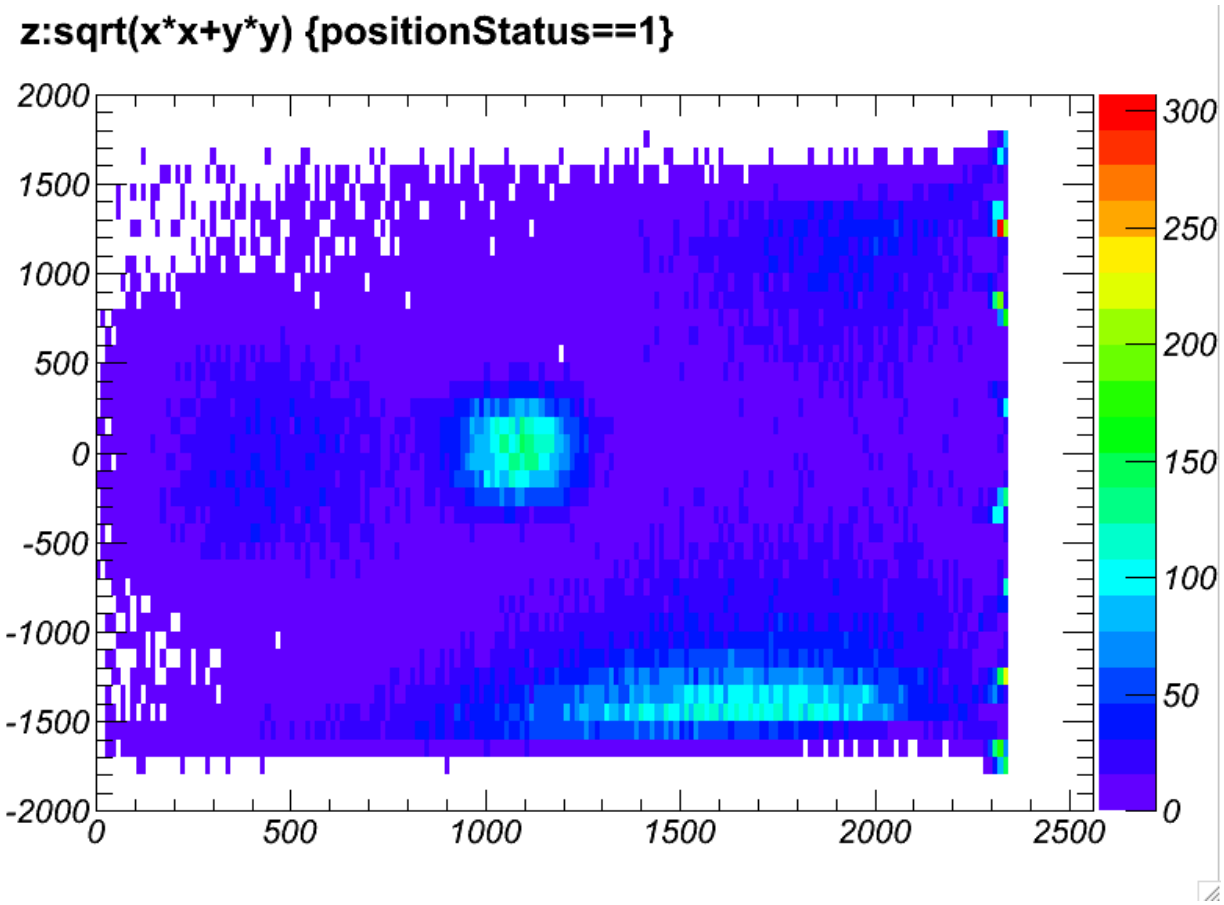


Figure 3.4: **fig:reconhists**
Example Histograms

A weighting can be added to each entry in histogram by multiplying your selection by the weighting factor (i.e. `weight*(selection)`. This can be used to draw the calibrated PMT charge distribution in `AD2` (Fig. *figs:calibhists*.) The charge distribution for a specfic event can be selected using the event number.

```
root[1] TTree* CalibReadoutHeader = (TTree*)f.Get("/Event/CalibReadout/CalibReadoutHeader");
root[2] CalibReadoutHeader->Draw("ring:column",
                                 "chargeAD*(detector==2)","colz")
root[3] CalibReadoutHeader->Draw("ring:column",
                                 "chargeAD*(detector==2 && eventNumber==12345)","colz")
```

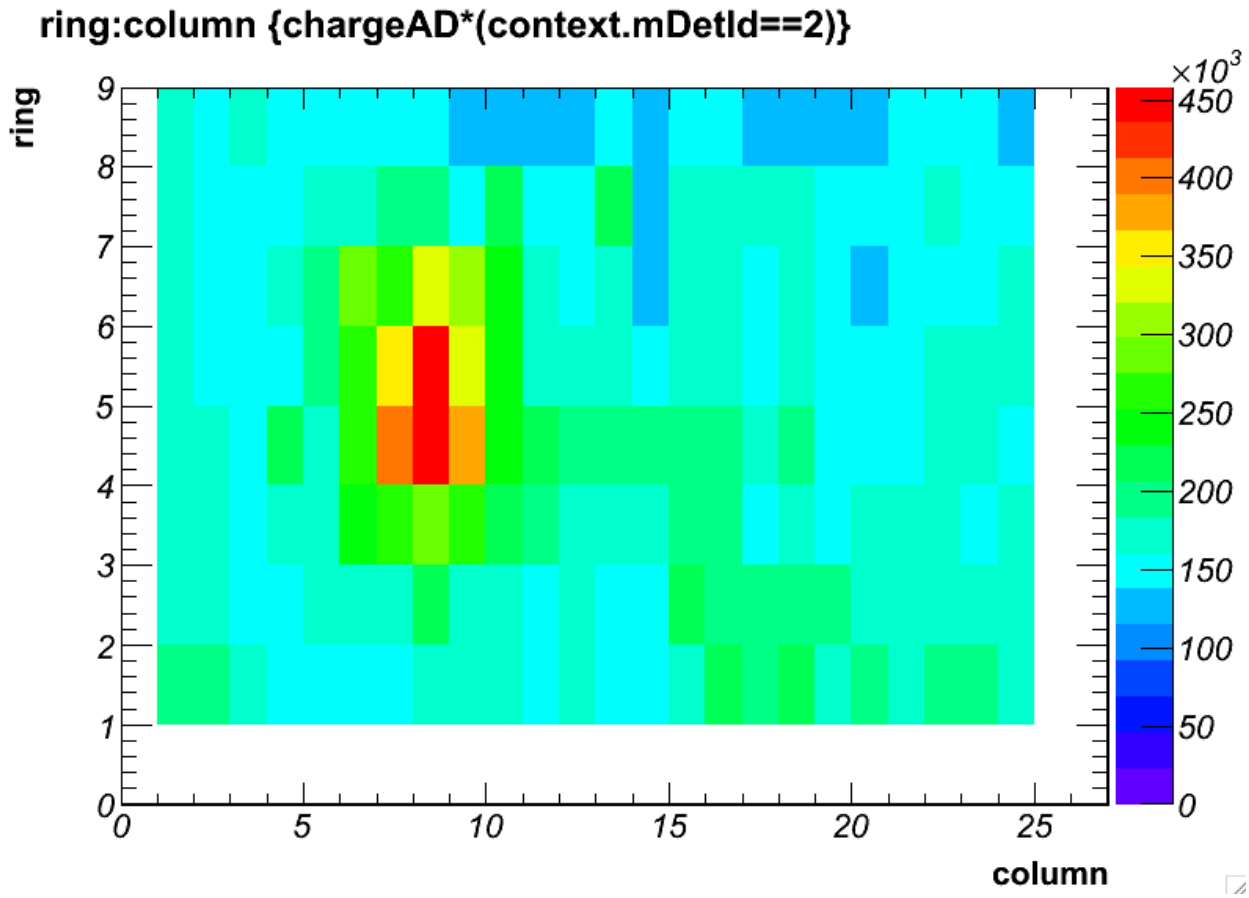


Figure 3.5: **fig:calibhists**

The trigger time is divided into two parts; a count of seconds from January 1970 (i.e. unixtime), and a precise count of nanoseconds from the last second. To draw the absolute trigger time, you must add these two counts. Figure *fig:chargevstimehist* shows a histogram of the calibrated PMT hit charges versus trigger time [1]. The ROOT `Sum$()` function will histogram the sum of a quantity for each event; it can be used to histogram the sum of charge over all AD PMTs.

```
root[2] CalibReadoutHeader->Draw("chargeAD:triggerTimeSec+triggerTimeNanoSec*1e-9",
        "(detector==2 && ring==4 && column==15 && chargeAD>-3 && chargeAD<7)",
        "colz");
root[3] CalibReadoutHeader->Draw("Sum$(chargeAD):triggerTimeSec+triggerTimeNanoSec*1e-9",
                                 "detector==2 && Sum$(chargeAD)<1500","colz");
```

[1] The trigger time can be converted to a readable Beijing local time format using the lines described in Sec. *Time Axes in ROOT*

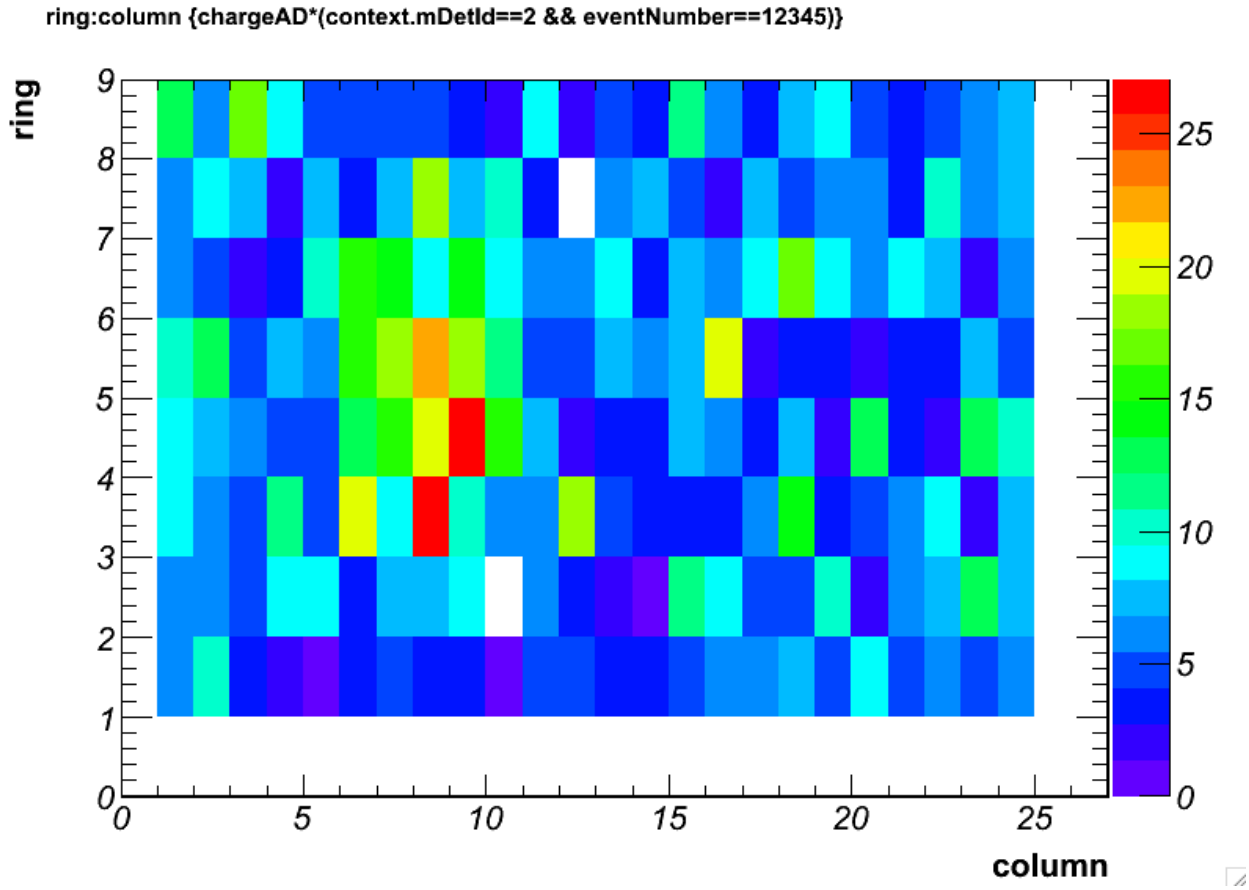


Figure 3.6: **fig:calibhists**
The calibrated PMT charge (in photoelectrons) for all events and for an individual event.

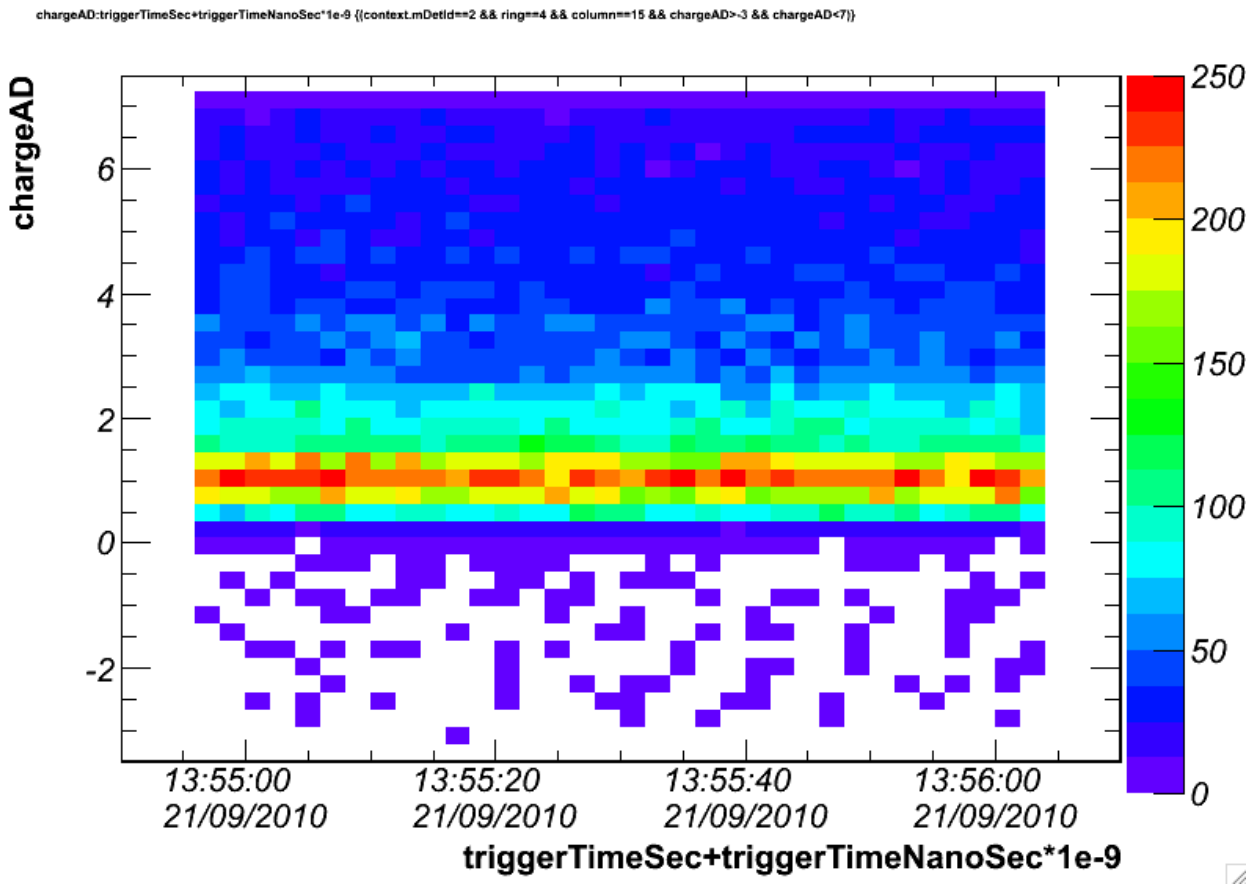


Figure 3.7: **fig:chargevstimehist**

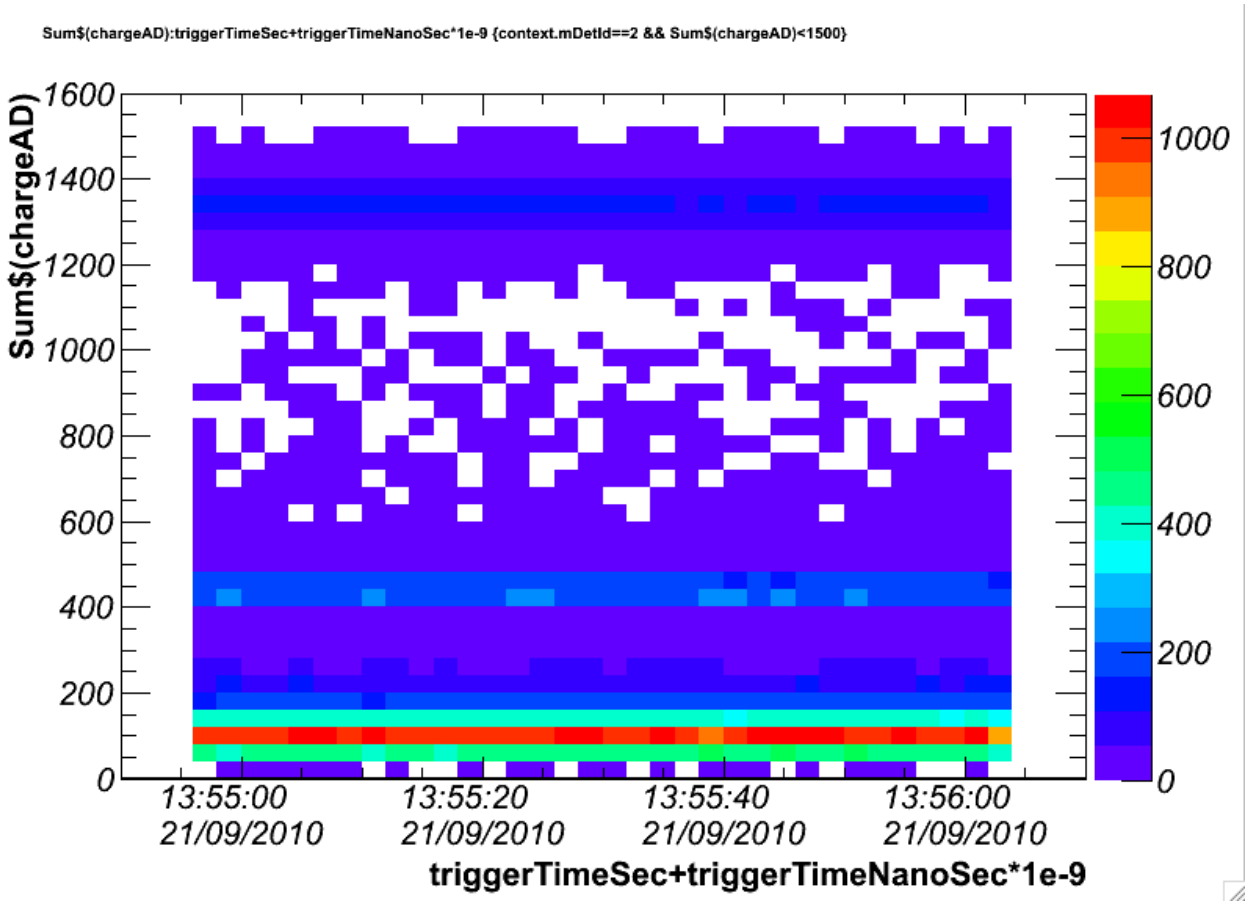


Figure 3.8: **fig:chargevstimehist**
The calibrated charge (in photoelectrons) for one PMT and for the sum of all PMTs versus trigger time.

3.2.3 Histogramming Raw DAQ data

To properly histogram raw DAQ data from `/Event/Readout`, you will need to use part of the Daya Bay software in addition to ROOT. You must load the NuWa software, as described in Sec. *Loading the NuWa software*. Running `load.C` will allow you to call functions in your `Draw()` command. For example, you can call the function to draw the raw fine-range ADC and TDC distributions for PMT electronics board 6, connector 5 (Fig. *fig:rawhists*.) The selection on `context.mDetId==2` selects the detector `AD2`; Sec. *Conventions and Context* lists the allowed detector and site IDs. If you have a raw `.data` file produced by the DAQ, see section *Conversion from .data* to wrap it in a ROOT tree so that you can directly histogram the raw data.

```
root[0] .x $ROOTIOTESTROOT/share/load.C
root[1] TFile f("daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root");
root[2] TTree* ReadoutHeader = (TTree*)f.Get("/Event/Readout/ReadoutHeader");
root[3] ReadoutHeader->Draw("daqPmtCrate().adcs(6,5,1).value()","context.mDetId==2");
root[4] ReadoutHeader->Draw("daqPmtCrate().tdcs(6,5,1).value()","context.mDetId==2");
```

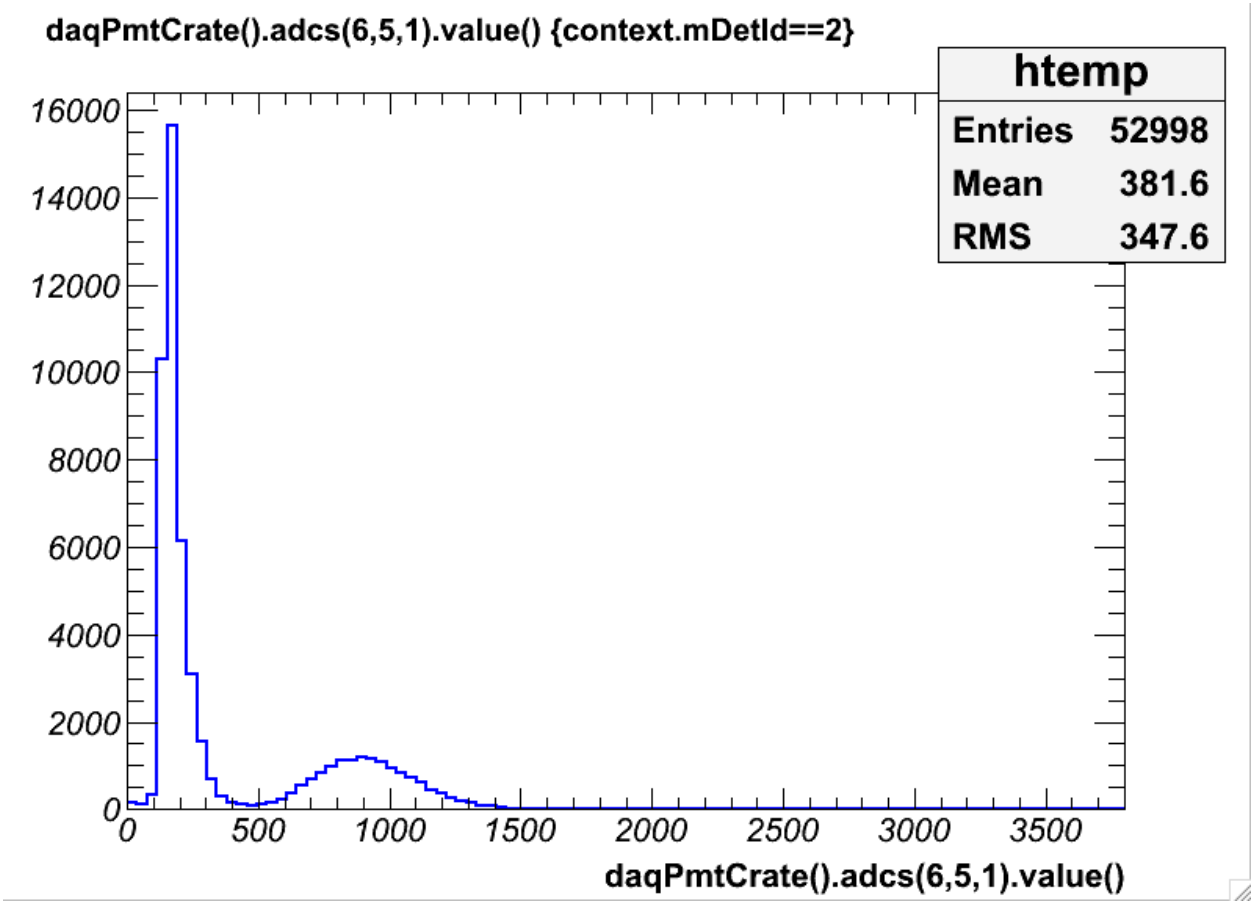


Figure 3.9: **fig:rawhists**

3.2.4 Some ROOT Tree Tricks

A ROOT `TChain` can be used to combine the trees of the same path from multiple files into one large tree. For example, if a data run produced two files, you can combine the trees from these files:

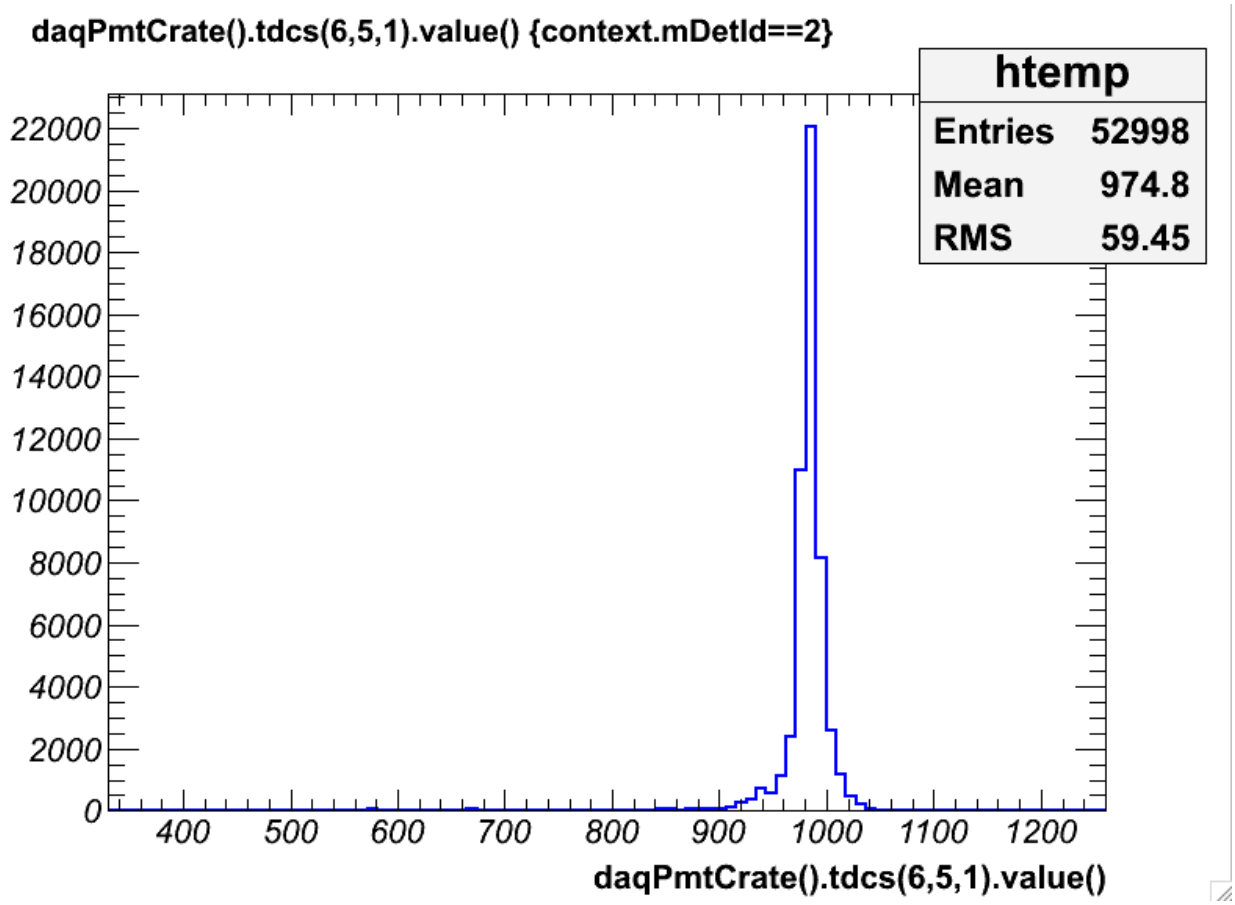


Figure 3.10: **fig:rawhists**
Histograms of Raw fine-range ADC and TDC values from PMT FEE board 6, connector 5.

```
root[0] TChain AdSimple("/Event/Rec/AdSimple");
root[1] AdSimple.Add("recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root");
root[2] AdSimple.Add("recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0002.root");
root[3] AdSimple.Draw("energy","energyStatus==1 && detector==2");
```

To combine all the variables from trees at different data paths into a single tree, you can use the `TTree::AddFriend()` function. This can be used to histogram or select using variables from both trees. This should only be done for trees that are synchronized. The raw, calibrated, and reconstructed data are generally synchronized, as long as the data has not been filtered. The simulated truth trees at `/Event/Gen` and `/Event/Sim` are generally not synchronized with the data trees since one simulated event may produce an arbitary number of triggered readouts.

```
root[1] TTree* CalibReadoutHeader = (TTree*)f.Get("/Event/CalibReadout/CalibReadoutHeader");
root[2] TTree* AdSimple = (TTree*)f.Get("/Event/Rec/AdSimple");
root[3] AdSimple->AddFriend( CalibReadoutHeader );
root[4] AdSimple->Draw("energy:nHitsAD","detector==2","colz");
```

See the ROOT User's Guide for more details on working with Trees, http://root.cern.ch/download/doc/12Trees.pdf.

3.2.5 Analysis Examples (or A Treatise on Cat-skinning)

What is the best / simplest / fastest way for me to examine event data and generate my histograms?

If this is your question, then please read this section. As discussed in the preceding sections, you can directly use ROOT to inspect NuWa event data files. Within ROOT, there are a few different methods to process event data. Alternatively, you can use the full power NuWa to process data. To demonstrate these different methods, a set of example scripts will be discussed in this section. Each example script generates the exact same histogram of number of hit PMTs versus reconstructed energy in the AD, but uses a different methods. Each ROOT script shows how to "chain" trees from multiple files, and how to "friend" data trees from the same file. All example scripts can be found in the dybgaudi:Tutorial/Quickstart software package.

- `dybTreeDraw.C`: ROOT script using `TTree::Draw()`
- `dybTreeGetLeaf.C`: ROOT script using `TTree::GetLeaf()`
- `dybTreeSetBranch.C`: ROOT script using `TTree::SetBranchAddress()`
- `dybNuWaHist.py`: NuWa algorithm using the complete data classes

The example `dybTreeDraw.C` is the simplest approach; it is recommended that you try this method first when generating your histograms. If you plan to include your algorithm as part of standard data production, you will eventually need to use a NuWa algorithm such as `dybNuWaHist.py`. The other two methods are only recommended for special circumstances. A detailed description of the advantages and disadvantages of each approach are provided in the following sections.

dybTreeDraw.C

This is the easiest approach and usually requires the least programming. Please consider using this approach first if possible.

Advantages:

- Simple to run
- Requires the least programming
- Easy for others to understand and reproduce
- Allows chaining and friending of data files

Disadvantages:

- Slower when you need to make many histograms
- Some cuts or variables cannot be expressed in a draw command
- No access to geometry, database, other external data
- Cannot be integrated with production analysis job

To run this example, use the following approach:

```
root [0] .L dybTreeDraw.C+
root [1] dybTreeDraw("recon*.root")
```

The key lines from the script are:

```
// Fill histograms
// AD#1
reconT.Draw("calibStats.nHit:energy>>nhitVsEnergyAD1H",
         "context.mDetId==1 && energyStatus==1");
// AD#2
reconT.Draw("calibStats.nHit:energy>>nhitVsEnergyAD2H",
         "context.mDetId==2 && energyStatus==1");
```

dybGetLeaf.C

There are some cases where the variables and cuts cannot be expressed in a simple `TTree::Draw()` command. Is this case, using `TTree::GetLeaf()` is an alternative. This is also a better alternative for those familiar with `TSelector` or `TTree::MakeClass`, since it allows chaining and friending of data files.

Advantages:

- Fairly simple to run
- Requires some minimal programming
- Allows chaining and friending of data files

Disadvantages:

- No access to geometry, database, other external data
- Cannot be integrated with production analysis job

To run this example, use the following approach:

```
root [0] .L dybTreeGetLeaf.C+
root [1] dybTreeGetLeaf("recon*.root")
```

The key lines from the script are:

```
// Process each event
int maxEntries=reconT.GetEntries();
for(int entry=0;entry<maxEntries;entry++){

  // Get next event
  reconT.GetEntry(entry);

  // Get event data
  int detector = (int) reconT.GetLeaf("context.mDetId")->GetValue();
  int energyStatus = (int) reconT.GetLeaf("energyStatus")->GetValue();
  double energy = reconT.GetLeaf("energy")->GetValue();
```

```
  int nHit = (int)reconT.GetLeaf("calibStats.nHit")->GetValue();

  // Fill histograms
  if(energyStatus==1){ // Reconstruction was successful
    if(detector==1){
   // AD#1
   nhitVsEnergyAD1H->Fill(energy,nHit);
    }else if(detector==2){
   // AD#2
   nhitVsEnergyAD2H->Fill(energy,nHit);
    }
  }
}
```

dybTreeSetBranch.C

Use this approach only if you really need the fastest speed for generating your histograms, and cuts cannot be expressed in a simple `TTree::Draw()` command. The example script relies on `TTree::SetBranchAddress()` to explicitly manage the event data location in memory. By avoiding reading data unnecessary data from the file, it also demonstrates how to achieve the highest speed.

Advantages:

- Fastest method to histogram data
- Allows chaining and friending of data

Disadvantages:

- Requires some careful programming
- No access to geometry, database, other external data
- Cannot be integrated with production analysis job

To run this example, use the following approach:

```
root [0] .L dybTreeSetBranch.C+
root [1] dybTreeSetBranch("recon*.root")
```

The key lines from the script are:

```
// Enable only necessary data branches
reconT.SetBranchStatus("*",0); // Disable all
calibStatsT.SetBranchStatus("*",0); // Disable all

// Must reenable execNumber since the tree indexing requires it
reconT.SetBranchStatus("execNumber",kTRUE);
reconT.SetBranchStatus("calibStats.execNumber",kTRUE);

int detector = 0;
reconT.SetBranchStatus("context.mDetId",kTRUE);
reconT.SetBranchAddress("context.mDetId",&detector);

int energyStatus = 0;
reconT.SetBranchStatus("energyStatus",kTRUE);
reconT.SetBranchAddress("energyStatus",&energyStatus);

float energy = -1;
reconT.SetBranchStatus("energy",kTRUE);
```

```
reconT.SetBranchAddress("energy",&energy);

int nHit = -1;
reconT.SetBranchStatus("calibStats.nHit",kTRUE);
reconT.SetBranchAddress("calibStats.nHit",&nHit);

// Process each event
int maxEntries=reconT.GetEntries();
for(int entry=0;entry<maxEntries;entry++){

  // Get next event
  reconT.GetEntry(entry);

  // Fill histograms
  if(energyStatus==1){ // Reconstruction was successful
    if(detector==1){
   // AD#1
   nhitVsEnergyAD1H->Fill(energy,nHit);
    }else if(detector==2){
   // AD#2
   nhitVsEnergyAD2H->Fill(energy,nHit);
    }
  }
}
```

dybNuWaHist.py

This example uses a full NuWa algorithm to generate the histogram. Use this approach when you need complete access to the event data object, class methods, geometry information, database, and any other external data. You must also use this approach if you want your algorithm to be included in the standard production analysis job. It is the most powerful approach to analysis of the data, but it is also the slowest. Although it is the slowest method, it may still be fast enough for your specific needs.

Advantages:

- Full data classes and methods are available
- Full access to geometry, database, other external data
- Can be integrated with production analysis job

Disadvantages:

- Slowest method to histogram data
- Requires some careful programming
- Requires a NuWa software installation

To run this example, use the following approach:

```
shell> nuwa.py -n -1 -m"Quickstart.dybNuWaHist" recon*.root
```

The key lines from the script are:

```
def execute(self):
    """Process each event"""
    evt = self.evtSvc()

    # Access the reconstructed data
```

```
    reconHdr = evt["/Event/Rec/AdSimple"]
    if reconHdr == None:
        self.error("Failed to get current recon header")
        return FAILURE
    # Access the calibrated data statistics
    calibStatsHdr = evt["/Event/Data/CalibStats"]
    if reconHdr == None:
        self.error("Failed to get current calib stats header")
        return FAILURE

    # Check for antineutrino detector
    detector = reconHdr.context().GetDetId()
    if detector == DetectorId.kAD1 or detector == DetectorId.kAD2:

        # Found an AD.  Get reconstructed trigger
        recTrigger = reconHdr.recTrigger()
        if not recTrigger:
            # No Reconstructed information
            self.warning("No reconstructed data for AD event!?")
            return FAILURE

        # Get reconstructed values
        energyStatus = recTrigger.energyStatus()
        energy = recTrigger.energy()
        nHit = calibStatsHdr.getInt("nHit")

        # Fill the histograms
        if energyStatus == ReconStatus.kGood:
            if detector == DetectorId.kAD1:
                self.nhitVsEnergyAD1H.Fill( energy/units.MeV, nHit )
            elif detector == DetectorId.kAD2:
                self.nhitVsEnergyAD2H.Fill( energy/units.MeV, nHit )

    return SUCCESS
```

The next section provides more information on data analysis using NuWa (Sec. *NuWa Basics*).

3.2.6 Advanced Examples

The following section presents advanced examples of working with Daya Bay data files. All example scripts can be found in the dybgaudi:Tutorial/Quickstart software package.

Combining 'Unfriendly' Trees

The examples in the previous section show how to histogram data by 'friending' trees. Trees can only be 'friended' if there is a natural relationship between the trees. The Coincidence and Spallation trees collect data from multiple triggers into one entry. As a consequence, you cannot 'friend' these trees with the trees which contain data with one trigger per entry (e.g. `CalibStats`, `AdSimple`, etc.). For example, you may want to histogram data in the `Coincidence` tree, but you want to apply a cut on a variable that is only present in `CalibStats`.

It is possible to combine data from these 'unfriendly' trees. The approach is to manually look up the data for the corresponding entries between the 'unfriendly' trees. By building on the example `dybTreeGetLeaf.C`, the advanced example `dybTreeGetLeafUnfriendly.C` generates a histogram with data from both the `Coincidence` and `CalibStats` data. The first step in this process is to create an index to allow a unique look-up of an entry from the `CalibStats` tree:

```
// Disable pre-existing index in the calib stats trees
//  (Another reason ROOT is frustrating; we must manually do this)
calibStatsT.GetEntries();
Long64_t* firstEntry = calibStatsT.GetTreeOffset();
for(int treeIdx=0; treeIdx<calibStatsT.GetNtrees(); treeIdx++){
  calibStatsT.LoadTree(firstEntry[treeIdx]);
  calibStatsT.GetTree()->SetTreeIndex(0);
}

// Build a new look-up index for the 'unfriendly' tree
//  (Trigger number and detector id uniquely identify an entry)
calibStatsT.BuildIndex("triggerNumber","context.mDetId");
```

Once this index is available, we can manually load a specific `CalibStats` entry with the call:

```
// Look up corresponding entry in calib stats
int status = calibStatsT.GetEntryWithIndex(triggerNumber, detector);
```

Now that we are prepared, we can step through each entry in the `Coincidence` tree. For each Coincidence multiplet we can look up all of the corresponding entries from the `CalibStats` tree. Here is the main loop over Coincidence entries from the example script, demonstrating how to fill a histogram with data from these unfriendly trees:

```
// Process each coincidence set
int maxEntries=adCoincT.GetEntries();
for(int entry=0;entry<maxEntries;entry++){

  // Get next coincidence set
  adCoincT.GetEntry(entry);

  // Get multiplet data
  int multiplicity = (int) adCoincT.GetLeaf("multiplicity")->GetValue();
  int detector = (int) adCoincT.GetLeaf("context.mDetId")->GetValue();
  std::vector<int>& triggerNumberV = getLeafVectorI("triggerNumber",&adCoincT);
  std::vector<int>& energyStatusV = getLeafVectorI("energyStatus",&adCoincT);
  std::vector<float>& energyV = getLeafVectorF("e",&adCoincT);

  // Loop over AD events in multiplet
  for(int multIdx=0; multIdx<multiplicity; multIdx++){

    // Get data for each AD trigger in the multiplet
    int triggerNumber = triggerNumberV[multIdx];
    int energyStatus = energyStatusV[multIdx];
    float energy = energyV[multIdx];

    // Look up corresponding entry in calib stats
    int status = calibStatsT.GetEntryWithIndex(triggerNumber, detector);
    if(status<=0){
   std::cout << "Failed to find calib stats for trigger number "
             << triggerNumber << " and detector ID " << detector
             << std::endl;
   continue;
    }
    // Get data from matching calib stats entry
    double nominalCharge = calibStatsT.GetLeaf("NominalCharge")->GetValue();

    // Fill histograms
    if(energyStatus==1 && energy>0){ // Reconstruction was successful
   if(detector==1){
     // AD#1
```

```
      chargeVsEnergyAD1H->Fill(energy,nominalCharge/energy);
    }else if(detector==2){
      // AD#2
      chargeVsEnergyAD2H->Fill(energy,nominalCharge/energy);
    }
     }

  }  // End loop over AD triggers in the multiplet
} // End loop over AD coincidence multiplets
```

Using `TTree::Draw()` with 'Unfriendly' Trees

The previous example script allowed us to correlate and histogram data between the 'unfriendly' `Coincidence` and `CalibStats` trees. This example required that we manually loop on the individual entries in the `Coincidence` tree, and fill the histograms entry-by-entry. An alternate approach is to reformat the data from the 'unfriendly' `CalibStats` tree into a 'friendly' format. Once in this 'friendly' format, we can return to simple calls to `TTree::Draw()` to place cuts and histogram data. This approach is more technical to setup, but can be useful if you want to continue to use `TCuts`, or if you want to repeatedly histogram the data to explore the variations of cuts.

As discussed, this approach relies on reformatting the data from an 'unfriendly' tree into a 'friendly' format. The example script `dybTreeDrawUnfriendly.C` generates the same histograms as the previous example `dybTreeGetLeafUnfriendly.C`, but uses this alternate approach. The following lines shows this in practice:

```
// Create 'friendly' version of data from CalibStats
std::string mainEntriesName = "multiplicity";
std::vector<string> calibVarNames; //variable names to copy from CalibStats
calibVarNames.push_back("MaxQ");
calibVarNames.push_back("NominalCharge");
std::string indexMajorName = "triggerNumber";
std::string indexMinorName = "context.mDetId";
TTree* calibStatsFriendlyT = makeFriendTree(&adCoincT,
                                            &calibStatsT,
                                            mainEntriesName,
                                            calibVarNames,
                                            indexMajorName,
                                            indexMinorName);
if(!calibStatsFriendlyT){
  std::cout << "Failed to create friendly tree" << std::endl;
  return;
}
// Add new friendly tree to coincidence tree
adCoincT.AddFriend(calibStatsFriendlyT,"calibStats");
```

Once this 'friendly' tree has been generated, we can use `TTree::Draw()` with the `CalibStats` variables:

```
// Fill histograms
// AD#1
adCoincT.Draw("calibStats.NominalCharge/e:e>>chargeVsEnergyAD1H",
           "context.mDetId==1 && energyStatus==1 && e>0","colz");
// AD#2
adCoincT.Draw("calibStats.NominalCharge/e:e>>chargeVsEnergyAD2H",
           "context.mDetId==2 && energyStatus==1 && e>0","colz");
```

The reformatted `CalibStats` data is available in the newly created tree `calibStatsFriendlyT`, which is dynamically created and kept in memory. Once you close your ROOT session, this tree will be deleted. If you wish to keep this 'friendly' tree around for later reuse, then you should write it to a file:

```
TFile outputFile("friendlyCalibStats.root","RECREATE");
calibStatsFriendlyT.SetDirectory(&outputFile);
calibStatsFriendlyT.Write();
```

The generation of this reformatted 'friendly' tree relies on the fairly complex helper function `makeFriendTree`:

```
TTree* makeFriendTree(TChain* mainT,
                      TChain* unfriendlyT,
                      const string& mainEntriesName,
                      const std::vector<string>& friendVarNames,
                      const string& indexMajorName,
                      const string& indexMinorName)
```

One entry in the tree `mainT` corresponds to multiple entries in the `unfriendlyT` tree; these are the `Coincidence` and `CalibStats` trees respectively in our example. `mainEntriesName` is the name of the branch in `mainT` that tells us the count of `unfriendlyT` entries that correspond to the current `mainT` entry. This is the variable `multiplicity` in our example, which tells us how many AD triggers are in the current coincidence multiplet. The variables names given in `friendVarNames` are reformatted from single numbers (i.e. `float friendVar`) in the `unfriendlyT` tree to arrays (i.e. `float friendVar[multiplicity]`) in the new 'friendly' tree returned by the function. For our example, these are the `CalibStat` variables `MaxQ` and `NominalCharge`. The `indexMajorName` and `indexMinorName` variables are present in both trees, and are used to correlate one entry in the `mainT` with multiple entries in the `unfriendlyT` tree. These are the variables `triggerNumber` and `context.mDetId`. Note that one or both of these index variables must be an array in the `mainT` tree to properly describe the 'unfriendly' one-to-many relationship between entries in `mainT` and `unfriendlyT`.

This helper function may require some slight modification for your specific case. It assumes that the branches have the following types:

- `mainEntriesName`: `integer` in `mainT`
- `friendVarNames`: `float` in `unfriendlyT`
- `indexMajorName`: `vector<int>` in `mainT` and `int` in `unfriendlyT`
- `indexMinorName`: `int` in both `mainT` and `unfriendlyT`

This helper function could be extended to dynamically check these variable types (eg. `float`, `int`, `vector<float>`, `vector<int>`, etc), and then respond accordingly. This is left as an exercise for the analyzer.

3.3 NuWa Basics

If you wish to do more analysis than histogramming data from files, you must use NuWa. NuWa is the name given to the analysis software written for the Daya Day experiment. It is installed and available on the computer clusters. To load the software on one of the clusters, see Sec. *Loading the NuWa software*. To install NuWa on another computer, see Sec. *Installing the NuWa software*.

NuWa analysis allows you to:

- Access all event data
- Relate data at different paths (ie. `/Event/Rec` to `/Event/Readout`)
- Access non-event data (ie. PMT positions, cable mapping, etc)
- Do more complex calculations
- Write NuWa data files

This section provides a short description of the `nuwa.py` program, Job Modules, and analysis algorithms. This is followed by a series of *recipes* for common analysis tasks.

3.3.1 The `nuwa.py` Command

The `nuwa.py` command is the main command to use the Daya Bay analysis software. A command has a structure similar to,

```
shell> nuwa.py -n <numberOfEntries> -m"<Module>" <inputFile>
```

A complete list of options is given in Sec *sec:nuwaoptions*. An example is,

```
shell> nuwa.py -n 100 -m"Quickstart.PrintRawData" daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

In this simple example, the first 100 triggered readouts are read from the input file, and their data is printed to the screen. The `-n` option specifies the number of entries to process. The `-n -1` option will process all events in the input file(s). The `-m` option specifies how the job should be configured. Sec. *NuWa Job Modules* discusses job configuration using Job Modules.

An arbitrary number of input files can be given, and will be processed in sequence.

```
shell> nuwa.py -n <numberOfEntries> -m"<Module>" <inputFile1> <inputFile2>
```

The `-o` option can be used to write the event data to a NuWa output file,

```
shell> nuwa.py -n <numberOfEntries> -m"<Module>" -o <outputFile> <inputFile>
```

Some other useful options are,

- `--no-history`: Do not print out job configuration information to the screen
- `-l n`: Set the minimum level of logging output printed to the screen (1: VERBOSE, 2: DEBUG, 3: INFO, 4: WARNING, 5: ERROR)
- `-A n*s`: Keep events for the past *n* seconds available for correlation studies with the current event.
- `--help`: Print nuwa.py usage, including descriptions of all options.

3.3.2 NuWa Job Modules

Job modules are used to configure simulation and analysis tasks. Specifically, Job modules are scripts which do the following:

- Add analysis Algorithms and Tools to the job
- Configure Algorithms, Tools, and Services used by the job

Job Modules are used with the nuwa.py command as follows,

```
shell> nuwa.py -n 100 -m"<Module1>" -m"<Module2>" <inputFile>
```

You can put as many modules as you like on the command line. Some modules can take arguments; these should be placed inside the quotes immediately after the module name,

```
shell> nuwa.py -n 100 -m"<Module1> -a argA -b argB" <inputFile>
```

3.4 NuWa Recipes

Many NuWa analysis tasks rely on a standard or familiar approach. This section provides a list of *recipes* for common analysis tasks such as,

- See the history of a NuWa file [Sec. *See the history of a NuWa File*]

- Tag a set of events in a NuWa file [Sec. *Tag Events in a NuWa File*]
- Add your own variables to the NuWa file [Sec. *Add Variables to a NuWa File*]
- Copy all the data at a path to a new file [Sec. *Copy Data Paths to a New File*]
- Write tagged data to a new file [Sec. *Write Tagged Data to a New File*]
- Change the configuration of an existing Job Module [Sec. *Change an Existing Job Module*]
- Write your own analysis Algorithm [Python] [Sec. *Write a Python analysis Algorithm*]
- Write your own analysis Algorithm [C++] [Sec. *Write a C++ analysis Algorithm*]
- Modify an existing part of NuWa [C++] [Sec. *Modify Part of NuWa*]

3.4.1 See the history of a NuWa File

Before using a NuWa data file, you may want to see what processing has already been done on the file. The following command will print the history of all NuWa jobs that have been run to produce this file:

```
shell> nuwa.py -n 0 --no-history -m"JobInfoSvc.Dump"
           recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

You will see much information printed to the screen, including the following sections which summarize the NuWa jobs that have been run on this file:

```
Cached Job Information:
{  jobId : daf3a684-6190-11e0-82f7-003048c51482
 cmtConfig : x86_64-slc4-gcc34-opt
 command : /eliza7/dayabay/scratch/dandwyer/NuWa-trunk-opt/dybgaudi/InstallArea/scripts/nuwa.py
           -n 0 --no-history -mJobInfoSvc.Dump
           recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
 hostid : 931167014
 jobTime : Fri, 08 Apr 2011 03:32:40 +0000
 nuwaPath : /eliza16/dayabay/users/dandwyer/installs/trunk_2011_03_30_opt/NuWa-trunk
 revision : 11307:11331
 username : dandwyer
}


Cached Job Information:
{  jobId : 6f5c02f4-6190-11e0-897b-003048c51482
 cmtConfig : x86_64-slc4-gcc34-opt
 command : /eliza7/dayabay/scratch/dandwyer/NuWa-trunk-opt/dybgaudi/InstallArea/scripts/nuwa.py
           -A None -n -1 --no-history --random=off -mQuickstart.DryRunTables
           -mQuickstart.Calibrate -mQuickstart.Reconstruct
           -o recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
           daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
 hostid : 931167014
 jobTime : Fri, 08 Apr 2011 03:29:39 +0000
 nuwaPath : /eliza16/dayabay/users/dandwyer/installs/trunk_2011_03_30_opt/NuWa-trunk
 revision : 11307:11331
 username : dandwyer
}


Cached Job Information:
{  jobId : 22c6620e-6190-11e0-84ac-003048c51482
 cmtConfig : x86_64-slc4-gcc34-opt
```

```
 command : /eliza7/dayabay/scratch/dandwyer/NuWa-trunk-opt/dybgaudi/InstallArea/scripts/nuwa.py
           -A None -n -1 --no-history --random=off -mProcessTools.LoadReadout
           -o daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
           /eliza7/dayabay/data/exp/dayabay/2010/TestDAQ/NoTag/0922/daq.NoTag.0005773.Physics.SAB-AD2
 hostid : 931167014
 jobTime : Fri, 08 Apr 2011 03:27:31 +0000
 nuwaPath : /eliza16/dayabay/users/dandwyer/installs/trunk_2011_03_30_opt/NuWa-trunk
 revision : 11307:11331
 username : dandwyer
}
```

The jobs are displayed in reverse-chronological order. The first job converted the raw daq `.data` file to a NuWa `.root` file. The second job ran an example calibration and reconstruction of the raw data. The final job (the current running job) is printing the job information to the screen.

3.4.2 Tag Events in a NuWa File

Event tags are used to identify a subset of events. These can be used to separate events into classes such as *muons*, *inverse-beta decay*, *noise*, etc. In general, tags be used to identify any set of events of interest.

The job module dybgaudi:Tagging/UserTagging/python/UserTagging/UserTag/DetectorTag.py is a simple example of tagging readouts by detector type. The tag can be applied by adding the module to a NuWa job:

```
shell> nuwa.py -n -1 --no-history -m"UserTagging.UserTag.DetectorTag"
           daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

To add your own tag, follow the steps for modifing an existing python module (section *Write a Python analysis Algorithm*.) Use dybgaudi:Tagging/UserTagging/python/UserTagging/UserTag/DetectorTag.py as a starting point. You should add your own tag in the `initTagList` function:

```
self.addTag('MySpecialEvent' , '/Event/UserTag/MySpecialEvent')
```

In the `check` function, you should retrieve event data and decide if you want to tag it:

```
# Get reconstructed data
recHdr = evt["/Event/Rec/AdSimple"]
# Add your calculation / decision here
# ...
#
if tagThisEvent:
    # Keep track of the reconstructed data you are tagging
    self.getTag('MySpecialEvent').setInputHeaders( [recHdr] )
    self.tagIt('MySpecialEvent')
```

Once a tag has been set, it can be used by later analysis algorithms in the current job, or saved to the output file and used at a later time. Here is a Python example of checking the tag:

```
# Check tag
tag = evt["/Event/UserTag/MySpecialEvent"]
if tag:
    # This event is tagged.  Do something.
    # ...
```

Tags can also be used to produce filtered data sets, as shown in section *Write Tagged Data to a New File*.

3.4.3 Add Variables to a NuWa File

A common task is to add a new user-defined variable for each event. For example, the time since the previous trigger can be calculated and added to each event. This is a task for `UserData`.

The example job module dybgaudi:Tutorial/Quickstart/python/Quickstart/DtData.py shows the example of adding the time since the previous trigger to each event. This example can be run:

```
shell> nuwa.py -n -1 --no-history -m"Quickstart.DtData"
           -o daqPlus.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
           daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

After completion, the output file can be opened in ROOT and the new data variables can be viewed and histogrammed (Fig *fig:userdata*.) The file can also be read back into another NuWa job, and the user data will still be accessible.

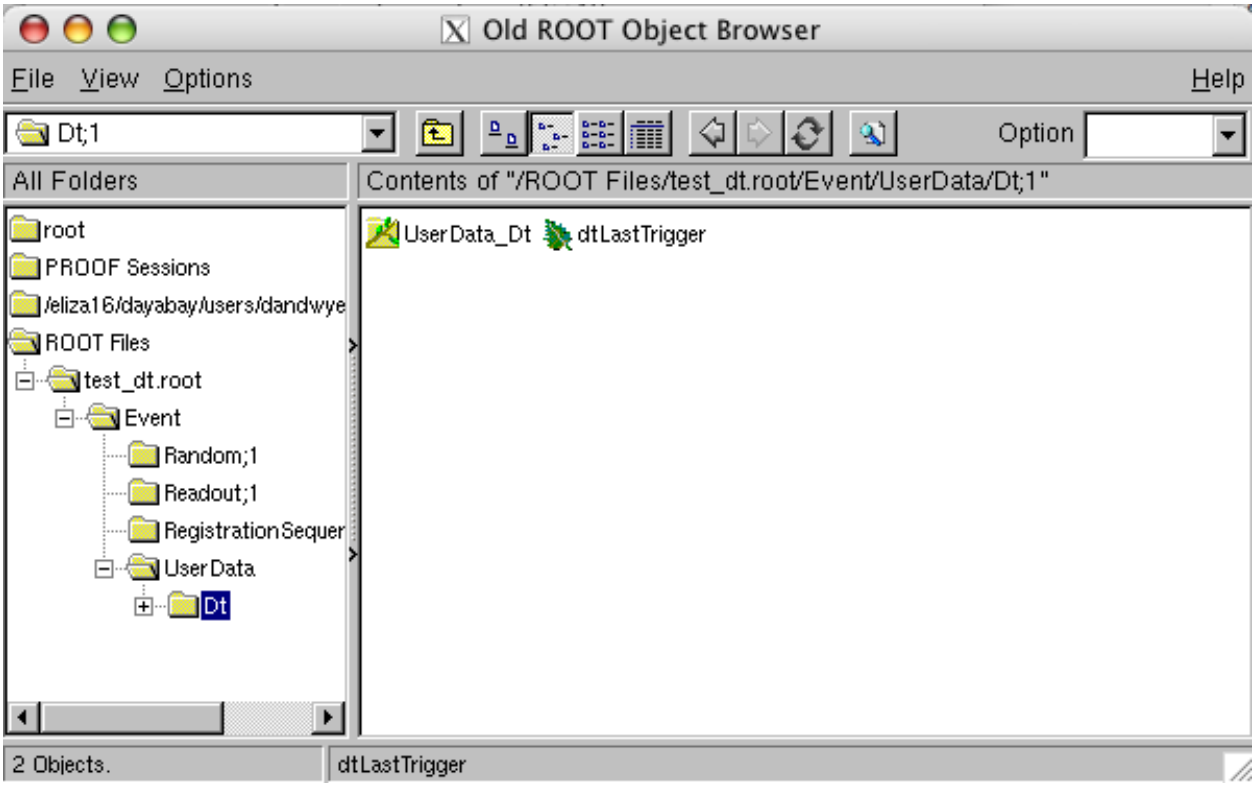


Figure 3.11: **fig:userdata**

To add your own variables, copy and modify the module dybgaudi:Tutorial/Quickstart/python/Quickstart/DtData.py. See section *Write a Python analysis Algorithm* for general advice on modifying an existing job module. Currently single integers, single floating-point decimal numbers, and arrays of each can be added as user-defined variables.

3.4.4 Adding User-defined Variables to Tagged Events

The dybgaudi:Tagging/UserTagging package provides some convenient tools for simultaneously applying tags and adding user data for those tagged events. Following the example described in section *Tag Events in a NuWa File*, user data can be added in parallel to an event tag. In the `initTagList` function, you can define user data associated with the tag:

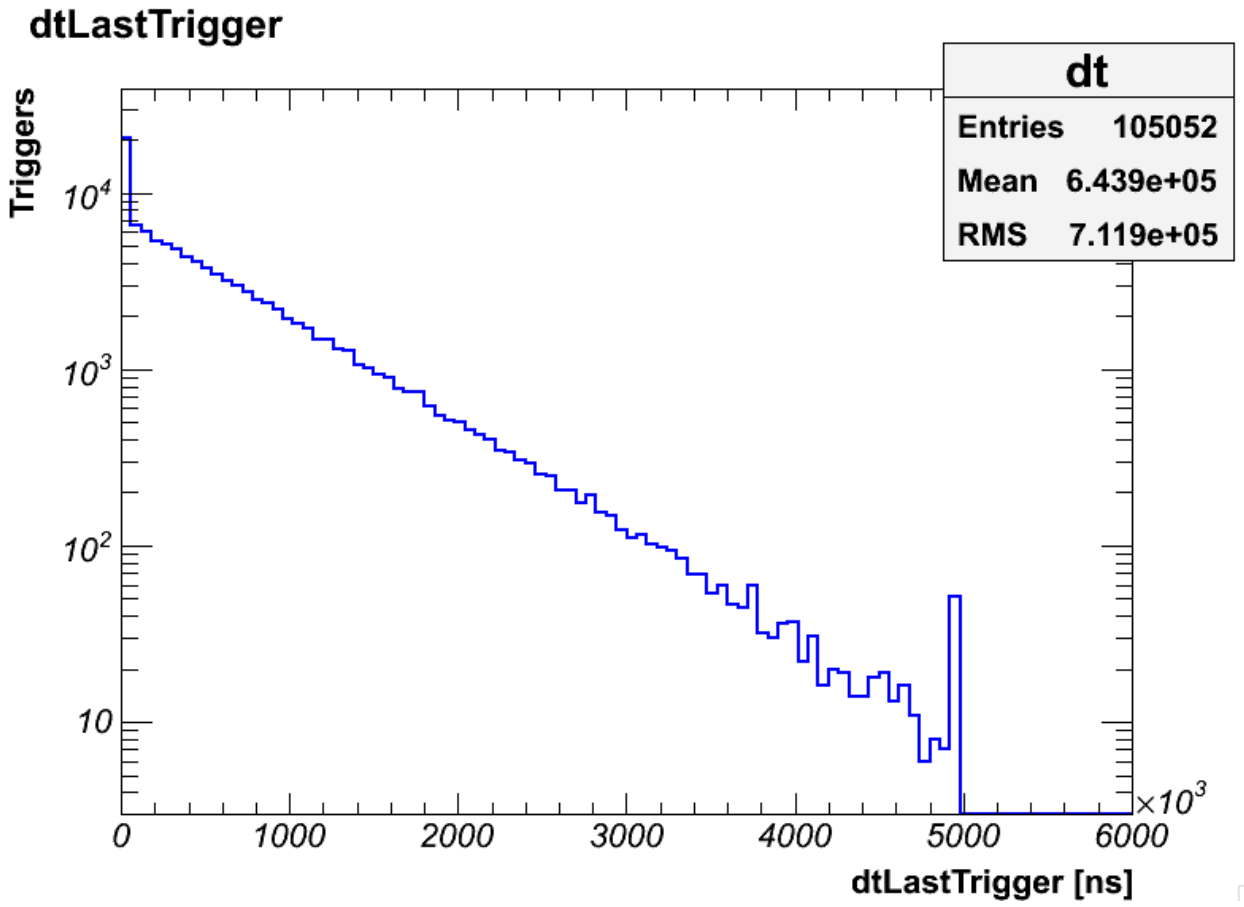


Figure 3.12: **fig:userdata**
Example of browsing and histogramming user-defined data in ROOT.

```
myTag = self.addTag('MySpecialEvent' , '/Event/UserTag/MySpecialEvent')
myData = myTag.addData('MySpecialData','/Event/UserData/MySpecialData')
myData.addInt('myInt')
```

In the `check` function, you should set the variable value before calling `tagIt`:

```
if tagThisEvent:
    # Keep track of the reconstructed data you are tagging
    self.getTag('MySpecialEvent').setInputHeaders( [recHdr] )
    myData = self.getTag('MySpecialEvent').getData('MySpecialData')
    myData.set('myInt',12345)
    self.tagIt('MySpecialEvent')
```

3.4.5 Copy Data Paths to a New File

There may be situations where you would like to filter only some paths of data to a smaller file. The job module `SimpleFilter.Keep` can be used for this purpose. The following example shows how to create an output file which contains only the `AdSimple` reconstructed data:

```
shell> nuwa.py -n -1 -m"SimpleFilter.Keep /Event/Rec/AdSimple"
            -o adSimple.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
            recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

This module can take multiple arguments to save more paths to the same file:

```
shell> nuwa.py -n -1 -m"SimpleFilter.Keep /Event/Rec/AdSimple /Event/Rec/AdQmlf"
            -o myRecData.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
            recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

3.4.6 Write Tagged Data to a New File

There may be situations where you would like to filter only some events to a smaller data file. The `SmartFilter` package provides some tools for this purpose. The first step is to define your own tag for the events you wish to keep, as discussed in section *Tag Events in a NuWa File*. The following example shows how to create an output file which contains only the events you have tagged as `MySpecialEvents`:

```
shell> nuwa.py -n -1 -m"MySpecialTagger" -m"SmartFilter.Keep /Event/UserTag/MySpecialEvents"
            -o mySpecialEvents.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
            recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

The output file will contain your tag `/Event/UserTag/MySpecialEvents`, plus any data that your tag refers to such as `/Event/Rec/AdSimple`, `/Event/Readout/ReadoutHeader`, etc.

To create more advanced data filters, copy and modify the job module dyb-gaudi:Filtering/SmartFilter/python/SmartFilter/Example.py.

3.4.7 Change an Existing Job Module

This section describes how to change an existing module with name *PACKAGE.MODULE*. First copy this Job Module to your local directory. You can locate a module using the environment variable `$ PACKAGE ROOT`,

```
shell> mkdir mywork
shell> cd mywork
shell> cp $<PACKAGE>ROOT/python/<PACKAGE>/<MODULE>.py myModule.py
```

Once you have a copy of the Job Module, open it with your favorite text editor. The module is written in the Python language (http://www.python.org); see the Python website for a good tutorial on this language. Job Modules are composed of two functions: `configure()` and `run()`,

```
def configure( argv=[] ):
    """A description of your module here
    """
    # Most job configuration commands here
    return

def run(app):
    """Specific run-time configuration"""
    # Some specific items must go here (Python algorithms, add libraries, etc.)
    pass
```

For advice on what lines to modify in the module, send your request to the offline software mailing list: `theta13-offline@dayabay.lbl.gov`.

To run your modified version of the module, call it in the `nuwa.py` command without the *PACKAGE.* prefix in the module name. With no prefix, modules from the current directory will be used.

```
shell> ls
myModule.py
shell> nuwa.py -n -1 -m"myModule" recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

3.4.8 Write a Python analysis Algorithm

If you wish to add your own algorithm to NuWa, a good place to start is by writing a prototype algorithm in Python. Writing your algorithm in Python is much easier than C++, and does not require you to compile.

To get started, copy the example template Python algorithm to your local directory:

```
shell> mkdir mywork
shell> cd mywork
shell> cp $QUICKSTARTROOT/python/Quickstart/Template.py myAlg.py
```

Alternatively, you can copy `PrintRawData.py`, `PrintCalibData.py`, or `PrintReconData.py` if you want to specifically process the readout, calibrated, or reconstructed data. Each of these files is a combination of a Python algorithm and a nuwa Python Job Module. To run this module and algorithm, you can call it in the following way:

```
shell> nuwa.py -n -1 -m"myAlg" recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

Inside this file, you can find a Python algorithm. It is a Python class that defines three key functions:

- `initialize()`: Called once at job start
- `execute()`: Called once for each event
- `finalize()`: Called once at job end

You should edit these functions so that the algorithm will do the task you want. There are a few common tasks for algorithms. One is to print to the screen some data from the event:

```
def execute(self):
    evt = self.evtSvc()
    reconHdr = evt["/Event/Rec/RecHeader"]
    print "Energy [MeV] = ", reconHdr.recResult().energy() / units.MeV
```

Another common task is to histogram some data from the event:

```
def initialize(self):
    # Define the histogram
    self.stats["/file1/myhists/energy"] = TH1F("energy",
                                               "Reconstructed energy for each trigger",
                                                100,0,10)

def execute(self):
    evt = self.evtSvc()
    reconHdr = evt["/Event/Rec/RecHeader"]
    if reconHdr.recResult().energyStatus() == ReconStatus.kGood:
        #Fill the histogram
        self.stats["/file1/myhists/energy"].Fill(reconHdr.recResult().energy() / units.MeV)
```

Although these examples are simple, algorithms can perform complex calculations on the data that are not possible directly from ROOT. For cheat-sheets of the data available in NuWa, see the following sections: Readout data [*Readout data in NuWa*], Calibrated hit data [*Calibrated data in NuWa*], Reconstructed data [*Reconstructed data in NuWa*].

Remember to commit your new algorithm to SVN! The wiki section wiki:SVN_Repository#Guidelines provides some tips on committing new software to SVN.

3.4.9 Write a C++ analysis Algorithm

A drawback of using Python algorithms is that they will usually run slower than an algorithm written in C++. If you wish to run your algorithm as part of data production, or if you just want it to run faster, then you should convert it to C++.

Adding a C++ algorithm to Gaudi is a more complex task. The first step is to create your own Project. Your own Project allows you to write and run your own C++ analysis software with NuWa. See section *Making your own Project* for how to prepare this.

Once you have your own project, you should prepare your own package for your new algorithm. A tool has been provided to help you with this. The following commands will set up your own package:

```
shell> cd myNuWa
shell> svn export http:/ /dayabay.ihep.ac.cn/svn/dybsvn/people/wangzhe/Start
shell> svn export http:/ /dayabay.ihep.ac.cn/svn/dybsvn/people/wangzhe/ProjRename
shell> ProjRename Start MyNewAlg
shell> ls
MyNewAlg  ProjRename
shell> emacs MyNewAlg/src/components/MyNewAlg.cc &
```

At this point you should edit the empty algorithm in `MyNewAlg/src/components/MyNewAlg.cc`. In particular, you should add your analysis code into the `initialize()`, `execute()`, and `finalize()` functions.

To compile your new algorithm, you should do the following in a new clean shell:

```
shell> pushd NuWa-trunk
shell> source setup.sh
shell> export CMTPROJECTPATH=/path/to/myProjects:${CMTPROJECTPATH}
shell> popd
shell> cd myNuWa/MyNewAlg/cmt
shell> cmt config; cmt make;
```

Now you should setup a separate 'running' shell for you to run and test your new algorithm. Staring with a clean shell, run the following:

```
shell> pushd NuWa-trunk
shell> source setup.sh
```

```
shell> export CMTPROJECTPATH=/path/to/myProjects:${CMTPROJECTPATH}
shell> cd dybgaudi/DybRelease/cmt
shell> source setup.sh
shell> popd
shell> pushd myNuWa/MyNewAlg/cmt
shell> source setup.sh; source setup.sh;
```

Now you should be set up and ready to run your new NuWa algorithm in this shell:

```
shell> nuwa.py -n -1 -m"MyNewAlg.run" recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

Remember to commit your new algorithm to SVN!

3.4.10 Modify Part of NuWa

Sometimes you may want to modify an existing part of NuWa and test the changes you have made. First, you must setup your own Project as shown in section *Making your own Project*.

Next, you should checkout the package into your Project:

```
shell> cd myNuWa
shell> svn checkout http:/ /dayabay.ihep.ac.cn/svn/dybsvn/dybgaudi/trunk/Reconstruction/CenterOfCharg
shell> ls
CenterOfChargePos
shell> emacs CenterOfChargePos/src/components/CenterOfChargePosTool.cc &
```

After you have made your changes, you should compile and test your modifications. To compile the modified package, you should run the following commands in a clean shell:

```
shell> pushd NuWa-trunk
shell> source setup.sh
shell> export CMTPROJECTPATH=/path/to/myProjects:${CMTPROJECTPATH}
shell> popd
shell> cd myNuWa/CenterOfChargePos/cmt
shell> cmt config; cmt make;
```

To make NuWa use your modified package, run the following commands in a new clean shell:

```
shell> pushd NuWa-trunk
shell> source setup.sh
shell> export CMTPROJECTPATH=/path/to/myProjects:${CMTPROJECTPATH}
shell> cd dybgaudi/DybRelease/cmt
shell> source setup.sh
shell> popd
shell> pushd myNuWa/CenterOfChargePos/cmt
shell> source setup.sh; source setup.sh;
```

This shell will now use your modified code instead of the original version in NuWa:

```
shell> nuwa.py -n -1 -m"Quickstart.Calibrate" -m"Quickstart.Reconstruct"
          -o recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
          daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

After you have verified that your changes are correct, you can commit your changes:

```
shell> cd CenterOfChargePos
shell> svn diff
(Review the changes you have made.)
shell> svn commit -m"I fixed a bug!"
```

3.4.11 Using Services

Another advantage of using NuWa is that it provides a set of useful *Services*. Services give you access to other data in addition to the event data, such as cable mappings, calibration parameters, geometry information, etc. Services can also provide other useful tasks. Table *Some Common Services* gives lists some common services. Section *NuWa Services* gives detailed descriptions of the common services.

Table 3.3: Some Common Services

ICableSvc	Electronics cable connection maps and hardware serial numbers
ICalibDataSvc	PMT and RPC calibration parameters
ISimDataSvc	PMT/Electronics input parameters for simulation
IJobInfoSvc	NuWa Job History Information (command line, software version, etc)
IRunDataSvc	DAQ Run information (run number, configuration, etc.)
IPmtGeomInfoSvc	Nominal PMT positions
IStatisticsSvc	Saving user-defined histograms, ntuples, trees, etc. to output files

Multiple versions of the same service can exists. For example, `StaticCalibDataSvc` loads the PMT calibration parameters from a text table, while `DbiCalibDataSvc` loads the PMT calibration parameters from the database. To access a Service from a Python algorithm, you should load the service in the `initialize()` function:

```
self.calibDataSvc = self.svc('ICalibDataSvc','StaticCalibDataSvc')
if self.calibDataSvc == None:
    self.error("Failed to get ICalibDataSvc: StaticCalibDataSvc")
    return FAILURE
```

When requesting a service, you provide the type of the service (`ICalibDataSvc`) followed by the specific version you wish to use (`StaticCalibDataSvc`).

Loading the service in C++ is similar:

```
ICalibDataSvc* calibDataSvc = svc<ICalibDataSvc>("StaticCalibDataSvc", true);
if( !calibDataSvc ) {
  error() << "Failed to get ICalibDataSvc: StaticCalibDataSvc" << endreq;
  return StatusCode::FAILURE;
}
```

3.5 Cheat Sheets

- Loading the NuWa software
- Installing the NuWa software
- Making your own Project
- Standard Data Files
  - Using the Catalog
- Data File Contents
- Common NuWa Commands
- Conventions and Context
  - Sites
  - Detectors
- Raw DAQ Data
  - Conversion from `.data`
  - Raw data in ROOT
  - Readout data in NuWa
- Calibrated Data
  - Calibrated data in ROOT
  - Calibrated data in NuWa
- Calibrated Statistics Data
  - Calibrated statistics data in ROOT
  - Calibrated statistics data in NuWa
- Reconstructed Data
  - Reconstructed data in ROOT
  - Reconstructed data in NuWa
- Spallation Data
  - Spallation data in ROOT
  - Spallation data in NuWa
- Coincidence Data
  - Coincidence data in ROOT
  - Coincidence data in NuWa
- NuWa Services
- Computer Clusters
- Miscellaneous
  - Time Axes in ROOT

3.5.1 Loading the NuWa software

On the computer clusters you must load the software each time you log on. You can load the NuWa software using the `nuwaenv` command,

```
shell> nuwaenv -r trunk -O
```

The `nuwaenv` command can incorporate both shared releases and personal projects. For more information on using and configuring nuwaenv see: https://wiki.bnl.gov/dayabay/index.php?title=Environment_Management_with_nuwaenv.

In the end, nuwaenv is a way of automating the sourcing of the following shell commands. The examples given are for the `pdsf` cluster.

```
# bash shell
shell> cd /common/dayabay/releases/NuWa/trunk-opt/NuWa-trunk/
shell> source setup.sh
shell> cd dybgaudi/DybRelease/cmt/
shell> source setup.sh
```

```
# c-shell
shell> cd /common/dayabay/releases/NuWa/trunk-opt/NuWa-trunk/
shell> source setup.csh
shell> cd dybgaudi/DybRelease/cmt/
shell> source setup.csh
```

3.5.2 Installing the NuWa software

For the brave, you can attempt to install NuWa on your own computer. Try the following:

```
shell> mkdir nuwa
shell> cd nuwa
shell> svn export http:/ /dayabay.ihep.ac.cn/svn/dybsvn/installation/trunk/dybinst/dybinst
shell> ./dybinst trunk all
```

If you are very lucky, it will work. Otherwise, send questions to `theta13-offline@dayabay.lbl.gov`. Your chance of success will be much greater if your try to install NuWa on a computer running Scientific Linux or OS X.

3.5.3 Making your own Project

If you want add or modify a part of NuWa, you should create your own Project. This will allow you to create your own packages to add or replace those in NuWa. The first step is to create a subdirectory for your packages in some directory `/path/to/myProjects`:

```
shell> mkdir -p /path/to/myProjects/myNuWa/cmt
```

Create two files under `myNuWa/cmt` with the following content:

```
shell> more project.cmt
project myNuWa

use dybgaudi

build_strategy with_installarea
structure_strategy without_version_directory
setup_strategy root

shell> more version.cmt
v0
```

Now you can create new packages under the directory `myNuWa/`, and use them in addition to an existing NuWa installation. See section *Write a C++ analysis Algorithm* for more details.

You can also replace an existing NuWa package with you own modified version in `myNuWa/`. See section *Modify Part of NuWa* for more details.

3.5.4 Standard Data Files

A set of standard Daya Bay data files are available on the computer clusters. The following table provides the location of these files on each cluster:

Type	Location
	Onsite Farm
daq. (.data)	/dyb/spade/rawdata
daq.	??
	PDSF
daq. (.data)	(In HPSS Archive)
daq.	/eliza16/dayabay/nuwaData/*exp,sim*/*dataTag*/daq
calib.	/eliza16/dayabay/nuwaData/*exp,sim*/*dataTag*/calib
recon.	/eliza16/dayabay/nuwaData/*exp,sim*/*dataTag*/recon
coinc.	/eliza16/dayabay/nuwaData/*exp,sim*/*dataTag*/coinc
spall.	/eliza16/dayabay/nuwaData/*exp,sim*/*dataTag*/spall
	IHEP
daq. (.data)	
daq.	
recon.	
coinc.	
spall.	
	BNL
daq. (.data)	
daq.	
recon.	
coinc.	
spall.	

Using the Catalog

A Catalog tool is provided to locate the raw data files. Be sure to load NuWa before running this example (see section *Loading the NuWa software*). Here is a simple example to locate the raw data files for a run:

```
shell> python
Python 2.7 (r27:82500, Jan  6 2011, 05:00:16)
[GCC 3.4.6 20060404 (Red Hat 3.4.6-8)] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> import DybPython.Catalog
>>> DybPython.Catalog.runs[8000]
['/eliza16/dayabay/data/exp/dayabay/2011/TestDAQ/NoTag/0430/daq.NoTag.0008000.Physics.EH1-Merged.SFO-
>>> DybPython.Catalog.runs[8001]
['/eliza16/dayabay/data/exp/dayabay/2011/TestDAQ/NoTag/0430/daq.NoTag.0008001.Physics.EH1-Merged.SFO-
>>> DybPython.Catalog.runs[8002]
['/eliza16/dayabay/data/exp/dayabay/2011/TestDAQ/NoTag/0430/daq.NoTag.0008002.Pedestal.EH1-WPI.SFO-1
```

For more information, refer to the Catalog description wiki:https://wiki.bnl.gov/dayabay/index.php?title=Accessing_Data_in_a_Wareho

3.5.5 Data File Contents

The table below lists the known data paths and provides a short description of their contents.

Path	Name	Description
	Real and Simulated Data	
/Event/Readout	ReadoutHeader	Raw data produced by the experiment
/Event/CalibReadout	CalibReadoutHeader	Calibrated times and charges of PMT and RPC hits
/Event/Rec	AdSimple	Toy AD energy and position reconstruction
	AdQmlf	AD Maximum-likelihood light model reconstruction
/Event/Tags		Standard tags for event identification
/Event/Tags/Coinc	ADCoinc	Tagged set of AD time- coincident events
/Event/Tags/Muon	MuonAny	Single muon trigger from any detector
	Muon/FirstMuonTrigger	First trigger from a prompt set of muon triggers
	Retrigger	Possible retriggering due to muon event
/Event/Data	CalibStats	Extra statistics calculated from calibrated data
/Event/Data/Coinc	ADCoinc	Summary data for sets of AD time-coincident events
/Event/Data/Muon	Spallation	Summary data for muon events and subsequent AD events
/Event/UserTags		User-defined event tags
/Event/UserData		User-defined data variables
	Simulated Data Only	
/Event/Gen	GenHeader	True initial position and momenta of simulated particles
/Event/Sim	SimHeader	Simulated track, interactions, and PMT/RPC hits (Geant)
/Event/Elec	ElecHeader	Simulated signals in the electronics system
/Event/Trig	TrigHeader	Simulated signals in the trigger system
/Event/SimReadout	SimHeader	Simulated raw data

3.5.6 Common NuWa Commands

This section provides a list of common `nuwa.py` commands. You must load the NuWa software before you can run these commands (see section *Loading the NuWa software*).

```
# Wrap raw DAQ files in ROOT tree:
shell> nuwa.py -n -1 -m"ProcessTools.LoadReadout"
          -o daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
          daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.data

# Generate Calibration Data
shell> nuwa.py -n -1 -m"Quickstart.Calibrate" -m"Tagger.CalibStats"
          -o calib.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
          daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root

# Generate Reconstruction-only data files
shell> nuwa.py -n -1 -A"0.2s" -m"Quickstart.Calibrate" -m"Tagger.CalibStats"
          -m"Quickstart.Reconstruct"
          -m"SmartFilter.Clear" -m"SmartFilter.KeepRecon"
          -o recon.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
          daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root

# Generate Spallation-only data files
shell> nuwa.py -n -1 -A"0.2s" -m"Quickstart.Calibrate" -m"Tagger.CalibStats"
          -m"Quickstart.Reconstruct"
          -m"Tagger.MuonTagger.MuonTag" -m"Tagger.MuonTagger.SpallData"
          -m"SimpleFilter.Keep /Event/Data/Muon/Spallation"
          -o spall.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
          daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

```
# Generate ADCoincidence-only data files
shell> nuwa.py -n -1 -m"Quickstart.Calibrate" -m"Tagger.CalibStats"
          -m"Quickstart.Reconstruct"
          -m"Tagger.CoincTagger.ADCoincTag" -m"Tagger.CoincTagger.ADCoincData"
          -m"SimpleFilter.Keep /Event/Data/Coinc/AD1CoincData /Event/Data/Coinc/AD2CoincData"
          -o coinc.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
          daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root

# Generate ODM figures
shell> nuwa.py -n -1 --output-stats="{'file1':'odmHistograms.root'}"
          -m"AdBasicFigs.MakeFigs"
          -m"Quickstart.Calibrate" -m"Tagger.CalibStats"
          -m"AdBasicFigs.MakeCalibFigs"
          -m"MuonBasicFigs.MakeCalibFigs"
          -m"Quickstart.Reconstruct"
          -m"AdBasicFigs.MakeReconFigs"
          daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
```

3.5.7 Conventions and Context

The following sections summarizes the conventions for sites, detectors, and other items used in the analysis software.

Sites

The site ID identifies the site location within the experiment.

Site	C++/Python Name	Number	Description
Unknown	kUnknown	0x00	Undefined Site
Daya Bay	kDayaBay	0x01	Daya Bay Near Hall (EH-1)
Ling Ao	kLingAo	0x02	Ling Ao Near Hall (EH-2)
Far	kFar	0x04	Far Hall (EH-3)
Mid	kMid	0x08	Mid Hall (Doesn't exist)
Aberdeen	kAberdeen	0x10	Aberdeen tunnel
SAB	kSAB	0x20	Surface Assembly Building
PMT Bench Test	kPMTBenchTest	0x40	PMT Bench Test at Dong Guan
All	kAll	(Logical OR of all sites)	All sites

To access the site labels from Python, you can use the commands,

```
from GaudiPython import gbl
gbl.DayaBay.Detector # Access any class in library, then ENUMs are available
Site = gbl.Site
print Site.kDayaBay
```

For C++, the site labels can be accessed,

```
#include "Conventions/Site.h"
std::cout << Site::kDayaBay << std::endl;
```

The Site convention is defined in dybgaudi:DataModel/Conventions/Conventions/Site.h.

Detectors

The detector ID identifies the detector location within the site.

Detector	C++/Python Name	Number	Description
Unknown	kUnknown	0	Undefined Detector
AD stand 1	kAD1	1	Anti-neutrino detector on stand #1
AD stand 2	kAD2	2	Anti-neutrino detector on stand #2
AD stand 3	kAD3	3	Anti-neutrino detector on stand #3
AD stand 4	kAD4	4	Anti-neutrino detector on stand #4
Inner water pool	kIWS	5	Inner water pool
Outer water pool	kOWS	6	Outer water pool
RPC	kRPC	7	Complete RPC assembly
All	kAll	8	All detectors

To access the detector labels from Python, you can use the commands,

```
from GaudiPython import gbl
gbl.DayaBay.Detector # Access any class in library, then ENUMs are available
DetectorId = gbl.DetectorId
print DetectorId.kAD1
```

For C++, the detector labels can be accessed,

```
#include "Conventions/DetectorId.h"
std::cout << DetectorId::kAD1 << std::endl;
```

The Detector convention is defined in dybgaudi:DataModel/Conventions/Conventions/DetectorId.h.

3.5.8 Raw DAQ Data

Conversion from `.data`

The raw DAQ file can be wrapped in a ROOT tree. This allows you to histogram the raw data directly from ROOT, as shown in section *Histogramming Raw DAQ data*. The following command will wrap the data. In addition, ROOT will compress the raw data by almost half the original size. The file still contains the raw binary data; no event data conversion is performed.

```
shell> nuwa.py -n -1 -m"ProcessTools.LoadReadout"
          -o daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.root
          daq.NoTag.0005773.Physics.SAB-AD2.SFO-1._0001.data
```

Raw data in ROOT

The following table summarizes the raw data that is accessible directly from ROOT. All ROOT variables must be preceded by `daqPmtCrate()`..

Item	ROOT Variable	Description
site	detector().site()	Site ID number
detector	detector().detectorId()	Detector ID number
trigger type	triggerType()	All active triggers, logically OR'd
trigger time	triggerTime().GetSeconds()	Complete trigger time [seconds]
TDC time	tdcs(*board*,*connector*,*adcGain*).values()	Channel TDC values
ADC charge	adcs(*board*,*connector*,*adcGain*).values()	Channel ADC values
	gains(*board*,*connector*).values()	Channel ADC Gain (1: Fine ADC, 2: Coarse ADC)
	preAdcRaws(*board*,*connector*,*adcGain*).values()	Channel pre-ADC raw values
	peaks(*board*,*connector*,*adcGain*).values()	Clock cycle (in 25ns) of ADC peak relative to TDC hit

Readout data in NuWa

Here is a cheat-sheet for processing raw data in Python. These lines can be used in the `execute()` function of a Python algorithm.

```
evt = self.evtSvc()

# Access the Readout Header.  This is a container for the readout data
readoutHdr = evt["/Event/Readout/ReadoutHeader"]
if readoutHdr == None:
    self.error("Failed to get current readout header")
    return FAILURE

# Access the Readout.  This is the data from one trigger.
readout = readoutHdr.daqCrate().asPmtCrate()
if readout == None:
    self.info("No readout this cycle")
    return SUCCESS

# Get the detector ID for this trigger
detector = readout.detector()
detector.detName()

# Trigger Type: This is an integer of the type for this trigger
readout.triggerType()
# Event Number: A count of the trigger, according to the DAQ
readout.eventNumber()

# Trigger Time: Absolute time of trigger for this raw data
triggerTime = readout.triggerTime()

# Loop over each channel data in this trigger
for channel in readout.channelReadouts():
    channelId = channel.channelId()

    # The channel ID contains the detector ID, electronics board number,
    # and the connector number on the board.
    channelId.detName()
    channelId.board()
```

```
channelId.connector()

# Loop over hits for this channel
for hitIdx in range( channel.hitCount() ):
    # TDC data for this channel
    #
    # The TDC is an integer count of the time between the time
    # the PMT pulse arrived at the channel, and the time the
    # trigger reads out the data.  Therefore, a larger TDC =
    # earlier time.  One TDC count ~= 1.5625 nanoseconds.
    #
    tdc = channel.tdc( hitIdx )

    # ADC data for this channel
    #
    # The ADC is an integer count of the charge of the PMT
    # pulse.  It is 12 bits (0 to 4095).  There are two ADCs
    # for every PMT channel (High gain and Low gain).  Only
    # the high gain ADC is recorded by default.  If the high
    # gain ADC is saturated (near 4095), then the low gain ADC
    # is recorded instead.
    #
    # For the Mini Dry Run data, one PMT photoelectron makes
    # about 20 high gain ADC counts and about 1 low gain ADC
    # count.  There is an offset (Pedestal) for each ADC of
    # ~70 ADC counts (ie. no signal = ~70 ADC, 1 photoelectron
    # = ~90 ADC, 2 p.e. = ~110 ADC, etc.)
    #
    # The ADC peal cycle is a record of the clock cycle which had
    # the 'peak' ADC.
    #
    # ADC Gain: Here is a description of ADC gain for these values
    #  Unknown = 0
    #  High = 1
    #  Low = 2
    #
    adc = channel.adc( hitIdx )
    preAdc = channel.preAdcAvg( hitIdx )
    peakCycle = channel.peakCycle( hitIdx )
    isHighGain = channel.isHighGainAdc( hitIdx )
```

3.5.9 Calibrated Data

Calibrated data in ROOT

The following table summarizes the calibrated data visible directly in ROOT. Array items have their length given in the brackets (i.e. *name[length]*). ROOT will automatically draw all entries in the array given the array name. See the ROOT User's Guide for more details on working with Trees, http://root.cern.ch/download/doc/12Trees.pdf.

Item	ROOT Variable	Description
site	site	Site ID number
detector	detector	Detector ID number
event number	eventNumber	Unique ID number for each triggered event in a run
trigger type	triggerType	All active triggers, logically OR'd
trigger time	triggerTimeSec	Trigger time: seconds from Jan. 1970 (unixtime)
	triggerTimeNanoSec	Trigger time: nanoseconds from last second
AD PMT hits	nHitsAD	Number of AD PMT hits
	timeAD[nHitsAD]	Calibrated time [ns] of PMT hit relative to trigger time
	chargeAD[nHitsAD]	Calibrated charge [photoelectrons] of PMT hit
	hitCountAD[nHitsAD]	Index of this hit for this PMT (0, 1, 2, ...)
	ring[nHitsAD]	PMT ring in AD (counts 1 to 8 from AD bottom)
	column[nHitsAD]	PMT column in AD (counts 1 to 24 counterclockwise)
Calib. PMT hits	nHitsAD_calib	Number of AD calibration PMT (2-inch) hits
	timeAD_calib[nHitsAD_calib]	Calibrated time [ns] of PMT hit relative to trigger time
	chargeAD_calib[nHitsAD_calib]	Calibrated charge [photoelectrons] of PMT hit
	hitCountAD_calib[nHitsAD_calib]	Index of this hit for this PMT (0, 1, 2, ...)
	topOrBottom[nHitsAD_calib]	PMT vertical position (1: AD top, 2: AD bottom)
	acuColumn[nHitsAD_calib]	PMT radial position (ACU axis: A=1, B=2, C=3)
Water Pool PMT hits	nHitsPool	Number of Water Pool PMT hits
	timePool[nHitsPool]	Calibrated time [ns] of PMT hit relative to trigger time
	chargePool[nHitsPool]	Calibrated charge [photoelectrons] of PMT hit
	hitCountPool[nHitsPool]	Index of this hit for this PMT (0, 1, 2, ...)
	wallNumber[nHitsPool]	PMT wall number
	wallSpot[nHitsPool]	PMT spot number in wall
	inwardFacing[nHitsPool]	PMT direction (0: outward, 1: inward)

Calibrated data in NuWa

Here is a cheat-sheet for processing calibrated data in Python. These lines can be used in the `execute()` function of a Python algorithm.

```
evt = self.evtSvc()

# Access the Calib Readout Header.
# This is a container for calibrated data
calibHdr = evt["/Event/CalibReadout/CalibReadoutHeader"]
if calibHdr == None:
    self.error("Failed to get current calib readout header")
    return FAILURE

# Access the Readout.  This is the calibrated data from one trigger.
calibReadout = calibHdr.calibReadout()
if calibReadout == None:
    self.error("Failed to get calibrated readout from header")
    return FAILURE

# Get the detector ID for this trigger
detector = calibReadout.detector()
```

```
detector.detName()

# Trigger Type: This is an integer of the type for this trigger
calibReadout.triggerType()
# Trigger Number: A count of the trigger, according to the DAQ
calibReadout.triggerNumber()

# Trigger Time: Absolute time of trigger for this calibrated data
triggerTime = calibReadout.triggerTime()

# Loop over each channel data in this trigger
for channel in calibReadout.channelReadout():
    sensorId = channel.pmtSensorId()
    if detector.isAD():
       pmtId = AdPmtSensor( sensorId.fullPackedData() )
       pmtId.detName()
       pmtId.ring()
       pmtId.column()
    elif detector.isWaterShield():
       pmtId = PoolPmtSensor( sensorId.fullPackedData() )
       pmtId.detName()
       pmtId.wallNumber()
       pmtId.wallSpot()
       pmtId.inwardFacing()

    # Calibrated hit data for this channel
    for hitIdx in range( channel.size() ):
        # Hit time is in units of ns, and is relative to trigger time
        hitTime = channel.time( hitIdx )
        # Hit charge is in units of photoelectrons
        hitCharge = channel.charge( hitIdx )
```

3.5.10 Calibrated Statistics Data

Calibrated statistics data in ROOT

The following table summarizes the calibrated statistics data for each event visible directly in ROOT. Array items have their length given in the brackets (i.e. *name[length]*). ROOT will automatically draw all entries in the array given the array name. See the ROOT User's Guide for more details on working with Trees, http://root.cern.ch/download/doc/12Trees.pdf.

ROOT Variable	Description
dtLastAD1_ms	Time since previous AD1 trigger [ms]
dtLastAD2_ms	Time since previous AD2 trigger [ms]
dtLastIWS_ms	Time since previous Inner water pool trigger [ms]
dtLastOWS_ms	Time since previous Outer water pool trigger [ms]
dtLast_ADMuon_ms	Time since previous AD event with greater than 20 MeV [ms]
dtLast_ADShower_ms	Time since previous AD event with greater than 1 GeV [ms]
ELast_ADShower_pe	Energy of last AD event with greater than 1 GeV [pe]
nHit	Total number of hit 8-inch PMTS
nPEMedian	Median charge (number of photoelectrons) on PMTs
nPERMS	RMS of charge (number of photoelectrons) on PMTs
nPESum	Total sum of charge (number of photoelectrons) on all PMTs
nPulseMedian	Median number of hits on PMTs

ROOT Variable	Description
nPulseRMS	Median number of hits on PMTs
nPulseSum	Total Sum of number of hits on all PMTs
tEarliest	Earliest hit time on all PMTs [ns]
tLatest	Latest hit time on all PMTS [ns]
tMean	Mean hit time on all PMTS [ns]
tMedian	Median hit time on all PMTS [ns]
tRMS	RMS of hit time on all PMTS [ns]
charge_sum_flasher_max	The maxima total charge collected for one PMT in one readout [PE] (sum over all possible h
time_PSD	For hits in each AD, for time window between -1650 and -1250 ns, $\frac{Nhit_{-1650,-1450}}{Nhit_{-1650,-1250}}$.
time_PSD1	For hits in each AD, for time window between -1650 and -1250 ns, $\frac{Nhit_{-1650,-1500}}{Nhit_{-1650,-1250}}$.
time_PSD_local_RMS	The RMS of the time of the first hit (also must be within -1650 and -1250) for 5x5 (or 4x5 fo
Q1	The total charge (within -1650 and -1250) of nearby $\pm$ 3 columns PMTs (total 7 columns)
Q2	The total charge (within -1650 and -1250) of $4 \rightarrow 9$ and $-4 \rightarrow -9$ columns PMTs (total 12
Q3	The total charge (within -1650 and -1250) of PMTs for the rest of columns (other than those
flasher_flag	"1-time_PSD + 1- time_PSD1 + Q3/Q2*2 + nPEMax/nPESum + time_PSD_local_RMS/10
EarlyCharge	The charge sum in time window t<-1650ns
LateCharge	The charge sum in time window t>-1250ns
NominalCharge	The charge sum in time window -1650ns<t<-1250ns, See Doc6926
MaxQ	The largest charge fraction of PMTs
maxqRing	The ring number of the MaxQ PMT
maxqCol	The column number of the MaxQ PMT
QuadrantQ1	Total charge of PMTs with column number in [maxqCol-2, maxqCol+3]). For the value in th
QuadrantQ2	Total charge of PMTs with column number in [(maxqCol+6)-2,(maxqCol+6)+3])
QuadrantQ3	Total Charge of PMTs with column number in [(maxq+12)-2, (maxqCol+12)+3])
QuadrantQ4	Total Charge of PMTs with column number in [(maxq+18)-2, (maxqCol+18)+3])
Quadrant	The ratio of QuadrantQ3/(QuadrantQ2 + QuadrantQ4)
MainPeakRMS	According to the location of MaxQ PMT, divide 24 columns into two clusters. MainPeak clu
SecondPeakRMS	See description in MainPeakRMS.
PeakRMS	The sum of MainPeakRMS and SecondPeakRMS
RingKurtosis	Kurtosis of charge weighted distance in the Ring dimension for the MainPeak cluster, see Do
ColumnKurtosis	Kurtosis of charge weighted distance in the Column dimension for the MainPeak cluster
Kurtosis	Sum of RingKurtosis and ColumnKurtosis
MiddleTimeRMS	RMS of PMT first hit time in the time window (-1650ns, -1250ns). This time window should
integralRunTime_ms	'DAQ Running time' from the start of the file up to the current trigger
integralLiveTime_buffer_full_ms	'DAQ Livetime' from the start of the file up to the current trigger. The 'DAQ Livetime' is th
integralLiveTime_blocked_trigger_ms	'DAQ Livetime', using an alternate correction for 'blocked trigger' periods
blocked_trigger	A count of the 'blocked triggers' immediately preceding the current trigger. When the electr
buffer_full_flag	This flag is true if the electronics memory buffers filled immediately preceding this trigger. I

Calibrated statistics data in NuWa

Here is a cheat-sheet for processing calibrated statistics data in Python. These lines can be used in the `execute()` function of a Python algorithm.

```
evt = self.evtSvc()

# Access the Calibrated Statistics Data Header.
# This is a container for calibrated statistics data
calibStats = evt["/Event/Data/CalibStats"]
if calibStats == None:
    self.debug("No calibrated statistics!")
```

```
    return FAILURE

# Access the Calibrated statistics data
nPESum = calibStats.get('nPESum').value()
```

3.5.11 Reconstructed Data

Reconstructed data in ROOT

The following table summarizes the reconstructed data visible directly in ROOT. Reconstruction can optionally estimate an energy, a position, and/or a track direction. The `status` variables should be checked to determine whether reconstruction has successfully set any of these quantities.

Item	ROOT Variable	Description
site	site	Site ID number
detector	detector	Detector ID number
trigger type	triggerType	All active triggers, logically added
trigger time	triggerTimeSec	Trigger time count in seconds from Jan. 1970 (unixtime)
	triggerTimeNanoSec	Trigger time count of nanoseconds from last second
energy	energyStatus	Status of energy reconstruction (0: unknown, 1: good, >1: failures)
	energy	reconstructed energy [MeV]
	energyQuality	Measure of fit quality (χ^2, likelihood, etc.)
position	positionStatus	Status of position reconstruction (0: unknown, 1: good, >1: failures)
	x	reconstructed x position [mm] in AD, Water Pool, or RPC coordinates
	y	reconstructed y position [mm] in AD, Water Pool, or RPC coordinates
	z	reconstructed z position [mm] in AD, Water Pool, or RPC coordinates
	positionQuality	Measure of fit quality (χ^2, likelihood, etc.)
direction	directionStatus	Status of track reconstruction (0: unknown, 1: good, >1: failures)
	dx	reconstructed dx track direction in AD, Water Pool, or RPC coordinates
	dy	reconstructed dy track direction in AD, Water Pool, or RPC coordinates
	dz	reconstructed dz track direction in AD, Water Pool, or RPC coordinates
	directionQuality	Measure of fit quality (χ^2, likelihood, etc.)
error matrix	errorMatrixDim	Dimension of error matrix (0 if not set)
	errorMatrix	Array of error matrix elements

Reconstructed data in NuWa

Here is a cheat-sheet for processing reconstructed data in Python. These lines can be used in the `execute()` function of a Python algorithm.

```
evt = self.evtSvc()

# Access the Recon Header.  This is a container for the reconstructed data
reconHdr = evt["/Event/Rec/AdSimple"]
if reconHdr == None:
    self.error("Failed to get current recon header")
    return FAILURE

result = reconHdr.recTrigger()

# Get the detector ID for this trigger
detector = result.detector()
detector.detName()
```

```
# Trigger Type: This is an integer of the type for this trigger
result.triggerType()
# Trigger Number: A count of the trigger, according to the DAQ
result.triggerNumber()

# Trigger Time: Absolute time of trigger for this raw data
triggerTime = result.triggerTime()

# Energy information
result.energyStatus()
result.energy()
result.energyQuality()

# Position information
result.positionStatus()
result.position().x()
result.position().y()
result.position().z()
result.positionQuality()

# Direction information, for tracks
result.directionStatus()
result.direction().x()
result.direction().y()
result.direction().z()
result.directionQuality()

# Covariance Matrix, if one is generated
result.errorMatrix()
```

3.5.12 Spallation Data

Spallation data in ROOT

The following table summarizes the spallation data visible directly in ROOT. Array items have their length given in the brackets (i.e. *name[length]*). ROOT will automatically draw all entries in the array given the array name. See the ROOT User's Guide for more details on working with Trees, http://root.cern.ch/download/doc/12Trees.pdf.

ROOT Variable	Description
tMu_s	Timestamp of this muon event (seconds part)
tMu_ns	Timestamp of this muon event (nanoseconds part)
dtLastMu_ms	Time since previous muon event [ms]
dtNextMu_ms	Time to next muon event [ms]
hitAD1	Did AD1 have a prompt trigger for this muon?
hitAD2	Did AD2 have a prompt trigger for this muon?
hitAD3	Did AD3 have a prompt trigger for this muon?
hitAD4	Did AD4 have a prompt trigger for this muon?
hitIWS	Did the Inner water pool have a prompt trigger for this muon?
hitOWS	Did the Outer water pool have a prompt trigger for this muon?
hitRPC	Did the RPC have a prompt trigger for this muon?
triggerNumber_AD1	Trigger number of prompt AD1 muon trigger (if exists)
triggerNumber_AD2	Trigger number of prompt AD2 muon trigger (if exists)
triggerNumber_AD3	Trigger number of prompt AD3 muon trigger (if exists)

Continued on next page

Table 3.5 – continued from previous page

ROOT Variable	Description
triggerNumber_AD4	Trigger number of prompt AD4 muon trigger (if exists)
triggerNumber_IWS	Trigger number of prompt IWS muon trigger (if exists)
triggerNumber_OWS	Trigger number of prompt OWS muon trigger (if exists)
triggerNumber_RPC	Trigger number of prompt RPC muon trigger (if exists)
triggerType_AD1	Trigger type of prompt AD1 muon trigger (if exists)
triggerType_AD2	Trigger type of prompt AD2 muon trigger (if exists)
triggerType_AD3	Trigger type of prompt AD3 muon trigger (if exists)
triggerType_AD4	Trigger type of prompt AD4 muon trigger (if exists)
triggerType_IWS	Trigger type of prompt IWS muon trigger (if exists)
triggerType_OWS	Trigger type of prompt IWS muon trigger (if exists)
triggerType_RPC	Trigger type of prompt IWS muon trigger (if exists)
dtAD1_ms	Time since first prompt muon trigger [ms]
dtAD2_ms	Time since first prompt muon trigger [ms]
dtAD3_ms	Time since first prompt muon trigger [ms]
dtAD4_ms	Time since first prompt muon trigger [ms]
dtIWS_ms	Time since first prompt muon trigger [ms]
dtOWS_ms	Time since first prompt muon trigger [ms]
dtRPC_ms	Time since first prompt muon trigger [ms]
calib_nPESum_AD1	CalibStats charge sum from prompt muon trigger
calib_nPESum_AD2	CalibStats charge sum from prompt muon trigger
calib_nPESum_AD3	CalibStats charge sum from prompt muon trigger
calib_nPESum_AD4	CalibStats charge sum from prompt muon trigger
calib_nPESum_IWS	CalibStats charge sum from prompt muon trigger
calib_nPESum_OWS	CalibStats charge sum from prompt muon trigger
nRetriggers	Total number of possible retriggers
detectorId_rt[nRetriggers]	Possible retrigger detector ID
dtRetrigger_ms[nRetriggers]	Time of retrigger relative to first prompt muon trigger
triggerNumber_rt[nRetriggers]	Trigger number of retrigger
triggerType_rt[nRetriggers]	Trigger type of retrigger
calib_nPESum_rt[nRetriggers]	Total charge sum of retrigger
nSpall	Number of AD triggers between this muon and next muon
detectorId_sp[nSpall]	Detector ID of AD trigger
triggerNumber_sp[nSpall]	Trigger number of AD trigger
triggerType_sp[nSpall]	Trigger type of AD trigger
dtSpall_ms[nSpall]	Time between AD trigger and first prompt muon trigger [ms]
energyStatus_sp[nSpall]	AD energy reconstruction status
energy_sp[nSpall]	AD reconstructed energy [MeV]
positionStatus_sp[nSpall]	AD position reconstruction status
x_sp[nSpall]	AD reconstructed X position [mm]
y_sp[nSpall]	AD reconstructed Y position [mm]
z_sp[nSpall]	AD reconstructed Z position [mm]

Spallation data in NuWa

Here is a cheat-sheet for processing spallation data in Python. These lines can be used in the `execute()` function of a Python algorithm.

```
evt = self.evtSvc()

# Access the Spallation Data Header.
# This is a container for muon spallation data
spallData = evt["/Event/Data/Muon/Spallation"]
```

```
if spallData == None:
    self.debug("No spallation data this cycle")
    return SUCCESS

# Access the spallation data
nSpall = spall.get('nSpall').value()
```

3.5.13 Coincidence Data

Coincidence data in ROOT

The following table summarizes the coincidence data visible directly in ROOT. Array items have their length given in the brackets (i.e. *name[length]*). ROOT will automatically draw all entries in the array given the array name. See the ROOT User's Guide for more details on working with Trees, http://root.cern.ch/download/doc/12Trees.pdf.

ROOT Variable	Description
multiplicity	Number of AD events within coincidence window
triggerNumber[multiplicity]	Trigger number of event
triggerType[multiplicity]	Trigger type of event
t_s[multiplicity]	Timestamp of event (seconds part)
t_ns[multiplicity]	Timestamp of event (nanoseconds part)
dt_ns[multiplicity]	Time relative to first event in multiplet
energyStatus[multiplicity]	Status of AD energy reconstruction
e[multiplicity]	Reconstructed energy [MeV]
positionStatus[multiplicity]	Status of AD position reconstruction
x[multiplicity]	AD Reconstructed X position [mm]
y[multiplicity]	AD Reconstructed Y position [mm]
z[multiplicity]	AD Reconstructed Z position [mm]
I[mult*(mult-1)/2]	Prompt helper array for ROOT histogramming
J[mult*(mult-1)/2]	Delayed helper array for ROOT histogramming
dtLastAD1_ms[multiplicity]	Time since last muon in AD1 [ms]
dtLastAD2_ms[multiplicity]	Time since last muon in AD2 [ms]
dtLastIWS_ms[multiplicity]	Time since last muon in Inner water pool [ms]
dtLastOWS_ms[multiplicity]	Time since last muon in Outer water pool [ms]
dtLast_ADMuon_ms	Time since previous AD event above 3200 pe (20 MeV) [ms]
dtLast_ADShower_ms	Time since previous AD event above 160000 pe (1 GeV) [ms]
ELast_ADShower_pe	Energy of last AD event with greater than 160000 pe [pe]
calib_nHit[multiplicity]	CalibStats data
calib_nPEMedian[multiplicity]	CalibStats data
calib_nPERMS[multiplicity]	CalibStats data
calib_nPESum[multiplicity]	CalibStats data
calib_nPulseMedian[multiplicity]	CalibStats data
calib_nPulseRMS[multiplicity]	CalibStats data
calib_nPulseSum[multiplicity]	CalibStats data
calib_tEarliest[multiplicity]	CalibStats data
calib_tLatest[multiplicity]	CalibStats data
calib_tMean[multiplicity]	CalibStats data
calib_tMedian[multiplicity]	CalibStats data
calib_tRMS[multiplicity]	CalibStats data
gen_count[multiplicity]	Monte-Carlo truth generator data
gen_e[multiplicity]	Monte-Carlo truth generator data
gen_execNumber[multiplicity]	Monte-Carlo truth generator data

Continued on next page

Table 3.6 – continued from previous page

ROOT Variable	Description
gen_lastDaughterPid[multiplicity]	Monte-Carlo truth generator data
gen_pid[multiplicity]	Monte-Carlo truth generator data
gen_px[multiplicity]	Monte-Carlo truth generator data
gen_py[multiplicity]	Monte-Carlo truth generator data
gen_pz[multiplicity]	Monte-Carlo truth generator data
gen_type[multiplicity]	Monte-Carlo truth generator data

Coincidence data in NuWa

Here is a cheat-sheet for processing coincidence data in Python. These lines can be used in the `execute()` function of a Python algorithm.

```
evt = self.evtSvc()

# Access the Coincidence Data Header.
# This is a container for AD coincidence data
coincHdr = evt["/Event/Data/Coinc/AD1Coinc"]
if coincHdr == None:
    self.debug("No coincidence header this cycle")
    return SUCCESS

# Access the Coincidence Data
dt_ms = coinc.get('dt_ms').value()
```

3.5.14 NuWa Services

(Add documentation for common services here.)

3.5.15 Computer Clusters

(Add details for each computer cluster here.)

3.5.16 Miscellaneous

Time Axes in ROOT

The following lines will display a time axis in a human-readable format using Beijing local time.

```
root [3] htemp->GetXaxis()->SetTimeDisplay(1);
root [4] htemp->GetXaxis()->SetTimeFormat("#splitline{%H:%M:%S}{%d\/%m\/%Y}");
root [5] htemp->GetXaxis()->SetNdivisions(505);
root [6] htemp->GetXaxis()->SetTimeOffset(8*60*60);
root [7] htemp->Draw("colz");
```

3.6 Hands-on Exercises

- Find the AD Dry Run data files from run 5773 on PDSF. —

- Convert the first file of this run from `.data` to `.root`. —
- Generate a calibrated data file from this data. —
- Plot the AD charge map figures shown in Fig. *fig:calibhists* —
- Generate a reconstructed data file from this data. —
- Plot the calibrated AD charge sum vs. the AD reconstructed energy. —
- From the first simulation file from run 29000, generate a spallation file and plot the time from each AD event to the last muon. —
- From the first simulation file from run 29000, generate an AD coincidence file and plot the prompt vs. delayed reconstructed energy. —

CHAPTER

FOUR

OFFLINE INFRASTRUCTURE

4.1 Mailing lists

- existing lists, their purposes
- offline list - expected topics
- subscribing
- archives
- how to get help

4.2 DocDB

- Content - what should go in DocDB
- how to access
- Major features
- Basic instructions
- how to get help

4.3 Wikis

- Content - what should go in DocDB
- How to access
- Basic markup help
- Conventions, types of topics
- Using categories

4.4 Trac bug tracker

- when to use it
- roles and responsibilities

CHAPTER

FIVE

INSTALLATION AND WORKING WITH THE SOURCE CODE

5.1 Using pre-installed release

All major clusters should have existing releases installed and ready to use. Specific information on different clusters is available in the wiki topic "Cluster Account Setup" [1]. The key piece of information to know is where the release is installed.

Configuring your environment to use an installed release progresses through several steps.

5.1.1 Basic setup

Move to the top level release directory and source the main setup script.

```
shell> cd /path/to/NuWa-RELEASE
bash> source setup.sh
tcsh> source setup.csh
```

Replace "`RELEASE`" with "`trunk`" or the release label of a frozen release.

5.1.2 Setup the `dybgaudi` project

Projects are described more below. To set up your environment to use our software project, "`dybgaudi`" and the other projects on which it depends to must enter a, so called, "release package" and source its setup script.

```
shell> cd /path/to/NuWa-RELEASE
bash> source setup.sh
tcsh> source setup.csh
```

You are now ready to run some software. Try:

```
shell> cd $HOME
shell> nuwa.py --help
```

5.2 Instalation of a Release

If you work on a cluster, it is best to use a previously existing release. If you do want to install your own copy it is time and disk consuming but relatively easy. A script called "`dybinst`" takes care of everything.

[1] https://wiki.bnl.gov/dayabay/index.php?title=Cluster_Account_Setup

First, you must download the script. It is best to get a fresh copy whenever you start an installation. The following examples show how to install the "trunk" branch which holds the most recent development.

```
shell> svn export http://dayabay.ihep.ac.cn/svn/dybsvn/installation/trunk/dybinst/dybinst
```

Now, let it do its work:

```
shell> ./dybinst trunk all
```

Expect it to take about 3-4 hours depending on your computer's disk, CPU and network speed. It will also use several GBs of storage, some of which can be reclaimed when the install is over.

5.3 Anatomy of a Release

external/ holds 3rd party binary libraries and header files under `PACKAGE/VERSION/` sub directories.

NuWa-RELEASE/ holds the projects and their packages that make up a release.

lcgcmt build information for using 3rd party external packages

gaudi the Gaudi framework

lhcb packages adopted from the LHCb experiment

dybgaudi packages specific to Daya Bay offline software

relax packages providing dictionaries for CLHEP and other HEP libraries.

5.3.1 Release, Projects and Packages

- What is a release. For now see https://wiki.bnl.gov/dayabay/index.php?title=Category:Offline_Software_Releases
- What is a package. For now see https://wiki.bnl.gov/dayabay/index.php?title=CMT_Packages
- What is a project. For now see https://wiki.bnl.gov/dayabay/index.php?title=CMT_Projects.

5.3.2 Personal Projects

- Using a personal project with projects from a NuWa release.
- CMTPROJECTPATH

For now see https://wiki.bnl.gov/dayabay/index.php?title=CMT_Projects.

5.4 Version Control Your Code

5.4.1 Using SVN to Contribute to a Release

5.4.2 Using GIT with SVN

Advanced developers may consider using `git` [2] to interface with the SVN repository. Reasons to do this include being able to queue commits, advanced branching and merging, sharing code with other git users or with yourself on other computers with the need to commit to SVN. In particular, git is used to

[2] http://git.or.cz/

track the projects (gaudi, etc) while retaining the changes Daya Bay makes. For more information see https://wiki.bnl.gov/dayabay/index.php?title=Synchronizing_Repositories.

5.5 Technical Details of the Installation

5.5.1 LCGCMT

The LCGCMT package is for defining platform tags, basic CMT macros, building external packages and "glueing" them into CMT.

Builders

The builders are CMT packages that handle downloading, configuring, compiling and installing external packages in a consistent manner. They are used by `dybinst` or can be run directly. For details see the `README.org` file under `lcgcmt/LCG_builders/` directory.

Some details are given for specific builders:

data: A select sampling of data files are installed under the "data" external package. These are intended for input to unit tests or for files that are needed as input but are too large to be conveniently placed in SVN. For the conventions that must be followed to add new files see the comments in the `data/cmt/requirements/` file under the builder area.

CHAPTER

SIX

OFFLINE FRAMEWORK

6.1 Introduction

When writing software it is important to manage complexity. One way to do that is to organize the software based on functionality that is generic to many specific, although maybe similar applications. The goal is to develop software which "does everything" except those specific things that make the application unique. If done well, this allows unique applications to be implemented quickly, and in a way that is robust against future development but still flexible to allow the application to be taken in novel directions.

This can be contrasted with the inverted design of a toolkit. Here one focuses on units of functionality with no initial regards of integration. One builds libraries of functions or objects that solve small parts of the whole design and, after they are developed, find ways to glue them all together. This is a useful design, particularly when there are ways to glue disparate toolkits together, but can lead to redundant development and inter-operational problems.

Finally there is the middle ground where a single, monolithic application is built from the ground up. When unforeseen requirements are found their solution is bolted on in whatever the most expedient way can be found. This can be useful for quick initial results but eventually will not be maintainable without growing levels of effort.

6.2 Framework Components and Interfaces

Gaudi components are special classes that can be used by other code without explicitly compiling against them. They can do this because they inherit from and implement one or more special classes called "interface classes" or just interfaces. These are light weight and your code compiles against them. Which actual implementation that is used is determined at run time by looking them up by name. Gaudi Interfaces are special for a few reasons:

Pure-virtual: all methods are declared `=0` so that implementations are required to provide them. This is the definition of an "interface class". Being pure-virtual also allows for an implementation class to inherit from multiple interfaces without problem.

References counted: all interfaces must implement reference counting memory management.

ID number: all interface implementations must have a unique identifying number.

Fast casting: all interfaces must implement the fast `queryInterface()` dynamic cast mechanism.

Part of a components implementation involves registering a "factory" class with Gaudi that knows how to produce instances of the component given the name of the class. This registration happens when the component library is linked and this linking can be done dynamically given the class name and the magic of generated `rootmap` files.

As a result, C++ (or Python) code can request a component (or Python shadow class) given its class name. At the same time as the request, the resulting instance is registered with Gaudi using a nick-name [1]. This nick-name lets you configure multiple instances of one component class in different ways. For example one might want to have a job with

[1] Nick-names default to the class name.

two competing instances of the same algorithm class run on the same data but configured with two different sets of properties.

6.3 Common types of Components

The main three types of Gaudi components are Algorithms, Tools and Services.

6.3.1 Algorithms

- Inherit from `GaudiAlgorithm` or if you will produce data from `DybAlgorithm`.
- execute(), initialize(), finalize() and associated requirements (eg. calling GaudiAlgorithm::initialize()).
- TES access with `get()` and `put()` or `getTes()` and `putTES` if implementing `DybAlgorithm`. There is also `getAES` to access the archive event store.
- Logging with `info()`, etc.
- required boilerplate (_entries & _load files, cpp macros)
- some special ones: sequencer (others?)

Algorithms contain code that should be run once per execution cycle. They may take input from the TES and may produce output. They are meant to encapsulate complexity in a way that allows them to be combined in a high-level manner. They can be combined in a serial chain to run one-by-one or they can run other algorithms as sub-algorithms. It is also possible to set up high-level branch decisions that govern whether or not sub-chains run.

6.3.2 Tools

Tools contain utility code or parts of algorithm code that can be shared. Tool instances can be public, in which case any other code may use it, or they may be private. Multiple instances of a private tool may be created. A tool may be created at any time during a job and will be deleted once no other code references it.

6.3.3 Services

Service is very much like a public tool of which there is a single instance created. Services are meant to be created at the beginning of the job and live for its entire life. They typically manage major parts of the framework or some external service (such as a database).

6.4 Writing your own component

6.4.1 Algorithms

One of the primary goals of Gaudi is to provide the concept of an Algorithm which is the main entry point for user code. All other parts of the framework exist to allow users to focus on writing algorithms.

An algorithm provide three places for users to add their own code:

`initialize()` This method is called once, at the beginning of the job. It is optional but can be used to apply any properties that the algorithm supports or to look up and cache pointers to services, tools or other components or any other initializations that require the Gaudi framework.

`execute()` This method is called once every execution cycle ("event"). Here is where user code does implements whatever algorithm the user creates.

`finalize()` This method is called once, at the end of the job. It is optional but can be used to `release()` any cached pointers to services or tools, or do any other cleaning up that requires the Gaudi framework.

When writing an algorithm class the user has three possible classes to use as a basis:

`Algorithm` is a low level class that does not provide many useful features and is probably best to ignore.

`GaudiAlgorithm` inherits from Algorithm and provide many useful general features such as access to the message service via `info()` and related methods as well as methods providing easy access to the TES and TDS (eg, `get()` and `getDet()`). This is a good choice for many types of algorithms.

`DybAlgorithm` inherits from GaudiAlgorithm and adds Daya Bay specific features related to producing objects from the DataModel. It should only be considered for algorithms that need to add new data to the TES. An algorithm may be based on GaudiAlgorithm and still add data to the TES but some object bookkeeping will need to be done manually.

Subclasses of `DybAlgorithm` should provide `initialize`, `execute` and `finalize` methods as they would if they use the other two algorithm base classes. `DybAlgorithm` is templated by the DataModel data type that it will produce and this type is specified when a subclass inherits from it. Instances of the object should be created using the `MakeHeaderObject()` method. Any input objects that are needed should be retrieved from the data store using `getTES()` or `getAES()`. Finally, the resulting data object is automatically put into the TES at the location specified by the "`Location`" property which defaults to that specified by the DataModel class being used. This will assure bookkeeping such as the list of input headers, the random state and other things are properly set.

6.4.2 Tools

- examples
- Implementing existing tool interface,
- writing new interface.
- required boilerplate (_entries & _load files, cpp macros)

6.4.3 Services

- common ones provided, how to access in C++
- Implementing existing service interface,
- writing new interface.
- Include difference between tools and service.
- required boilerplate (_entries & _load files, cpp macros)

6.4.4 Generalized Components

6.5 Properties and Configuration

Just about every component that Gaudi provides, or those that Daya Bay programmers will write, one or more *properties*. A property has a name and a value and is associated with a component. Users can set properties that will then get applied by the framework to the component.

Gaudi has two main ways of setting such configuration. Initially a text based C++-like language was used. Daya Bay does not use this but instead uses the more modern Python based configuration. With this, it is possible to write a main Python program to configure everything and start the Gaudi main loop to run some number of executions of the top-level algorithm chain.

The configuration mechanism described below was introduced after release 0.5.0.

6.5.1 Overview of configuration mechanism

The configuration mechanism is a layer of Python code. As one goes up the layer one goes from basic Gaudi configuration up to user interaction. The layers are pictured in Fig. *fig:config-layers*. The four layers are described from lowest to highest in the next sections.

6.5.2 Configurables

All higher layers may make use of Configurables. They are Python classes that are automatically generated for all components (Algorithms, Tools, Services, etc). They hold all the properties that the component defines and include their default values and any documentation strings. They are named the same as the component that they represent and are available in Python using this pattern:

```
from PackageName.PackageNameConf import MyComponent
mc = MyComponent()
mc.SomeProperty = 42
```

You can find out what properties any component has using the `properties.py` script which should be installed in your `PATH`.

```
shell> properties.py
GtGenerator :
     GenName:  Name of this generator for book keeping purposes.
     GenTools:  Tools to generate HepMC::GenEvents
     GlobalTimeOffset: None
     Location:  TES path location for the HeaderObject this algorithm produces.
        ...
```

A special configurable is the `ApplicationMgr`. Most users will need to use this to include their algorithms into the "`TopAlg`" list. Here is an example:

```
from Gaudi.Configuration import ApplicationMgr
theApp = ApplicationMgr()

from MyPackage.MyPackageConf import MyAlgorithm
ma = MyAlgorithm()
ma.SomeProperty = "harder, faster, stronger"
theApp.TopAlg.append(ma)
```

Configurables and Their Names

It is important to understand how configurables eventually pass properties to instantiated C++ objects. Behind the scenes, Gaudi maintains a catalog that maps a key name to a set of properties. Normally, no special attention need be given to the name. If none is given, the configurable will take a name based on its class:

```
# gets name 'MyAlgorithm'
generic = MyAlgorithm()
# gets name 'alg1'
```

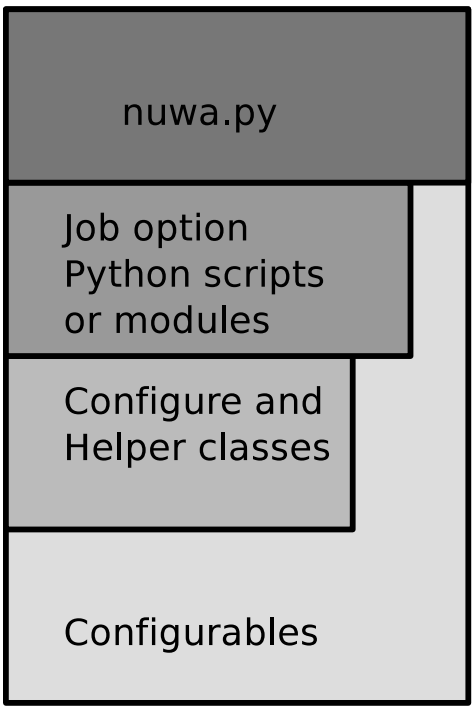


Figure 6.1: **fig:config-layers**
Cartoon of the layers of configuration code.

```
specific = MyAlgorithm('alg1')

theApp.TopAlg.append(generic)
theApp.TopAlg.append(specific)
# TopAlg now holds ['MyAlgorithm/MyAlgorithm', 'MyAlgorithm/alg1']
```

Naming Gaudi Tool Configurables

In the case of Gaudi Tools, things become more complex. Tools themselves can (and should) be configured through configurables. But, there are a few things to be aware of or else one can become easily tricked:

- Tool configurables can be public or private. A public tool configurable is "owned" by ToolSvc and shared by all parents, a private one is "owned" by a single parent and not shared.
- By default, a tool configurable is public.
- "Ownership" is indicated by prepending the parent's name, plus a dot (".") to the a simple name.
- Ownership is set, either when creating the tool configurable by prepending the parent's name, or during assignment of it to the parent configurable.
- During assignment to the parent **a copy** will be made if the tool configurable name is not consistent with the parent name plus a dot prepended to a simple name.

What this means is that you may end up with different final configurations depending on:

- the initial name you give the tool configurable
- when you assign it to the parent
- if the parent uses the tool as a private or a public one
- when you assign the tool's properties

To best understand how things work some examples are given. An example of how public tools work:

```
mt = MyTool("foo")
mt.getName()             # -> "ToolSvc.foo"

mt.Cut = 1
alg1.pubtool = mt
mt.Cut = 2
alg2.pubtool = mt
mt.Cut = 3
# alg1 and alg2 will have same tool, both with cut == 3
```

Here a single "`MyTool`" configurable is created with a simple name. In the constructor a "`ToolSvc.`" is appended (since there was no "." in the name). Since the tool is public the final value (3) will be used by both `alg1` and `alg2`.

An example of how private tools work:

```
mt = MyTool("foo")
mt.getName()             # -> "ToolSvc.foo"

mt.Cut = 1
alg1.privtool = mt
# alg1 gets "alg1.foo" configured with Cut==1
mt.Cut = 2
alg2.privtool = mt
# (for now) alg2 gets "alg2.foo" configured with Cut==2
```

```
# after assignment, can get renamed copy
from Gaudi.Configuration import Configurable
mt2 = Configurable.allConfigurables["alg2.foo"]
mt2.Cut = 3
# (now, really) alg2 gets "alg2.foo" configured with Cut==3
```

Again, the same tool configurable is created and implicitly renamed. An initial cut of 1 is set and the tool configurable is given to alg1. Guadi makes a copy and the "`ToolSvc.foo`" name of the original is changed to "`alg1.foo`" in the copy. The original then as the cut changed to 2 and given to alg2. Alg1's tool's cut is still 1. Finally, the copied `MyTool` configurable is looked up using the name "`alg2.foo`". This can be used if you need to configure the tool after it has been assigned to alg2.

6.5.3 The Package `Configure` Class and Optional Helper Classes

Every package that needs any but the most trivial configuration should provide a `Configure` class. By convention this class should be available from the module named after the package. When it is instantiated it should:

- Upon construction (in `__init__()`), provide a sensible, if maybe incomplete, default configuration for the general features the package provides.
- Store any and all configurables it creates in the instance (Python's `self` variable) for the user to later access.

In addition, the package author is encouraged to provide one or more "helper" classes that can be used to simplify non-default configuration. Helper objects can either operate on the `Configure` object or can be passed in to `Configure` or both.

To see an example of helpers are written look at:

`$SITEROOT/dybgaudi/InstallArea/python/GenTools/Helpers.py`

Package authors should write these classes and all higher layers may make use of these classes.

6.5.4 User Job Option Scripts

The next layer consists of job option scripts. These are short Python scripts that use the lower layers to provide non-default configuration that makes the user's job unique. However, these are not "main program" files and do not execute on their own (see next section).

Users can configure an entire job in one file or spread parts of the configuration among multiple files. The former case is useful for bookkeeping and the latter is if the user wants to run multiple jobs that differ in only a small part of their configuration. In this second case, they can separate invariant configuration from that which changes from run to run.

An example of a job script using the `GenTools` helpers described above is:

```
from GenTools.Helpers import Gun
gunner = Gun()

import GaudiKernel.SystemOfUnits as units
gunner.timerator.LifeTime = int(60*units.second)
# ...
import GenTools
gt = GenTools.Configure("gun","Particle Gun",helper=gunner)
gt.helper.positioner.Position = [0,0,0]
```

In the first two lines a "`Gun`" helper class is imported and constructed with defaults. This helper will set up the tools needed to implement a particle gun based generator. It chooses a bunch of defaults such as particle type, momentum, etc, which you probably don't want so you can change them later. For example the mean life time is set in line 5.

Finally, the package is configured and this helper is passed in. The configuration creates a `GtGenerator` algorithm that will drive the GenTools implementing the gun based kinematics generation. After the `Configure` object is made, it can be used to make more configuration changes.

This specific example was for GenTools. Other package will do different things that make sense for them. To learn what each package does you can read the `Configure` and/or helper code or you can read its inlined documentation via the `pydoc` program. Some related examples of this latter method:

```
shell> pydoc GenTools.Helpers
Help on module GenTools.Helpers in GenTools:

NAME
    GenTools.Helpers

FILE
    /path/to/NuWa-trunk/dybgaudi/InstallArea/python/GenTools/Helpers.py

DESCRIPTION
    Several helper classes to assist in configuring GenTools.  They
    assume geometry has already been setup.  The helper classes that
    produce tools need to define a "tools()" method that returns an
    ordered list of what tools it created.  Users of these helper classes
    should use them like:

CLASSES
    Gun
    HepEVT
...

shell> pydoc GenTools.Helpers.Gun
Help on class Gun in GenTools.Helpers:

GenTools.Helpers.Gun = class Gun
 |  Configure a particle gun based kinematics
 |
 |  Methods defined here:
 |
 |  __init__(self, ...)
 |      Construct the configuration.  Coustom configured tools can
 |      be passed in or customization can be done after construction
 |      using the data members:
 |
 |      .gun
 |      .positioner
 |      .timerator
 |      .transformer
 |
 |      The GtGenerator alg is available from the .generatorAlg member.
 |
 |      They can be accessed for additional, direct configuration.
...
```

6.5.5 User Job Option Modules

A second, complimentary high-level configuration method is to collect lower level code into a user job module. These are normal Python modules and as such are defined in a file that exist in the users current working, in the packages `python/` sub directory or otherwise in a location in the user's `PYTHONPATH`.

Any top level code will be evaluated as the module is `import`ed in the context of configuration (same as job option scripts). But, these modules can supply some methods, named by convention, that can allow additional functionality.

`configure(argv=[])` This method can hold all the same type of configuration code that the job option scripts do. This method will be called just after the module is `import`ed. Any command line options given to the module will be available in `argv` list.

`run(appMgr)` This method can hold code that is to be executed after the configuration stage has finished and all configuration has been applied to the actual underlying C++ objects. In particular, you can define pure-Python algorithms and add them to the `TopAlg` list.

There are many examples Job Option Modules in the code. Here are some specific ones.

`GenTools.Test` this module [2] gives an example of a `configure(argv=[])` function that parses command line options. Following it will allow users to access the command line usage by simply running — `nuwa.py -m 'GenTools.Test --help'`.

`DivingIn.Example` this module [3] gives an example of a Job Option Module that takes no command line arguments and configures a Python Algorithm class into the job.

6.5.6 The `nuwa.py` main script

Finally, there is the layer on top of it all. This is a main Python script called `nuwa.py` which collects all the layers below. This script provides the following features:

- A single, main script everyone uses.
- Configures framework level things
- Python, interactive vs. batch
- Logging level and color
- File I/O, specify input or output files on the command line
- Geometry
- Use or not of the archive event store
- Access to visualization
- Running of user job option scripts and/or loading of modules

After setting up your environment in the usual way the `nuwa.py` script should be in your execution `PATH`. You can get a short help screen by just typing [4]:

```
shell> nuwa.py --help
Usage:
    This is the main program to run NuWa offline jobs.

    It provides a job with a minimal, standard setup.  Non standard
    behavior can made using command line options or providing additional
    configuration in the form of python files or modules to load.

    Usage:

      nuwa.py [options] [-m|--module "mod.ule --mod-arg ..."] \
              [config1.py config2.py ...] \
              [mod.ule1 mod.ule2 ...] \
```

[2] Code is at `dybgaudi/Simulation/GenTools/python/GenTools/Test.py`.
[3] Code is at `tutorial/DivingIn/python/DivingIn/Example.py`
[4] Actual output may differ slightly.

```
            [input1.root input2.root ...]

    Python modules can be specified with -m|--module options and may
    include any per-module arguments by enclosing them in shell quotes
    as in the above usage.  Modules that do not take arguments may
    also be listed as non-option arguments.  Modules may supply the
    following functions:

    configure(argv=[]) - if exists, executed at configuration time

    run(theApp) - if exists, executed at run time with theApp set to
    the AppMgr.

    Additionally, python job scripts may be specified.

    Modules and scripts are loaded in the order they are specified on
    the command line.

    Finally, input ROOT files may be specified.  These will be read in
    the order they are specified and will be assigned to supplying
    streams not specificially specified in any input-stream map.

    The listing of modules, job scripts and/or ROOT files may be
    interspersed but must follow all options.


Options:
  -h, --help            show this help message and exit
  -A, --no-aes          Do not use the Archive Event Store.
  -l LOG_LEVEL, --log-level=LOG_LEVEL
                        Set output log level.
  -C COLOR, --color=COLOR
                        Use colored logs assuming given background ('light' or
                        'dark')
  -i, --interactive     Enter interactive ipython shell after the run
                        completes (def is batch).
  -s, --show-includes   Show printout of included files.
  -m MODULE, --module=MODULE
                        Load given module and pass optional argument list
  -n EXECUTIONS, --executions=EXECUTIONS
                        Number of times to execute list of top level
                        algorithms.
  -o OUTPUT, --output=OUTPUT
                        Output filename
  -O OUTPUT_STREAMS, --output-streams=OUTPUT_STREAMS
                        Output file map
  -I INPUT_STREAMS, --input-streams=INPUT_STREAMS
                        Input file map
  -H HOSTID, --hostid=HOSTID
                        Force given hostid
  -R RUN, --run=RUN     Set run number
  -N EXECUTION, --execution=EXECUTION
                        Set the starting execution number
  -V, --visualize       Run in visualize mode
  -G DETECTOR, --detector=DETECTOR
                        Specify a non-default, top-level geometry file
```

Each job option `.py` file that you pass on the command line will be `eval`uated in turn and the list of `.root` files will be appended to the "`default`" input stream. Any non-option argument that does not end in `.py` or `.root` is assumed to be a Python module which will be loaded as described in the previous section.

If you would like to pass command line arguments to your module, instead of simply listing them on the command line you must `-m` or `--module`. The module name and arguments must be surrounded by shell quotes. For example:

```
shell> nuwa.py -n1 -m "DybPython.TestMod1 -a foo bar" \
                   -m DybPython.TestMod2 \
                   DybPython.TestMod3
```

In this example, only `DybPython.TestMod1` takes arguments. `TestMod2` does not but can still be specified with "`-m`". As the help output states, modules and job script files are all loaded in the order in which they are listed on the command line. All non-option arguments must follow options.

6.5.7 Example: Configuring `DetSimValidation`

During the move from the legacy G4dyb simulation to the Gaudi based one an extensive validation process was done. The code to do this is in the package `DetSimValidation` in the `Validation` area. It is provides a full-featured configuration example. Like `GenTools`, the configuration is split up into modules providing helper classes. In this case, there is a module for each detector and a class for each type of validation run. For example, test of uniformly distributed positrons can be configured like:

```
from DetSimValidation.AD import UniformPositron
up = UniformPositron()
```

CHAPTER

SEVEN

DATA MODEL

- Over all structure of data
- One package per processing stage
- Single "header object" as direct TES DataObject
- Providence
- Tour of DataModel packages

7.1 Overview

The "data model" is the suite of classes used to describe almost all of the information used in our analysis of the experimental results. This includes simulated truth, real and simulated DAQ data, calibrated data, reconstructed events or other quantities. Just about anything that an algorithm might produce is a candidate for using existing or requiring new classes in the *data model*. It does not include some information that will be stored in a database (reactor power, calibration constants) nor any analysis ntuples. In this last case, it is important to strive to keep results in the form of *data model* classes as this will allow interoperability between different algorithms and a common language that we can use to discuss our analysis.

The classes making up the *data model* are found in the `DataModel` area of a release. There is one package for each related collection of classes that a particular analysis stage produces.

7.1.1 HeaderObject

There is one special class in each package which inherits from `HeaderObject`. All other objects that a processing stage produces will be held, directly or indirectly by the `HeaderObject` for the stage. `HeaderObjects` also hold a some book-keeping items such as:

TimeStamp giving a single reference time for this object and any subobjects it may hold. See below for details on what kind of times the *data model* makes use of.

Execution Number counts the number of times the algorithm's execution method has been called, starting at 1. This can be thought of as an "event" number in more traditional experiments.

Random State holds the stage of the random number generator engine just before the algorithm that produced the `HeaderObject` was run. It can be used to re-run the algorithm in order to reproduce and arbitrary output.

Input `HeaderObjects` that were used to produce this one are referenced in order to determine providence.

Time Extent records the time this data spans. It is actually stored in the `TemporalDataObject` base class.

7.2 Times

There are various times recorded in the data. Some are absolute but imprecise (integral number of ns) and others are relative but precise (sub ns).

7.2.1 Absolute Time

Absolute time is stored in `TimeStamp` objects from the `Conventions` package under `DataModel`. They store time as seconds from the Unix Epoch (Jan 1, 1970, UTC) and nanoseconds w/in a second. A 32 bit integer is currently given to store each time scale [1]. While providing absolute time, they are not suitable for recording times to a precision less than 1 ns. `TimeStamp` objects can be implicitly converted to a `double` but will suffer a loss of precision of 100s of μsec when holding modern times.

7.2.2 Relative Time

Relative times simply count seconds from some absolute time and are stored as a `double`.

7.2.3 Reference times

Each `HeaderObject` holds an absolute reference time as a `TimeStamp`. How each is defined depends on the algorithms that produced the `HeaderObject`.

Sub-object precision times

Some `HeaderObjects`, such as `SimHeader`, hold sub-objects that need precision times (eg `SimHits`). These are stored as doubles and are measured from the reference time of the `HeaderObject` holding the sub- objects.

7.2.4 Time Extents

Each `TemporalObject` (and thus each `HeaderObject`) has a time extent represented by an earliest TimeStamp followed by a latest one. These are used by the window-based analysis window implemented by the Archive Event Store*aes* to determine when objects fall outside the window and can be purged. How each earliest/latest pair is defined depends on the algorithm that produced the object but are typically chosen to just contain the times of all sub-objects held by the `HeaderObject`.

7.2.5 How Some Times are Defined

This list how some commonly used times are defined. The list is organized by the top-level `DataObject` where you may find the times.

`GenHeader` Generator level information.

Reference Time Defined by the generator output. It is the first or primary signal event interaction time.

Time Extent Defined to encompass all primary vertices. Will typically be infinitesimally small.

Precision Times Currently, there no precision times in the conventional sense. Each primary vertex in an event may have a unique time which is absolute and stored as a `double`.

[1] Before 2038 someone had better increase the size what stores the seconds!

SimHeader Detector Simulation output.

Reference Time This is identical to the reference time for the `GenHeader` that was used to as input to the simulation.

Time Extent Defined to contain the times of all `SimHits` from all detectors.

Precision Times Each RPC/PMT `SimHit` has a time measured from the reference time.

FIXME Need to check on times used in the `Historian`.

ElecHeader TrigHeader Readout ...

7.3 Examples of using the Data Model objects

Please write more about me!

7.3.1 Tutorial examples

Good examples are provided by the tutorial project which is located under `NuWa-RELEASE/tutorial/`. Each package shoudl provide a simple, self contained example but note that sometimes they get out of step with the rest of the code or may show less than ideal (older) ways of doing things.

Some good examples to look at are available in the `DivingIn` tutorial package. It shows how to do almost all things one will want to do to write analysis. It includes, accessing the data, making histograms, reading/writing files. Look at the Python modules under `python/DivingIn/`. Most provide instructions on how to run them in comments at the top of the file. There is a companion presentation available as DocDB #3131 [2].

[2] http://dayabay.ihep.ac.cn/cgi-bin/DocDB/ShowDocument?docid=3131

CHAPTER

EIGHT

DATA I/O

Gaudi clearly separates transient data representations in memory from those that persist on disk. The transient representations are described in the previous section. Here the persistency mechanism is described from the point of view of configuring jobs to read and write input/output (I/O) files and how to extend it to new data.

8.1 Goal

The goal of the I/O subsystem is to persist or preserve the state of the event store memory beyond the life time of the job that produced it and to allow this state to be restored to memory in subsequent jobs.

As a consequence, any algorithms that operate on any particular state of memory should not depend, nor even be able to recognize, that this state was restored from persistent files or was generated "on the fly" by other, upstream algorithms.

Another consequence of this is that users should **not** need to understand much about the file I/O subsystem except basics such as deciding what to name the files. This is described in the section on configuration below. Of course, experts who want to add new data types to the subsystem must learn some things which are described in the section below on adding new data classes.

8.2 Features

The I/O subsystem supports these features:

Streams: Streams are time ordered data of a particular type and are named. In memory this name is the location in the Transient Event Store (TES) where the data will be accessed. On disk this name is the directory in the ROOT `TFile` where the `TTree` that stores the stream of data is located.

Serial Files: A single stream can be broken up into sequential files. On input an ordered list of files can be given and they will be navigated in order, transparently. On output, files closed and new ones opened based on certain criteria.

FIXME This is not yet implemented! But, it is easy to do so, the hooks are there.

Parallel Files: Different streams from one job need not be stored all together in the same file. Rather, they can be spread among one or more files. The mapping from stream name to file is user configurable (more on this below).

Navigation: Input streams can be navigated forward, backward and random access. The key is the "entry" number which simply counts the objects in the stream, independent of any potential file breaks. [1]

[1] Correct filling of the Archive Event Service is only guaranteed when using simple forward navigation.

Policy: The I/O subsystem allows for various I/O policies to be enforced by specializing some of its classes and through the converter classes.

8.3 Packages

The I/O mechanism is provided by the packages in the `RootIO` area of the repository. The primary package is `RootIOSvc` which provides the low level Gaudi classes. In particular it provides an event selector for navigating input as well as a conversion service to facilitate converting between transient and persistent representations. It also provides the file and stream manipulation classes and the base classes for the data converters. The concrete converters and persistent data classes are found in packages with a prefix "`Per`" under `RootIO/`. There is a one-to-one correspondence between these packages and those in `DataModel` holding the transient data classes.

The `RootIOSvc` is generic in the sense that it does not enforce any policy regarding how data is sent through I/O. In order to support Daya Bay's unique needs there are additional classes in `DybSvc/DybIO`. In particular `DybEvtSelector` and `DybStorageSvc`. The first enforces the policy that the "next event" means to advance to the next `RegistrationSequence` [2] and read in the objects that it references. The second also enforces this same policy but for the output.

8.4 I/O Related Job Configuration

I/O related configuration is handled by `nuwa.py`. You can set the input and output files on the command line. See section *The nuwa.py main script* for details.

8.5 How the I/O Subsystem Works

This section describes how the bits flow from memory to file and back again. It isn't strictly needed but will help understand the big picture.

8.5.1 Execution Cycle vs. Event

Daya Bay does not have a well defined concept of "event". Some physics interactions can lead overlapping collections of hits and others can trigger multiple detectors. To correctly simulate this reality it is required to allow for multiple results from an algorithm in any given run through the chain of algorithms. This run is called a "top level execution cycle" which might simplify to an "event" in other experiments.

8.5.2 Registration Sequence

In order to record this additional dimension to our data we use a class called `RegistrationSequence` (RS). There is one RS created for each execution cycle. Each time new data is added to the event store it is also recorded to the current RS along with a unique and monotonically increasing sequence number or index.

The RS also hold flags that can be interpreted later. In particular it holds a flag saying whether or not any of its data should be saved to file. These flags can be manipulated by algorithms in order to implement a filtering mechanism.

Finally, the RS, like all data in the analysis time window, has a time span. It is set to encompass the time spans of all data that it contains. Thus, RS captures the results of one run through the top level algorithms.

[2] **FIXME** This needs to be described in the Data Model chapter and a reference added here

8.5.3 Writing data out

Data is written out using a `DybStorageSvc`. The service is given a RS and will write it out through the converter for the RS. This conversion will also trigger writing out all data that the RS points to.

When to write out

In principle, one can write a simple algorithm that uses `DybStorageSvc` and is placed at the end of the chain of top-level algorithms [3]. As a consequence, data will be forced to be written out at the end of each execution cycle. This is okay for simple analysis but if one wants to filter out records from the recent past (and still in the AES) based on the current record it will be too late as they will be already written to file.

Instead, to be completely correct, data must not be written out until every chance to use it (and thus filter it) has been exhausted. This is done by giving the job of using `DybStorageSvc` to the agent that is responsible for clearing out data from the AES after they have fallen outside the analysis window.

8.5.4 Reading data in

Just as with output, input is controlled by the RS objects. In Gaudi it is the jobs of the "event selector" to navigate input. When the application says "go to the next event" it is the job of the event selector to interpret that command. In the Daya Bay software this is done by `DybIO/DybEvtSelector` which is a specialization of the generic `RootIOSvc/RootIOEvtSelector`. This selector will interpret "next event" as "next RegistrationSequence". Loading the next RS from file to memory triggers loading all the data it referenced. The TES and thus AES are now back to the state they were in when the RS was written to file in the first place.

8.6 Adding New Data Classes

For the I/O subsystem to support new data classes one needs to write a persistent version of the transient class and a converter class that can copy information between the two.

8.6.1 Class Locations and Naming Conventions

The persistent data and converters classes are placed in a package under `RootIO/` named with the prefix "`Per`" plus the name of the corresponding `DataModel` package. For example:

`DataModel/GenEvent/` ⟷ `RootIO/PerGenEvent/`

Likewise, the persistent class names themselves should be formed by adding "`Per`" to the their transient counterparts. For example, `GenEvent`'s `GenVertex` transient class has a persistent counterpart in `PerGenEvent` with the name `PerGenVertex`.

Finally, one writes a converter for each top level data class (that is a subclass of DataObject with a unique Class ID number) and the converters name is formed by the transient class name with "`Cnv`" appended. For example the class that converts between `GenHeader` and `PerGenHeader` is called `GenHeaderCnv`.

The "`Per`" package should produce both a linker library (holding data classes) and a component library (holding converters). As such the data classes header (`.h`) files should go in the usual `PerXxx/PerXxx/` subdirectory and the implementation (`.cc`) files should go in `PerXxx/src/lib/`. All converter files should go in `PerXxx/src/components/`. See the `PerGenHeader` package for example.

[3] This is actually done in `RootIOTest/DybStorageAlg`

8.6.2 Guidelines for Writing Persistent Data Classes

In writing such classes, follow these guidelines which differ from normal best practices:

- Do not include any methods beyond constructors/destructors.
- Make a default constructor (no arguments) as well as one that can set the data members to non-default values
- Use public, and not private, data members.
- Name them with simple, but descriptive names. Don't decorate them with "`m_`", "`f`" or other prefixes traditionally used in normal classes.

8.6.3 Steps to Follow

1. Your header class should inherit from `PerHeaderObject`, all sub-object should, in general, not inherit from anything special.
2. Must provide a default constructor, convenient to define a constructor that passes in initial values.
3. Must initialize **all** data members in any constructor.
4. Must add each header file into `dict/headers.h` file (file name must match what is in `requirements` file below.
5. Must add a line in `dict/classes.xml` for every class and any STL containers or other required instantiated templates of these classes. If the code crashes inside low-level ROOT I/O related "T" classes it is likely because you forgot to declare a class or template in `classes.xml`.
6. Run a `RootIOTest` script to generate trial output.
7. Read the file with bare root + the `load.C` script.
8. Look for ROOT reporting any undefined objects or missing streamers. This indicates missing entries in `dict/classes.xml`.
9. Browse the tree using a `TBrowser`. You should be able to drill down through the data structure. Anything missing or causes a crash means missing `dict/classes.xml` entries or incorrect/incomplete conversion.
10. Read the file back in using the `RootIOTest` script.
11. Check for any crash (search for "Break") or error in the logs.
12. Use the `diff_out.py` script to diff the output and intput logs and check for unexplained differences (this may require you to improve `fillStream()` methods in the DataModel classes.

8.6.4 Difficulties with Persistent Data Classes

Due to limitations in serializing transient objects into persistent ones care must be taken in how the persistent class is designed. The issues of concern are:

Redundancy: Avoid storing redundant transient information that is either immaterial or that can be reconstructed by other saved information when the object is read back in.

Referencing: One can not directly store pointers to other objects and expect them to be correct when the data is read back in.

The Referencing problem is particularly difficult. Pointers can refer to other objects across different "boundaries" in memory. For example:

- Pointers to subobjects within the same object.

- Pointers to objects within the same HeaderObject hierarchy.
- Pointers to objects in a different HeaderObject hierarchy.
- Pointers to objects in a different execution cycle.
- Pointers to isolated objects or to those stored in a collection.

The `PerBaseEvent` package provides some persistent classes than can assist the converter in resolving references:

PerRef Holds a TES/TFile path and an entry number

PerRefInd Same as above but also an array index

In many cases the transient objects form a hierarchy of references. The best strategy to store such a structure is to collect all the objects into like-class arrays and then store the relationships as indices into these arrays. The `PerGenHeader` classes give an example of this in how the hierarchy made up of vertices and tracks are stored.

8.6.5 Writing Converters

The converter is responsible for copying information between transient and persistent representations. This copy happens in two steps. The first allows the converter to copy information that does not depend on the conversion of other top-level objects. The second step lets the converter fill in anything that required the other objects to be copied such as filling in references.

A Converter operates on a top level `DataObject` subclass and any subobjects it may contain. In Daya Bay software, almost all such classes will inherit from `HeaderObject`. The converter needs to directly copy only the data in the subclass of `HeaderObject` and can delegate the copying of parent class to its converter.

The rest of this section walks through writing a converter using the `GenHeaderCnv` as an example.

Converter Header File

First the header file:

```
#include "RootIOSvc/RootIOTypedCnv.h"
#include "PerGenEvent/PerGenHeader.h"
#include "Event/GenHeader.h"

class GenHeaderCnv : public RootIOTypedCnv<PerGenHeader,
                                           DayaBay::GenHeader>
```

The converter inherits from a base class that is templated on the persistent and transient class types. This base class hides away much of Gaudi the machinery. Next, some required Gaudi boilerplate:

```
public:
    static const CLID& classID() {
        return DayaBay::CLID_GenHeader;
    }

    GenHeaderCnv(ISvcLocator* svc);
    virtual ~GenHeaderCnv();
```

The transient class ID number is made available and constructors and destructors are defined. Next, the initial copy methods are defined. Note that they take the same types as given in the templated base class.

```
StatusCode PerToTran(const PerGenHeader& per_obj,
                     DayaBay::GenHeader& tran_obj);
```

```
StatusCode TranToPer(const DayaBay::GenHeader& per_obj,
                     PerGenHeader& tran_obj);
```

Finally, the fill methods can be defined. These are only needed if your classes make reference to objects that are not subobjects of your header class:

```
//StatusCode fillRepRefs(IOpaqueAddress* addr, DataObject* dobj);
//StatusCode fillObjRefs(IOpaqueAddress* addr, DataObject* dobj);
```

FIXME This is a low level method. We should clean it up so that, at least, the needed `dynamic_cast<>` on the `DataObject*` is done in the base class.

Converter Implementation File

This section describes what boilerplate each converter needs to implement. It doesn't go through the actual copying code. Look to the actual code (such as `GenHeaderCnv.cc`) for examples.

First the initial boilerplate and constructors/destructors.

```
#include "GenHeaderCnv.h"
#include "PerBaseEvent/HeaderObjectCnv.h"

using namespace DayaBay;
using namespace std;

GenHeaderCnv::GenHeaderCnv(ISvcLocator* svc)
    : RootIOTypedCnv<PerGenHeader,GenHeader>("PerGenHeader",
                                             classID(),svc)
{ }
GenHeaderCnv::~GenHeaderCnv()
{ }
```

Note that the name of the persistent class, the class ID number and the `ISvcLocator` all must be passed to the parent class constructor. One must get the persistent class name correct as it is used by ROOT to locate this class's dictionary.

When doing the direct copies, first delegate copying the `HeaderObject` part to its converter:

```
// From Persistent to Transient
StatusCode GenHeaderCnv::PerToTran(const PerGenHeader& perobj,
                                   DayaBay::GenHeader& tranobj)
{
    StatusCode sc = HeaderObjectCnv::toTran(perobj,tranobj);
    if (sc.isFailure()) return sc;

    // ... rest of specific p->t copying ...

    return StatusCode::SUCCESS;
}

// From Transient to Persistent
StatusCode GenHeaderCnv::TranToPer(const DayaBay::GenHeader& tranobj,
                                   PerGenHeader& perobj)
{
    StatusCode sc = HeaderObjectCnv::toPer(tranobj,perobj);
    if (sc.isFailure()) return sc;

    // ... rest of specific t->p copying ...
```

```
    return StatusCode::SUCCESS;
}
```

For filling references to other object you implement the low level Gaudi methods `fillRepRefs` to fill references in the persistent object and `fillObjRefs` for the transient. Like above, you should first delegate the filling of the `HeaderObject` part to `HeaderObjectCnv`.

```
StatusCode GenHeaderCnv::fillRepRefs(IOpaqueAddress*, DataObject* dobj)
{
    GenHeader* gh = dynamic_cast<GenHeader*>(dobj);
    StatusCode sc = HeaderObjectCnv::fillPer(m_rioSvc,*gh,*m_perobj);
    if (sc.isFailure()) { ... handle error ... }

    // ... fill GenHeader references, if there were any, here ...

    return sc;
}

StatusCode GenHeaderCnv::fillObjRefs(IOpaqueAddress*, DataObject* dobj)
{
    HeaderObject* hobj = dynamic_cast<HeaderObject*>(dobj);
    StatusCode sc = HeaderObjectCnv::fillTran(m_rioSvc,*m_perobj,*hobj);
    if (sc.isFailure()) { ... handle error ... }

    // ... fill GenHeader references, if there were any, here ...

    return sc;
}
```

Register Converter with Gaudi

One must tell Gaudi about your converter by adding two files. Both are named after the package and with "`_entries.cc`" and "`_load.cc`" suffixes. First the "load" file is very short:

```
#include "GaudiKernel/LoadFactoryEntries.h"
LOAD_FACTORY_ENTRIES(PerGenEvent)
```

Note one must use the package name in the CPP macro. Next the "entries" file has an entry for each converter (or other Gaudi component) defined in the package:

```
#include "GaudiKernel/DeclareFactoryEntries.h"
#include "GenHeaderCnv.h"
DECLARE_CONVERTER_FACTORY(GenHeaderCnv);
```

Resolving references

The Data Model allows for object references and the I/O code needs to support persisting and restoring them. In general the Data Model will reference an object by pointer while the persistent class must reference an object by an index into some container. To convert pointers to indices and back, the converter must have access to the transient data and the persistent container.

Converting references can be additionally complicated when an object held by one `HeaderObject` references an object held by another `HeaderObject`. In this case the converter of the first must be able to look up the converter of the second and obtain its persistent object. This can be done as illustrated in the following example:

```
#include "Event/SimHeader.h"
#include "PerSimEvent/PerSimHeader.h"
StatusCode ElecHeaderCnv::initialize()
{
    MsgStream log(msgSvc(), "ElecHeaderCnv::initialize");

    StatusCode sc = RootIOBaseCnv::initialize();
    if (sc.isFailure()) return sc;

    if (m_perSimHeader) return StatusCode::SUCCESS;

    RootIOBaseCnv* other = this->otherConverter(SimHeader::classID());
    if (!other) return StatusCode::FAILURE;

    const RootIOBaseObject* base = other->getBaseObject();
    if (!base) return StatusCode::FAILURE;

    const PerSimHeader* pgh = dynamic_cast<const PerSimHeader*>(base);
    if (!pgh) return StatusCode::FAILURE;

    m_perSimHeader = pgh;

    return StatusCode::SUCCESS;
}
```

A few points:

- This done in `initialize()` as the pointer to the persistent object we get in the end will not change throughout the life of the job so it can be cached by the converter.
- It is important to call the base class's `initialize()` method as on line 7.
- Next, get the other converter is looked up by class ID number on line 12.
- Its persistent object, as a `RootIOBaseObj` is found and `dynamic_cast` to the concrete class on lines 15 and 18.
- Finally it is stored in a data member for later use during conversion at line 21.

8.6.6 CMT `requirements` File

The CMT `requirements` file needs:

- Usual list of `use` lines
- Define the headers and linker library for the public data classes
- Define the component library
- Define the dictionary for the public data classes

Here is the example for `PerGenEvent`:

```
package PerGenEvent
version v0

use Context    v*     DataModel
use BaseEvent    v*     DataModel
use GenEvent    v*     DataModel
use ROOT       v*     LCG_Interfaces
use CLHEP      v*     LCG_Interfaces
```

```
use PerBaseEvent v*     RootIO

# public code
include_dirs $(PERGENEVENTROOT)
apply_pattern install_more_includes more="PerGenEvent"
library PerGenEventLib lib/*.cc
apply_pattern linker_library library=PerGenEventLib

# component code
library PerGenEvent components/*.cc
apply_pattern component_library library=PerGenEvent


# dictionary for persistent classes
apply_pattern reflex_dictionary dictionary=PerGenEvent \
              headerfiles=$(PERGENEVENTROOT)/dict/headers.h \
              selectionfile=../dict/classes.xml
```

CHAPTER

NINE

DETECTOR DESCRIPTION

9.1 Introduction

The Detector Description, or "DetDesc" for short, provides multiple, partially redundant hierarchies of information about the detectors, reactors and other physical parts of the experiment.

The description has three main sections:

Materials defines the elements, isotopes and materials and their optical properties that make up the detectors and the reactors.

Geometry describes the volumes, along with their solid shape, relative positioning, materials and sensitivity and any surface properties, making up the detectors and reactors. The geometry, like that of Geant4, consists of logical volumes containing other placed (or physical) logical volumes. Logical volumes only know of their children.

Structure describes a hierarchy of distinct, placed "touchable" volumes (Geant4 nomenclature) also known as Detector Elements (Gaudi nomenclature). Not all volumes are directly referenced in this hiearchy, only those that are considered important.

The data making up the description exists in a variety of forms:

XML files The definitive source of ideal geometry is stored in XML files following a well defined DTD schema.

DetDesc TDS objects In memory, the description is accessed as objects from the DetDesc package stored in the Transient Detector Store. These objects are largely built from the XML files but can have additional information added, such as offsets from ideal locations.

Geant4 geometry Objects in the Materials and Geometry sections can be converted into Geant4 geometry objects for simulation purposes.

9.1.1 Volumes

There are three types of volumes in the description. Figure *fig:log-phy-touch* describes the objects that store logical, physical and touchable volume information.

Logical

XML `<logvol>`

C++ `ILVolume`

Description: The logical volume is the basic building block. It combines a shape and a material and zero or more daughter logical volumes fully contained inside the shape.

Example: The single PMT logical volume placed as a daughter in the AD oil and Pool inner/outer water shields [1].

9.1.2 Physical

XML `<physvol>`

C++ `IPVolume`

Description: Daughters are placed inside a mother with a transformation matrix giving the daughters translation and rotation with respect to the mother's coordinate system. The combination of a transformation and a logical volume is called a physical volume.

Example: The 192 placed PMTs in the AD oil logical volume.

9.1.3 Touchable

XML `<detelem>`

C++ `DetectorElement`

Description: Logical volumes can be reused by placing them multiple times. Any physical daughter volumes are also reused when their mother is placed multiple times. A touchable volume is the trail from the top level "world" volume down the logical/physical hiearchy to a specific volume. In Geant4 this trail is stored as a vector of physical volumes (G4TouchableHistory). On the other hand in Gaudi only local information is stored. Each DetectorElement holds a pointer to the mother DetectorElement that "supports" it as well as pointers to all child DetectorElements that it supports.

Example: The $8 \times 192 = 1536$ AD PMTs in the whole experiment

Scope of Detector Description, basics of geometry, structure and materials. Include diagrams showing geometry containment and structure's detector element / geometry info relationships.

9.2 Conventions

The numbering conventions reserve 0 to signify an error. PMTs and RPCs are addressed using a single bit-packed integer that also records the site and detector ID. The packing is completely managed by classes in `Conventions/Detectors.h`. The site ID is in `Conventions/Site.h` and the detector ID (type) is in `Conventions/DetectorId.h`. These are all in the `DataModel` area.

9.2.1 AD PMTs

The primary PMTs in an AD are numbered sequentially as well as by which ring and column they are in. Rings count from 1 to 8 starting at the bottom and going upwards. Columns count from 1 to 24 starting at the column just above the X-axis [2] and continuing counter clockwise if looking down at the AD. The sequential ID number can be calculated by:

column# + 24*(ring# - 1)

Besides the 192 primary PMTs there are 6 calibration PMTs. Their ID numbers are assigned 193 - 198 as 192 +:

1. top, target-viewing
2. bottom, target-viewing

[1] We may create a separate PMT logical volume for the AD and one or two for the Pool to handle differences in PMT models actually in use.
[2] Here the X-axis points to the exit of the hall.

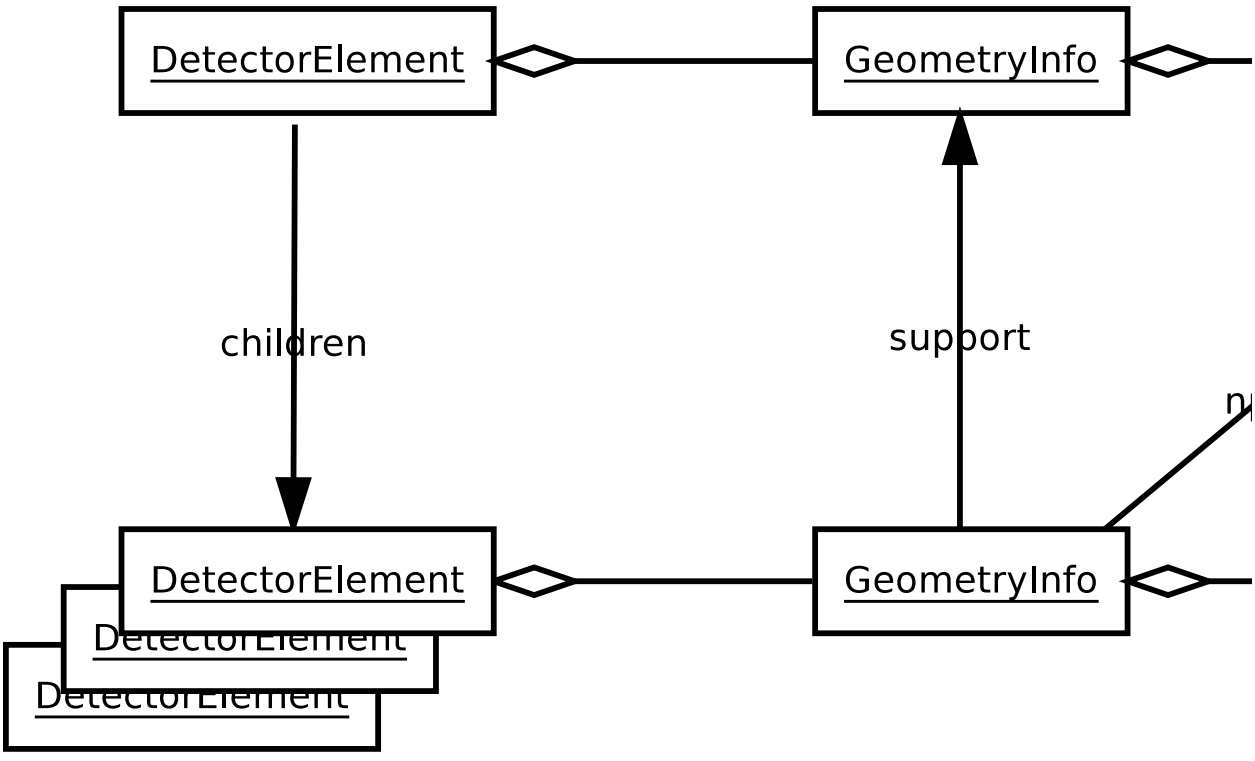


Figure 9.1: **fig:log-phy-touch**
Logical, Physical and Touchable volumes.

3. top, gamma-catcher-viewing
4. bottom, gamma-catcher-viewing
5. top, mineral-oil-viewing
6. bottom, mineral-oil-viewing

FIXME Add figures showing PMT row and column counts, orientation of ADs in Pool. AD numbers. coordinate system w.r.t pool.

9.2.2 Pool PMTs

Pool PMT counting, coordinate system w.r.t hall.

9.2.3 RPC

RPC sensor id convention. Coordinate system w.r.t. hall.

9.3 Coordinate System

As described above, every mother volume provides a coordinate system with which to place daughters. For human consumption there are three canonical coordinate system conventions. They are:

Global Th global coordinate system has its origin at the mid site with X pointing East, Y pointing North and Z pointing up. It is this system in which Geant4 works.

Site Each site has a local coordinate system with X pointing towards the exit and Z pointing up. Looking down, the X-Y origin is at the center of the tank, mid way between the center of the ADs. The Z origin is at the floor level which is also the nominal water surface. This makes the Pools and ADs at negative Z, the RPCs at positive Z.

AD Each AD has an even more local coordinate system. The Z origin is mid way between the inside top and bottom of the Stainless Steal vessel. This $Z_{AD} = 0$ origin is nominally at $Z_{Site} = -(5m - 7.5mm)$. The Z axis is collinear with the AD cylinder axis and the X and Y are parallel to X and Y of the Site coordinate system, respectively.

The Site and AD coordinate systems are related to each other by translation alone. Site coordinate systems are translated and rotated with respect to the Global system.

Given a global point, the local Site or AD coordinate system can be found using the `CoordSysSvc` service like:

```
// Assumed in a GaudiAlgorithm:
IService* isvc = 0;
StatusCode sc = service("CoordSysSvc", isvc, true);
if (sc.isFailure()) handle_error();
ICoordSvc* icss = 0;
sc = isvc->queryInterface(IID_ICoordSysSvc,(void**)&icss);
if (sc.isFailure()) handle_error();

Gaudi::XYZPoint globalPoint = ...;
IDetectorElement* de = icss->coordSysDE(globalPoint);
if (!de) handle_error();
Gaudi::XYZPoint localPoint = de->geometry()->toLocal(globalPoint);
```

9.4 XML Files

Schema, conventions.

9.5 Transient Detector Store

In a subclass of `GaudiAlgorithm` you can simply access the Transient Detector Store (TDS) using `getDet()` templated method or the `SmartDataPtr` smart pointer.

```
// if in a GaudiAlgorithm can use getDet():
DetectorElement* de = getDet<DetectorElement>("/dd/Structure/DayaBay");
LVolume* lv = getDet<LVolume>("/dd/Geometry/AD/lvOIL");

// or if not in a GaudiAlgorithm do it more directly:
IDataProviderSvc* detSvc = 0;
StatusCode sc = service("DetectorDataSvc",detSvc,true);
if (sc.isFailure()) handle_error();

SmartDataPtr<IDetectorElement> topDE(detSvc,"/dd/Structure/DayaBay");
if (!topDE) return handle_error();

// use topDE...

detSvc->release();
```

9.6 Configuring the Detector Description

The detector description is automatically configured for the user in `nuwa.py`.

9.7 PMT Lookups

Information about PMTs can be looked up using the `PmtGeomInfoSvc`. You can do the lookup using one of these types of keys:

Structure path which is the `/dd/Structure/...` path of the PMT

PMT id the PMT id that encodes what PMT in what detector at what site the PMT is

`DetectorElement` the pointer to the `DetectorElement` that embodies the PMT

The resulting `PmtGeomInfo` object gives access to global and local PMT positions and directions.

9.8 Visualization

Visualization can be done using our version of LHCb's PANORAMIX display. This display is started by running:

```
shell> nuwa.py -V
```

Take this tour:

- First, note that in the tree viewer on the left hand side, if you click on a folder icon it opens but if you click on a folder name nothing happens. The opposite is true for the leaf nodes. Clicking on a leaf's name adds the volume to the viewer.
- Try openning /dd/Geometry/PMT/lvHemiPmt. You may see a tiny dot in the middle of the viewer or nothing because it is too small.
- Next click on the yellow/blue eyeball icon on the right. This should zoom you to the PMT.
- You can then rotate with a mouse drag or the on-screen rollers. If you have a mouse with a wheel it will zoom in/out. Cntl-drag or Shift-drag pans.
- Click on the red arrow and you can "pick" volumes. A Ctrl-pick will delete a volume. A Shift-click will restore it (note some display artifacts can occur during these delete/restores).
- Go back to the Michael Jackson glove to do 3D moves.
- You can clear the scene with Scene->Scene->Clear. You will likely want to do this before displaying any new volumes as each new volume is centered at the same point.
- Scene->"Frame m" is useful thing to add.
- Materials can't be viewed but /dd/Structure can be.
- Another thing to try: Click on /dd/Structure/DayaBay, select the yellow/blue eye, then the red arror and Ctrl-click away the big cube. This shows the 3 sites. You can drill down them further until you get to the AD pmt arrays.
- Finally, note that there is still a lot of non-DayaBay "cruft" that should be cleaned out so many menu items are not particularly useful.

CHAPTER

TEN

KINEMATIC GENERATORS

10.1 Introduction

Generators provide the initial kinematics of events to be further simulated. They must provide a 4-position, 4-momentum and a particle type for every particle to be tracked through the detector simulation. They may supply additional "information" particles that are otherwise ignored. The incoming neutrino or radioactive decay parent are two examples of such particles.

10.2 Generator output

Each generated event is placed in the event store at the default location `/Event/Gen/GenHeader` but when multiple generators are active in a single job they will place their data in other locations under `/Event/Gen`.

The data model for this object is in `DataModel/GenEvent`. The `GenHeader` object is simply a thin wrapper that holds a pointer to a `HepMC::GenEvent` object. See HepMC documentation for necessary details on using this and related objects.

10.3 Generator Tools

A `GenEvent` is built from one or more special Gaudi Tools called `GenTools`. Each `GenTool` is responsible for constructing part of the kinematic information and multiple tools work in concert to produce a fully described event. This lets the user easily swap in different tools to get different results.

10.4 Generator Packages

There are a number of packages providing `GenTools`. The primary package is called `GenTools` and provides basic tools as well as the `GtGenerator` algorithm that ties the tools together. Every execution cycle the algorithm will run through its tools, in order, and place the resulting event in the event data store. A separate package, `GenDecay`, provides GenTools that will produce kinematics for various radioactive nuclear decays.

The `GtGenerator` is suitable only for "linear" jobs that only simulate a single type of event. In order to mix multiple events together the, so called, Fifteen suite of packages (see Ch *fifteen*) are used. To configure for this type of job the `Gnrt` package's `Configure` is used.

10.5 Types of GenTools

The available GenTools and a sample of their properties are given. You can query their full properties with `properties.py ToolName`.

10.5.1 GenTools package

GtPositionerTool provides a local vertex 3-position. It does it by placing the vertex at its given point or distributing it about its given volume in various ways.

GtTransformTool provides global vertex 3-position and 3-direction given local ones. This will take existing an position and direction, interpret them as being defined in the given volume and transform them into global coordinates (needed for further simulation). It can optionally transform only position or direction.

GtTimeratorTool provides a vertex time. Based on a given lifetime (rate) it can distribute times exponentially or uniformly. It can also set the time in an "Absolut" (spelling intentional) or Relative manner. The former will set the time unconditionally and the latter will add the generated time to any existing value.

GtGunGenTool provides a local 4-momentum. It simulates a virtual particle "gun" that will shoot a given particle type in various ways. It can be set to point in a given direction or spray particles in a few patterns. It can select a fixed or distributed momentum.

GtBeamerTool provides a global 3-vertex and a global 4-momentum. It produces a parallel beam of circular cross section pointed at some detector element and starting from a given direction and distance away.

GtDiffuserBallTool provides a relative 3-vertex and local 4-momentum. It simulates the diffuser balls used in calibration. Subsequent positioner and transform tools are needed to place it at some non origin position relative to an actual volume.

GtHepEvtGenTool provides a local 4-momentum. It is used to read in kinematics in HepEVT format either from a file or through a pipe from a running executable. Depending on the HepEVT source it may need to be followed by positioner, timerator or transform tools.

10.5.2 GenDecay Package

The GenDecay package simulation radioactive decay of nuclei. It relies on Evaluated Nuclear Structure Data File (ENSDF) data sets maintained by National Nuclear Data Center (NNDC) located at BNL. It is fully data driven in that all information on branching fractions, half lifes and radiation type are taken from the ENSDF data sets. GenDecay will set up a hierarchy of mothers and daughters connected by a decay radiation. When it is asked to perform a decay, it does so by walking this hierarchy and randomly selecting branches to follow. It will apply a correlation time to the lifetime of every daughter state to determine if it should force that state to decay along with its mother. The abundances of all uncorrelated nuclear states must be specified by the user.

The GenDecay package provides a single tool called `GtDecayerator` which provides a local 4-vertex and 4-momentum for all products. It should be followed up by positioner and transformer tools.

10.6 Configuration

General configuration is described in Ch *Offline Framework*. The `GenTools` and related packages follow these conventions. This section goes from low level to high level configuration.

10.6.1 Configurables

As described above, a `GtGenerator` algorithm is used to collect. It is configured with the following properties

TimeStamp sets an absolute starting time in integral number of seconds. Note, the unit is implicit, do not multiple by seconds from the system of units.

GenTools sets the ordered list of tools to apply.

GenName sets a label for this generator.

Location sets where in the event store to place the results.

Each tool is configured with its own, specific properties. For the most up to date documentation on them, use the `properties.py` tool. Common or important properties are described:

Volume names a volume, specifically a Detector Element, in the geometry. The name is of the form "`/dd/Structure/Detector/SomElement`".

Position sets a local position, relative to a volume's coordinate system.

Spread alone or as a modifier is used to specify some distribution width.

Strategy or Mode alone or as a modifier is used to modify some behavior of the tool.

GenDecay Configurables

The GenDecay package provides a GtDecayerator tool which has the following properties.

ParentNuclide names the nuclide that begins the decay chain of interest. It can use any libmore supported form such as "U-238" or "238U" and is case insensitive.

ParentAbundance the abundance of this nuclide, that is, the number of nuclides of this type.

AbundanceMap a map of abundances for all nuclides that are found in the chain starting at, and including, the parent. If the parent is listed and ParentAbundance is set the latter takes precedence.

SecularEquilibrium If true (default), set abundances of uncorrelated daughter nuclides (see CorrelationTime property) to be in secular equilibrium with the parent. If any values are given by the AbundanceMap property, they will take precedence.

CorrelationTime Any nuclide in the chain that has a decay branch with a half life (total nuclide halflife * branching fraction) shorter than this correlation time will be considered correlated with the parent(s) that produced it and the resulting kinematics will include both parent and child decays together and with a time chosen based on the parent abundance. Otherwise, the decay of the nuclide is considered dependent from its parent and will decay based on its own abundance.

10.6.2 `GenTools.Configure`

The `GenTools` package's `Configure` object will take care of setting up a `GtGenerator` and adding it to the list of "top algorithms". The `Configure` object requires a "helper" object to provide the tools.

There are several helpers provided by `GenTools` and one provided by `GenDecay` that cover most requirements. If a job must be configured in a way that no helper provides, then a new helper can be written using the existing ones as examples. The only requirement is that a helper object provides a `tools()` method that returns a list of the tools to add to a GtGenerator algorithm.

Each helper described below takes a number of arguments in its constructor. They are given default values so a default helper can be constructed to properly set up the job to do something, but it may not be what you want. After construction the objects are available as object members taking the same name as the argument.

Helpers are self documented and the best way to read this is using the `pydoc` program which takes the full Python name. For example:

```
shell> pydoc GenTools.Helpers.Gun
Help on class Gun in GenTools.Helpers:

GenTools.Helpers.Gun = class Gun
 |  Configure a particle gun based kinematics
 |
 |  Methods defined here:
 |
 |  __init__(....)
....
```

Remember that `__init__()` is the constructor in Python.

The rest of this section gives the full Python name and a general description of the available helpers. Again, use `pydoc` to see the reference information.

`GenTools.Helpers.Gun` takes a volume and a gun, positioner, timerator and a transformer to set up a `GtGunGenTool` based generator.

`GenTools.Helpers.DiffuserBall` as above but sets up a diffuser ball. It also takes an AutoPositionerTool to modify the location of the diffuser ball in the geometry.

`GenTools.Helpers.HepEVT` takes a source of HepEVT formatted data and positioner, timerator and transformer tools.

`GenDecay.Helpers.Decay` takes a volume and decayerator, positioner and timerator tools.

10.6.3 `Gnrtr.Configure` and its Stages

Currently, the, so called, "pull mode" or "Fifteen style" of mixing of different types of events configuration mechanisms need work.

10.6.4 GenTools Dumper Algorithm

The `GenTools` package provides an algorithm to dump the contents of the generator output to the log. It can be included in the job by creating an instance of the `GenTools.Dumper` class. The algorithm can be accessed through the resulting object via its `.dumper` member. From that you can set the properties:

Location in the event store to find the kinematics to dump.

StandardDumper set to `True` to use the dumper that HepMC provides. By default it will use one implemented in the algorithm.

10.6.5 GenTools Job Option Modules

The GenTools package provides a `GenTools.Test` Job Option Module which gives command line access to some of the helpers. It is used in its unit test "`test_gentools.py`". It takes various command line options of its own which can be displayed via:

```
shell> nuwa.py -m 'GenTools.Test --help'
Importing modules GenTools.Test [ --help ]
Trying to call configure() on GenTools.Test
Usage:
This module can be used from nuwa.py to run GenTools in a few canned way as a test.
```

```
It is run as a unit test in GenTools/tests/test_gentools.py

Options:
  -h, --help            show this help message and exit
  -a HELPER, --helper=HELPER
                        Define a "helper" to help set up GenTools is gun,
                        diffuser or hepevt.
  -v VOLUME, --volume=VOLUME
                        Define a volume to focus on.
  -s DATA_SOURCE, --data-source=DATA_SOURCE
                        Define the data source to use for HepEVT helper
```

10.7 MuonProphet

10.7.1 Motivation

MuonProphet [DocDB 4153, DocDB 4441] is designed to address the simulation of muon which will be a major background source of Daya Bay neutrino experiment. Spallation neutrons and cosmogenic background, namely 9Li, 8He etc., are supposed to give the biggest systematic uncertainty.

The vast majority of muons are very easy to identify due to its distinguishable characteristic in reality. Usually its long trajectory in water pool or AD will leave a huge amount of light and different time pattern rather than a point source.

The simulation of muon in Geant4 is quite time-consuming. The hugh amount of optical photons' propargation in detector, usually over a few million, can bring any computer to its knee. One CPU has to spend 20-30 minutes for a muon track sometimes. The real muon rate requires to simulate is a few hundred to a thousand per second.

In the end people realized that they only need to know whether a muon has passed the detector and tagged, while not really care too much about how light are generated and distributed in water pool and AD.

Beside that it is technically impossible to finish all these muon simulation, the physics model of radioative isotope's generation in Geant4 is not very reliable. Photon nuclear process triggered by virturl or real photon, pion- nucleus interaction, nucleon-nucleus interaction, etc. are all possible be responsible to spallation background generation. They are poorly described in Genat4. Tuning the generation rate of some background is very difficult, since they are usually very low, then it is very inefficient to do MC study.

Based on these consideration MuonProphet is designed so that the tiresome optical photon simulation can be skipped and the generation of spallation background can be fully controled and fully simulated by Geant4.

10.7.2 Generation Mechanism

Firstly it starts from a muon track with initial vertex and momentum. The intersections of the muon track with each sub-detectors' surface and track lengths in each segment are calculated. Low energy muon could stop in detector according to a calculation based on an average dE/dx. According to its track length in water and whether it crossed RPC and user configuration it will determine whether this track is going to be triggered. Spallation neutron and cosmogenic background generation rate is usually a function of muon's energy, track length and material density. According to a few empirical formulas from early test beam and neutrino experiments, spallation neutron and/or radioactive isotopes are generated around the muon track. Because water is not sensitive to radioactive isotopes and their initial momentum is very low, they are only generated in AD. Muon is always tagged as "don't need simulation" by a trick in Geant4. However neutron and radioactive isotope are left for full Geant4 simulation.

10.7.3 Code Organisation

Besides the big structure determined by the motivation most parts of the codes are loosely bound together. Under MuonProphet/src/functions, all generation probabity functions, vertex and energy distribution functions are included. They can easily be modified and replaced. Under MuonProphet/src/components, MpGeometry.cc is dedicated to geometry related calculation; MpTrigger.cc is for trigger prediction; MpNeutron.cc and MpSpallation.cc handle the production of neutron and other isotopes respectively. All of them are controlled by MuonProphet::mutate like a usual gentool. It will make use of other radioactive background generators, so no need for extra code development.

10.7.4 Configuration

Here one example is given for 9Li or 8He background configuration. It will create a gentool - prophet. This tool should be attached after muon GtPositionerTool, GtTimeratorTool and GtTransformTool like demonstrated in MuonProphet/python/MuonProphet/FastMuon.py . According the formulas in [DocDB 4153, DocDB 4441] a set of four parameters including a gentool for an isotope background, yield, the energy where the yield is measured and lifetime must supplied. Following is a snippet of python code from FastMuon.py showing how it is configured.

```
# - muonprophet
prophet=MuonProphet()
prophet.Site= ''DayaBay''
# - spallation background
## - The tool to generate 9Li or 8He background
## - According to the formula refered in [DocDB 4153, DocDB 4441]
## - every isotope need a set of four parameters.
prophet.GenTools= [ ''Li9He8Decayerator/Li9He8'' ]
## - There is a measurement of yield 2.2e-7 cm2/g for 260 GeV muon,
## - then we can extrapolate the yield to other energy point.
prophet.GenYields= [ 2.2e-7 *units.cm2/units.g ]
prophet.GenYieldMeasuredAt= [ 260*units.GeV]
## - The lifetime of them is set to 0.002 second
prophet.GenLifetimes= [ 0.002*units.s]
# - trigger related configuration
## - Any muon track with a track length in water above 20 cm will be tagged as triggered.
prophet.TrkLengthInWaterThres= 20*units.cm
## - We can also assign a trigger efficiency even it passed above track length cut.
prophet.WaterPoolTriggerEff = 0.9999
```

10.7.5 Output

Geant4 will skip the muon simulation and do full simulation for neutron and other isotopes. The rest of the simulation chain in Fifteen is set up to be able to respond that correctly. Electronic simulation will only simulate the hits from spallation background and only pass a empty ElecHeader for the muon to the next simulation stage. If muon is tagged triggered, then trigger simulation will pop out a trigger header for the muon, otherwise, it will be dropped there like the real system.

In the final output of readout stream, user should expect the following situations: a) Only muon is triggered. There will be an empty ReadoutHeader for muon. User can trace back to the original GenHeader to confirm the situaion. b) Only spallation background is triggered. c) Both muon and background induced by this muon are triggered. There will be a empty ReadoutHeader for muon and another one with hits for the background. d) No trigger.

In reality if there is something very close to the muon in time, their hits will overlap and their hits are not distinguishable. For example, some fast background following muon won't be triggered separately. User should do the background trigger efficiency calculation based on the understanding of the real Daya Bay electronics.

10.7.6 Trigger Bits

Although the output got from MuonProphet simulation is empty, i.e. no hit, but the trigger information is set according to the fast simulation result. According to the geometry input it could have RPC and waterpool trigger.

10.7.7 Quick Start

There is one example already installed with nuwa. After you get into nuwa environment, you can start with

```
> nuwa.py -n50 -o fifteen.root -m "MuonProphet.FullChain" > log
```

It will invoke the FastMuon.py.

CHAPTER

ELEVEN

DETECTOR SIMULATION

11.1 Introduction

The detector simulation performs a Monte Carlo integration by tracking particles through the materials of our detectors and their surroundings until any are registered (hit) sensitive elements (PMTs, RPCs). The main package that provides this is called DetSim.

DetSim provides the following:

- Glue Geant4 into Gaudi through GiGa
- Takes initial kinematics from a generator, converts them to a format Geant4 understands.
- Takes the resulting collection of hits and, optionally, any unobservable statistics or particle histories, and saves them to the event data store.
- Modified (improved) Geant4 classes such as those enacting Cherenkov and scintillation processes.

The collection of "unobservable statistics" and "particle histories" is a fairly unique ability and is described more below.

11.2 Configuring DetSim

The `DetSim` package can be extensively configured. A default is set up done like:

```
import DetSim
detsim = DetSim.Configure()
```

You can provide various options to `DetSim`'s `Configure()`:

`site` indicating which site's geometry should be loaded. This can be "far" (the default) or one of the two near sites "dayabay" or "lingao" or you can combine them if you wish to load more than one.

`physics_list` gives the list of modules of Physics processes to load. There are two lists provided by the `configure` class: `physics_list_basic` and `physics_list_nuclear`. By default, both are loaded.

You can also configure the particle `Historian` and the `UnObserver` (unobservable statistics collector). Here is a more full example:

```
import DetSim.configure
# only load basic physics
detsim = DetSim.configure(physics_list=DetSim.configure.physics_list_basic)
detsim.historian(trackSelection="...", vertexSelection="...")
detsim.unobserver(stats=[...])
```

Details of how to form `trackSelection`, `vertexSelection` and `stats` are given below.

11.3 Truth Information

Besides hits, information on the "true" simulated quantities is available in the form of a *particle history* and a collection of *unobservable statistics*.

11.3.1 Particle Histories

Geant 4 is good at simulating particles efficiently. To this end, it uses a continually-evolving stack of particles that require processing. As particles are simulated, they are permanently removed from the stack. This allows many particles to be simulated in a large event without requiring the entire event to be stored at one time.

However, users frequently wish to know about more than simply the input (primary particles) and output (hits) of a simulation, and instead want to know about the intermediate particles. But simply storing all intermediate particles is problematic for the reason above: too many particles will bring a computer's virtual memory to it's knees.

Particle Histories attempts to give the user tools to investigate event evolution without generating too much extraneous data. The philosophy here is to generate only what the user requests, up to the granularity of the simulation, and to deliver the output in a Geant-agnostic way, so that data may be persisted and used outside the Geant framework.

Particle History Data Objects

Let us briefly review how Geant operates. A particle is taken off the stack, and a `G4Track` object is initialized to hold it's data. The particle is then moved forward a step, with an associated `G4Step` object to hold the relevant information. In particular, a `G4Step` holds two `G4StepPoint` representing the start and end states of the that particle.

The *Particle Histories* package crudely corresponds to these structures. There are two main data objects: `SimTrack` which corresponds to `G4Track`, and `SimVertex` which corresponds to a `G4StepPoint`. [1]

So, each particle that is simulated in by Geant can create a `SimTrack`. If the particle takes n steps in the Geant simulation, then it can create at most $n + 1$ `SimVertex` objects (one at the start, and one for each step thereafter). If all vertices are saved, then this represents the finest granularity possible for saving the history of the simulation.

The data saved in a Track or Vertex is shown in Figures *f:simtrack_accessors* and *f:simvertex_accessors*. Generally speaking, a SimTrack simply holds the PDG code for the particle, while a SimVertex holds a the state: position, time, volume, momentum, energy, and the process appropriate for that point in the simulation. Other information may be derived from these variables. For instance, the properties of a particle may be derived by looking up the PDG code via the ParticlePropertiesSvc, and the material of a step may be looked up by accessing the IPVolume pointer. (If there are two vertices with different materials, the material in between is represented by the first vertex. This is not true if vertices have been pruned.)

Each track contains a list of vertices that correspond to the state of the particle at different locations in it's history. Each track contains at least one vertex, the start vertex. Each Vertex has a pointer to it's parent Track. The relationship between SimVertices and SimTracks is shown in Figure *f:simtrack_and_simvertex*.

The user may decide *which* vertices or tracks get saved, as described in Sec *Creation Rules*. If a SimVertex is pruned from the output, then any references that should have gone to that SimVertex instead point to the SimVertex preceeding it on the Track. If a SimTrack is pruned from the output, then any references that would have pointed to that track in fact point back to that track's parent. The output is guaranteed to have at least one SimTrack created for each primary particle that the generator makes, and each SimTrack is guaranteed to have at least one vertex, the start vertex for that particle, so all of these references eventually hand somewhere. An example of this pruning is shown in Figure *f:history_pruning*.

[1] Another way to describe this is that a SimTrack corresponds to a single G4Trajectory, and SimVertex corresponds to a single G4TrajectoryPoint. The G4Trajectory objects, however, are relatively lightweight objects that are used by nothing other than the Geant visualization. It was decided not to use the G4Trajectory objects as our basis so as to remain Geant-independent in our output files. The similarity between the *Particle Histories* output and the G4Trajectories is largely the product of convergent evolution.

Figure 11.1: **f:simtrack_accessors**
SimTrack Accessors. A list of accessible data from the SimTrack object.

```
class SimTrack {
        ...
        /// Geant4 track ID
        int trackId() const;

        /// PDG code of this track
        int particle() const;

        /// PDG code of the immediate parent to this track
        int parentParticle() const;

        /// Reference to the parent or ancestor of this track.
        const DayaBay::SimTrackReference& ancestorTrack() const;

        /// Reference to the parent or ancestor of this track.
        const DayaBay::SimVertexReference& ancestorVertex() const;

        /// Pointer to the ancestor primary kinematics particle
        const HepMC::GenParticle* primaryParticle() const;

        /// Pointers to the vertices along this track. Not owned.
        const vertex_list& vertices() const;

        /// Get number of unrecordeds for given pdg type
        unsigned int unrecordedDescendants(int pdg) const;
        ...
}
```

Figure 11.2: **f:simvertex_accessors**
SimVertex Accessors. A list of accessible data from the SimVertex object.

```
class SimVertex {
  ...
  const SimTrackReference&    track()          const;
  const SimProcess&           process()        const;
  double                      time()           const;
  Gaudi::XYZPoint             position()       const;
  double                      totalEnergy()    const;
  Gaudi::XYZVector            momentum()       const;

  double                      mass()           const; // Approximate from 4-momentum.
  double                      kineticEnergy()  const; // Approximate from 4-momentum.

  const std::vector<SimTrackReference>& secondaries() const;
  ...
}
```

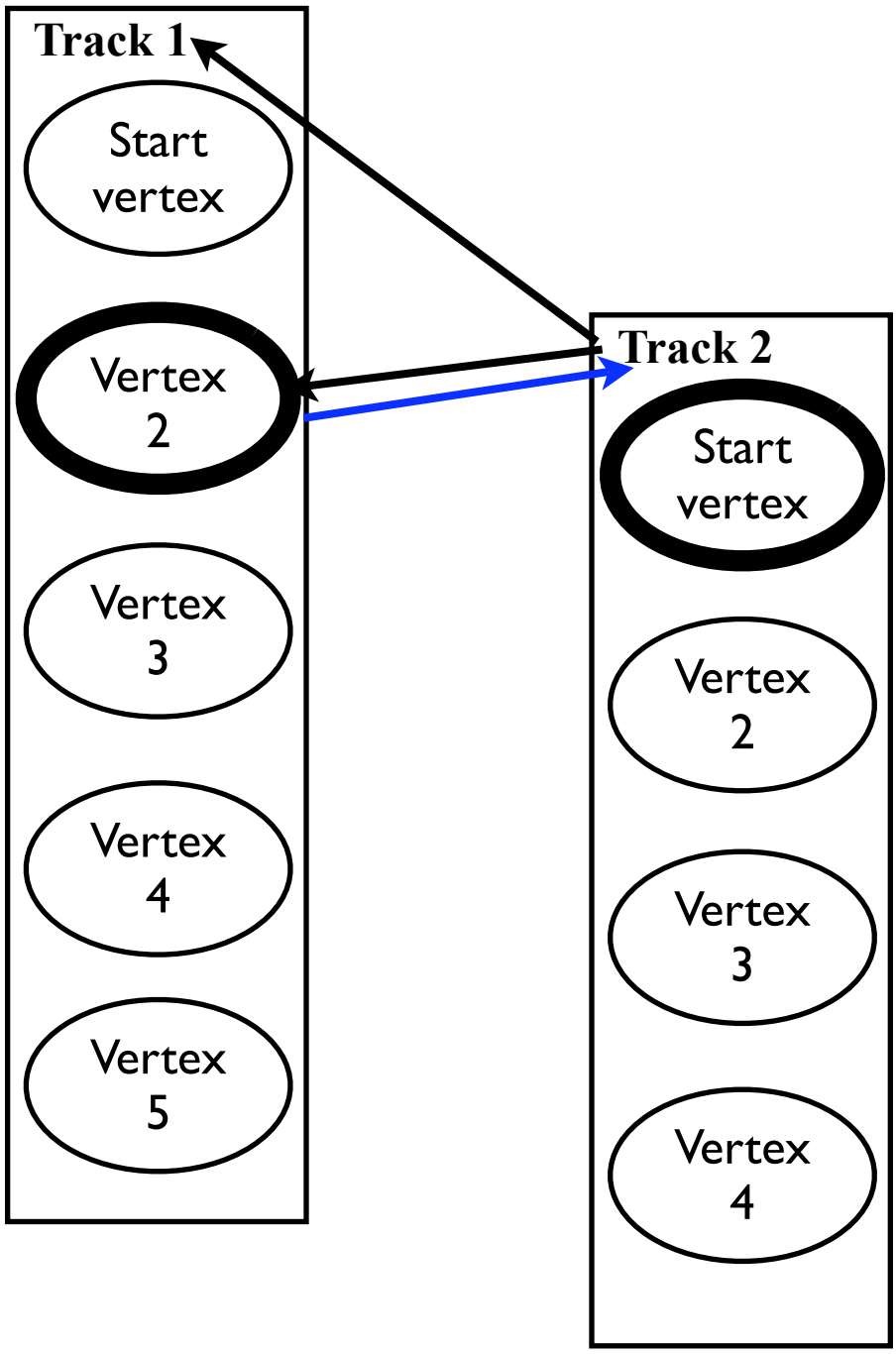


Figure 11.3: **f:simtrack_and_simvertex**

Relationship between SimTrack and SimVertex Track 1 represents a primary SimTrack, and Track 2 a secondary particle created at the end of Track 1s first step. Thus, the position, time, volume, and process may be the same for the two highlighted vertices. Track 2 contains a link both to its parent track (Track 1) and to its parent vertex (Vertex 2 of Track 1). There is also a forward link from Vertex 2 of Track 1 to Track 2. Not shown is that every SimVertex has pointer to its parent SimTrack, and each SimTrack has a list of its daughter SimVertices.

To keep track of this indirect parentage, links to a `SimTrack` or `SimVertex` actually use lightweight objects called `SimTrackReference` and `SimVertexReference`. These objects record not only a pointer to the object in question, but also a count of how indirect the reference is.. i.e. how many intervening tracks were removed during the pruning process.

Because pruning necessarily throws away information, some detail is kept in the parent track about those daughters that were pruned. This is kept as map by pdg code of "Unrecorded Descendents". This allows the user to see, for instance, how many optical photons came from a given track when those photons are not recorded with their own SimTracks. The only information recorded is the number of tracks pruned - for more elaborate information, users are advised to try Unobservable Statistics.

To get ahold of Particle Histories, you need to get the `SimHeader`. Each running of the Geant simulation creates a single `SimHeader` object, which contains a pointer to a single `SimParticleHistory` object. A `SimParticleHistory` object contains a list of primary tracks, which act as entrance points to the history for those who wish to navigate from first causes to final state. Alternatively, you may instead start with `SimHit` objects, which each contain a SimTrackReference. The references point back to the particles that created the hit (e.g. optical photons in the case of a PMT), or the ancestor of that particle if its been pruned from the output.

Creation Rules

The Historian module makes use of the BOOST "Spirit" parser to build rules to select whether particles get saved as tracks and vertices. The user provides two selection strings: one for vertices and one for tracks. At initialization, these strings are parsed to create a set of fast Rule objects that are used to quickly and efficiently select whether candidate G4Tracks and G4StepPoints get turned into SimTracks or SimVertices respectively.

The selection strings describe the criteria neccessary for *acceptance*, not for rejection. Thus, the default strings are both "none", indicating that no tracks or vertices meet the criteria. In fact, the Historian knows to always record primary SimTracks and the first SimVertex on every track as the minimal set.

Selection strings may be:

"None" Only the default items are selected

"All" All items are created

An expression which is interpreted left-to-right.

Expressions consist of comparisons which are separated by boolean operators, grouped by parentheses. For example, a valid selection string could be: — * `"(pdg != 20022 and totalEnergy<10 eV) or (materialName =='MineralOil')"` Each comparison must be of the form `<PARAMETER OPERATOR CONSTANT [UNIT]>`. A list of valid `PARAMETER`s is given in table *t:truthiness_parameters*. Valid `OPERATOR`s consist of `>, >=, <, <=, ==, !=` for numerical parameters, and `==, !=` for string parameters. A few parameters accept custom operators - such as `in` for the detector element relational parameter. For numerical operators, `CONSTANT` is a floating-point number. For string paramters, `CONSTANT` should be of the form `'CaseSensitiveString'`, using a single quote to delimit the string. For numerical parameters, the user may (should) use the optional `UNIT`. Units include all the standard CLHEP-defined constants. All parameters and unit names are case-insensitive.

Boolean operators must come only in pairs. Use parentheses to limit them. This is a limitation of the parser. For instance, `"a<2 and b>2 and c==1"` will fail, but `"(a<2 and b>2) and c==1"` will be acceptable. This ensures the user has grouped his 'and' and 'or' operators correctly.

Because these selections are applied to every single G4Track and every single G4Step, having efficient selection improves simulation time. After compilation, selection is evaluated in the same order as provided by the user, left-to-right. Efficient selection is obtained if the user puts the easiest-to-compute parameters early in the selection. The slowest parameters to evaluate are those that derive from DetectorElement, including NicheID, Niche, DetectorId, SiteId, Site, AD, AdNumber, local_(xyz), DetectorElementName, etc. The fastest parameters are those that are already in the G4 data structures, such as particle code IDs, energy, global position, etc. String comparisons are of medium speed.

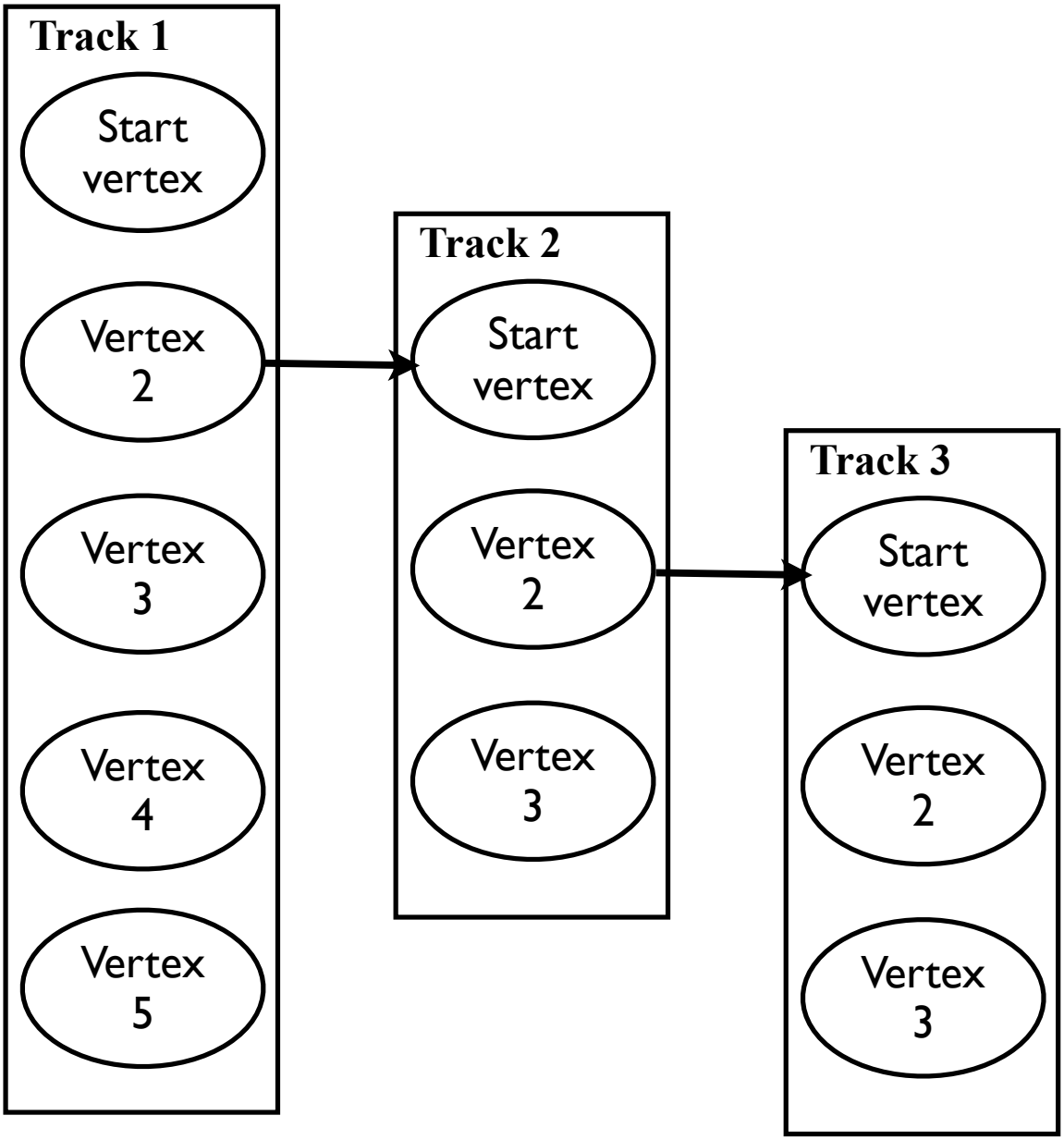


Figure 11.4: **f:history_pruning**

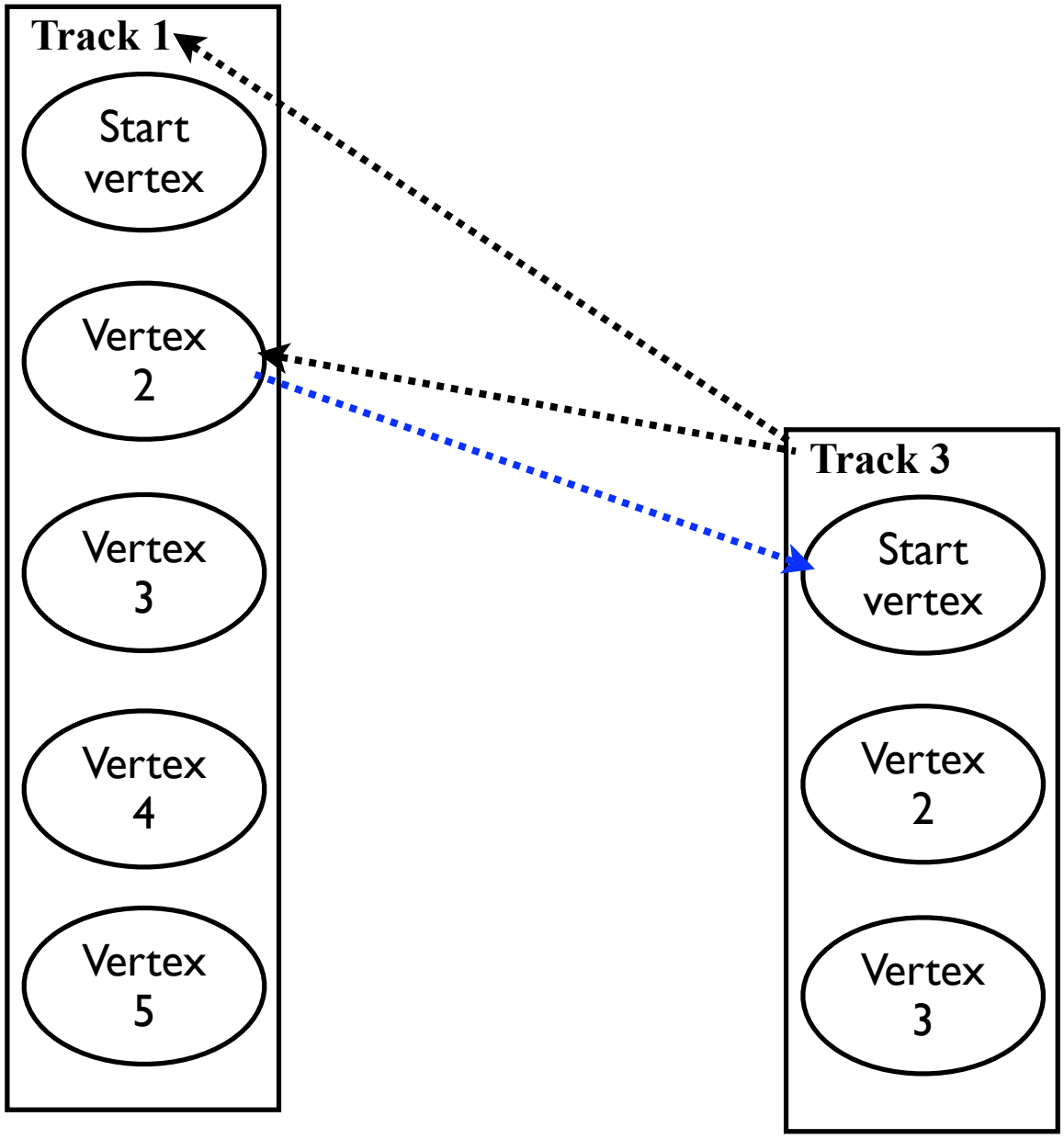


Figure 11.5: **f:history_pruning**
History Pruning The first figure shows a hypothetical case before pruning. The second case shows the links after pruning Track 2. The dotted lines indicate that the data objects record that the links are indirect.

11.3.2 Examples, Tips, Tricks

Choosing specific particle types is easy. For instance, the following selects all particles except for optical photons. (This is an excellent use case for low-energy events like IBD.)

```
historian.TrackSelection = "(pdg != 20022)"
```

Here is a brief list of the more important PDG codes. A complete list can be found at the PDG website. (Antiparticles are denoted by negative numbers.)

e^-	11
μ^-	13
γ	22
optical photon	20022
neutron	2112
proton	2212
π^0	111
$\pi-$	211

This example will save all tracks that are not optical photons, plus save one out of every 100 optical photons. This might be nice for an event viewer: — *

```
historian.TrackSelection = "(pdg != 20022) or (prescale by 100)"
```

This example will select any track created by a neutron capture (likely gamma rays): — *

```
historian.TrackSelection = "CreatorProcess == 'G4NeutronCapture'"
```

This should be contrasted with this example, which will save vertices with a neutron capture. This means: the vertex saved will be a neutron capture vertex, and is only valid for neutron tracks:

```
historian.VertexSelection = "Process == 'G4NeutronCapture'"
```

This example is slightly tricksy, but useful for muon-induced showers. It will select muons and particles that came off the muon, but not sub-particles of those. This lets you see delta rays or muon-induced neutrons, for example, but not record the entire shower.

```
historian.Track = "((AncestorTrackPdg = 13 or AncestorTrackPdg = -13)
                     and AncestorIndirection < 2)
                or (pdg == 13 or pdg == -13)"
```

This example selects only vertices which are inside the oil volume or sub-volume of the oil at the LingAo detector 1. i.e. in oil, AVs, or scintillator volumes: — *

```
historian.VertexSelection = "DetElem in '/dd/Structure/AD/la-oil1'"
```

This example selects vertices which are in the oil, not any subvolumes: — *

```
historian.VertexSelection = "DetectorElementName == '/dd/Structure/AD/la-oil1'"
```

This example saves only start and end vertices, as well as vertices that change materials: — *

```
historian.VertexSelection = "IsStopping ==1 and MaterialChanged > 0"
```

This example saves a vertex about every 20 cm, or if the track direction changes by more than 15 degrees:

```
historian.VertexSelection = "distanceFromLastVertex > 20 cm or AngleFromLastVertex > 15 deg"
```

Users should fill out more useful examples here.

11.3.3 Unobservable Statistics

Description

Although users may be able to answer nearly any question about the history of an event with the *Particle Histories*, it may be awkward or time-consuming to compile certain variables. To this end, users may request "Unobservable" statistics to be compiled during the running of the code.

For instance, let us say we want to know how many meters of water were traversed by all the muons in the event. We could do this above by turning on SimTracks for all muons and turning on all the SimVertecies at which the muon changed material.

```
historian.TrackSelection = "(pdg == 13 or pdg == -13)"
historian.VertexSelection = "(pdg == 13 or pdg == -13)
                             and (MaterialChanged >0 )"
```

Then, after the event had been completed, we would need to go through all the saved SimTracks and look for the tracks that were muons. For each muon SimTrack, we would need to go through each pair of adjacent SimVertices, and find the distance between each pair, where the first SimVertex was in water. Then we would need to add up all these distances. This would get us exactly what we wanted, but considerable code would need to be written, and we've cluttered up memory with a lot of SimVertices that we're only using for one little task.

To do the same job with the Unobserverable Statistics method, we need only run the "Unobserver" SteppingTask, and give it the following configuration:

```
UnObserver.Stats =[ ["mu_track_length_in_water" , "dx" ,
                     "(pdg == 13 or pdg == -13) and MaterialName=='Water'" ] ]
```

This creates a new statistic with the name `mu_track_length_in_water`, and fills it with exactly what we want to know!

This method is very powerful and allows the description of some sophisticated analysis questions at run-time. However, compiling many of these Statistics can be time-consuming during the execution of the simulaton. For serious, repeated analyses, using the *Particle Histories* may yield better results in the long run.

"Unobservable" Statistic Objects

Unobservable Statistics are stored in a SimStatistic object shown in Figure *f:simstatistic*.

These statistic objects are stored in a map, referenced by name, in the `SimUnobservableStatisticsHeader`. This object in turn is stored in the `SimHeader`, once per simulated event.

Creation Rules

The `Unobserver` module operates using the same principles as the *Particle History* selector, above. At initialization, a selection string and variable string is parsed into a set of Rule objects that can be rapidly evaluated on the current G4Step. The user supplies a list of Statistics to the module. Each Statistic is defined as follows: — * `["STATNAME" , "VARIABLE" , "EXPRESSION"]` or — *

```
["STATNAME_1" , "VARIABLE_1" ,
 "STATNAME_2" , "VARIABLE_2" ,
 "STATNAME_3" , "VARIABLE_3" ,
 ... , "EXPRESSION"]
```

Here, `STATNAME` is a string of the user's choosing that describes the statistic, and is used to name the statistic in the `SimUnobservableStatisticsHeader` for later retrieval. `VARIABLE` is a parameter listed in Table *t:truthiness_parameters* that is the actual value to be filled. Only numeric parameters may be used as variables.

.

Figure 11.6: **f:simstatistic**
SimStatistic A Statistic object used for Unobservable Statistics.

```
class SimStatistic {
    SimStatistic() : m_count(0),
                     m_sum(0),
                     m_squaredsum(0) {}

    double count() const;      /// Counts of increment() call
    double sum() const;        /// Total of x over all counts.
    double squaredsum() const;/// Total of x^2 over all counts.
    double mean() const;       /// sum()/count()
    double rms() const;        /// Root mean square

    void increment(double x);   /// count+=1, sum+=x, sum2+=x*x

  private:
    double m_count;       ///< No. of increments
    double m_sum;         ///< Total of x over all counts.
    double m_squaredsum; ///< Total of x^2 over all counts.
}
```

EXPRESSION is a selection string, as described in Sec. *Creation Rules*. In the second form of listing, several different variables may be defined using the same selection string, to improve runtime performance (and make the configuration clearer).

Any number of statistics may be defined, at the cost of run-time during the simulation.

The statistics are filled as follows. At each step of the simulation, the current G4Step is tested against each EXPRESSION rule to see if the current step is valid for that statistic. If it is, then the VARIABLE is computed, and the Statistic object is incremented with the value of the variable.

11.3.4 Examples, Tips, Trucks

Statistics are *per-step*. For example: — *

```
UnObserver.Stats =[ ["x_vertex" , "global_x" ,
                     "(pdg == 13 or pdg == -13)'" ] ]
```

will yield a statistic n entries, where n is the number of steps taken by the muon, with each entry being that step's global X coordinate. However, you can do something like the following: — *

```
UnObserver.Stats =[ ["x_vertex" , "global_x" ,
             "(pdg == 13 or pdg == -13)' and IsStarting==1" ] ]
```

which will select only the start points for muon tracks. If you know that there will be at most one muon per event, this will yield a statistic with one entry at the muon start vertex. However, this solution is not generally useful, because a second muon in the event will confuse the issue - all you will be able to retrieve is the mean X start position, which is not usually informative. For specific queries of this kind, users are advised to use Particle Histories.

Users should fill out more useful examples here.

11.3.5 Parameter Reference

The Particle History parser and the Unobservable Statistics parser recognize the parameter names listed in table *t:truthiness_parameters*

11.3.6 The DrawHistoryAlg Algorithm

These lines in your python script will allow you to run the DrawHistoryAlg and the DumpUnobservableStatisticsAlg, which provide a straightforward way of viewing the output of the Particle Histories and Unobservables, respectively:

```
simseq.Members = [ "GiGaInputStream/GGInStream",
                   "DsPushKine/PushKine",
                   "DsPullEvent/PullEvent",
                   "DrawHistoryAlg/DrawHistory",
                   "DumpUnobservableStatisticsAlg/DumpUnobserved"
                 ]
```

The DrawHistoryAlg produces two "dot" files which can be processed by the GraphViz application. (A very nice, user-friendly version of this exists for the Mac.) The dot files describe the inter-relation of the output objects so that they can be drawn in tree-like structures. Sample output is shown in Figures *f:drawhistoryalg_tracks* and *f:drawhistoryalg_tracksandvertices*.

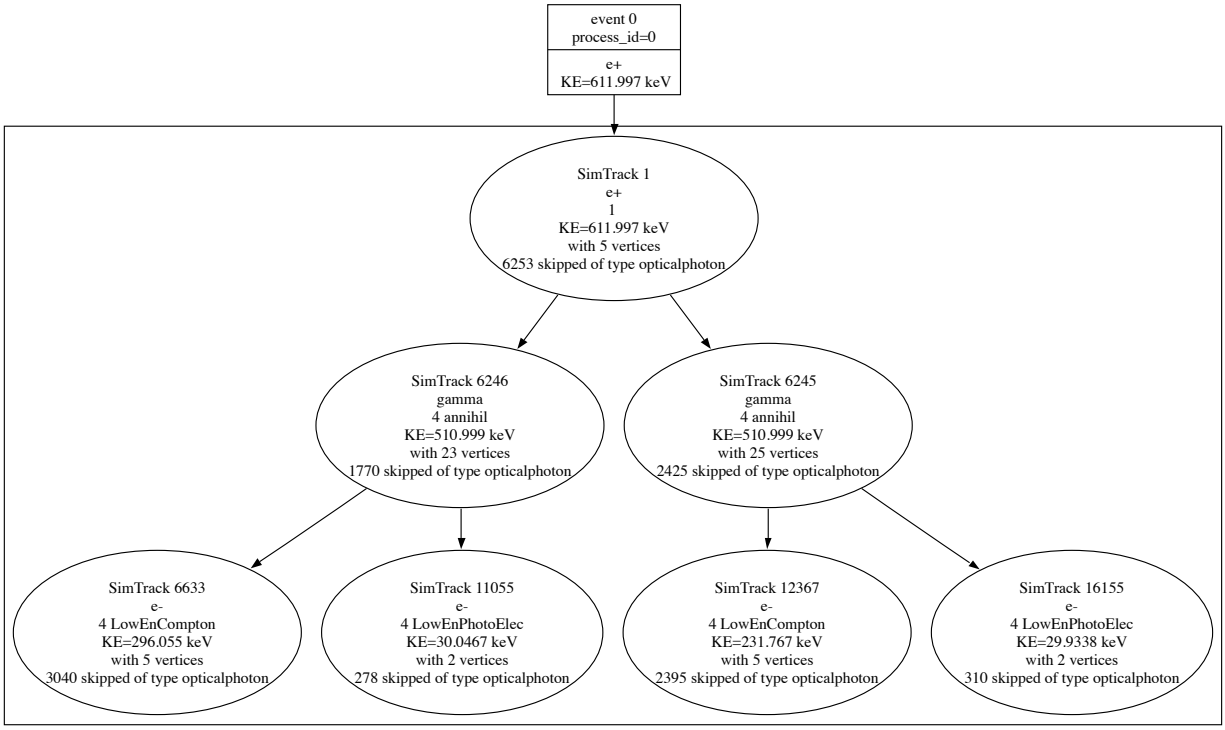
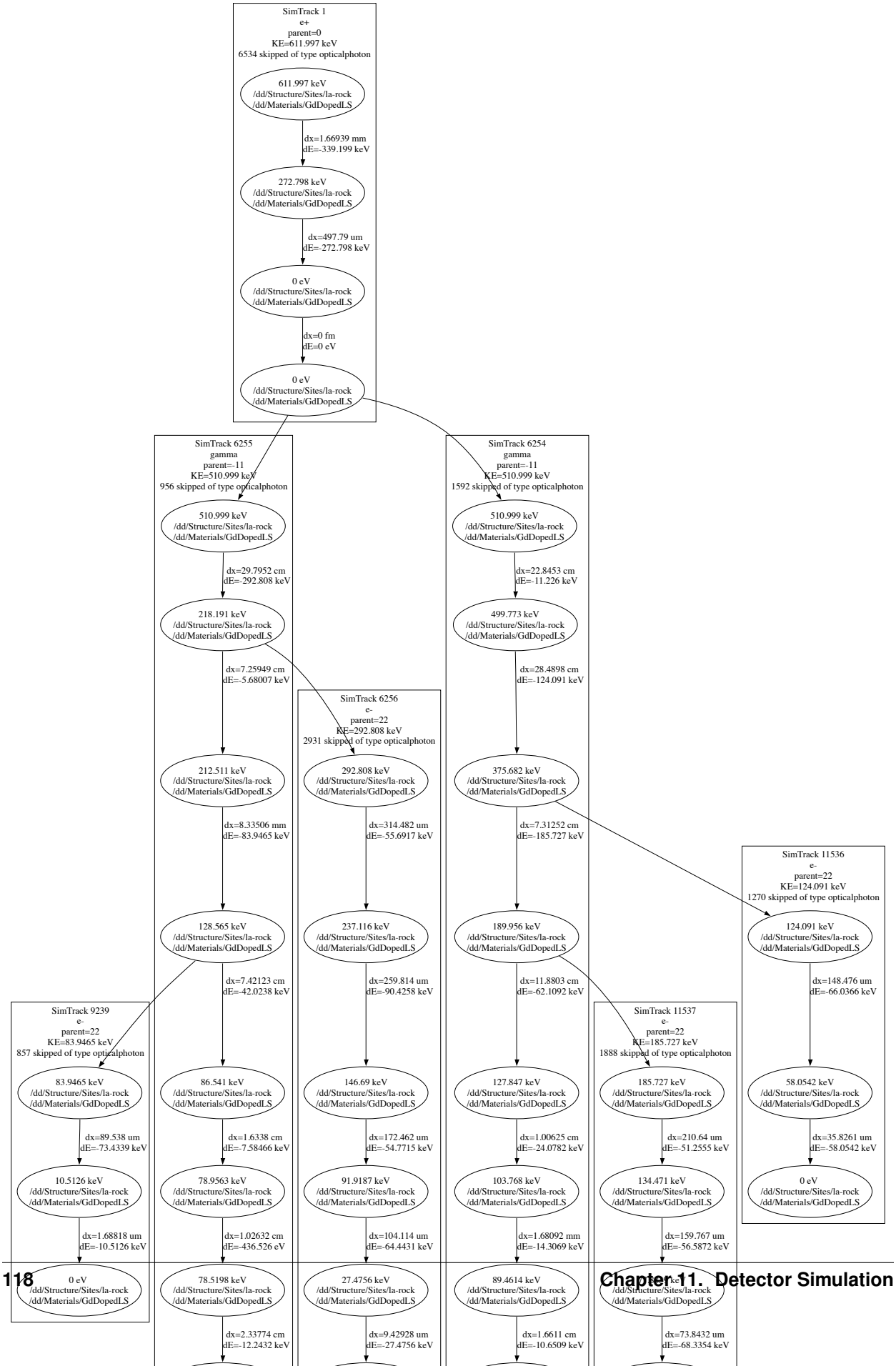


Figure 11.7: **f:drawhistoryalg_tracks**
Output of tracks file for a single 1 MeV positron. Circles denote SimTracks - values listed are starting values. In this example, do_hits was set to zero.

The DrawHistoryAlg can be configured like so:


SimTrack 1
e+
parent=0
KE=611.997 keV
6534 skipped of type opticalphoton
611.997 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=1.66939 mm
dE=-339.199 keV
272.798 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=497.79 um
dE=-272.798 keV
0 eV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=0 fm
dE=0 eV
0 eV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
SimTrack 6255
gamma
parent=-11
KE=510.999 keV
956 skipped of type opticalphoton
510.999 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=29.7952 cm
dE=-292.808 keV
218.191 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=7.25949 cm
dE=-5.68007 keV
212.511 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=8.33506 mm
dE=-83.9465 keV
128.565 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=7.42123 cm
dE=-42.0238 keV
86.541 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=1.6338 cm
dE=-7.58466 keV
78.9563 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=1.02632 cm
dE=-436.526 eV
78.5198 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=2.33774 cm
dE=-12.2432 keV
SimTrack 6256
e-
parent=22
KE=292.808 keV
2931 skipped of type opticalphoton
292.808 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=314.482 um
dE=-55.6917 keV
237.116 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=259.814 um
dE=-90.4258 keV
146.69 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=172.462 um
dE=-54.7715 keV
91.9187 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=104.114 um
dE=-64.4431 keV
27.4756 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=9.42928 um
dE=-27.4756 keV
SimTrack 6254
gamma
parent=-11
KE=510.999 keV
1592 skipped of type opticalphoton
510.999 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=22.8453 cm
dE=-11.226 keV
499.773 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=28.4898 cm
dE=-124.091 keV
375.682 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=7.31252 cm
dE=-185.727 keV
189.956 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=11.8803 cm
dE=-62.1092 keV
127.847 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=1.00625 cm
dE=-24.0782 keV
103.768 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=1.68092 mm
dE=-14.3069 keV
89.4614 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=1.6611 cm
dE=-10.6509 keV
SimTrack 11536
e-
parent=22
KE=124.091 keV
1270 skipped of type opticalphoton
124.091 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=148.476 um
dE=-66.0366 keV
58.0542 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=35.8261 um
dE=-58.0542 keV
0 eV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
SimTrack 11537
e-
parent=22
KE=185.727 keV
1888 skipped of type opticalphoton
185.727 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=210.64 um
dE=-51.2555 keV
134.471 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=159.767 um
dE=-56.5872 keV
77.884 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=73.8432 um
dE=-68.3354 keV
SimTrack 9239
e-
parent=22
KE=83.9465 keV
857 skipped of type opticalphoton
83.9465 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=89.538 um
dE=-73.4339 keV
10.5126 keV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS
dx=1.68818 um
dE=-10.5126 keV
0 eV
/dd/Structure/Sites/la-rock
/dd/Materials/GdDopedLS

```
app.algorithm("DrawHistory").do_hits = 0
app.algorithm("DrawHistory").track_filename = 'tracks_%d.dot'
app.algorithm("DrawHistory").trackandvertex_filename = 'vertices_and_tracks_%d.dot'
```

The filename configuration is for two output files. Using '%d' indicates that the event number should be used, to output one file per event. The `do_hits` option indicates whether SimHits should be shown on the plot. (For scintillator events, this often generates much too much detail.)

The DumpUnobservableStatisticsAlg algorithm simply prints out the counts, sum, mean, and rms for each statistic that was declared, for each event. This is useful for simple debugging.

Warning: latexparser did not recognize : color columnwidth

11.4 Truth Parameters

Name & Synonyms	Type	Track	Vertex	Stats	Description
timet	double	X	X	X	Time of the vertex/track start/step
xglobal_x	double	X	X	X	Global X position of the vertex/track start/step
yglobal_y	double	X	X	X	Global Y position of the vertex/track start/step
zglobal_z	double	X	X	X	Global Z position of the vertex/track start/step
rradiuspos_r	double	X	X	X	Global sqrt(X*X+Y*Y) position of the vertex/st
lxlocal_xdet_x	double	X	X	X	X Position relative to the local physical volume
lylocal_ydet_y	double	X	X	X	Y Position relative to the local physical volume
lzlocal_zdet_z	double	X	X	X	Z Position relative to the local physical volume
lrlocal_rdet_r	double	X	X	X	sqrt(X*X+Y*Y) position relative to the local ph
VolumeVolumeNameLogicalVolume	string	X	X	X	Name of the logical volume of vertex/track start
MaterialMaterialName	string	X	X	X	Name of material at vertex/track start/step
DetectorElementName	double	X	X	X	Name of best-match Detector Element at vertex/
MatchDetectorElementMatch	double	X	X	X	Level of match for Detector Element. 0=perfect
NicheIdNiche	double	X	X	X	ID number (4-byte) best associated with DetEle
DetectorId	double	X	X	X	Detector ID number (4-byte)
SiteId	double	X	X	X	Site ID number (4-byte)
Site	double	X	X	X	Site number (1-16)
ADAdNumber	double	X	X	X	AD number (1-4)
momentump	double	X	X	X	Momentum at vertex/track start/step
EtotEnergyTotalEnergy	double	X	X	X	Energy at track start or vertex
KEkineticEnergy	double	X	X	X	Kinetic energy at vertex/track start/step
vxdir_xu	double	X	X	X	X-direction cosine
vydir_yv	double	X	X	X	Y-direction cosine
vzdir_zw	double	X	X	X	Z-direction cosine
ProcessType	double	X	X	X	Type of process (see below)
ProcessProcessName	string	X	X	X	Name of current process (via `G4VProcess->`
pdgpdgcodeparticle	double	X	X	X	PDG code of particle. Note that opticalphoton=2
chargeParticleChargeq	double	X	X	X	Charge of particle
idtrackid	double	X	X	X	Geant TrackID of particle. Useful for debugging
creatorPdgcreator	double	X	X	X	PDG code for the immediate parent particle
massm	double	X	X	X	Mass of the particle
ParticleName	string	X	X	X	Name of the particle (Geant4 name)
CreatorProcessNameCreatorProcess	string	X	X	X	Name of process that created this particle. (Trac
DetElem inDetectorElement in	custom	X	X	X	Special: matches if the detector element specifie

Table 11.1 – continued from previous page

Name & Synonyms	Type	Track	Vertex	Stats	Description
Step_dEdE	double		X	X	Energy deposited in current step
Step_dE_Ionde_ionionization	double		X	X	Energy deposited by ionization in current step
Step_qDEquenched_dEqdE	double		X	X	Quenched energy. Valid only for scintillator
Step_dxStepLengthdx	double		X	X	Step length
Step_dtStepDurationdt	double		X	X	Step duration
Step_dAngledAngle	double		X	X	Change in particle angle before/after this Step (d
ExE_weighted_x	double		X	X	Energy-weighted global position - x
EyE_weighted_y	double		X	X	Energy-weighted global position - y
EzE_weighted_z	double		X	X	Energy-weighted global position - z
EtE_weighted_t	double		X	X	Energy-weighted global time
qExqE_weighted_xquenched_weighted_x	double		X	X	Quenched energy- weighted global position - x
qEyqE_weighted_yquenched_weighted_y	double		X	X	Quenched energy- weighted global position - y
qEzqE_weighted_zquenched_weighted_z	double		X	X	Quenched energy- weighted global position - z
qEtqE_weighted_tquenched_weighted_t	double		X	X	Quenched energy- weighted global time
IsStoppingstopEnd	double		X	X	1 if particle is stopping0 otherwise
IsStartingstartbegin	double		X	X	1 if particle is starting (this is the first step)0 oth
StepNumber	double		X	X	Number of steps completed for this particle
VolumeChangedNewVolume	double		X	X	1 if the particle is entering a new volume0 other
MaterialChangedNewMaterial	double		X	X	1 if the particle is entering a new material0 other
ParentPdgAncestorPdgAncestor	double	X	X		PDG code of the last ancestor where a SimTrack
ParentIndirectionAncestorIndirection	double	X	X		Generations passed since the last ancestor was c
GrandParentPdgGrandParent	double	X	X		PDG code of the immediate ancestor's ancestor
GrandParentIndirection	double	X	X		Indirection to the immediate ancestor's ancestor
distanceFromLastVertex	double		X		Distance from the last created SimVertex.
TimeSinceLastVertex	double		X		Time since the last created SimVertex.
EnergyLostSinceLastVertex	double		X		Energy difference sine the last created SimVerte
AngleFromLastVertex	double		X		Change in direction since the last created SimVe

CHAPTER

TWELVE

ELECTRONICS SIMULATION

12.1 Introduction

The Electronics Simulation is in the ElecSim package. It takes an SimHeader as input and produces an ElecHeader, which will be read in by the Trigger Simulation package. The position where ElecSim fit in the full simulation chain is given in figure *fig-electronics-simchain*. The data model used in ElecSim is summarized in the UML form in figure *fig-electronics-elecsimuml*.

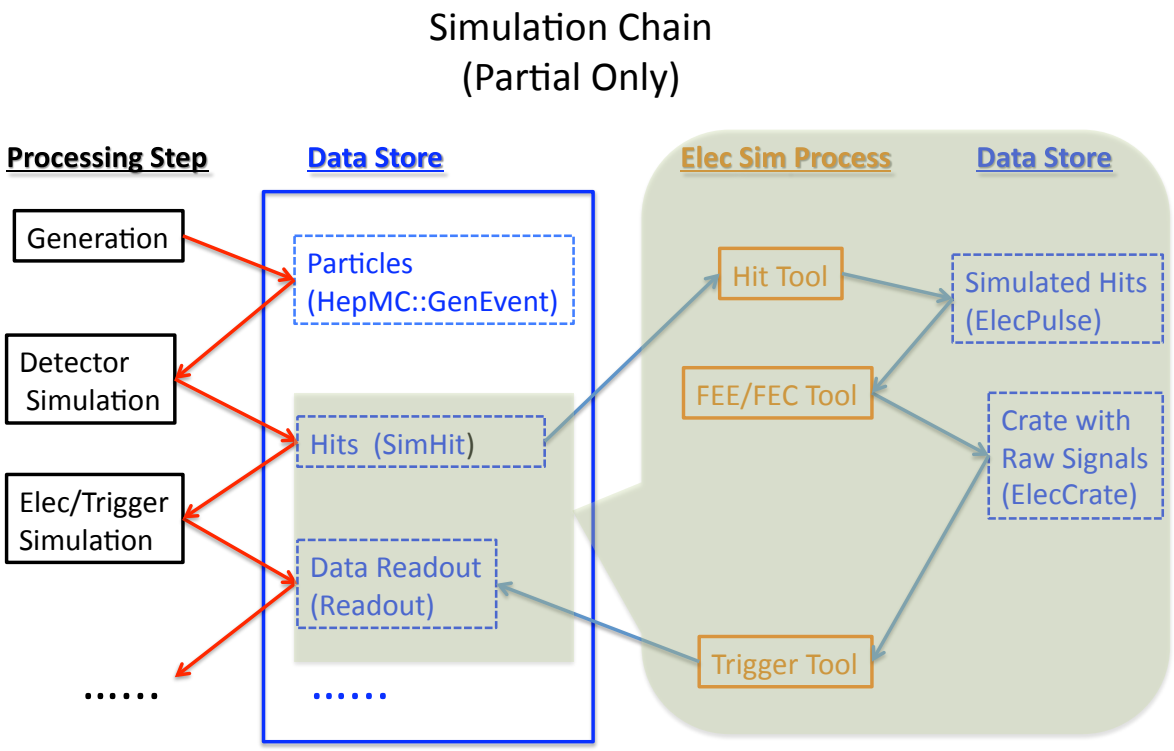


Figure 12.1: **fig-electronics-simchain**
Electronics Simulation Chain

Location: dybgaudi/DataModel/ElecEvent
Current as of: r4061

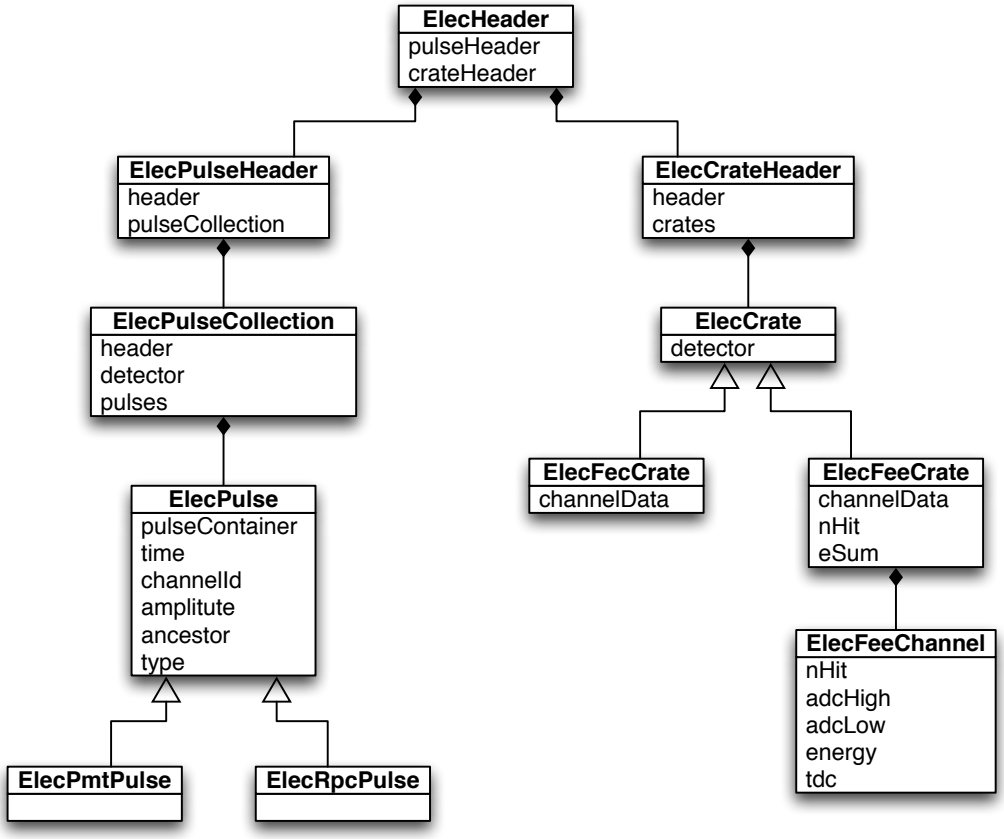


Figure 12.2: **fig-electronics-elecsimuml**
UML for data model in ElecSim.

12.2 Algorithms

There are two algorithms. They are listed in table *Algorithms and their properties.*

Table 12.1: Algorithms and their properties.

Algorithm Name	Property	Defualt
7*EsFrontEndAlg	SimLocation	SimHeaderLocationDefault
2-3	Detectors	DayaBayAD1(2,3,4)
2-3	PmtTool	EsPmtEffectPulseTool
2-3	RpcTool	EsIdealPulseTool
2-3	FeeTool	EsIdealFeeTool
2-3	FecTool	EsIdealFecTool
2-3	MaxSimulationTime	50 us

12.3 Tools

Tools are declared as properties in the algorithms in the previous section. Two kinds of tools are present in the EleSim package. They are:

- Hit tools: these types of tools take SimHitHeader as input and generate ElecPulseHeader.
- FEE/FEC tools: these tools takes the output from hit tools in ElecPulseHeader and create ElecCrate. The foundation of these tools are the hardware of FEE for AD and FEC(Front-end Card) for RPC electronics.

12.3.1 Hit Tools

12.3.2 FEE Tool: EsIdealFeeTool

The properties is summaried in table *Properties declared in EsIdealFeeTool.*.

Table 12.2: Properties declared in EsIdealFeeTool.

Property	Default
CableSvcName	StaticCableSvc
SimDataSvcName	StaticSimDataSvc
TriggerWindowCycles	Dayabay::TriggerWindowCylces
NoiseBool	true
NoiseAmp	0.5mV

Pulses(**ElecPulse**) generated in HitTools are first mapped to channels in each FEE board via CableSvc service. For each channel, pulses are then converted and time-sequenced to create two analog signals to simulate real signals in FEE. The two major analog signals are RawSignal and shapedSignal. The following shows the generation steps.

- pmt Analog Signal (**m_pmtPulse(nSample) vector<double> **): each pulse (**ElePulse**) is converted to a pmt analog signal(**m_pmtPulse(nSample)**) according to an ideal pmt waveform parametrization given in equation (**??**).
- Shaped PMT Signal(**m_shapedPmtPulse(nSample)**): the pmt analog signal (**m_pmtPulse(nSample)** is convoluted with shaper transfer function to get the shaper output analog singal (**shapedPmtPulse(nSample)**).
- RawSignal (**RawSignal(simSamples) vector<double>**): represents the time sequenced pmt signal with gaussian distributed noises included. This RawSignal is sent to discriminator to form multiplicit and TDC values. Analogsum is also based on this RawSignal.

- shapedSignal(**shapedSignal(SimSample) vector<double>**) is composed of time- sequenced shapedPMTsignals(**shapedPmtPulse**).

$$V(t) = VoltageScale \cdot \frac{(e^{-t/t_0} - e^{-t/t_1})}{(t_1 - t_0)} \quad (12.1)$$
$$t_0 = 3.6ns$$
$$t_1 = 5.4ns$$

Multiplicity Generation and TDC

Multiplicity at hit Clock i for one FEE board is the sum of the hitHold signal(**hitHold vector<int>**) at the hit Clock hitHold(i) for all the hitted channels in the FEE channel. Figure *fig-electronics-npmtgen* shows the flow on how the hitHold signals are generated. One example of two 1 p.e. pulses are shown in figure *fig-electronics-npmtgenexample*.

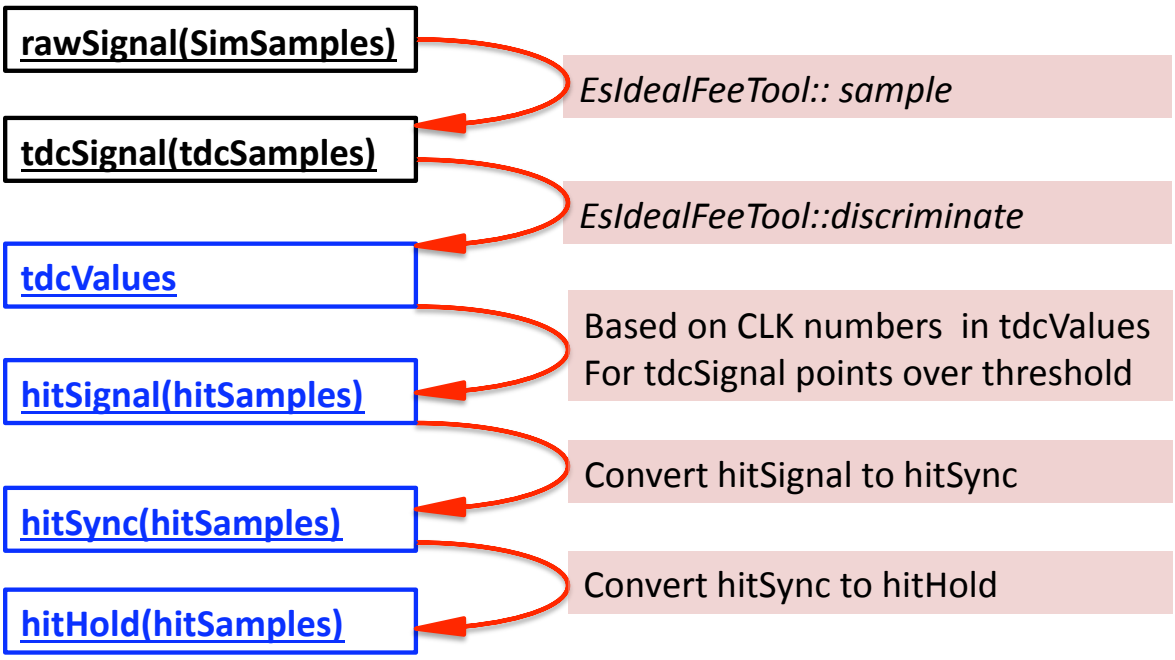


Figure 12.3: **fig-electronics-npmtgen**
: hitHold signal generation sequence. Analog Signals are shown in the black box. And ditigal signals are shown in blue boxes. On the right hand side, related functions or comments are listed to specify the convertion between different signals.

ADC Generation

12.4 Simulation Constant

Simulation constants based on electronics hardware is defined in dybgaudi/DataModel/Conventions/Conventions/Electronics.h Table *table-elecsim-const* summaries the major vaiables defined and their hardwired values.

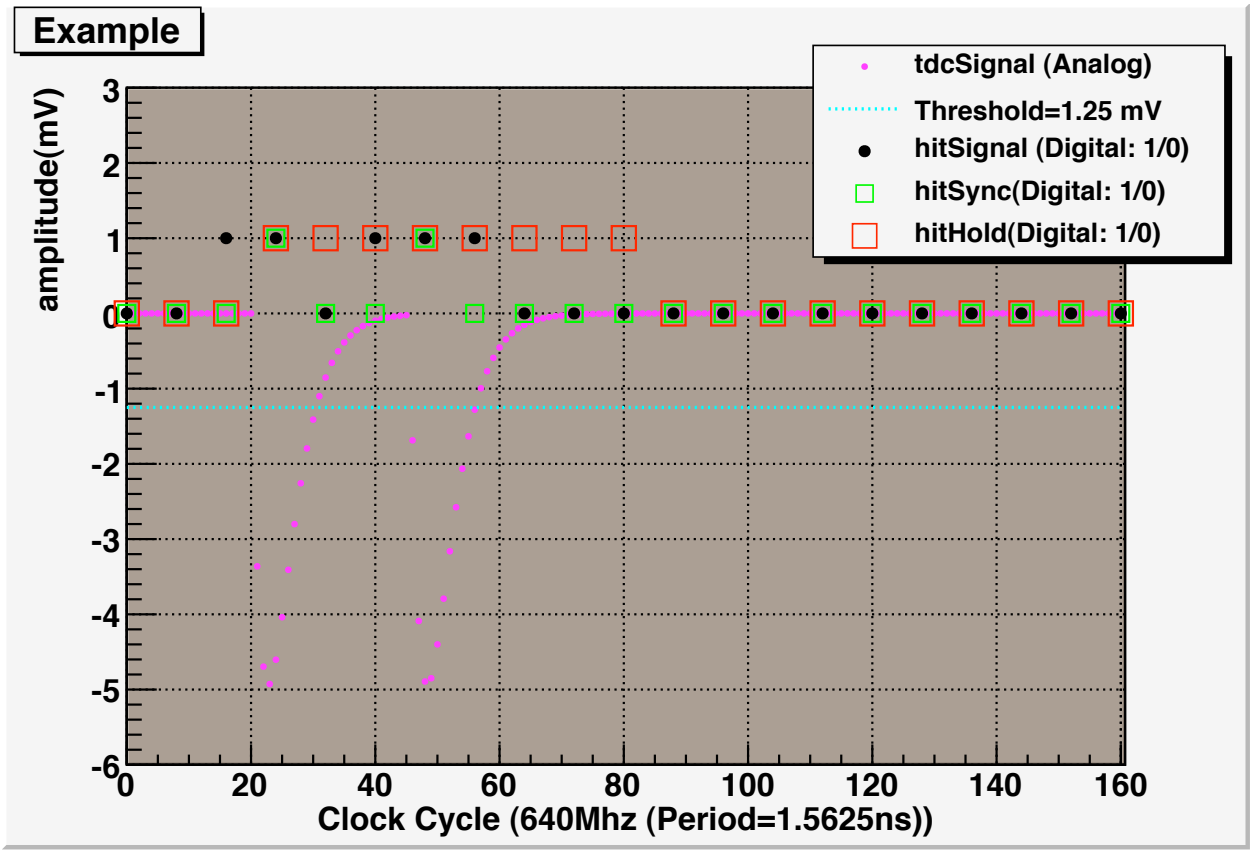


Figure 12.4: **fig-electronics-npmtgenexample**
: An example of convertions from tdcSignal to hitHold Signal. The the label in Y axis is only for the analog signal tdcSignal and the Threshold line.

Variable Defined	Value
BaseFrequency	$40 \cdot 1E6$ (hz)
TdcCycle	16
AdcCycle	1
EsumCycle	5
NhitCycle	2
preTimeTolerance	300ns
postTimeTolerance	10us
TriggerWindowCycle	8

Warning: latexparser did not recognize : multirow cline

CHAPTER

THIRTEEN

TRIGGER SIMULATION

13.1 Introduction

The Trigger Simulation is implemented in the TrigSim package. `TrigSim` takes an `ElecHeader` as input and produces a `SimTrigHeader`. See Figure *fig::simtrigheader*.

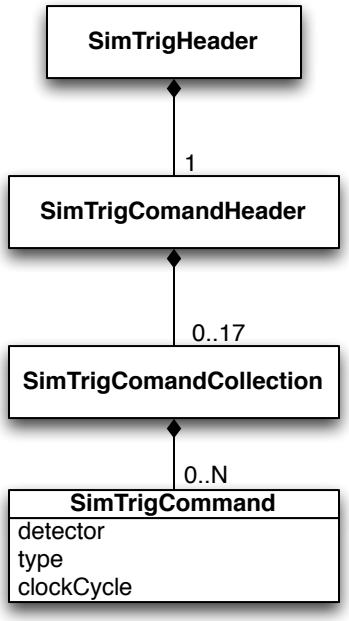


Figure 13.1: **fig::simtrigheader**
`SimTrigHeader` contains a single `SimTrigCommandHeader` which in turn potentially contains a `SimTrigCommandCollection` for each detector. Each `SimTrigCommandCollection` contains `SimTrigCommands` which correspond to an actual trigger.

13.2 Configuration

The main algorithm in TrigSim, `TsTriggerAlg` has 3 properties which can be specified by the user.

TrigTools `Default` : "TsMultTriggerTool" List of Tools to run.

TrigName `Default` : "TriggerAlg" Name of the main trigger algorithm for bookkeeping.

ElecLocation `Default:` "/Event/Electroincs/ElecHeader" Path of ElecSimHeader in the TES, currently the default is picked up from ElecSimHeader.h

The user can change the properties through the TrigSimConf module as follows:

```
import TrigSim
trigsim = TrigSim.Configure()
import TrigSim.TrigSimConf as TsConf
TsConf.TsTriggerAlg().TrigTools = [ "TsExternalTriggerTool" ]
```

The `TrigTools` property takes a list as an argument allowing multiple triggers to be specified. The user can apply multiple triggers as follows:

```
import TrigSim
trigsim = TrigSim.Configure()
import TrigSim.TrigSimConf as TsConf
TsConf.TsTriggerAlg().TrigTools = [ "TsMultTriggerTool" ,
                                    "TsEsumTriggerTool" ,
                                    "TsCrossTriggerTool" ]
```

The mutate method within each tool will be called once per event in the order in which they are listed.

13.3 Current Triggers

This section will describe specific trigger implementations. Most implementations will have properties which can be set like this:

INSERT EXAMPLE

13.3.1 TsMultTriggerTool

A Multiplicity Trigger implementation. This will issue a local trigger when a specified number of channels are go over threshold within a given time window. This tool has two properties:

DetectorsToProcess is a list of detectors for this trigger to work on. The default value for this property is a list containing all pmt based detectors. This tool loops over all detectors within the ElecHeader and checks it against those in the list. If the detector is in the list the tool issues all applicable triggers for that detector. If the detector is not found in the DetectorsToProcess list the detector is ignored.

RecoveryTime sets the number of nhit clock cycles to wait after a trigger is issued before potentially issuing another trigger. The default value is 24 which corresponds to 300ns for the 80MHz clock.

13.3.2 TsExternalTriggerTool

An External Trigger implementation. This will issue a local triggers at a specified frequency. Currently used with the dark rate module for the MDC08. The properties are:

DetectorsToProcess Same as TsMultTriggerTool in section *TsMultTriggerTool*.

TriggerOffset Frequency AutoSet

13.4 Adding a new Trigger

To add a new trigger type, create a new class which inherets from GaudiTool and ITsTriggerTool as shown here:

```
class TsMyTriggerTool : public GaudiTool,
                            virtual public ITsTriggerTool
{
 public:

  TsMyTriggerTool(const std::string& type,
                  const std::string& name,
                  const IInterface* parent);
  virtual ~TsMyTriggerTool();

  virtual StatusCode mutate(DayaBay::SimTrigHeader* trigHeader,
                            const DayaBay::ElecHeader& elecHeader);
  virtual StatusCode initialize();
  virtual StatusCode finalize();

 private:
  std::vector<std::string> m_detectorsToProcess;
};
```

CHAPTER

FOURTEEN

READOUT

14.1 Introduction

`ReadoutSim` is located in `Simulation/ReadoutSim` within the dybgaudi project. It uses `SimTrigCommand`'s and `ElecCrate`'s to produce `readouts`. The produced `readouts` are held within a `SimReadoutHeader` object. An addition `ReadoutHeader` object exists to satify the requirement that only one (1) `readout` be produced each execution cycle. The details of the header objects are shown in figures *fig::simreadoutheader* and *fig::readoutheader*

14.2 ReadoutHeader

The `ReadoutHeader` contains a single readout which consists of the following:

detector `Detector` uniquely identifying the subsystem that was readout to produce this object.

triggerNumber `unsigned int` enumerating triggers.

triggerTime `TimeStamp` of trigger issuance.

triggerType `TriggerType_t` enum which constructs a bitmap to define the trigger type.

readoutHeader A pointer back to the `ReadoutHeader` which contains this object.

Two flavors of Readouts exist, `ReadoutPmtCrate` and `ReadoutRpcCrate`. The `ReadoutPmtCrate` contains a map of `FeeChannelId`'s to `ReadoutPmtChannel`'s and the `ReadoutRpcCrate` contains a similar map of `FeeChannelId`'s to `ReadoutRpcChannel`'s. The `ReadoutPmtChannel` Contains

channelId `FeeChannelId` uniquely identifying the channel that was read out.

tdc a vector of tdc values

adc a map of adc values, keyed with their clock cycle.

adcGain `FeeGain_t` denoting either that the high or low gain was read out.

readout pointer back to the `ReadoutPmtCrate` which contains this channel readout.

The ReadoutRpcChannel contains

channelId `FeeChannelId` uniquely identifying the channel that was read out.

hit a boolean value indicating a hit.

readout a pointer back to the `ReadoutRpcCrate` which contains this channel readout.

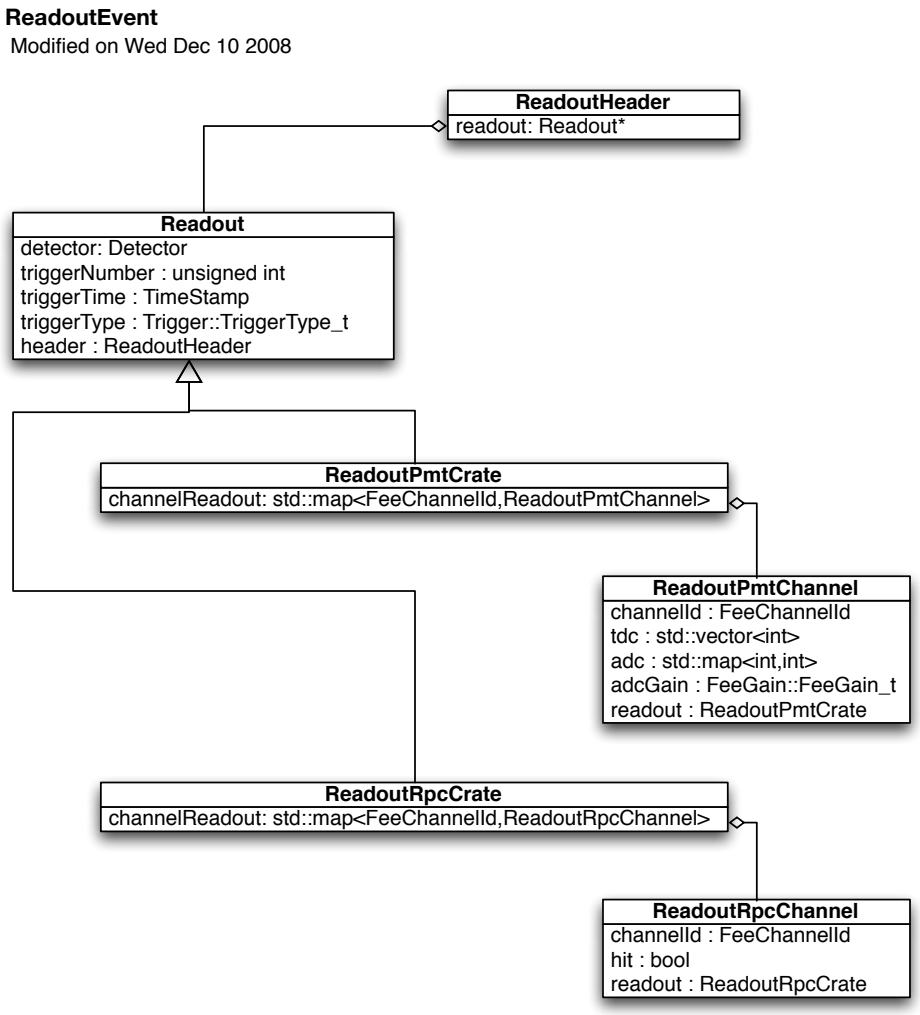


Figure 14.1: **fig::readoutheader**

The `ReadoutHeader` contains a single Readout. The two flavors of readouts are discussed in *ReadoutHeader*

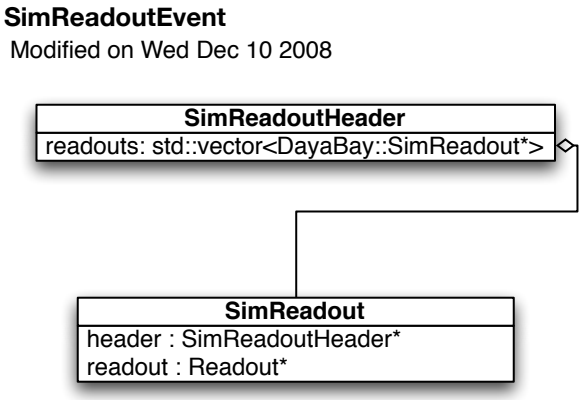


Figure 14.2: **fig::simreadoutheader**

The `SimReadoutHeader` holds multiple `SimReadout`'s which in turn contain a pointer to a single `Readout` object. The `Readout` object pointer points to the same object a `SimReadoutHeader` points to.

14.3 SimReadoutHeader

The `SimReadoutHeader` contains all the readout headers produced during a single execution cycle. This can include $0..N$ readouts for each detector.

14.4 Readout Algorithms

ReadoutSim currently has two Algorithms described below:

14.4.1 ROsSequencerAlg

`ROsSequencerAlg` tries to fix the many-to-one, readouts to execution cycle mismatch. The sequencer fill the ReadoutHeader object with only the first ReadoutEvent produced during each execution cycle.

14.4.2 ROsReadoutAlg

`ROsReadoutAlg` is the driving algorithm for `ReadoutSim`. This algorithm applies each tool specified in the `RoTools` property for each trigger event. It is up to the tool to decide if it should act or not. The default setup is as follows:

```
import ReadoutSim
rosim = ReadoutSim.Configure()
import ReadoutSim.ReadoutSimConf as ROsConf
ROsConf.ROsReadoutAlg().RoTools=["ROsFecReadoutTool","ROsFeeReadoutTool"]
ROsConf.ROsReadoutAlg().RoName="ReadoutAlg"
ROsConf.ROsReadoutAlg().TrigLocation="/Event/SimTrig/SimTrigHeader"
ROsConf.ROsReadoutAlg().ElecLocation="Event/Elec/ElecHeader"
```

14.5 Readout Tools

ReadoutSim currently has 5 tools described below which can be used to customize readout.

14.5.1 ROsFeeReadoutTool

`ROsFeeReadoutTool` handles reading out pmt based detectors. By default this tool acts on all trigger commands associated with a pmt based detector. To specify different parameters for specific pmt based detectors create multiple instances of this tool and specify `DetectorsToProcess` appropriately in each. The default configuration is shown below.

```
import ReadoutSim.ReadoutSimConf as ROsConf
ROsConf.ROsFeeReadoutTool().DetectorsToProcess=["DayaBayAD1","DayaBayAD2",\
                        "DayaBayIWS","DayaBayOWS","LingAoAD1","LingAoAD2",\
                        "LingAoIWS","LingAoOWS","FarAD1", "FarAD2",\
                        "FarAD3","FarAD4", "FarIWS","FarOWS"]
ROsConf.ROsFeeReadoutTool().AdcTool="ROsFeeAdcPeakOnlyTool"
ROsConf.ROsFeeReadoutTool().TdcTool="ROsFeeTdcTool"
ROsConf.ROsFeeReadoutTool().ReadoutLength=12
ROsConf.ROsFeeReadoutTool().TriggerOffset=2
```

14.5.2 ROsFecReadoutTool

`ROsFecReadoutTool` handles reading out the rpc based detectors. By default this acts on all rpc based detectors. This is the only property currently available as seen below in the default setup.

```
import ReadoutSim.ReadoutSimConf as ROsConf
ROsConf.ROsFeeReadoutTool()=detectorsToProcess=[ "DayaBayRPC" ,\
                                                 "LingAoRPC" , "FarRPC" ]
```

14.5.3 ROsFeeAdcMultiTool

`ROsFeeAdcMultiTool` reads out samples the adc values in the readout window based on the readout window start. The user specifies the `ReadoutCycles` with 0 corresponding the adc value at the beginning of the readout window.

```
ROsConf.ROsFeeReadoutTool().AdcTool="ROsFeeAdcMultiTool"
ROsConf.ROsFeeAdcMultiTool().ReadoutCycles=[ 0 , 2 , 3 , 4 , 8 ]
```

14.5.4 ROsFeeAdcPeakOnlyTool

`ROsFeeAdcPeakOnlyTool` reads out the peak adc value in the readout window.

```
ROsConf.ROsFeeReadoutTool().AdcTool="ROsFeeAdcPeakOnlyTool"
```

14.5.5 ROsFeeTdcTool

`ROsFeeTdcTool` readout the tdc values during the readout window. The user has the option to readout multiple tdc values but changing the `UseMultiHitTdc` property.

```
ROsConf.ROsFeeReadoutTool().TdcTool="ROsFeeTdcTool"
ROsConf.ROsFeeTdcTool().UseMultiHitTdc=False
ROsConf.ROsFeeTdcTool().TdcResetCycles=True
```

CHAPTER

FIFTEEN

SIMULATION PROCESSING MODELS

15.1 Introduction

To properly simulate Daya Bay experiment, events from different event classifications must be properly mixed with any overlapping in space and time properly handled. To do this is complex and so a simpler simulation that only considers a single event type at a time is also desired. The former model goes by the name of "pull mode" or "Fifteen minutes style" simulation. The latter is known as "push mode" or "linear style" simulation.

15.2 Fifteen

Fifteen package successfully extends gaudi frame work to another level. It makes use of many advance features of dybgaudi, like AES, inputHeaders and using Stage tool to handle data transfer. Fifteen package is designed to handle the max complexity in simulation. It has sophisticated consideration on all kinds of possible physics scenario, event time information handling and data management. After two years' usage and the feedback from users, it's already absorbed a lot of ideas, like mixing pre-simulated events and reusing, and has gone into a mature stage.

15.2.1 Quick Start

After you get into nuwa environment, you are ready to start to generate your own simulation sample. In /NuWa-trunk-dbg/NuWa- trunk/dybgaudi/Tutorial/Sim15/aileron, after type in nuwa.py -n50 -o fifteen.root -m "FullChainSimple -T SingleLoader" > log it will generate 50 readouts from IBD and K40 events.

15.2.2 Simulation Stage

Simulation is separated into a few stages: Kinematic, Detector, Electronic, TrigRead and SingleLoader. Kinematic stage generates kinematic information, including time, position, particle and its momentum, etc. Detector stage is to geant4 to do detector response simulation, like scattering, cerenkov and scintillation light. At the end it will generate hit number (P.E.) in each PMT and hit information on RPC. Electronic simulation convert these physics hit into electronic signal. For example, hits on PMT are converted to pulses. TrigRead will do trigger judgement based on user setting, like NHit>10, which means number of fired PMTs must be above 10. When an event is triggered, it also produces readout. That means it will output ADC and TDC instead of a raw PMT pulse. The real data acquisition system works like a pipe line, it outputs its result one by one in time order. SingleLoader is designed for this purpose. The above description can be summarized in Fig. *fig:stages*

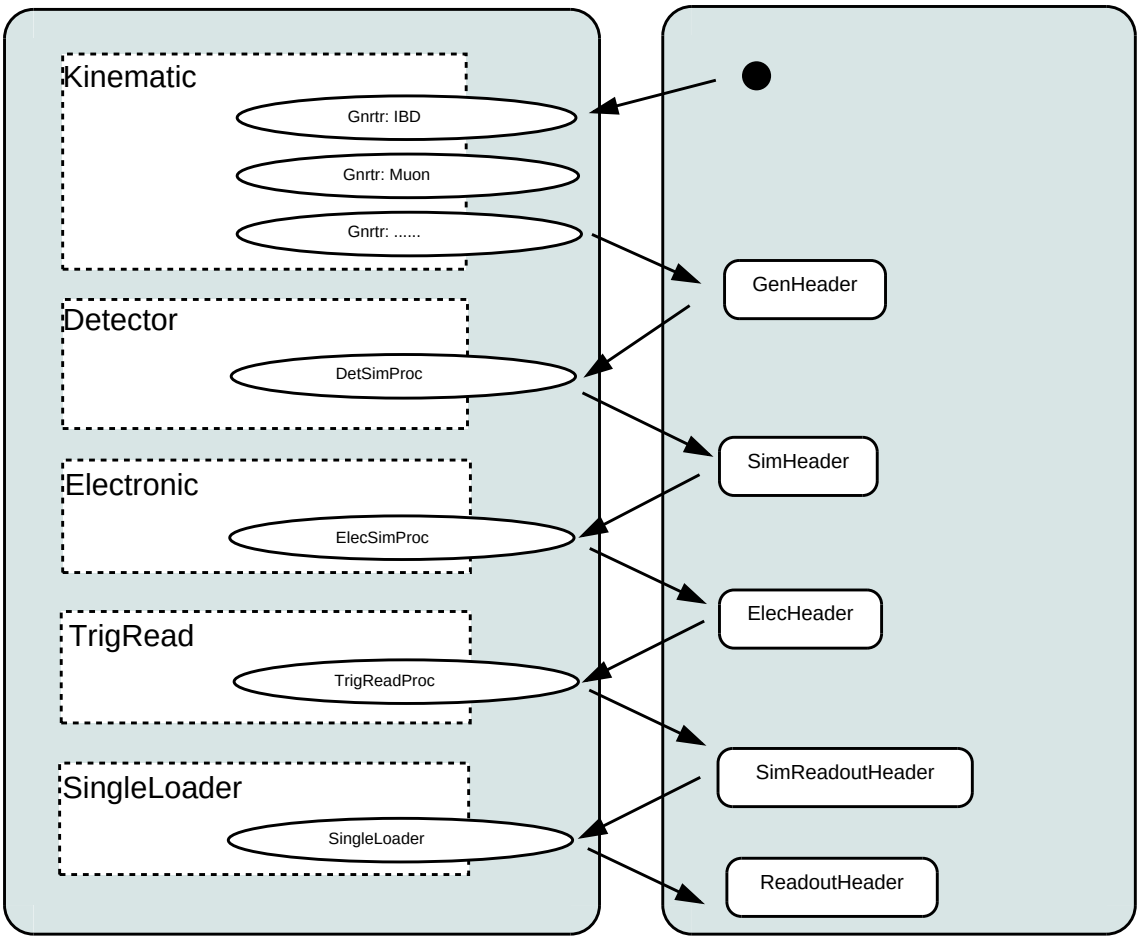


Figure 15.1: **fig:stages**
Simulation stages.

15.2.3 Stage Tool

Stage as explained in previous sections is an abstract concept in dividing all simulation components. For Fifteen package, stage tool physically separates each simulation tools, but also is a media in data transfer.

While synchronizing many generation sources, they generate many data in the same time – same execution cycle. For dybgaudi they are held by AES and inputHeaders. The time sequence in which they are generated is disordered. Stage tool is put in charge of managing all the processors in one simulation stage. it manages the execution of them, i.e. only run them when data is needed, and it caches the data from all processors, sorts them and output them in time order. A bad metaphor might be stage tool works like a central train station. It controls the incoming stream of all the trains to avoid possible crushing. It has some ability to let train stop for some period, then let them leave on time.

15.2.4 Gnrtr

Gnrtr stands for Generator. For one type of events one generator needs to be specified. The type here is not limited to its physics generation mechanism. The same type of event in different volume or geometry structure may have different event rates, so they should be specified as two different Gnrtr. For example a type of radioactive background have different abundance in two types of material, then it will have different event rate.

While running Gnrtr will invoke each GenTools it owns, i.e. a real generator, timrator positioner, etc. User needs to specify all these tools for it.

15.2.5 DetSimProc

One of DetSimProc's main functions is to call the real simulation tool Geant4 through its Gaudi interface GiGa. The other important feature is to output each simheader in time order.

Imagine two GenHeaders' times are very close: the first one in time is far away to any PMTs, while the second one is close to one PMT, it is possible that because of the time of light propagation, light from the second event will generate a PMT hit first. The chance of this to happen is small, but it is serious enough to cause whole simulation process to crush and all the following electronic and trigger logic to fail.

DetSimProc asks data input from simulation stage "Kinematic". As promised by stage tool, all the kinematic information out of stage "Kinematic" are in time order, earliest to latest, no violation. Then DetSimProc take this advantage to ensure its output is also in time order. After DetSimProc got a GenHeader to simulate, it finished the detector simulation for that GenHeader first. That is it can know the earliest hit time of this SimHeader. DetSimProc keeps asking GenHeader from its lower stage and doing their detector simulation, until a time comparison test is success. DetSimProc caches all the information of processed GenHeaders and SimHeaders. It compares the earliest time of all SimHeaders and the time of the last GenHeader. When the time of a SimHeader is less than the last GenHeader, it claims safe for output for that SimHeader. Because the causality of event development, since the last GenHeader time is already bigger than the time of a previous SimHeader, any new simulated result SimHeader won't go before this GenHeader, i.e. the previous SimHeader.

15.2.6 ElecSimProc

ElecSimProc maintains a pipeline of SimHits which are sorted by time. Normal geant4 simulated PMT and RPC hits from all kinds of sources are kept in this pipeline.

The first thing to do every time execute ElecSimProc is to find a time gap between two successive hits in this hit pipeline. The size of the gap is determined by DayaBay::preTimeTolerance + DayaBay::postTimeTolerance which should be actually corresponding to the time period where a prepulse or a afterpulse exist. Then in the real electronics simulation, prepulses and afterpulse can be inserted into these places. Certainly as explained in previous sections, when a time gap is found, the time of the gap stop must be less the current time of detector simulation stage. This is the only way to know there won't be any hits from later simulation will fool into this gap.

The chunk of hits before the gap start are packed together and made a new hit collection, then sent to electronic simulation. So hits of all kinds of sources have a chance to mix and overlap. Electronics simulation tools will take over the job and each sub detector will process its part separately.

For each fast simualted MuonProphet muon, a fake hit is created and put into this pipeline. Instead of going into a full eletronics simulation, they are pushed into a fast electronics simulation. They are always 100 percent accepted even they didn't passed trigger. Since they are also in the pipeline, their time is synchronized to the other geant4 simulated hits. User won't obeserve a big delay between fast simulated muon and other events.

15.2.7 TrigReadProc

Trigger simulation and Readout simulation are combined together into one simulation stage, because they all needs input from electronic simulation, i.e. pulses information. In electronic simulation there is no such requirement that only some detector can join the simulation, so in the same way, trigger will work for all required detectors.

In principle the different delay from different electronic channel can flip the time order between different events, however the time gap requirement is at the scale of $10\mu s$. It is believed that the possible time flip caused by electronic simulation will never go beyond that and there is no physics concern in simulating such a effect, so there is no complex time comparison in TrigReadProc.

15.2.8 SingleLoader

Triggers and readouts found in ElecHeader are packed into one SimReadoutHeader. Certainly it is also possible that no trigger is found, since there are many low energy background events. SingleLoader caches all the triggers and readouts and output them one by one. When its own buffer is empty it will automatically ask data from lower stage.

15.2.9 LoadingProc

The only chance that events of different type can overlap and produce some impact is in electronic simulation. Hits from different events which are close in time may not be distinguished in electronics. A correct mixing approaching with pre-simulated sample should happen before it goes into electronic simulation.

Another idea is to re-use some geant4 pre-simulated sample. Like for muon events, it has a high frequency and is extremely time-consuming. We care a lot more about its influence on its adjacent events than its own topology.

LoadingProc is created on this background. It accepts a pre-simulated file, which must contain SimHeaders, as an input stream and output them to Stage Detector tool.

At the same time it can be configured to reset the event rate, i.e. time of the generated events. It also simplify the process if any trigger or electronic simulation parameter needs to be adjusted, since don't have to waste time to redo the longest geant4 simulation.

15.2.10 Algorithm Sim15

Algorithm Sim15 is a simple Gaudi algorithm which is inserted into Gaudi top algorithm list. It runs once every execution cycle. It sends out the initial request for generating MC events.

15.2.11 Customize Your Simulation Job

A General Example

This part will explain how exactly to write your own simulation script with Fifteen package. The example is from dybgaudi/Tutorial/Sim15/aileron/FullChainSimple.py which implements all the basic elements.

```
#!/usr/bin/env python
'''
Configure the full chain of simulation from kinematics to readouts and
with multiple kinematics types mixed together.

usage:
    nuwa.py -n50 -o fifteen.root -m "FullChainSimple -T SingleLoader" > log

    -T: Optional stages are: Kinematic, Detector, Electronic, TrigRead or SingleLoader.

    More options are available like -w: wall clock starting time
                                    -F: time format
                                    -s: seed for IBD generator


    //////
    Aside:
    This is a copy of MDC09b.runIBD15.FullChain, however with less options,
    less generators configured and less truth info saved.
    //////
'''
```

This is the first part of this script. In the first line it declares the running environment. What follows, quoted by "', are a brief introduction of this script and usage of this script. It tells that this script will configure a full chain of simulation. It also includes a command line which can be used right away to start. Before looking into the script it also explains what arguments can be set and what are their options. These arguments will explained later.

Next I will follow the order of how this script is going to be executed in nuwa. Then it will bring us to the end of the script.

```
def configure(argv=[]):
    cfc = ConfigureFullChain(argv)
    cfc.configure()
    return

if __name__ == "__main__":
    configure()
    pass
```

A python script is executable in a shell environment when it has

```
if __name__ == "__main__":
```

Like this FullChainSimple.py, you can directly type FullChainSimple.py in a tcsh or bash see what happens. It is often used to test the configuration needed before running nuwa.

When nuwa is loading a python module it will check whether it has a configure() method. User's gaudi algorithms, services and tools' should go into there. Here an object about Fifteen is created and some parameters "argv" are passed to it. Next we will see some details in Fifteen package configuration.

```
class ConfigureFullChain:
    def __init__(self,argv):
        ...
```

```
    def parse_args(self,argv):
        ...
    def configureKinematic(self):
        ...
    def configureDetector(self):
        ...
    def configureElectronic(self):
        ...
    def configureTrigRead(self):
        ...
    def configureSingleLoader(self):
        ...
    def configureSim15(self):
        ...
    def configure(self):
        ...
```

Now all the details are stripped out, and only the skeleton are left. "..." indicates the real working code are omitted for a second. A class ConfigureFullChain is defined.

```
__init__(self,argv)
```

is always called when a data object is created. The useful interface invoked by nuwa will be $configure(self)$. Note don't confuse with the $configure(argv = [])$ mentioned previously.

Apparently it has configure functions for Kinematic, Detector, Electronic, TrigRead, SingleLoader simulation stages. It also can handle some parameters to be more user friendly in $parse_args$. The configureSim15 will create an algorithm called Sim15 which is the diver of the simulation job. Algorithm Sim15 sits on the top of all the simulation stages asking output.

Stage tools are firstly set up in the following.

```
def configure(self):

    from Stage import Configure as StageConfigure
    self.stage_cfg = StageConfigure()

    stagedic={'Kinematic':1,'Detector':2,'Electronic':3,'TrigRead':4,'SingleLoader':5}
...

     if stagedic[self.opts.top_stage]>=1:
        self.configureKinematic()
     if stagedic[self.opts.top_stage]>=2:
        self.configureDetector()
    if stagedic[self.opts.top_stage]>=3:
        self.configureElectronic()
     if stagedic[self.opts.top_stage]>=4:
        self.configureTrigRead()
    if stagedic[self.opts.top_stage]>=5:
        self.configureSingleLoader()

     self.configureSim15()
```

According to the top simulation stage all required lower stage tools are created. For example if top stage is set to be Detector, then only stage tool Kinematic and Detector will be added. In the end the algorithm Sim15 is configured. Correspondingly Sim15 will ask data from stage tool Detector.

Next we will see the configuration of Gnrtr. In this example two generators, IBD and K40 are added to work at the same time.

```
def configureKinematic(self):
    #IBD
    from Gnrtr.IBD import EvtGenerator
    # from IBD import EvtGenerator
    ibd_gds = EvtGenerator(name     = 'IBD_gds',
                           seed     = self.opts.seed,
                           volume   = '/dd/Structure/AD/db-oil1',
                           strategy = 'Material',
                           material = 'GdDopedLS',
                           mode     = 'Uniform',
                           lifetime = 78.4*units.second, #daya bay site
                           wallTime = self.start_time_seconds)

    ibd_gds.ThisStageName = "Kinematic"
    self.stage_cfg.KinematicSequence.Members.append( ibd_gds )

 from Gnrtr.Radioact import Radioact
    #K40
    k40_gds = Radioact(name       = 'K40_gds',
                       volume     = '/dd/Structure/AD/db-oil1',
                       nuclide    = 'K40',
                        abundance  = 3.01e17,
                       strategy   = 'Material',
                       material   = 'GdDopedLS',
                        start_time = self.start_time_seconds)

     k40_gds.ThisStageName = "Kinematic"
    self.stage_cfg.KinematicSequence.Members.append( k40_gds )
```

Basically only one line command is needed to specify one type of event. In the end their stage names are all assigned to be "Kinematic" and it generator algorithms are also added to stage tool Kinematic. i.e. the connection between stage tool and processors are built up. For details about generators' configuration user can refer to previous sections, and they also need to have the knowledge of detector geometry and material.

```
def configureDetector(self):
    '''Configure the Detector stage'''

    import DetSim
    ds = DetSim.Configure(physlist=DetSim.physics_list_basic+DetSim.physics_list_nuclear,
                          site="dayabay",
                          use_push_algs = False)

    # QuantumEfficiency*CollectionEfficiency*QEScale = 0.24*1/0.9
    from DetSim.DetSimConf import DsPhysConsOptical
     optical = DsPhysConsOptical()
     #optical.UseScintillation = False
    optical.CerenPhotonScaleWeight = 3.5
    #optical.UseCerenkov = False
    optical.ScintPhotonScaleWeight = 3.5

     from DetSimProc.DetSimProcConf import DetSimProc
    dsp = DetSimProc()
    dsp.ThisStageName = "Detector"
     dsp.LowerStageName = "Kinematic"
     #dsp.OutputLevel = 2
     self.stage_cfg.DetectorSequence.Members.append(dsp)

     ds.historian(trackSelection="(pdg == 2112)",vertexSelection="(pdg == 2112)")
```

```
    return
```

The above example shows how detector simulation part is configured. Usually DetSim works in a normal gaudi manner, here the option $use_push_algs = False$ will stop adding its to top algorithm list. The lines assigning stage names, lower stage and this stage, tells where the input data is from, and what the current stage is. Then this DetSimProc algorithm was added to the stage tool Detector.

In the rest the physics list is customized and both cerenkov and scintillation light are pre-scaled. From this example and the above one for generator it is already very obvious that Fifteen package just uses the simulation tools as others. It doesn't create another set of tools. All setting of them can be directly moved to here.

Next we will see how electronic simulation is set up.

```
def configureElectronic(self):
    '''Configure the Electronics stage'''

    import ElecSim
    es = ElecSim.Configure(use_push_algs = False)

 from ElecSimProc.ElecSimProcConf import ElecSimProc
    esp = ElecSimProc()
    esp.ThisStageName = "Electronic"
 esp.LowerStageName = "Detector"
 #esp.OutputLevel = 2
    self.stage_cfg.ElectronicSequence.Members.append(esp)

    from ElecSim.ElecSimConf import EsIdealFeeTool
 feetool = EsIdealFeeTool()
     feetool.EnableNonlinearity=False

 return
```

There is nothing new here regarding about Fifteen package configuration, except that name of this stage is "Electronic" and lower stage is "Detector". The simulation chain is setup in this way.

Here a non-linearity option is turn off to demonstrate how to configure the real working tool.

For completeness the configuration of TrigReadProc and SingleLoader are included.

```
def configureTrigRead(self):
    '''Configure the Trigger and Readout stage'''
    from TrigReadProc.TrigReadProcConf import TrigReadProc
 tsp = TrigReadProc()
 tsp.ThisStageName = "TrigRead"
    tsp.LowerStageName = "Electronic"
    #tsp.TrigTools = [...]
    #tsp.RoTools = [...]
    #tsp.OutputLevel = 2
    self.stage_cfg.TrigReadSequence.Members.append(tsp)
    return

def configureSingleLoader(self):
    '''Configure the SingleLoader stage'''
    from SingleLoader.SingleLoaderConf import SingleLoader
    sll = SingleLoader()
    sll.ThisStageName = "SingleLoader"
    sll.LowerStageName = "TrigRead"
    #sll.OutputLevel = 2
    self.stage_cfg.SingleLoaderSequence.Members.append(sll)
```

In the end the top pulling algorithm Sim15 is added to gaudi top algorithm list. Its only job is to bring up the initial request from top stage tool.

```
def configureSim15(self):
    from Stage.StageConf import Sim15
    sim15=Sim15()
    sim15.TopStage=self.opts.top_stage

 from Gaudi.Configuration import ApplicationMgr
    theApp = ApplicationMgr()
    theApp.TopAlg.append(sim15)
```

Example for LoadingProc

LoadingProc is another input stream for SimHeader. So the configuration of LoadingProc should be a replacement for configureDetector in the above example. A working example can be found in Fifteen/LoadingProc/aileron/testAll.py

Here the configuration after stage Detector will not be repeated. Only the part for LoadingProc is shown. In that example two input files are specified. Each one is set to a new start time and a new event rate. Details are shown below. As usual the chain of simulation line are set up and input file are specified as expected.

```
def configureLoadingProc(self):
    from LoadingProc.LoadingProcConf import LoadingProc
    load = LoadingProc("LoadingProc.Oxygen18")
    load.StartSec = 0
    load.StartNano = 0
    #load.Distribution = "Exponential"
    load.Distribution = "Periodic"
    load.Rate = 1.0
    assembler_name = "Ox18Assem"
 load.HsAssembler = assembler_name
    load.OutputLevel = 2
     assem = Assembler(toolname = assembler_name,
                       filename = "input.root")

    # This and lower stage
    load.ThisStageName = "Detector"
    load.LowerStageName = ""
 # Add this processor to Gaudi sequencer
    self.stage_cfg.DetectorSequence.Members.append(load)
    return
```

15.2.12 Reminders and Some Common Errors

AES must be used to use Fifteen to generate simulation sample. The number of events specified on the command line is the number of execution cycles. If asking readout as the final output, then the initial number of GenHeader varies depending on trigger efficiency.

CHAPTER

SIXTEEN

RECONSTRUCTION

CHAPTER

SEVENTEEN

DATABASE

17.1 Database Interface

This chapter is organized into the following sections.

Concepts is an introduction to the basic concepts behind the DatabaseInterface. You can skip this section if you are in a hurry, but reading it will help you understand the package.

Installing and Running provides a few tips on building running programs that use the DatabaseInterface.

Accessing Existing Tables tells you how you write code to retrieve data from existing tables.

Creating New Tables describes how new tables are added to the database and the corresponding classes, that serve the data, are designed.

Filling Tables explains how new data is added to existing tables in the database.

MySQL Crib gives the bare minimum necessary to use MySQL to manage a database. The DatabaseInterface runs directly on top ROOT under which MySql and flat ASCII files are used to implement a hierarchical database.

17.2 Concepts

17.2.1 Types of Data

Besides the data from the detector itself, off-line software requires additional types of data. Some possible examples:

Detector Description i.e. data that describes the construction of the detector and how it responds to the passage of particles through it. The geometry, the cabling map and calibration constants are all examples of this type of data.

Reactor Data i.e. reactor power, fuel makeup, or extrapolated neutrino spectra

Physics Data i.e. cross-section tables, optical constants, etc.

It is the purpose of the DatabaseInterface to provide simple and efficient access to such data and to provide a framework in which new types of data can be added with minimal effort.

17.2.2 Simple, Compound and Aggregated

Within the database, data is organised into tables. When the user requests data from a table, the DatabaseInterface collect rows of data from the appropriate table. From the perspective of the interface, there are 3 types of organisation:-

Simple A single row is retrieved. Algorithm Configuration data is always simple; even if multiple configurations are possible, only one can be selected at a time. Detector Description, on the other hand, is almost never Simple.

Compound Multiple rows are retrieved. Each row represents a single sub-system and the request retrieves data for a complete set of sub-systems. For example a request for PMT positions will produce a set of rows, one for each PMT.

Aggregated A special form of Compound depending on the way new data is added to the database:-

- **If data for the entire detector is written as a single logical block, then it** is Compound. A table that describes the way PMTs to electronics channels might be compound: a complete description is written as a single unit
- **If it is written in smaller chunks (called aggregates) then it is Aggregated.**

  For example, it might be possible to calibrate individual electronics cards independently of the rest of the detectors at on sit. When calibrated, you will want to update only a subset of the calibrations in the database. One of the jobs of the interface is to reassemble these aggregates so that the user only ever sees a complete set.

  There are two types of aggregation:-

  Complete In this type the number of aggregates present at any time is constant, with the possible exception of detector construction periods during which the number increases with time. This is the normal form and is used to describe a set of sub-systems that are permanently present e.g. the set of steel planes.

  Sparse In this type the number of aggregates present at any time is variable, there could even be none. This form is used to describe abnormal conditions such as alarms.

17.2.3 Tables of Data

The DatabaseInterface provides a simple, uniform concept regardless of the data being accessed. Each request for data produces a pointer giving read access to a results table, which is effectively a slice of the underlying database table. Each row of the results table is an object, the type of which is table-specific. These table row objects give access to the data from one row but can hide the way the database table is organised. So changes to the physical layout of a database table should only effect its table row object, not the end users of the data. Note that a single request only ever accesses a single table; the interface does not support retrieval of data from multiple database tables simultaneously.

If the request for data fails for some reason, then the resulting table will be empty, otherwise it will have a single row for Simple organisation and more than one row for Compound and Aggregated. The user can ask how many rows the table has and can directly access any of them. The physical ordering of the rows in the table reflects the way the data was originally written, so for Aggregated data, the ordering is not optimised for retrieval. To deal with this, each table row object can declare a natural index, independent of its physical position, and this natural index can be used to retrieve data.

17.2.4 A Cascade of Databases

The DatabaseInterface can access data for more than one database. During initialisation it is given a list of database URLs. The list order reflects priority; the interface first looks for data in the first database in the list, but if that fails, tries the others in turn until all have been tried or data is found. This scheme allows a user to override parts of the official database by creating a mini-database with their own data and then placing it in the list ahead of the official database. The concept of a set of overlaying databases is called a cascade.

17.2.5 Context Sensitive

In principle, any of the data retrieved by the interface could depend on the the current event being processed. Clearly Detector Descriptions, such as calibration constants, will change with time and the interface has to retrieve the right

ones for the current event. For this reason, all requests for data through the interface must supply information about the:-

- The type of data: real or Monte Carlo.
- The site of the detector: Daya Bay, Ling Ao, Mid, Far, or Aberdeen
- The date and times of the event.

Collectively this information is called the *Context* and is represented by the `Context` class of the Context package. Note that in common with event data and times

---

Note: All Database date and times are in UTC.

In the database all data is tagged by a *Context Range* which identifies the types of data and detector and the ranges of date times for which it is valid. This is represented by the `C`ontextRange class of the Context package. Some data is universal; the same database data can be used for any event. Others may be very specific to a single type of data and detector and a limited date time range.

Note that the Context Range of the data defines the context at for which the data will be accessed, NOT where data is generated. For example, reactor data will be associated with all detector sites, not assigned to a reactor site.

Physically, the way to associate the Context Range metadata with the actual data is to have a pair of tables:-

Context Range Table This table consists of rows of ContextRange objects, each with a unique sequence number which is used as a key into the Main Data Table.

Main Data Table Each row has a sequence number corresponding to an entry in the Context Range Table.

The interface first finds a match in the Context Range Table for the current context and then retrieves all rows in the Main Data Table that match its sequence number. The reasons for this two step approach are:-

- To simplify the task of Context Management.
- To avoid repeated data. For Compound and Aggregated data, many rows can share a single Context Range. So this range only appears once and only a simple sequence number has to be repeated in the main table.

17.2.6 Extended Context

The primary function of DatabaseInterface is to provide the best information for a specific context, but it can also retrieve information for much more general queries. The query is still broken into two parts: the "context" which is matched to the Context Range Table and then the data from the main table is taken for the selected sequence number(s). However the user can supply a context such as "All ranges that start between this time and that time" hence the term "Extended Context". Further, during the retrieval of data from the main table addition restrictions can be imposed. The result of an Extended Context query is a collection of rows that will not normally represent the state of the detector at a single moment in time and it is up to the user to interpret the results meaningfully. However, it does allow the user the power of raw SQL queries.

17.2.7 SimFlag Association

As explained in the preceding section, the interface finds the database data that best matches the context of the data. There are occasions when this matching needs to be changed, for example there can be times when Monte Carlo data needs to be treated exactly as if it were event data and this includes the way it retrieves from the database. To support this the user can specify, for any type of data, an associated list of data types. If this is done then, instead of using the current type, each of the alternative types are tried until a match is found. This matching takes precedence over the cascade i.e. all associated types are tried on the first database in the cascade before moving on to the second and subsequent cascade members. This ensures that higher members, which might even refer back to the ORACLE database at FNAL, are only tried as a last resort.

17.2.8 Authorising Databases and Global Sequence Numbers

As explained in the previous section, sequence numbers in the Context Range Table are unique. However this can present a problem if the same type of data is being entered into several different databases. For example calibration constants will be created in the Near, Far and Calibration detectors. Eventually the tables will be merged but it is essential that there is no conflict in the sequence numbers. To solve this problem, certain databases are special: they are able to produce globally unique sequences numbers. They do this as each is allocated a unique block of 10,000,000 sequence numbers (which is enough to allow a new entry to be made every minute for 20 years!). These blocks are recorded in a special table: `GLOBALSEQNO` that holds the last used sequence number for each table. The block 1..9,999,999 is used for local sequence numbers i.e. ones that are only guaranteed unique within the current database table.

By default permanent data written to an authorising database will be written with global sequence numbers. For temporary data, or if writing to a non- authorising database, local sequence numbers are used and in this case a `LOCALSEQNO` table is generated automatically if required.

Important:-

Note: Merging database tables that have local sequence numbers will require a special procedure to avoid conflicts.

Note: `GLOBALSEQNO` and `LOCALSEQNO` tables must never be propagated between databases.

17.2.9 Validity Management

For constants that change with time (if that is not a contradiction in terms!) it makes sense to have overlapping Context Ranges. For example, suppose we know that a certain sort of calibration constants drifts with time and that, once determined, is only satisfactory for the next week's worth of data. A sensible procedure would be to limit its validity to a week when writing to the database but to determine new constants every few days to ensure that the constants are always "fresh" and that there is no danger that there will be a gap. However, this means that the interface has to perform two types of Validity Management:-

Ambiguity Resolution When faced with two or more sets of data the interface has to pick the best. It does this simply by picking the one with the latest creation date time.

Context Range Trimming Having found the best set, the interface wants to know how long it will remain the best. Any set whose creation date is later will be better according to the above rule and so the retrieved data has its range trimmed so as not to overlap it. This reduced Context Range is called the *Effective Context Range*. This only happens in memory; the database itself is not modified, but it does mean that the interface does not need to check the database again for this set of data until the Effective Context Ranges has expired. This trimming also applies between databases in a cascade, with sets in higher priority databases trimming those in lower ones.

Overlay Version Dates As explained above, creation dates play a crucial role in resolving which set of data to use; later creation dates take priority over earlier ones. This scheme assumes that constants from earlier runs are created before constants from later runs, but this isn't always true. When improving e.g. calibration constants, it's quite normal to recalibrate recent runs before going back and fixing earlier ones and then, simply to use the date when the constants were created would mean that the constants from earlier runs would take priority over any later runs they overlapped. To allow constants to be created in any order the interface provides a system for deducing the best creation dates for any constants as follows:-

- **A query is made using as the context, the start of the validity for the new** constants.
- **If the query finds no data, the creation date of the new constants is set to** its validity start date.
- **If the query finds data, the creation date of the new data is set to be 1**

  minute greater than the creation date of the found data i.e. just late enough to replace it.

The scheme means that creation dates always follow that dates of the runs that they correspond to rather than the dates when their constants were created. When using the scheme its probably better to consider the "dates" to be version numbers.

17.2.10 Rollback

The database changes almost constantly to reflect the state of the detector, particularly with regard to the calibration constants. However this can mean that running the same job twice can produce different results if database updates that have occurred between the two runs. For certain tasks, e.g. validation, its necessary to decouple jobs from recent updates and this requires database rollback i.e. restoring the database to a previous state. Rollback works by exploiting the fact that data is not, in general, ever deleted from the database. Instead new data is added and, by the rules of Ambiguity Resolution (see the previous section) supersede the old data. All data is tagged by the date it was inserted into the local database, so rollback is implemented by imposing an upper limit on the insertion date, effectively masking out all updates made after this limit.

17.2.11 Lightweight Pointers to Heavyweight Data

One of the interface's responsibilities is to minimise I/O. Some requests, particularly for Detector Configuration, can pull in large amounts of data but users must not load it once at the start of the job and then use it repeatedly; it may not be valid for all the data they process. Also multiple users may want access to the same data and it would be wasteful for each to have their own copy.

To deal with both of the above, the interface reuses the concept of a handle, or proxy, that appears in other packages such as Candidate. The system works as follows:-

1. When the user wants to access a particular table they construct a table- specific pointer object. This object is very small and is suitable to be stack based and passed by value, thus reducing the risk of a memory leak.
2. During construction of the pointer, a request for data is passed down through the interface and the results table, which could be large, is created on the heap. The interface places the table in its cache and the user's pointer is attached to the table, but the table is owned by the interface, not the user.
3. Each request for data is first sent to the cache and if already present then the table is reused.
4. Each table knows how many user pointers are connected to it. As each pointer is discarded by its owner, it disconnects itself from the table it points to.
5. Once a table has no pointers left it is a candidate for being dropped by its cache. However this is not done at once as, between events, there are likely to be no user pointers, so just because a table is not currently being pointed to, it doesn't mean that it won't be needed again.

17.2.12 Natural Table Index

For Detector Description data, tables can be large and the user will require direct access to every row. However, the way the table is arranged in memory reflects the way the data was originally written to the database. For Simple and Compound data the table designer can control this organisation as complete sets are written as a single unit. For Aggregated data, the layout reflects the way aggregates are written. This allows the interface to replace individual aggregates as their validity expires. However this means that the physical layout may not be convenient for access. To deal with this table row objects, which all inherit from `DbiTableRow` are obliged to return a Natural Table Index, if the physical ordering is not a natural one for access. Tables can then be accessed by this index.

17.2.13 Task

Task will provide a way to further select the type of data retrieved. For example:-

- There might be nominal set of geometry offsets, or a jittered geometry to test for systematic effects.
- Detector Configuration data could have two tasks, one for raw calibration and another for refined calibration.

The aim is that Task will allow a particular database table to be sub-divided according to the mode of use. Currently Task is a data type defined in Dbi i.e. `Dbi::Task` and is implemented as an integer. The default value is zero.

17.2.14 Sub-Site

Sub-Site can be used like the Task to disambiguate things at a single site. For example, this can be used to distinguish between antineutrino detector modules, between electronics crates, etc.

Currently SubSite is a data type defined in Dbi i.e. `Dbi::SubSite` and is implemented as an integer. The default value is zero.

17.2.15 Level 2 (disk) Cache

Loading a large table from the database is a lot of work:-

1. The query has to be applied and the raw data loaded.
2. The row objects have to be individually allocated on the heap.
3. Each data word of each row object has to be individually converted through several layers of the support database software from the raw data.

Now as the detector configuration changes slowly with time identically the same process outlined above is repeated many times, in many jobs that process the data, so the obvious solution is to cache the results to disk in some way that can be reloaded rapidly when required. The technique essentially involves making an image copy of the table to disk. It can only be applied to some tables, but these include the Calibration tables which represent the largest database I/O load, and for these tables loading times can be reduced by an order of magnitude.

17.3 Running

17.3.1 Setting up the Environment

The interface needs a list of Database URLs, a user name and a password. This was previously done using envvars `ENV_TSQL_URL`, `ENV_TSQL_USER`, `ENV_TSQL_PSWD` that directly contained this configuration information. As this approach resulted in the configuration information being duplicated many times a new DBCONF approach has now been adopted.

The DBCONF approach is based on the standard mysql configuration file `HOME/.my.cnf` which has the form :

```
[testdb]

host = dybdb1.ihep.ac.cn
user = dayabay
password = youknowit
database = testdb

[dyb_cascade]
host = dybdb1.ihep.ac.cn
user = dayabay
password = youknowit
database =
```

```
db1 = offline_db
db2 = dyb_temp
```

Typical configurations can be communicated via the setting of a single environment variable DBCONF that points to a named section in the configuration file. Other envvars can also be used to change the default behaviour allowing more complex configurations such as cascades of multiple databases to be configured.

envvar	default	notes
DBCONF		name of section in config file
DBCONF_URL	mysql://%(host)s/%(database)s	
DBCONF_USER	%(user)s	
DBCONF_PSWD	%(password)s	
DBCONF_HOST	%(host)s	
DBCONF_DB	%(database)s	
DBCONF_PATH	/etc/my.cnf:$SITEROOT/../.my.cnf:/.my.cnf	list of config file paths

The defaults are python patterns that are filled in using the context variables obtained from the section of the config

The meanings are as follows.

DBCONF_PATH Colon delimited list of paths (which can include envvars such as $SITEROOT and the home directory tilde symbol). Non-existing paths are silently ignored and sections from the later config files override sections from prior files. Using the default paths shown in the table allows the system administrator to manage config in /etc/my.cnf which is overridden by the dybinst administrator managed $SITEROOT/../.my.cnf.

Users only need to create their own config file in HOME/.my.cnf if they need to override the standard configuration.

DBCONF_URL This is a semi-colon separated list of URLs. Each URL takes the form:-

```
protocol://host[:port]/[database][?options]
where:
   protocol - DBMS type , e.g. mysql etc.
   host - host name or IP address of database server
   port - port number
   database - name of database
   options - string key=value's separated by ';' or '&'
 Example:
 "mysql://myhost:3306/test?Trace=Yes;TraceFile=qq.log"
```

DBCONF_USER Pattern that yields database user name. Only needs to be set if you require different names for different databases in the cascade then this can be a semi- colon separated list in the same order as DBCONF_URL. If the list is shorter than that list, then the first entry is used for the missing entries.

DBCONF_PSWD Pattern that yields database password. As with DBCONF_USER it can be a semi-colon separated list with the first entry providing the default if the list is shorter than DBCONF_URL. It only needs to be set if you require different passwords for the different databases in a cascade. Security risks are avoided by never using actual passwords in this envvar but rather using a pattern such as %(pass1)s;%(pass2)s that will be filled in using the parameters from the config file section identified by DBCONF. Setting it to null will mean that it will be prompted for when the interface initializes.

These variable should be set for the standard read-only configuration. These variables can be trivially overridden for specific jobs by resetting the environment variables in the python script:

Note that using setdefault allows the config to be overridded without editing the file

```
import os
os.environ.setdefault('DBCONF','dyb_offline')
print 'Using Database Config %s ' % os.environ['DBCONF']
```

For framework jobs when write-access to the database is required, or other special configuration is desired a less flexible approach is preferred. With a comment pointing out that some special configuration in /.my.cnf is required. Be careful not to disclose real passwords; passwords do not belong in repositories.

```
"""
    NB requires section of ~/.my.cnf

    [dyb_offline]
    host = dybdb1.ihep.ac.cn
    user = dayabay
    password = youknowit
    db1 = dyb_offline
    db2 = dyb_other

"""
import os
os.environ['DBCONF'] = 'dyb_offline'
os.environ['DBCONF_URL'] = 'mysql://%(host)s/%(db1)s;mysql://%(host)s/%(db2)s'
print 'Using Database Config %s ' % os.environ['DBCONF']
```

17.3.2 Configuring

The database can be configured through a Gaudi Service before starting your job.

Once the job is running you can configure the DatabaseInterface via the DbiSvc:

```
from gaudimodule import *
theApp = AppMgr()
theApp.Dlls += ['Conventions']
theApp.Dlls += ['Context']
theApp.Dlls += ['DatabaseInterface']
theApp.createSvc('DbiSvc')

dbisvc = theApp.service('DbiSvc')
dbisvc.<property>=<newvalue>
dbisvc.<property>=<newvalue>
...
```

Rollback

To impose a global rollback date to say September 27th 2002:-

```
theApp.service('DbiSvc').RollbacDates ='* = 2002-09-27 00:00:00'
```

This will ensure that the interface ignores data inserted after this date for all future queries. The hours, minutes and seconds can be omitted and default to 00:00:00.

Rollback can be more selective, specifying either a single table or a group of tables with a common prefix. For example:-

```
theApp.service('DbiSvc').RollbackDates ='*          =  2002-09-01';
theApp.service('DbiSvc').RollbackDates ='Cal*       =  2002-08-01'
theApp.service('DbiSvc').RollbackDates ='CalPmtGain =  2002-07-01'
```

Now the table CalPmtGain is frozen at July 2002, other Cal tables at August and all other tables at September. The ordering of the commands is not important; the interface always picks the most specific one to apply to each table.

> *Rollback only applies to future queries, it does not invalidate any existing query result in the cache which are still available to satisfy future requests. So impose rollback conditions at the start of the program to ensure they apply consistently.*

MakeConnectionsPermanent

By default the DatabaseInterface closes connection to the database between queries, to minimise use of resources - see section *Holding Open Connections*. If the job is doing a lot of database I/O, for example creating calibration constants then this may degrade performance in which case all connections can be made permanent by:-

```
theApp.service('DbiSvc').MakeConnectionsPermanent='true'
```

Ordering Context Query Results

By default when the DatabaseInterface retrieves the data for a Context Query, it does not impose an order on the data beyond requiring that it be in sequence number order. When an ordering is not imposed, the database server is under no obligation to return data in a particular order. This means that the same job running twice connected to the same database could end up with result sets that contain the same data but with different ordering. Normally this doesn't matter, the ordering of rows is not significant. However, results from two such jobs may not be identical as floating point calculations can change at machine level precision if their ordering is changed. There are situations where it is required that the results be identical. For example:-

- When bug hunting.
- When checking compatibility between two databases that should be identical.

and for such occasions it is possible to completely specify the ordering of rows within a sequence number by forcing sub-ordering by ROW_COUNTER, a column that should be present in all Main Data tables:-

```
theApp.service('DbiSvc').OrderContextQuery='true'
```

Level 2 Cache

Enabling the Level 2 Cache allows certain large tables query results to be written to disk from which they can be reloaded by subsequent jobs saving as much as an order of magnitude in load time. Data in the cache will not prevent changes in the database from taking affect for the DatabaseInterface does an initial (lightweight) query of the database to confirm that the data in the cache is not stale. To enable the cache, the user specifies a directory to which they have read/write access. For example, to make the current working directory the cache:-

```
theApp.service('DbiSvc').Level2Cache='./'
```

Cache files all have the extension .dbi_cache. Not all tables are suitable for Level 2 caching; the DatabaseInterface will only cache the ones that are.

Cache files can be shared between users at a site to maximise the benefit. In this case the local Database Manager must set up a directory to which the group has read/write access. Management is trivial, should the cache become too large, it can simply be erased and then the next few jobs that run will re- populate it with the currently hot queries.

Note that Cache performance is achieved by doing raw binary I/O so the cache files are platform specific, so if running in a heterogeneous cluster the Database Manager should designate a platform specific directory. To simplify this, the name of the directory used by the cache can include environmental variables e.g.:-

```
theApp.service('DbiSvc').Level2Cache='$DBI_L2CACHE'
```

Output Level

The verbosity of the error log from the DatabaseInterface can be controlled by:

```
theApp.service('DbiSvc').OutputLevel = 3
```

The output levels are standard Gaudi levels.

17.4 Accessing Existing Tables

17.4.1 Introduction

To access database data, the user specifies the database table to be accessed and supplies a "context" for the query. The context describes the type and date time of the current event. This is stored in a Context package `Context` object.

FIXME Need a description here of how to get a Context from a Data Model object.

It should be something like:

```
Context   GetContext() const
```

methods to get their context. The DatabaseInterface uses the context to extract all the rows from the database table that are valid for this event. It forms the result into a table in memory and returns a object that acts like a pointer to it.

> *You are NOT responsible for deleting the table; the Database Interface will do that when the table is no longer needed*

You have random access to any row of the results table. Each row is an object which is specific to that table. The key to understanding how to get data from a database table is study the class that represent a row of it results table.

17.4.2 Accessing Detector Descriptions

Making the Query

As explained above, the key to getting data is to locate the class that represents one row in a database table. To understand how this all works look at one of the sample tables included in the DbiTest package and imaginatively called `DbiDemoData1, DbiDemoData2` and `DbiDemodata3`. For purposes of illustration we will pick the first of these. Its header can be found in:-

```
DbiTest/DbiDemoData1.h
```

To make a query you create a `DbiResultPtr` object. Its header can be found in:-

```
DatabaseInterface/DatabaseInterface/DbiResultPtr.h
```

This is a class that is templated on the table row class, so in this case the instantiated class is:-

```
DbiResultPtr<DbiDemoData1>
```

and to instantiate an object of this class you just need a `Context` object. Suppose vc is such an object, then this creates the pointer:-

```
DbiResultPtr<DbiDemoData1> myResPtr(vc);
```

This statement creates a DbiResultPtr for DbiDemoData1 class. First it searches through the database for all DbiDemoData1 objects that are valid for vc, then it assembles them into a table and finally passes back a pointer to it. Not bad for one statement! The constructor can take a second argument:-

```
DbiResultPtr(Context vc,Dbi::SubSite subsite=0,Dbi::Task task=0);
```

Dbi::SubSite is an optional parameter that sub-divides a table to select a specific component at a given detector Site, e.g. an antineutrino detector.

Dbi::Task offers a way to sub-divided a table according to the mode of operation. For example a Detector Configuration data could have two modes, one for raw calibration and another for refined calibration.

If the concept of a subsite or task is not relevant for a particular database table, then the parameter should be left at its default value of 0. Otherwise data should be allocated a unique positive number and then selection will only pick rows with the required value of task.

The constructor can take further arguments which can normally be left at their default values - a `Dbi::AbortTest` see section *Error Handling* and a `Bool_t findFullTimeWindow` see section *Truncated Validity Ranges*.

Accessing the Results Table

Having got a pointer to the table the first thing you will want to know is how many rows it has. Do this using the method:-

```
UInt_t GetNumRows() const;
```

If the query failed then the number of rows returned will be zero. This could either be the result of some catastrophic failure, for example the database could not be opened, or simply that no appropriate data exists for the current event. If you want to know which of these it is you can use the:-

```
const DbiValidityRec* GetValidityRec() const;
```

If this returns a null pointer, then the failure was a major one, see *Error Logging*. If not then the `DbiValidityRec` tells you about the validity of the gap. Its method:-

```
const ContextRange& GetContextRange() const;
```

returns a Context package `ContextRange` object that can yield the start and end times of the gap. Due to the way the DatabaseInterface forms the query, this may be an underestimate, but never an overestimate.

If the table has rows then the GetContextRange() will give you an object that tells you the range of the data. Again, the range may be an underestimate. To get to the data itself, use the method:-

```
const T* GetRow(UInt_t i) const;
```

where T = DbiDemoData1 in this case. This gives you a const pointer to the ith row where i is in the range $0 <= i <$ GetNumRows().

FIXME Need complete example here including DataModel object.

Putting this all together, suppose you have a `CandDigitListHandle` object cdlh, and you want to loop over all `DbiDemoData1` objects that are valid for it, the code is:-

```
DbiTest/DbiDemoData1.h
DatabaseInterface/DbiResultPtr.h

...
```

```
DbiResultPtr<DbiDemoData1> myResPtr(cdlh.GetContext());

for ( UInt_t irow = 0; irow < myResPtr.GetNumRows(); ++ires) {
  const DbiDemoData1* ddd1 = myResPtr.GetRow(irow);

// Process row.

}
```

GetRow is guaranteed to return a non-zero pointer if the row number is within range, otherwise it returns zero. The ordering of rows reflects the way the data was written to the database. For some types of data this layout is not well suited for access. For example, for pulser data, all the strip ends illuminated by an LED will appear together in the table. To deal with this table row object are obliged to return a Natural Table Index, if the physical ordering is not a natural one for access. You get rows from a table according to their index using the method:-

```
const T* GetRowByIndex(UInt_t index) const;
```

You should always check the return to ensure that its non-zero when using this method unless you are absolutely certain that the entry must be present.

Getting Data from a Row

Having got to the table row you want, the last job is to get its data. Its up to the table row objects themselves to determine how they will present the database table row they represent. In our example, the `DbiDemoData1` is particularly dumb. Its internal state is:-

```
Int_t    fSubSystem;
Float_t  fPedestal;
Float_t  fGain1;
Float_t  fGain2;
```

which it is content to expose fully:-

```
  Int_t GetSubSystem() const { return fSubSystem; }
Float_t GetPedestal() const { return fPedestal; }
Float_t GetGain1() const { return  fGain1; }
Float_t GetGain2() const { return fGain2; }
```

Its worth pointing out though that it is the job of the table row object to hide the physical layout of the database table and so shield its clients from changes to the underlying database. Its just another example of data encapsulation.

Making Further Queries

Even though a `DbiResultPtr` is lightweight it is also reusable; you can make a fresh query using the `NewQuery` method:-

```
UInt_t NewQuery(Context vc, Dbi::Task task=0);
```

which returns the number of rows found in the new query. For example:-

```
DbiResultPtr<DbiDemoData1> myResPtr(vc);
...
Context newVc;
...
myResPtr.NewQuery(newVc);
...
```

Having made a query you can also step forwards or backwards to the adjacent validity range using the method:-

```
UInt_t NextQuery(Bool_t forwards = kTRUE);
```

supply a false value to step backwards. This method can be used to "scan" through a database table, for example to study calibration constants changes as a function of time. To use this efficiently you need to request accurate validity ranges for your initial query, although this is the default see section *Truncated Validity Ranges*. For aggregated data stepping to a neighbouring range will almost certainly contain some rows in common unless all component aggregates have context ranges that end on the boundary you are crossing. See the next section for a way to detect changes to data using the `DbiResult::GetID()` method.

Simple Optimisation

The first, and most important, level of optimisation is done within the DatabaseInterface itself. Each time it retrieves data from the database it places the data in an internal cache. This is then checked during subsequent queries and reused as appropriate. So the first request for a large table of calibration constants may require a lot of I/O. However the constants may remain valid for an entire job and in which case there is no further I/O for this table.

Although satisfying repeat requests for the same data is quick it still requires the location of the appropriate cache and then a search through it looking for a result that it is suitable for the current event. There are situations when even this overhead can be a burden: when processing many rows in a single event. Take for example the procedure of applying calibration. Here every digitization needs to be calibrated using its corresponding row in the database. The naive way to do this would be to loop over the digits, instantiating a `DbiResultPtr` for each, extracting the appropriate row and applying the calibration. However it would be far more efficient to create a little calibration object something like this:-

```
class MyCalibrator {
public:
  MyCalibrator(const Context vc): fResPtr(vc) {}
  Float_t Calibrate(DataObject& thing) {
     /*  Use fResPtr to calibrate thing  */
}

private
  DbiResultPtr<DbiDemoData1> fResPtr;
};
```

`MyCalibrator` is a lightweight object holding only a pointer to a results table. It is created with a `Context` object which it uses to prime its pointer. After that it can be passed `DataObject` objects for which it returns calibrated results using its Calibrate method. Now the loop over all digitizations can use this object without any calls to the DatabaseInterface at all. Being lightweight `MyCalibrator` is fine as a stack object, staying in scope just long enough to do its job.

Another optimisation strategy involves caching results derived from a query. In this case it is important to identify changes in the query results so that the cached data can be refreshed. To aid this, each `DbiResult` is given an key which uniquely identifies it. This key can be obtained and stored as follows:-

```
DbiResultKey MyResultKey(myResPtr.GetKey());
```

This should be stored by value (the DbiResultKey pointed to by GetKey will be deleted when the results expire) as part of the cache and checked each time a change is possible:-

```
if ( ! MyResultKey.IsEqualTo(myResPtr.GetKey()) ) {

  // recreate the cache data ...

  MyResultKey = *myResPtr.GetKey();
}
```

Caution: This tests to see that the current `DbiResult` has exactly the same data as that used when the cached was filled, but not that it is physically the same object. If there have been intervening queries the original object may have been deleted but this should not matter *unless the cache holds pointers* back to the `DbiResult`. In this case the result ID should be used. Initialise with:-

```
Int_t MyResultID(myResPtr.GetResultID());
```

and then check as follows:-

```
if ( MyResultID != (myResPtr.GetResultID()) ) {

  // recreate the cache data ...

   MyResultID = myResPtr.GetResultID();
}
```

17.4.3 Extended Context Queries

Making the Query

The constructor of a `DbiResultPtr` for an Extended Context Query is:-

```
DbiResultPtr(const string& tableName,
             const DbiSqlContext& context,
             const Dbi::SubSite& subsite = Dbi::kAnySubSite,
             const Dbi::Task& task = Dbi::kAnyTask,
             const string& data = "",
             const string& fillOpts = "",
```

Dealing with each of these arguments in turn:-

const string& tableName The name of the table that is to be accessed. This allows any type of `DbiTableRow` to be loaded from any type of table, but see section *Filling Tables* on filling if you are going to play tricks!

const DbiSqlContext& context This argument provides the extended context through the utility class `DbiSqlContext`. Consider the following code:-

```
// Construct the extended context: FarDet data that starts on Sept 1 2003.
// (note: then end time stamp is exclusive)
TimeStamp tsStart(2003,9,1,0,0,0);
TimeStamp   tsEnd(2003,9,2,0,0,0);
DbiSqlContext context(DbiSqlContext::kStarts,tsStart,
                      tsEnd,Site::kFar,SimFlag::kData);
```

You supply the type of context (in this case `DbiSqlContext::kStarts`), the date range and the detector type and sim flag. Other types of context are kEnds and kThroughout. See

```
DatabaseInterface/DbiSqlContext.h
```

for the complete list.

You are not limited to the contexts that `DbiSqlContext` provides. If you know the SQL string you want to apply then you can create a DbiSqlContext with the WHERE clause you require e.g.:-

```
DbiSqlContext myContext("SITEMASK & 4")
```

which would access every row that is suitable for the CalDet detector.

const Dbi::Task& task The task is as for other queries but with the default value of:-

```
Dbi::kAnyTask
```

which results in the task being omitted from the context query and also allows for more general queries: anything that is is valid after the **where** is permitted. For example:-

```
DbiSqlContext myContext("versiondate > '2004-01-01 00:00:00' "
                        " order by versiondate limit 1");
```

The SQL must have a where condition, but if you don't need one, create a dummy that is always true e.g.:-

```
DbiSqlContext myContext("1 = 1 order by timeend desc limit 1 ")
```

const string& data This is an SQL fragment, that if not empty (the default value) is used to extend the WHERE clause that is applied when querying the main table. For example consider:-

```
DbiSqlContext context(DbiSqlContext::kStarts,tsStart,tsEnd,
                      Site::kFar,SimFlag::kData);
DbiResultPtr<DbuSubRunSummary>
                      runs("DBUSUBRUNSUMMARY",context,
                           Dbi::kAnyTask,"RUNTYPENAME = 'NormalData'");
```

This query reads the DBUSUBRUNSUMMARY table, and besides imposing the context query also demands that the data rows satisfies a constraint on RUNTYPENAME.

const string& fillOpts This is a string that can be retrieved from `DbiResultSet` when filling each row so could be used to program the way an object fills itself e.g. by only filling certain columns. The DatabaseInterface plays no part here; it merely provides this way to communicate between the query maker and the the author of the class that is being filled.

Accessing the Results Table

Accessing the results of an Extended Context query are essentially the same as for a standard query but with following caveats:-

- If the method:-

  ```
  const DbiValidityRec* GetValidityRec(const DbiTableRow* row=0) const;
  ```

  is used with the default argument then the "global validity" of the set i.e. the overlap of all the rows is returned. Given the nature of Extended Queries there may be no overlap at all. In general it is far better to call this method and pass a pointer to a specific row for in this case you will get that validity of that particular row.

- The method:-

  ```
  const T* GetRowByIndex(UInt_t index) const;
  ```

  will not be able to access all the data in the table if two or more rows have the same Natural Index. This is prohibited in a standard query but extended ones break all the rules and have to pay a price!

17.4.4 Error Handling

Response to Errors

All `DbiResultPtr` constructors, except the default constructor, have a optional argument:-

```
Dbi::AbortTest abortTest = Dbi::kTableMissing
```

Left at its default value any query that attempts to access a non-existent table will abort the job. The other values that can be supplied are:-

kDisabled Never abort. This value is used for the default constructor.

kDataMissing Abort if the query returns no data. Use this option with care and only if further processing is impossible.

Currently aborting means just that; there is no graceful shut down and saving of existing results. You have been warned!

Error Logging

Errors from the database are recorded in a `DbiExceptionLog`. There is a global version of that records all errors. The contents can be printed as follows:-

```
#include "DatabaseInterface/DbiExceptionLog.h"
...
LOGINFO(mylog) << "Contents of the Global Exception Log: \n"
           <<  DbiExceptionLog::GetGELog();
```

Query results are held in a `DbiResult` and each of these also holds a `DbiExceptionLog` of the errors (if any) recorded when the query was made. If `myResPtr` is a `DbiResultPtr`, then to check and print associated errors:-

```
const DbiExceptionLog& el(myResPtr.GetResult()->GetExceptionLog());
if ( el.Size() == 0 ) LOGINFO(mylog) << "No errors found" << endl;
else                  LOGINFO(mylog) << "Following errors found" << el << endl;
```

17.5 Creating New Tables

17.5.1 Choosing Table Names

The general rule is that a table name should match the `DbiTableRow` subclass object that it is used to fill. For example the table CalPmtGain corresponds to the class `CalPmtGain`. The rules are

- Use only upper and lower case characters
- Avoid common names such as VIEW and MODE are used by ORACLE. A good list of names to avoid can be found at:-

  http://home.fnal.gov/%7Edbox/SQL_API_Portability.htmlhttp://home.fnal.gov/%7Edbox/SQL_API_Portability.html

These restrictions also apply to column names. Moreover, column names should be all capital letters.

17.5.2 Creating Detector Descriptions

A Simple Example

Creating new Detector Descriptions involves the creation of a database table and the corresponding table row Class. The main features can be illustrated using the example we have already studied: `DbiDemoData1`. Recall that its state data is:-

```
  Int_t  fSubSystem;
Float_t  fPedestal;
Float_t  fGain1;
Float_t  fGain2;
```

Its database table, which bears the same name, is defined, in MySQL, as:-

```
CREATE TABLE DBIDEMODATA1(
         SEQNO INTEGER not null,
         ROW_COUNTER INTEGER not null,
         SUBSYSTEM  INT,
         PEDESTAL   FLOAT,
         GAIN1      FLOAT,
         GAIN2      FLOAT,
         primary key(SEQNO,ROW_COUNTER));
```

as you can see there is a simple 1:1 correspondence between them except that the database table has two additional leading entries:-

```
SEQNO INTEGER not null,
ROW_COUNTER INTEGER not null,
```

and a trailing entry:-

```
primary key(SEQNO,ROW_COUNTER));
```

ROW_COUNTER is a column whose value is generated by the interface, it isn't part of table row class. Its sole purpose is to ensure that every row in the table is unique; an import design constraint for any database. This is achieved by ensuring that, for a given SEQNO, each row has a different value of ROW_COUNTER. This allows the combination of these two values to form a primary (unique) key, which is declared in the trailing entry.

All database tables supported by the DatabaseInterface have an auxiliary Context Range Tables that defines validity ranges for them. Each validity range is given a unique sequence number that acts as a key and corresponds to `SeqNo`. In our case, indeed every case apart from the table name, the definition is:-

```
create table  DbiDemoData1Vld(
         SEQNO integer not null primary key,
         TIMESTART datetime not null,
         TIMEEND datetime not null,
         SITEMASK tinyint(4),
         SIMMASK tinyint(4),
         TASK integer,
         AGGREGATENO integer,
         VERSIONDATE datetime not null,
         INSERTDATE datetime not null,
         key TIMESTART (TIMESTART),
         key TIMEEND (TIMEEND));
```

When the DatabaseInterface looks for data that is acceptable for a give validity it:-

1. Matches the validity to an entry in the appropriate Context Range Table and gets its SeqNo.
2. Uses SeqNo as a key into the main table to get all the rows that match that key.

So, as a designer, you need to be aware of the sequence number, and the row counter *must* be the first two columns in the database table, but are not reflected in the table row class.

Filling a table row object from the database is done using the class's Fill method. For our example:-

```
void DbiDemoData1::Fill(DbiResultSet& rs,
                        const DbiValidityRec* vrec) {

  rs >> fSubSystem >> fPedestal >> fGain1 >> fGain2;
```

```
}
```

the table row object is passed a `DbiResultSet` which acts rather like an input stream. The sequence number has already been stripped off; the class just has to fill its own data member. The DatabaseInterface does type checking (see the next section) but does not fail if there is a conflict; it just produces a warning message and puts default data into the variable to be filled.

The second argument is a `DbiValidityRec` which can, if required, be interrogated to find out the validity of the row. For example:-

```
const ContextRange& range = vrec->GetContextRange();
```

vrec may be zero, but only when filling `DbiValidityRec` objects themselves. On all other occasions vrec should be set.

Creating a Database Table

The previous section gave a simple MySQL example of how a database table is defined. There is a bit more about MySql in section *MySQL Crib*. The table name normally must match the name of the table row class that it corresponds to. There is a strict mapping between database column types and table row data members, although in a few cases one column type can be used to load more than one type of table row member. The table *Recommended table row and database column type mappings* gives the recommended mapping between table row, and MySQL column type.

Table 17.1: Recommended table row and database column type mappings

Table Row Type	MySQL Type	Comments
Bool_t	CHAR	
Char_t	CHAR	
Char_t*	CHAR(n) n<4	n <4
Char_t*	TEXT	n >3
string	TEXT	
Short_t	TINYINT	8 bit capacity
Short_t	SMALLINT	16 bit capacity
Int_t	TINYINT	8 bit capacity
Int_t	SMALLINT	16 bit capacity
Int_t	INT or INTEGER	32 bit capacity
Float_t	FLOAT	
Double_t	DOUBLE	
TimeStamp	DATETIME	

Notes

1. To save table space, select CHAR(n) for characters strings with 3 or less characters and select the smallest capacity for integers.
2. The long (64 bit) integer forms are not supported as on (some?) Intel processors they are only 4 bytes long.
3. Although MySQL supports unsigned values we banned them when attempting to get a previous interface to work with ORACLE, so unsigned in database column type should be avoided. It is allowed to have unsigned in the table row when a signed value is not appropriate and the interface will correctly handle I/O to the signed value in the database even if the most significant bit is set i.e. the signed value in the database is negative. It is unfortunate that the signed value in the database will look odd in such cases.

Designing a Table Row Class

Here is a list of the requirements for a table row class.

Must inherit from DbiTableRow All table row objects must publicly inherit from the abstract class`DbiTableRow`. `DbiTableRow` does provide some default methods even though it is abstract.

Must provide a public default constructor e.g.:-

```
DbiDemoData1::DbiDemoData1() { }
```

The DatabaseInterface needs to keep a object of every type of table row class.

Must implement CreateTableRow method e.g.:-

```
virtual DbiTableRow* CreateTableRow() const {
                              return new DbiDemoData1; }
```

The DatabaseInterface uses this method to populate results tables.

May overload the GetIndex method As explained in section *Accessing the Results Table* the ordering of rows in a table is determined by the way data is written to the database. Where that does not form a natural way to access it, table row objects can declare their own index using:-

```
UInt_t GetIndex(UInt_t defIndex) const
```

`DbiDemoData2` provides a rather artificial example:-

```
UInt_t GetIndex(UInt_t defIndex) const { return fSubSystem/10; }
```

and is just meant to demonstrate how a unique index could be extracted from some packed identification word.

The following is required of an index:-

- The number must be unique within the set.
- It must fit within 4 bytes.

  GetIndex returns an unsigned integer as the sign bit has no special significance, but its O.K. to derive the index from a signed value, for example:-

  ```
  Int_t PlexStripEndId::GetEncoded() const
  ```

  would be a suitable index for tables indexed by strip end.

Must implement Fill method This is the way table row objects get filled from a `DbiResultSet` that acts like an input stream. We have seen a simple example in `DbiDemoData1`:-

```
void DbiDemoData1::Fill(DbiResultSet& rs,
                        const DbiValidityRec* vrec) {

  rs >> fSubSystem >> fPedestal >> fGain1 >> fGain2;

}
```

However, filling can be more sophisticated. `DbiResultSet` provides the following services:-

```
      string DbiResultSet::CurColName() const;
      UInt_t DbiResultSet::CurColNum() const;
      UInt_t DbiResultSet::NumCols() const;
DbiFieldType DbiResultSet::CurColFieldType() const;
```

The first 3 give you the name of the current column, its number (numbering starts at one), and the total number of columns in the row. `DbiFieldType` can give you information about the type, concept and size of the data in this column. In particular you can see if two are compatible i.e. of the same type:-

```
Bool_t DbiFieldType::IsCompatible(DbiFieldType& other) const;
```

and if they are of the same capacity i.e. size:-

```
Bool_t DbiFieldType::IsSmaller(DbiFieldType& other) const;
```

You can create `DbiFieldType` objects e.g:-

```
DbiFieldType myFldType(Dbi::kInt)
```

see enum Dbi::DataTypes for a full list, to compare with the one obtained from the current row.

In this way filling can be controlled by the names, numbers and types of the columns. The Fill method of `DbiDemoData1` contains both a "dumb" (take the data as it comes) and a "smart" (look at the column name) code. Here is the latter:-

```
Int_t numCol = rs.NumCols();

//  The first column (SeqNo) has already been processed.
for (Int_t curCol = 2; curCol <= numCol; ++curCol) {
  string colName = rs.CurColName();
  if (      colName == "SubSystem" ) rs >> fSubSystem;
  else if ( colName == "Pedestal" )  rs >> fPedestal;
  else if ( colName == "Gain1" )     rs >> fGain1;
  else if ( colName == "Gain2" )     rs >> fGain2;
  else {
    LOGDEBUG1(dbi) << "Ignoring column " << curCol
                   << "(" << colName << ")"
                   << "; not part of DbiDemoData1" << endl;
    rs.IncrementCurCol();
  }
}

*Being "smart" comes at a price; if your table has many  rows valid at at time,
defensive programming like this can cost  performance!*
```

In such cases, and if the table only exists is a few variants, its better to determine the variant and then branch to code that hardwires that form

Other services that `DbiResultSet` offers are:-

```
UInt_t DbiResultSet::CurRowNum() const;
Bool_t DbiResultSet::IsExhausted() const;
string DbiResultSet::TableName();
```

These tell you the current row number, whether there is no data left and the name of the table.

Also note that it is not a rule that database columns and class data members have to be in a 1:1 correspondence. So long as the table row can satisfy its clients (see below) it can store information derived from the database table rather than the data itself.

Must impliment the Store method Similar to the Fill method, a row must know how to store itself in the database. Again, this is usually simple; you simply stream out the row elements to the stream provided:

```
void DbiDemoData1::Store(  (DbiOutRowStream& ors,
                           const DbiValidityRec* /* vrec */) const {
```

```
  ors << fSubSystem << fPedestal << fGain1 << fGain2;

}
```

must impliment the GetDatabaseLayout method This method is used by a user wanting to do first-time creation of the databases from within the code. Doing this simplifies the table creation process slightly: simply list the columns that this class requires.

```
std::string  DbiDemoData1::GetDatabaseLayout()
{
  std::string table_format =
    "SUBSYSTEM  int,      "
    "PEDESTAL    float,   "
    "GAIN1       float,   "
    "GAIN2       float    ";
  return table_format;
}
```

May overload the CanL2Cache method As explained in section *Concepts* the Level 2 cache allows table loading to be speeded up by caching the query results as disk files. Only certain tables support this option which by default is disabled. To enable it the table row object overrides this method as follows:-

```
Bool_t CanL2Cache() const { return kTRUE; }
```

Only table row classes who data members are built-in data types (ints, floats and chars) should do this. Table rows having objects or dynamic data e.g. string or pointers must not claim to support L2 caching. Note the table row doesn't need code to save/restore to the cache, this is handled by the `DbiTableProxy`

Must Provide Services to its Clients There would not be much point in its existence otherwise would there? However its not necessarily the case that all its does is to provide direct access to all the data that came from the table. This subject is explored in the next section.

The Dictionary files

FIXME Need to include instructions for properly doing dict.h and dict.xml files describing table rows, DbiResultPtr and DbiWriter, if I ever figure out how.

Data Encapsulation

A table row object is the gateway between a database table and the end users who want to use the data it contains. Like any good OO design, the aim should be to hide implementation and only expose the abstraction. There is nothing wrong in effectively giving a 1:1 mapping between the columns of the database table and the getters in the table row object if that is appropriate. For example, a table that gives the position of each PMT in a detector is going to have an X, Y and Z both in the database and in the getter. However at the other extreme there is calibration. Its going to be well into detector operation before the best form of calibration has been found, but it would be bad design to constantly change the table row getters. Its far better to keep the data in the database table very generic, for example:-

```
SeqNo      int,
SubSystem  int,
CalibForm  int,
parm0      float,
parm1      float,
parm2      float,
...
```

The significance of parm0,... depends on CalibForm. The table row object could then provide a calibration service:-

```
Float_t Calibrate(Float_t rawValue) const;
```

rather than expose parm0,.. Calibrate() would have code that tests the value of CalibForm and then uses the appropriate formula involving parm0... Of course some validation code will want to look at the quality of the calibration by looking at the calibration constants themselves, but this too could be abstracted into a set of values that hide the details of the form of the calibration.

However, it is strongly advised to make the raw table values available to the user.

17.6 Filling Tables

17.6.1 Overview

DatabaseInterface can be used to write back into any table from which it can read. To do this you need the services of a `DbiWriter` which is a templated class like `DbiResultPtr`. For example, to write `DbiDemoData1` rows you need an object of the class:-

```
DbiWriter<DbiDemoData1>
```

`DbiWriter` only fills tables, it does not create them

> *Always create new tables with mysql before attempting to fill them*

If you want to create the tables within the same job as the one that fills it then you can do so as follows:-

```
// Create a single instance of the database row, and use
// it to prime the database.  This needs only be done once.
// It will do nothing if the tables already exist.
MyRowClass dummy; // Inherits from DbiTableRow.
int db = 0;       // DB number. If 0, this data is put into the first
                  // database in the cascade;
                  // i.e. the first database in the ENV_TSQL_URL
dummy.CreateDatabaseTables(db);
```

In outline the filling procedure is as follows:-

1. Decide the validity range of the data to be written and store it in a `ContextRange` object.
2. Instantiate a `DbiWriter` object using this `ContextRange` object together with an aggregate number and task. Aggregate numbers are discussed below.
3. Pass filled `DbiTableRow` sub-class objects (e.g. `DbiDemoData1`) to the `DbiWriter`. It in turn will send these objects their Store message that performs the inverse of the Fill message. DbiWriter caches the data but performs no database I/O at this stage.
4. Finally send the `DbiWriter` its Close message which triggers the output of the data to the database.

The fact that I/O does not occur until all data has been collected has a couple of consequences:-

- It minimises the chances of writing bad data. If you discover a problem with the data while `DbiWriter` is assembling it you use `DbiWriter`'s Abort method to cancel the I/O. Likewise if `DbiWriter` detects an error it will not perform output when Close is invoked. Destroying a `DbiWriter` before using Close also aborts the output.
- Although `DbiWriter` starts life as very lightweight, it grows as the table rows are cached.

  > *Be very sure that you delete the DbiWriter once you have finished with it or you will have a serious memory leak!*

  To cut down the risk of a memory leak, you cannot copy construct or assign to `DbiWriter` objects.

17.6.2 Aggregate Numbers

As explained in Concepts (see section *Concepts*) some types of data are written for the entire detector as a single logical block. For example the way PMT pixels map to electronics channels might be written this way. On the other hand if it is written in smaller, sub-detector, chunks then it is Aggregated. For example light injection constants come from pulser data and it is quite possible that a calibration run will only pulse some LEDs and so only part of a full detector set of constants gets written to the database for the run. Each chunk is called an aggregate and given an aggregate number which defines the sub-section of the detector it represents. For pulser data, the aggregate number will probably be the logical (positional) LED number A single `DbiWriter` can only write a single aggregate at a time, for every aggregate can in principle have a different validity range. For unaggregated data, the aggregate number is -1, for aggregated data numbers start at 0,1,2...

The way that the DatabaseInterface assembles all valid data for a given context is as follows:-

- First if finds all aggregate records that are currently valid.
- For each aggregate number it finds the best (most recently created) record and loads all data associated with it.

This has two consequences:-

- For a given table, the regime whereby the data is organised into aggregates should remain constant throughout all records in the table. If absolutely necessary the regime can be changed, but no records must have validities that span the boundary between one regime and another. Were that to be the case the same entry could appear in two valid records with different aggregates numbers and end up appearing in the table multiple times. The system checks to see that this does not happen by asking each row to confirm it's aggregate number on input.
- For any given context it is not necessary for all detector elements to be present; just the ones that are really in the detector at that time. For example, the Far detector will grow steadily over more than a year and this will be reflected in some database tables with the number of valid aggregates similarly growing with time. What aggregates are present can appear in any order in the database tables, the interface will assemble them into the proper order as it loads them.

Its perfectly possible that a calibration procedure might produce database data for multiple aggregates at a single pass. If you are faced with this situation and want to write all aggregates in parallel, then simply have a vector of `DbiWriter`'s indexed by aggregate number and pass rows to the appropriate one. See `D`biValidate::Test_6() for an example of this type of parallel processing.

17.6.3 Simple Example

We will use the class `DbiDemoData1` to illustrate each of the above steps.

1. Set up `ContextRange` object. — Typically the `ContextRange` will be based on the `Context` for the event data that was used to generate the database data that is to be stored. For our example we will assume that `DbiDemoData1` represents calibration data derived from event data. It will be valid for 1 week from the date of the current event and be suitable for the same type of data.

```
Context now;  // Event context e.g. CandHandle::GetContext()
TimeStamp start = now.GetTimeStamp();
// Add 7 days (in secs) to get end date.
time_t vcSec = start.GetSec() + 7*24*60*60;
TimeStamp    end(vcSec,0);
// Construct the ContextRange.
ContextRange      range(now.GetDetector(),
                    now.GetSimFlag(),
                    start,
                    end,
                    "Demo");
```

2. Instantiate a `DbiWriter`. — Create a `DbiDemoData1` writer for unaggregated data task 0.

```
Int_t aggNo = -1;
Dbi::SubSite subsite = 0;
Dbi::Task task = 0;
// Decide a creation date (default value is now)
TimeStamp create;
DbiWriter<DbiDemoData1> writer(range,aggNo,subsite,task,create);
```

3. Pass filled `DbiDemoData1` objects.

```
// Create some silly data.
DbiDemoData1 row0(0,10.,20.,30.);
DbiDemoData1 row1(0,11.,21.,31.);
DbiDemoData1 row2(0,12.,22.,32.);

// Store the silly data.
writer << row0;
writer << row1;
writer << row2;
```

   The `DbiWriter` will call `DbiDemoData1`'s Store method.

   Again notice that the SeqNo, which is part of the table row, but not part of the class data, is silently handled by the system.

4. Send the `DbiWriter` its Close message.

```
writer.Close();
```

17.6.4 Using DbiWriter

- The `DbiWriter`'s constructor is:-

```
DbiWriter(const ContextRange& vr,
          Int_t aggNo,
          Dbi::SubSite subsite= 0,
          Dbi::Task task = 0,
          TimeStamp versiondate = TimeStamp(0,0),
          UInt_t dbNo = 0,
          const std::string& LogComment = "",
          const std::string& tableName = ""
          );
```

- **The first argument determines the validity range of the data to be written,** i.e. what set of `Contexts` it is suitable for. You can control the date range as well as the type(s) of data and detector.
- **The second argument is the aggregate number. For unaggregated data it is -1,** for aggregated data its a number in the range 0..n-1 where n is the number of aggregates.
- The third argument is the SubSite of the data. It has a default of 0.
- The third argument is the Task of the data. It has a default of 0.
- **The fourth argument supplies the data's version date. The default is a** special date and time which signifies that `DbiWriter` is to use Overlay Version Dates (see Concepts section *dbi:overlayversiondates*.) Alternatively, at any time before writing data, use the method:-

  ```
  void SetOverlayVersionDate();
  ```

  to ensure that `DbiWriter` uses Overlay Version Dates.

- **The fifth argument defines which entry in the database cascade the data is** destined for. By default it is entry 0 i.e. the highest priority one.

  Caution: Supplying the entry number assumes that at execution time the cascade is defined in a way that is consistent with the code that is using the `DbiWriter`. As an alternative, you can supply the database name (e.g. offline) if you know it and are certain it will appear in the cascade.

- **The sixth argument supplies a comment for the update. Alternatively, at any** time before writing data, use the method:-

  ```
  void  SetLogComment(const std::string& LogComment)
  ```

  Update comments are ignored unless writing to a Master database (i.e. one used as a source database e,g. the database at FNAL), and in this case a non-blank comment is mandatory unless the table is exempt. Currently only DBI, DCS and PULSER tables are exempt.

  If the first character on the string is the '@' character then the rest of the string will be treated as the name of a file that contains the comment. If using DbiWriter to write multiple records to the same table as part of a single update then only create a single DbiWriter and use the Open method to initialise for the second and subsequent records. That way a single database log entry will be written to cover all updates.

- **The last argument supplies the name of the table to be written to. Leaving it** blank will mean that the default table will be used i.e. the one whose name matches, apart from case, the name of object being stored. Only use this feature if the same object can be used to fill more than one table.

- Having instantiated a `DbiWriter`, filled table row objects must be passed using the operator:-

  ```
  DbiWriter<T>& operator<<(const T& row);
  ```

  for example:-

  ```
  writer << row0;
  writer << row1;
  writer << row2;
  ```

  `DbiWriter` calls the table row's Store method, see the next section. It also performs some basic sanity checks:-

- The row's aggregate number matches its own.
- The type of the data written is compatible with database table.

  If either check fails then an error message is output and the data marked as bad and the subsequent Close method will not produce any output.

- Once all rows for the current aggregate have been passed to `DbiWriter` the data can be output using:-

  ```
  Bool_t Close();
  ```

  which returns true if the data is successfully output.

  Alternatively, you can write out the data as a DBMauto update file by passing the name of the file to the Close command:-

  ```
  Close("my_dbmauto_update_file.dbm");
  ```

- On output a new sequence number is chosen automatically. By default, if writing permanent data to an authorising database or if writing to a file, a global sequence number will be allocated. In all other cases a local sequence number will be be used. For database I/O, as opposed to file I/O, you can change this behaviour with

  ```
  void SetRequireGlobalSeqno(Int_t requireGlobal)

  Where requireGlobal
    > 0  Must be global
  ```

```
= 0  Must be global if writing permanent data to an authorising database
< 0  Must be local
```

- At any time before issuing the Close command you can cancel the I/O by either:-
- Destroying the `DbiWriter`.
- Using the method:-

```
void Abort();
```

- If you want to, you can reuse a `DbiWriter` by using:-

```
Bool_t Open(const ContextRange& vr,
            Int_t aggNo,
            Dbi::Task task = 0,
            TimeStamp versionDate = TimeStamp(),
            UInt_t dbNo = 0);
```

The arguments have the same meaning as for the constructor. An alternative form of the Open statement allows the database name to be supplied instead of its number. If the `DbiWriter` is already assembling data then the Close method is called internally to complete the I/O. The method returns true if successful. As explained above, the Open method must be used if writing multiple records to the same table as part of a single update for then a single database log entry will be written to cover all updates.

17.6.5 Table Row Responsibilities

All `DbiTableRow` sub-class objects must support the input interface accessed through `DbiResultPtr`. The responsibilities that this implies are itemised in section *Designing a Table Row Class*. The output interface is optional; the responsibilities listed here apply only if you want to write data to the database using this interface.

Must override GetAggregateNo method if aggregated `DbiTableRow` supplies a default that returns -1. The GetAggregateNo method is used to check that table row objects passed to a particular `DbiWriter` have the right aggregate number.

Must override Store Method The Store method is the inverse to Fill although it is passed a `DbiOutRowStream` reference:-

```
void Store(DbiOutRowStream& ors) const;
```

rather than a `DbiResultSet` reference. Both these classes inherit from `DbiRowStream` so the same set of methods:-

```
      string DbiResultSet::CurColName() const;
      UInt_t DbiResultSet::CurColNum() const;
      UInt_t DbiResultSet::NumCols() const;
DbiFieldType DbiResultSet::CurColFieldType() const;
      UInt_t DbiResultSet::CurRowNum() const;
      string DbiResultSet::TableName();
```

are available. So, as with the Fill method, there is scope for Store to be "smart". The quotes are there because it often does not pay to be too clever! Also like the Fill method its passed a `DbiValidityRec` pointer (which is only zero when filling `DbiValidityRec` objects) so that the validity of the row can be accessed if required.

17.6.6 Creating and Writing Temporary Tables

It is possible to create and write temporary tables during execution. Temporary tables have the following properties:-

- For the remainder of the job they look like any other database table, but they are deleted when the job ends.
- They completely obscure all data from any permanent table with the same name in the same database. Contrast this with the cascade, which only obscures data with the same validity.
- They are local to the process that creates them. Even the same user running another job using the same executable will not see these tables.

Temporary tables are a good way to try out new types of table, or different types of data for an existing table, without modifying the database. Writing data is as normal, by means of a `DbiWriter`, however before you write data you must locate a database in the cascade that will accept temporary tables and pass it a description of the table. This is done using the `DbiCascader` method `CreateTemporaryTable`. You can access the cascader by first locating the singleton `DbiTableProxyRegister` which is in overall charge of the DatabaseInterface. The following code fragment shows how you can define a new table for DbiDemoData1:-

```
#include "DatabaseInterface/DbiCascader.h"
#include "DatabaseInterface/DbiTableProxyRegistry.h"

...

//  Ask the singleton DbiTableProxyRegistry for the DbiCascader.
  const DbiCascader& cascader
               = DbiTableProxyRegistry::Instance().GetCascader();

//  Define the table.
  string tableDescr = "(SEQNO INT,   SUBSYSTEM  INT, PEDESTAL FLOAT,"
                      " GAIN1 FLOAT, GAIN2 FLOAT )";
//  Ask the cascader to find a database that will accept it.
  Int_t dbNoTemp = cascader.CreateTemporaryTable("DbiDemoData1",
                                                 tableDescr);

  if ( dbNoTemp < 0 ) {
     cout << "No  database to will accept temporary tables. " << endl;
  }
```

You pass `CreateTemporaryTable` the name of the table and its description. The description is a parenthesised comma separated list. It follows the syntax of the MYSQL CREATE TABLE command, see section *MySQL Crib*.

In principle not every database in the cascade will accept temporary tables so the cascader starts with the highest priority one and works done until it finds one, returning its number in the cascade. It returns -1 if it fails. For this to work properly the first entry in the cascade must accept it so that it will be taken in preference to the true database. It is recommended that the first entry be the temp database, for everyone has write-access to that and write- access is needed to create even temporary tables. So a suitable cascade might be:-

```
setenv ENV_TSQL_URL "mysql://pplx2.physics.ox.ac.uk/temp;\
                     mysql://pplx2.physics.ox.ac.uk/offline"
```

Having found a database and defined the new or replacement table, you can now create a `DbiWriter` and start writing data as describe in section *Filling Tables*. You have to make sure that the DbiWriter will output to the correct database which you can either do by specifying it using the 5th arg of its constructor:-

```
DbiWriter(const ContextRange& vr,
          Int_t aggNo,
          Dbi::Task task = 0,
          TimeStamp versionDate = TimeStamp(),
          UInt_t dbNo = 0);
```

or alternatively you can set it after construction:-

```
DbiWriter<DbiDemoData1> writer(range,aggNo);
writer.SetDbNo(dbNoTemp);
```

As soon as the table has been defined it will, as explained above, completely replace any permanent table in the same database with the same name. However, if there is already data in the cache for the permanent table then it may satisfy further requests for data. To prevent this from happening you can clear the cache as described in the next section.

> *Do NOT write permanent data to any temporary database for it could end up being used by anyone who includes the database for temporary tables. Database managers may delete any permanent tables in temporary databases without warning in order to prevent such problems.*

17.6.7 Clearing the Cache

Normally you would not want to clear the cache, after all its there to improve performance. However if you have just created a temporary table as described above, and it replaces an existing table, then clearing the cache is necessary to ensure that future requests for data are not satisfied from the now out of date cache. Another reason why you may want to clear the cache is to study database I/O performance.

Although this section is entitled Clearing the Cache, you cannot actually do that as the data in the cache may already be in use and must not be erased until its clients have gone away. Instead the data is marked as stale, which is to say that it will ignored for all future requests. Further, you don't clear the entire cache, just the cache associated with the table that you want to refresh. Each table is managed by a `DbiTableProxy` that owns a `DbiCache`. Both `DbiWriter` and `DbiResultPtr` have a `TableProxy` method to access the associated `DbiTableProxy`. The following code fragment shows how to set up a writer and mark its associated cache as stale:-

```
DbiWriter<DbiDemoData1> writer(range,aggNo);
writer.SetDbNo(dbNoTemp);
writer.TableProxy().GetCache()->SetStale();
```

17.7 ASCII Flat Files and Catalogues

17.7.1 Overview

ASCII flat files and catalogues provide a convenient way to temporarily augment a database with additional tables under your control. A flat file is a file that contains, in human readable form, the definition of a table and its data. It can be made an entry in a cascade and, by placing before other entries allows you to effectively modify the database just for the duration of a single job. As has already been explained, for each Main Data Table there is also an auxiliary Context Range Table, so you need 2 entries in the cascade for each table you want to introduce. The problem with this scheme is that, if introducing a number of tables, the cascade could get rather large. To avoid this catalogues are used. A catalogue is actually nothing more that a special ASCII flat file, but each row of its data is a URLs for another ASCII flat file that becomes part of the same cascade entry. In this way a single cascade entry can consist of an arbitrary number of files.

17.7.2 Flat Files

An ASCII flat file defines a single database table.

Format

The format is sometimes referred to as Comma Separated Value (CSV). Each line in the file corresponds to a row in the table. As you might suspect, values are separated by commas, although you can add additional white space (tabs

and spaces) to improve readability (but heed the caution in section *Example*). The first row is special, it contains the column names and types. The types must valid MySQL types, see table *Recommended table row and database column type mappings* for some examples. If the special row is omitted or is invalid then the column names are set to C1, C2, ... etc. and all types are set to string (TEXT). Here is a simple example of a CSV file:-

```
SeqNo int, Pedestal float, SubSystem int, Gain1 float, Gain2 float
1,    1.0,    0,    10.,    100.
1,    1.1,    1,    11.,    110.
1,    1.2,    2,    12.,    120.
1,    1.3,    3,    13.,    130.
```

Its in a convention to use the file extension .csv, but it is not compulsory.

If any value is a string or a date, it *must* be delimited by double quotes.

URL

The database URL is based on the standard one extended by adding the suffix

```
#absolute-path-to-file
```

For example:-

```
mysql://coop.phy.bnl.gov/temp#/path/to/MyTable.csv
```

The table name is derived from the file name after stripping off the extension. In this example, the table name will be MyTable

17.7.3 Catalogues

These are special types of ASCII Flat File. Their data are URLs to other flat files. You cannot nest them i.e. one catalogue cannot contain a URL that is itself catalogue.

Format

The first line of the file just contains the column name "name". The remaining lines are URLs of the flat files. Here is a simple example:-

```
name
file:/home/dyb/work/MyData.csv
file:/home/dyb/work/MyDataVld.csv
file:$MY_ENV/MyDataToo.csv
file:$MY_ENV/MyDataTooVld.csv
```

This catalogue defines two tables MyData and MyDataToo each with its associated auxiliary validity range table. Note that files names must be absolute but can begin with an environmental variable.

URL

The URL is identical to any other flat file with one additional constraint: the extension must be .cat or .db. For example:

```
mysql://coop.phy.bnl.gov/dyb_offline#/home/dyb/work/MyCatalogue.db
```

17.7.4 Example

The stand-alone testing of the Database Interface includes an example of an ASCII Catalogue. The URL of the cascade entry is:-

```
mysql://coop.phy.bnl.gov/dyb_test#\$DATABASEINTERFACE_ROOT/DbiTest/scriptsDemoASCIICatalogue.db
```

If you look at the file:-

```
\$DATABASEINTERFACE_ROOT/DbiTest/scripts/DemoASCIICatalogue.db
```

you will see it contains 4 lines, defining the tables `DEMOASCIIDATA` (a Detector Descriptions table) and `DEMOASCIICONFIG` (Algorithm Configurations table):-

```
file:$DBITESTROOT/scripts/DEMOASCIIDATA.csv
file:$DBITESTROOT/scripts/DEMOASCIIDATAVld.csv
file:$DBITESTROOT/scripts/DEMOASCIICONFIG.csv
file:$DBITESTROOT/scripts/DEMOASCIICONFIGVld.csv
```

In both cases, the auxiliary validity range table defines a single validity range, although there is no reason why it could not have defined any number. For the `DEMOASCIIDATA`, there are 5 rows, a header row followed by 4 rows of data:-

```
SEQNO INT, UNWANTED INT, PEDESTAL FLOAT, SUBSYSTEM INT, GAIN1 FLOAT, GAIN2 FLOAT
1,99,1.0,0,10.,100.
1,99,1.1,1,11.,110.
1,99,1.2,2,12.,120.
1,99,1.3,3,13.,130.
```

For the `DEMOASCIICONFIG` table, there are only two rows:-

```
SEQNO INT, CONFIGSTRING TEXT
1,"mybool=1 mydouble=1.23456789012345678e+200 mystring='This is a string' myint=12345"
```

Caution: Note, don't have any white space between the comma and the leading double quote of the configuration string.

17.8 MySQL Crib

This provides the absolute bare minimum to install, manage and use a MySQL database in the context of the DatabaseInterface.

17.8.1 Introduction

The following are useful URLs:-

- MySQL home page:-

  http://www.mysql.com/ http://www.mysql.com/

- from which you can reach a documentation page:-

  http://www.mysql.com/documentation/index.html http://www.mysql.com/documentation/index.html

- and the downloads for 3.23:-

  http://www.mysql.com/downloads/mysql-3.23.html http://www.mysql.com/downloads/mysql-3.23.html

A good book on MySQL is:-

MySQL by Paul DuBois, Michael Widenius. New Riders Publishing; ISBN: 0-7357-0921-1

17.8.2 Installing

See:-

https://wiki.bnl.gov/dayabay/index.php?title=Databasehttps://wiki.bnl.gov/dayabay/index.php?title=Database
— https://wiki.bnl.gov/dayabay/index.php?title=MySQL_Installationhttps://wiki.bnl.gov/dayabay/index.php?title=MySQL_Insta

17.8.3 Running mysql

mysql is a utility, used both by system administrators and users to interact with MySQL database. The command syntax is:-

```
mysql [-h host_name] [-u user_name] [-pyour_pass]
```

if you are running on the server machine, with you Unix login name and no password then:-

```
mysql
```

is sufficient. To exit type:-

```
\q
```

Note: most mysql commands are terminated with a semi-colon. If nothing happens when you type a command, the chances are that mysql is still waiting for it, so type it and press return again.

17.8.4 System Administration

This also has to be done as root. As system administrator, MySQL allows you to control access, on a user by user basis, to databases. Here are some example commands:-

```
create database dyb_offline;
grant all on    dyb_offline.*       to  smart@coop.bnl.phy.gov
grant all on    dyb_offline.*       to  smart@"%"
grant select    dyb_offline.Boring  to  dumb@coop.bnl.phy.gov
\q
```

- The first lines creates a new database called dyb_offline. With MySQL you can have multiple databases.
- The next two lines grants user smart, either logged in locally to the server, or remotely from anywhere on the network all privileges to all tables in that database.
- The next line grants user dumb, who has to be logged in locally, select (i.e. read) access to the table Boring in the same database.

17.8.5 Selecting a Database

Before you can use mysql to create, fill or examine a database table you have to tell it what database to use. For example:-

```
use dyb_offline
```

'use' is one of the few commands that does not have a trailing semi-colon.

17.8.6 Creating Tables

The following commands create, or recreate, a table and display a description of it:-

```
drop table if exists DbiDemoData1;
create table DbiDemoData1(
    SeqNo      int,
    SubSystem  int,
    Pedestal   float,
    Gain1      float,
    Gain2      float
 );
describe DbiDemoData1;
```

See table *Recommended table row and database column type mappings* for a list of MySQL types that the DatabaseInterface currently supports.

17.8.7 Filling Tables

The following commands add data from the file DemoData1.dat to an existing table:-

```
load data local infile 'DemoData1.dat' into table DbiDemoData1;
```

Each line of the file corresponds to a row in the table. Columns should be separated with tabs. Table *Example data formats.* shows typical formats of the various data types.

Table 17.2: Example data formats.

MySQL Type	Table Row Type
CHAR	a
TINYINT	-128
SMALLINT	-32768
INT or INTEGER	-2147483647
FLOAT	-1.234567e-20
DOUBLE	1.23456789012345e+200
TEXT	'This is a string'
DATETIME	'2001-12-31 04:05:06'

17.8.8 Making Queries

Here is a sample query:-

```
select * from DbiDemoData2Validity where
    TimeStart <= '2001-01-11 12:00:00'
and TimeEnd    > '2000-12-22 12:00:00'
and SiteMask & 4
order by TimeStart desc
;
```

17.9 Performance

17.9.1 Holding Open Connections

Connections to the database are either permanent i.e. open all the time or temporary i.e. they are closed as soon as a I/O operation is complete. A connection is made permanent if:-

- Connecting to a ASCII flat file database as re-opening such a database would involve re-loading all the data.
- Temporary data is written to the database for such data would be lost if the connection were closed.

In all other cases the connection is temporary so as to minimise resources (and in the case ORACLE resources that have to be paid for!). For normal operations this adds little overhead as typically there are several major database reads at the start of a production job after which little or no further database I/O occurs. However if you require the connection to remain open throughout the job then you can force any entry in the cascade to be permanent. The following code sets entry 0 in the cascade to have a permanent connection:-

```
#include "DatabaseInterface/DbiCascader.h"
#include "DatabaseInterface/DbiTableProxyRegistry.h"


//  Ask the singleton DbiTableProxyRegistry for the DbiCascader.
  const DbiCascader& cascader
               = DbiTableProxyRegistry::Instance().GetCascader();
// Request that entry 0 is permanently open.
  cascader.SetPermanent(0);
```

Note that this won't open the connection but will prevent it from closing after its next use.

If you want all connections to remain open this can be set through the configuration parameter MakeConnectionsPermanent. See section *MakeConnectionsPermanent*.

17.9.2 Truncated Validity Ranges

Standard context specific queries are first trimmed to a time window to limit the number of Vld records that have to be analysed. Having established the best data, a further 4 calls to query the Vld table is made to determine the full validity. For data with long validities, these extra calls are worthwhile as they can significantly increase the lifetime of the results. However there are two cases where these should not be use:-

- For data that changes at high frequency (minutes or hours rather than days) it may waste time doing the extra searches, although the results would be valid.
- For sparse aggregation - see *Simple, Compound and Aggregated*. The algorithm opens up the window on the basis of the aggregates present at the supplied context so won't take account of aggregates not present and might over- estimate the time window.

The following `DbiResultPtr` methods support this request:-

```
DbiResultPtr(const Context& vc,
             Dbi::Task task = Dbi::kDefaultTask,
             Dbi::AbortTest abortTest = Dbi::kTableMissing,
             Bool_t findFullTimeWindow = true);

DbiResultPtr(const string& tableName,
             const Context& vc = Dbi::fgDefaultContext,
             Dbi::Task task = Dbi::kDefaultTask,
             Dbi::AbortTest abortTest = Dbi::kTableMissing,
             Bool_t findFullTimeWindow = true);
```

```
UInt_t NewQuery(Context vc,
             Dbi::Task task=0,
             Bool_t findFullTimeWindow = true);
```

It is selected by passing in the value `false` for `findFullTimeWindow`.

17.9.3 Timing

DbiTimerManager is a static object that provides performance printout when enabled. By default it is enabled but can be disabled by:-

```
DbiTimerManager::gTimerManager.Enable(false);
```

Warning: latexparser did not recognize : href

CHAPTER

EIGHTEEN

DATABASE MAINTANENCE

18.1 Introduction

The DatabaseMaintenance package produces a single binary application: **dbmjob** that provides very basic database maintenance support. Specifically its current function is only as a tool to distribute data between databases.

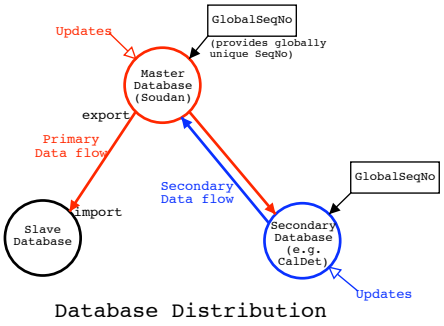


Figure 18.1: **dbm_db_distribution_fig**

The flow of data is shown schematically in diagram *dbm_db_distribution_fig*. At the heart of the system is the Master Database at Soudan. Most database updates enter the database realm here. At regular intervals dbmjob is used to export all recently updated data and these export files are distributed to all other databases where the data is imported if not already present. This is done by the local database manager again using dbmjob. These primary data flows are shown in red.

Smaller amounts of data come from secondary databases e.g. at CalDet and these are exported up to the Master Database where they join other updates for distribution.

This system relies on the ability to:-

- Record the insertion date so that updates can be incremental.
- Uniquely identify data so that it is not accidentally duplicated if attempting import more than once. For example updates to a secondary database might be reflected back if exporting all recent changes. However such data is ignored as duplicated data when resubmitted to the Master.

dbmjob exploits the fact that all Dbi compliant database tables come in pairs, the main data table and an auxiliary validity range table. The auxiliary table records insertion dates and have globally unique SeqNos (Sequence Numbers). The diagram shows how globally unique numbers are assigned. Every database that is a source of data has a `GlobalSeqNo` table that is used to generate sequence numbers. Each time one is allocated the count is incremented in the table. For each database the table operates in a different range of numbers hence ensuring that all are unique. dbmjob moves data in "Validity Packets" i.e. a single row in the auxiliary table and all its associated data rows. The insertion date and SeqNo on the auxiliary row allow dbmjob to support incremental updates and avoid data duplication.

All this implies a very important restriction on dbmjob:-

> *dbmjob can only distribute Dbi compliant database tables i.e. ones that come in pairs, the main data table and an auxiliary validity range table.*

18.2 Building and Running dbmjob

18.2.1 Building

The DatabaseMaintenance package is a standard Framework package and the dbmjob application is build in the standard way:-

```
cd $SRT_PUBLIC_CONTEXT    %$
gmake DatabaseMaintenance.all
```

18.2.2 Running

Before running, a Database cascade must be defined using the `ENV_TSQL_*` variables as described in *dbi:install*. Alternatively use the -d, -u and -p switches that are also described there or use the `ENV_TSQL_UPDATE_*` (e.g. `ENV_TSQL_UPDATE_USER`) set of variables. Where they exist, they will take precedence over the equivalent `ENV_TSQL_*` variable. This allows for a safe read-only setting of the `ENV_TSQL_*` variables that can be shared by a group, with just the local database manager also having the `ENV_TSQL_UPDATE_*` set for write-access. Note that the job switches take priority over everything else.

To run, just type:-

```
dbmjob
```

dbmjob enters interactive mode. For help type `H`elp and to quit type `Q`uit. The following illustrate simple exporting and importing. For more detail consult the Help command.

Exporting Data

dbmjob always exports data from the first database in the cascade.

To export data use the `E`xport command. The syntax is:-

```
Export {--Since <date>}  <table>  <file>
```

This exports the contents of <table> into <file> which can subsequently be imported into another database using the Import command. <table> can be a specific table e.g. PlexPixelSpotToStripEnd or * for all tables. For example:-

```
Export * full_backup.dat
Export -since "2001-09-27 12:00:00" PlexPixelSpotToStripEnd update.dat
```

The first updates the entire database whilst the second just records updates to PlexPixelSpotToStripEnd since midday on the 27 September 2001.

Importing Data

By default dbmjob always imports into the first database in the cascade but this can be overridden.

To Import data use the `I`mport command. The syntax is:-

```
Import {--Test } {--DatabaseNumber <no>} <file>
```

This imports the contents <file> into the database. The insertion dates in the file's validity records are replaced by the current date and time so that the insertion dates in the database reflect the local insertion date. Any SeqNo already present will be skipped but the associated data is compared to the corresponding entries in the database to confirm that they are identical, neglecting differences in insertion dates. For example:-

```
Import full_backup.dat
Export --DatabaseNumber 1  update.dat
Import --Test full_backup.dat
```

The first updates the first database (Cascade number 0) whilst the second updates the second database in the cascade. The last does not import at all but still does comparisons so is a convenient way to compare a database to an import file.

CHAPTER

NINETEEN

BIBLIOGRAPHY

Bibliography

CHAPTER

TWENTY

TESTING CODE WITH NOSE

20.1 Nosetests Introduction

- Unit Testing Philosophy
- Examples
  - DybDbi
  - DBUpdate
  - DbiTest
- Recommendations
  - short and focussed
  - dont repeat yourself
- Zero Cost Test Development
- References
  - External
  - doc:6280 : Encouraging Nose Testing
  - doc:5258 : Your NuWa Testing System
  - doc:3645 : NuWa Offline Software Testing System
  - doc:3091 : NuWa-Trac and Testing System

Many presentations are available describing how to create nosetests, doc:3645 is recommended starting point for the absolute beginner. Also wiki:Unit_Tests provides an excellent introduction.

20.1.1 Unit Testing Philosophy

The benefits from *unit* (class level) testing come principally when testing development takes place together with (and informs) interface design/development. By thinking first of how to test (rather than how to implement) you are more likely to end up with quality code.

Quality code

is focussed, decoupled, easy to use, easy to test

Because of this retro-unit testing once the interface has solidified is not useful, except as a way to document and fix bugs.

Unit tests should not be complicated, as when they fail you (and others not familiar with the code) want to be able to understand why quickly.

20.1.2 Examples

Many of the packages of NuWa include a *tests* directory with nosetests named *test_<something>.py*. This plethora of examples using many different styles can make it difficult to decide which is the appropriate approach to follow. Thus the below provides some guidelines to the testing done in a few packages.

DybDbi

- dybgaudi:Database/DybDbi/tests/

Large numbers of tests at all levels, the shorter ones make good beginner examples. Such as:

- dybgaudi:Database/DybDbi/tests/test_seqno.py
- dybgaudi:Database/DybDbi/tests/test_feecablemap.py

DBUpdate

- dybgaudi:Calibration/DBUpdate/tests/
- dybgaudi:Calibration/DBUpdate/tests/test_calibpmtfinegain.py

test_calibpmtfinegain.py makes good use generative nosetests allowing separate tests for every validity record in a table to be generated via the **yield** of check functions. Note that for testing from the main have to interate over the test in order to get the check functions and their arguments. Other packages are easier to follow if you are new to nosetesting.

DbiTest

- dybgaudi:Database/DbiTest/tests/

Mostly deals with testing the internals of DBI. Typically testing would not need to descend to these levels.

20.1.3 Recommendations

short and focussed

Individual tests and test modules should be kept short and focussed. The motivation being that when a test fails it is advantageous to be able to work out what went wrong quickly without having to debug a complicated morass of code.

Also as running:

```
nosetests -v
```

will run all *def test_<name>:* functions from all *test_<modulename>.py* modules in the *tests* directory so there is no cost to splitting tests as much as practical.

dont repeat yourself

Common functionalty should not be repeated in multiple test modules. Instead import the classes and functions from other python modules. The examples often do this from a common *cnf.py* module.

20.1.4 Zero Cost Test Development

A simple concrete development style example of how to develop and test a python class in a manner that creates tests with almost no overhead.

1. implement single **Name** classes within single *name.py* files and make them executable:

   ```
   svn ps svn:executable yes name.py    # set SVN property to make executable everywhere
   ```

2. run the *__main__* block:

   ```
   ./name.py
   ```

3. as each feature is added to a class test it within the *__main__* block:

   ```
   if __name__ == '__main__':
       obj = Whatever()
       obj.feature_A()
       assert ...
   ```

4. once the feature is working, copy the *__main__* into a test named after the feature:

   ```
   def test_feature_A():
       obj = Whatever()
       obj.feature_A()
       assert obj.whatever == smth
   ```

5. once done with a class move the tests over to a *test_name.py* file that lives within a *tests* directory

20.1.5 References

External

A few interesting resources providing opinions and experience on testing.

1. http://misko.hevery.com/code-reviewers-guide/
2. http://www.agitar.com/downloads/TheWayOfTestivus.pdf
3. http://arstechnica.com/information-technology/2013/03/why-does-automated-testing-keep-failing-at-my-company/

doc:6280 : Encouraging Nose Testing

Make adding tests a zero step process

doc:5258 : Your NuWa Testing System

Guide to running and creating tests within nose based testing system, allowing NuWa behaviour to be contrained to fulfil the expectations of package experts.

doc:3645 : NuWa Offline Software Testing System

Demonstrating the ease and usefulness of our software testing system, with the desire to increase its usage.

doc:3091 : NuWa-Trac and Testing System

Guide to using NuWa-Trac, creating and modifying tickets and running tests, developer guide to adding tests.

20.2 Using Test Attributes

As test runs get longer it becomes very useful to control which tests get run in a flexible manner. This functionality is based on the nose `attrib` plugin documented at `nose.plugins.attrib`

- Package Level Nosetesting with attributes
- Testing at dybinst level
- Testing at bitten slave level
  - Commit Message controlled deep testing
  - Periodic deep testing based on revision number

20.2.1 Package Level Nosetesting with attributes

Example based on simple and quick to run dybgaudi:Database/DybDbi/tests/test_feecablemap.py for easy checking.

```
from cnf import setup, teardown
from DybDbi import GFeeCableMap


def test_spin():
    r = GFeeCableMap.Rpt()
    print len(r)
    print r[0]
    for i,o in enumerate(r):
        print " %3d feechannelid %d feechanneldesc %s feehardwareid %d sensorid %d sensordesc %s pmt
              ( i, o.feechannelid.fullPackedData() , o.feechanneldesc, o.feehardwareid.id() , o.senso

def test_spin_slowfake():
    r = GFeeCableMap.Rpt()
    print len(r)
    print r[0]
    for i,o in enumerate(r):
        print " %3d feechannelid %d feechanneldesc %s feehardwareid %d sensorid %d sensordesc %s pmt
              ( i, o.feechannelid.fullPackedData() , o.feechanneldesc, o.feehardwareid.id() , o.senso
test_spin_slowfake.minutes = 10


if __name__ == '__main__':
    setup()
    test_spin()
    test_spin_slowfake()
    teardown()
```

minutes convention

Assigning an indicative number of minutes to longer running tests allows flexible control over which tests should be run.

The below line assigns a **minutes** attribute to `test_spin_slowfake`.

```
test_spin_slowfake.minutes = 10
```

Subsequently can select which tests using an attribute expression:

```
nosetests -v -A "minutes > 5"
nosetests -v -A "minutes < 5"
```

Real command examples from `DybDbi` package directory:

- **`DBCONF=offline_db nosetests -v -A "minutes > 5"`** run only tests for which the attribute expression is true : currently only 1 test
- **`DBCONF=offline_db nosetests -v -A "minutes < 5"`** run only tests for which the attribute expression is true : currently 270 tests
- **`DBCONF=offline_db nosetests -v`** run all tests in the package : currently 271 tests
- **`DBCONF=offline_db NOSE_EVAL_ATTR="minutes > 5" nosetests -v`** using environment controlled attribute setting : runs 1 test
- **`DBCONF=offline_db nosetests -v tests/test_feecablemap.py -A "minutes > 5"`** runs just `test_spin_slowfake`
- **`DBCONF=offline_db nosetests -v tests/test_feecablemap.py -A "minutes < 5"`** runs just `test_spin`

20.2.2 Testing at dybinst level

Analogously to the above (from dybsvn:r11731) the control can be done at `dybinst trunk tests <pkg-or-alias>` level with:

- **`./dybinst trunk tests dybdbi`** run all tests in `dybdbi` package, currently 271
- **`NOSE_EVAL_ATTR="minutes > 5" ./dybinst trunk tests dybdbi`** only tests meeting the expression, currently 1
- **`NOSE_EVAL_ATTR="minutes < 5" ./dybinst trunk tests dybdbi`** only tests meeting the expression, currently 270

20.2.3 Testing at bitten slave level

Commit Message controlled deep testing

Attribute expressions `attr:<expr>` in svn commit messages like the below are detected and passed to nosetests:

```
example commit message that triggers long tests only attr:"minutes > 10"
example commit message that triggers medium tests attr:"5 < minutes < 10"
```

> **Warning:** a build must be triggered within 60 min of the commit time for the `attr:` command to take effect

Protecting quotes is required, eg with:

```
svn ci -m '  attr:"minutes > 5" '
```

Example exercising the machinery, which demonstrates how the bitten-slave access the `SVNLOG_attr` parsed from commit messages.

```
./dybinst -E demo.sh trunk tests dybdbi      # demo.sh contains export statements
```

Periodic deep testing based on revision number

BUILD_REVISION is available to dybinst from dybsvn:r11732 and is used to set default attribute expressions that select nosetests from dybsvn:r11738.

build revision	default expression
ends with 00	minutes < 101
ends with 0	minutes < 11
otherwise	minutes < 6

Examples of how to exercise the machinery:

```
BUILD_REVISION=12345 ./dybinst trunk tests dybdbi
BUILD_REVISION=12300 ./dybinst trunk tests dybdbi
BUILD_REVISION=12340 ./dybinst trunk tests dybdbi
```

Note: commit message `attr:` commands trump BUILD_REVISION defaults

20.3 Running Tests Using dybinst

- Informing dybinst about tests
- Getting the slaves to auto run package tests

20.3.1 Informing dybinst about tests

Lists of CMT packages containing tests are configured in installation:dybinst/scripts/dybinst-common.sh,

```
dyb_tests_djaffe="dybalg mdc10b fmcp11a"
dyb_tests_jetter="elecsim digitizealg"
# add tests here under alias corresponding to your svn username

dyb_tests_db_conditional="dbitest dybdbitest dybdbi"   ## conditional on DBCONF sections named after
dyb_tests_default="gaudimessages gentools rootiotest simhistsexample dbivalidate $dyb_tests_djaffe $
dyb_tests_suspects="gentools rootiotest mdc10b"

dyb_tests_db="daqruninfosvc dbidatasvc dbirawdatafilesvc"
dyb_tests_all="$dyb_tests_default $dyb_tests_db dethelpers conventions gendecay"
dyb_tests_failing="detsim"

# these sets define the content of the bitten-slave recipes for configs "dybinst" and "detdesc"
dyb_tests_dybinst="$dyb_tests_default"
dyb_tests_detdesc="xmldetdescchecks"
```

with variables of form dyb_tests_<alias> where the alias names djaffe, jetter, suspects, all can be used to refer to the lists of packages. This allows sets of packages to be run with for example:

```
./dybinst trunk tests jetter
./dybinst trunk tests djaffe
```

```
./dybinst trunk tests db
./dybinst trunk tests db_conditional
```

No argument corresponds to the `default` alias, which runs the tests of most of the packages:

```
./dybinst trunk tests
```

20.3.2 Getting the slaves to auto run package tests

The bitten-slave follow xml recipes that specify build and test steps to perform. To add tests to the standard set run by the slaves requires these xml recipes to be updated and committed to dybsvn. After modifying installation:dybinst/scripts/dybinst-common.sh generate updated bitten-slave xml recipes using commands:

```
./dybinst trunk tests recipe:dybinst
./dybinst trunk tests recipe:opt.dybinst

cd installation/trunk/dybinst/scripts
svn ci -m "update the slave recipes to include tests for mypkga, mypkgb under the alias mysvnusername
```

After auto builds have been performed the status of the added test steps run on all the slaves can be seen through the web interface at build:dybinst and build:opt.dybinst.

20.4 Testing nose plugins

- Setup vitualenv sandbox
- Get into the virtualenv
- Interesting Plugins
  - nosepipe
  - insulate

20.4.1 Setup vitualenv sandbox

1. Install virtualenv (only this step requires write access to *nuwa* installation):

   ```
   ./dybinst trunk external virtualenv
   ```

2. Get virtualenv into your PATH:

   ```
   cd $SITEROOT/lcgcmt/LCG_Interfaces/virtualenv/cmt
   cmt config ; . setup.sh
   which virtualenv           ## should be the NuWa one
   ```

3. Create virtual python environment, *spawned* from nuwa python eg:

   ```
   virtualenv ~/v/nose
   ```

For background info on `virtualenv` see http://www.virtualenv.org/en/latest/

20.4.2 Get into the virtualenv

1. Get into the environment:

```
. ~/v/nose/bin/activate
which pip python easy_install ## should all be from ~/v/nose/bin
```

2. install plugin:

   ```
   pip install nosepipe
   ```

3. list plugins:

   ```
   PYTHONPATH=~/v/nose/lib/python2.7/site-packages:$PYTHONPATH nosetests -p
   ```

20.4.3 Interesting Plugins

Many 3rd party plugins:

- http://nose-plugins.jottit.com/

nosepipe

Plugin for the nose testing framework for running tests in a subprocess

- http://code.activestate.com/pypm/nosepipe/

Such a feature would be very useful for DBI testing in order to work with different DBI configurations within a single test run. But it is not clear about the granularity control, would want each module of tests to correspond to a separate process.

From the help:

```
PYTHONPATH=~/v/nose/lib/python2.7/site-packages:$PYTHONPATH nosetests --help

--with-process-isolation
       Enable plugin ProcessIsolationPlugin: Run each test in
       a separate process. [NOSE_WITH_PROCESS_ISOLATION]
```

But looks like not running in py27:

```
(nose)[blyth@belle7 ~]$ PYTHONPATH=~/v/nose/lib/python2.7/site-packages:$PYTHONPATH nosetests --with-
setup 22041
ERROR
ERROR
ERROR
teardown 22041

======================================================================
ERROR: test_mp.test_red
----------------------------------------------------------------------
Traceback (most recent call last):
  File "/data1/env/local/dyb/external/nose/0.11.4_python2.7/i686-slc5-gcc41-dbg/lib/python2.7/site-pa
    self.runTest(result)
  File "/data1/env/local/dyb/external/nose/0.11.4_python2.7/i686-slc5-gcc41-dbg/lib/python2.7/site-pa
    test(result)
  File "/home/blyth/v/nose/lib/python2.7/site-packages/nosepipe.py", line 152, in __call__
    (request_len, len(data)))
Exception: short message body (want 1416782179, got 207)
```

insulate

- http://code.google.com/p/insulatenoseplugin/wiki/Documentation

About this testing section

The documentation is sourced from reStructuredText in dybgaudi:Documentation/OfflineUserManual/tex/nose, and html and pdf versions are derived as part of the automated Offline User Manual build. For help with building see *Build Instructions for Sphinx based documentation*

CHAPTER

TWENTYONE

STANDARD OPERATING PROCEDURES

Release 22909

Date May 16, 2014

This documentation attempts to provide the practical knowledge needed to perform database operations. Inner details of how DBI works and conceptual background are not covered, these are available at *Database Interface*. A very brief description of some DBI conventions is provided in *DBI Very Briefly*.

The description of DB operations are divided into sections:

1. *DB Definitions* to facilitate communication
2. *DBI Very Briefly*
3. *Rules for Code that writes to the Database*
4. *Configuring DB Access*
5. *DB Table Updating Workflow*
6. *Table Specific Instructions* Special instructions for some tables
7. *DB Table Writing*
8. *DB Table Reading*
9. *Debugging unexpected parameters*
10. *DB Table Creation*
11. *DB Validation*
12. *DB Testing*
13. *DB Administration*
14. *Custom DB Operations*
15. *DB Services*
16. *DCS tables grouped/ordered by schema*
17. *Non DBI access to DBI and other tables*
18. *Scraping source databases into offline_db*
19. *DBI Internals*
20. *DBI Overlay Versioning Bug*

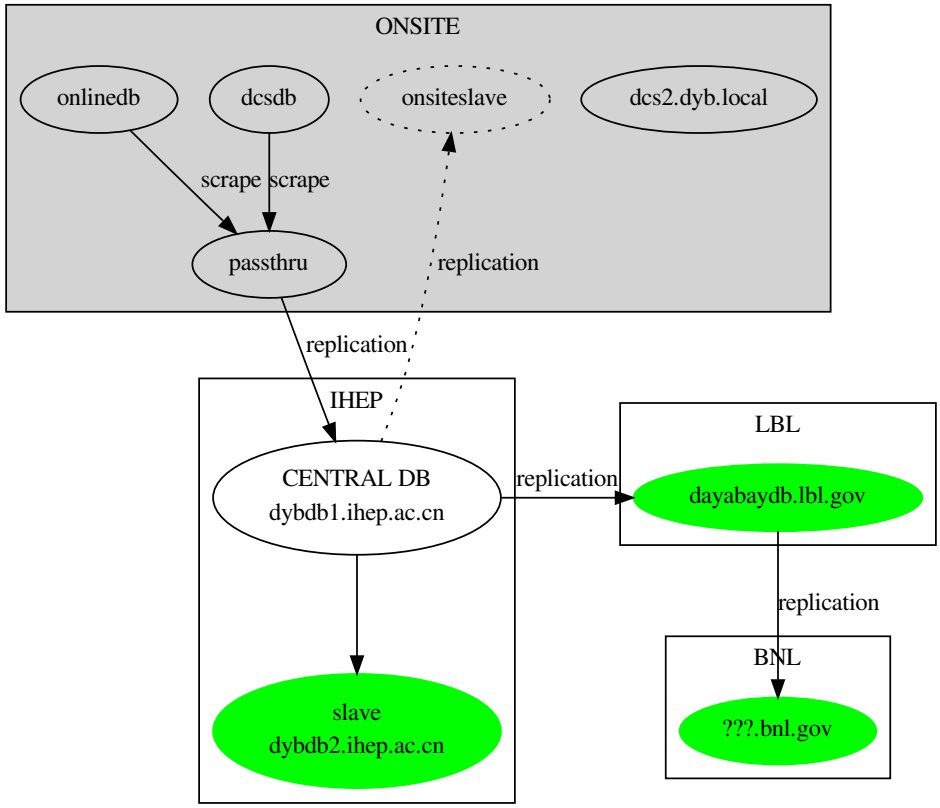
Detailed table of contents:

21.1 DB Definitions

For clarity of expression common naming of the various components is useful.

21.1.1 Database Topology Diagram

`offline_db` replication data flow



Future plans:

1. Offline DB slave Onsite as well (perhaps on same hardware as `passthru` DB)

Which Database to read from ?

Use nearest replicated *slave* of `offline_db`, ie `dybdb2.ihep.ac.cn`

Which Database to write to ?

Your copy of `offline_db`, known as `tmp_offline_db`

Database content and handling is divided into two categories with very different handling:

- monitored DCS/DAQ quantities that are automatically scraped into the `offline_db` by continously running scripts
- calibration parameters that are calculated based on data taking files and updated in an initally manual manner

The above figure is sourced in dybgaudi:Documentation/OfflineUserManual/tex/sop/dbdefn.rst, please commit any corrections/updates to the figure (in dot/graphviz language). The figure is gleaned mostly from p9 of doc:4449 *cet091219offline-database.ppt.pdf*

21.1.2 Database names

Section Names or Database names

This documentation refers to databases by their configuration file section names such as `tmp_offline_db` rather than by the actual database name (eg **tmp_username_offline_db**), as this parallels the approach taken by the tools: `db.py` and `DBI`.

For clarity a few definitions are required

offline_db central DB at IHEP

tmp_offline_db temporary copies of *offline_db*

21.2 DBI Very Briefly

- Validity Tables
- Validity Table Timestamps
  - How these times fit in
  - Choosing Validity Ranges
  - Rollback and Production
- Using Rollback to Debug/Workaround problem DB entries
- What is `TASK` for ?
- Features of Clean Validity Tables
  - Overlay Versioning
- DBI Q and A
  - Doesnt `TIMEEND` of `EOT` overshadow valid entries when we correct an earlier entry ?
  - How do we make sure not to end up with `SEQNO` gaps ?
  - If my update has a given SEQNO in my `tmp_offline_db`, will it have the same in the `offline_db` ?
  - What are fastforward commits ? Why are they needed ?
  - Or is the `offline_db` smart so that it automatically gives it the next number in the sequence ?
  - How can `SEQNO` be missed?

21.2.1 Validity Tables

DBI validity tables are the heart of how DBI operates:

```
mysql> describe TableNameVld ;
+-------------+------------+------+-----+---------+----------------+
| Field       | Type       | Null | Key | Default | Extra          |
+-------------+------------+------+-----+---------+----------------+
| SEQNO       | int(11)    | NO   | PRI | NULL    | auto_increment |
| TIMESTART   | datetime   | NO   |     | NULL    |                |
| TIMEEND     | datetime   | NO   |     | NULL    |                |
| SITEMASK    | tinyint(4) | YES  |     | NULL    |                |
| SIMMASK     | tinyint(4) | YES  |     | NULL    |                |
| SUBSITE     | int(11)    | YES  |     | NULL    |                |
| TASK        | int(11)    | YES  |     | NULL    |                |
| AGGREGATENO | int(11)    | YES  |     | NULL    |                |
| VERSIONDATE | datetime   | NO   |     | NULL    |                |
| INSERTDATE  | datetime   | NO   |     | NULL    |                |
+-------------+------------+------+-----+---------+----------------+
10 rows in set (0.00 sec)
```

21.2.2 Validity Table Timestamps

Each validity entry includes 4 timestamps:

`TIMESTART` start of context range

`TIMEEND` end of context range, often end-of-time

`VERSIONDATE` used by overlay versioning to distinguish otherwise equal validities, overlay versioning usage if signalled by using `versiondate=TimeStamp(0,0)` in writer contexts. allowing easy overriding ... just rewrite with same contextrange to override

`INSERTDATE` the actual insert time, used by rollback to select a snapshot of DB at a chosen time (or times ... this can be a per-table time) This means : **NEVER CHEATED** ... should always be actual UTC now of the `offline_db` update.

How these times fit in

Stating the obvious, in order to clarify the large numbers of timestamps floating around:

The timestamps embedded into real datafiles and simulation files, form the contexts used to make DBI queries so database validity `TIMESTART/TIMEEND` must be appropriate for those embedded timestamps.

Choosing Validity Ranges

The choice of validity range should be made as appropriate to the parameters.

In the case of MC production runs which have pre-defined non-overlapping and monotonically increasing time ranges, it is straighforward to choose `TIMESTART`. Where you suspect validity may extend beyond a single production using `TimeStamp.GetEOT()` for `TIMEEND` is the appropriate choice. Subsequent writes can of course override these entries.

Rollback and Production

The DBI **ROLLBACK** feature is very important for controlled production usage of DBI. A global timestamp or per-table timestamps are defined that all DBI queries incorporate, allowing the DB tables seen by all production jobs(or reruns thereof) to be the same no matter what DB updates are done in the meantime.

Reprocessing an existing dataset following DB updates with improved parameters would entail definition of a new set of rollback dates to benefit from the improved parameters.

Note that these rollback dates pertain **only** to the `INSERTDATE` used. This is orthogonal to the `TIMESTART/TIMEEND` which pertains to the timestamps which are embedded into the files.

Note this presupposes DBI is used appropriately:

1. no deletions
2. no changes to existing entries
3. only additions are permissible

Deletions/changes are only allowed at the initial setup stage.

21.2.3 Using Rollback to Debug/Workaround problem DB entries

To verify that a DB update is causing issues or to workaround such problems it is possible to utilise DBI rollback to return to a prior state of all or some of the tables in the DB. This works by applying *INSERTDATE* < *rollbackdate* cuts .

For example setting the rollback date for all tables:

```
DBCONF_ROLLBACK="* = 2011-10-01 08:08:08" nuwa.py ...etc...
```

Single tables:

DBCONF_ROLLBACK=”CalibPmtSpec = 2011-10-01 08:08:08” nuwa.py ....etc...

Multiple tables via comma delimited mappings:

```
DBCONF_ROLLBACK="CalibPmtSpec = 2011-10-01 08:08:08,EnergyRecon = 2011-05-01 08:08:08, "  nuwa.py ...
```

Wildcarded sets of tables:

```
DBCONF_ROLLBACK="Cal* = 2011-10-01 08:08:08"  nuwa.py ....etc...
```

Combine global setting with table specific ones using comma delimited string:

```
DBCONF_ROLLBACK="* = 2011-10-01 08:08:08,Cal* = 2011-10-01 08:08:08"
```

The above envvar setting approach is bash specific, if you must use inferior shells you will probably need to ranslate into “setenv DBCONF_ROLLBACK ... ; nuwa.py ...”

21.2.4 What is `TASK` for ?

`TASK` is usually left at its default value of zero, greater than zero values are used for testing out non-default algorithms.

21.2.5 Features of Clean Validity Tables

1. SEQNO starting from 1 and with no gaps, with maximum corresponding to the LASTUSEDSEQNO
2. Far future times all using TimeStamp.GetEOT() namely 2038-01-19 03:14:07
3. Overlay versioning in use, see below

An example of a clean table with SEQNO = 1:213:

```
mysql> select * from CableMapVld ;
+-------+---------------------+---------------------+----------+---------+----------+------+----------
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATE
+-------+---------------------+---------------------+----------+---------+----------+------+----------
|    *1*| 2009-03-16 11:27:43 | 2038-01-19 03:14:07 |        1 |       2 |        2 |    0 |
|     2 | 2009-03-16 11:27:43 | 2038-01-19 03:14:07 |        2 |       2 |        6 |    0 |
|     3 | 2009-03-16 11:27:43 | 2038-01-19 03:14:07 |        4 |       2 |        6 |    0 |
|     4 | 2009-03-16 11:27:43 | 2038-01-19 03:14:07 |        4 |       2 |        5 |    0 |
|     5 | 2009-03-16 11:27:43 | 2038-01-19 03:14:07 |        4 |       2 |        4 |    0 |
...
|   208 | 2011-05-23 08:22:19 | 2038-01-19 03:14:07 |        2 |       2 |        7 |    0 |
|   209 | 2011-05-23 08:22:19 | 2038-01-19 03:14:07 |        4 |       2 |        7 |    0 |
|   210 | 2011-05-23 08:22:19 | 2038-01-19 03:14:07 |        1 |       2 |        7 |    0 |
|   211 | 2011-05-23 13:09:43 | 2038-01-19 03:14:07 |        2 |       2 |        7 |    0 |
|   212 | 2011-05-23 13:09:43 | 2038-01-19 03:14:07 |        4 |       2 |        7 |    0 |
|  *213*| 2011-05-23 13:09:43 | 2038-01-19 03:14:07 |        1 |       2 |        7 |    0 |
+-------+---------------------+---------------------+----------+---------+----------+------+----------
*213* rows in set (0.34 sec)
```

LOCALSEQNO table contains the last used SEQNO for each table, 213 for CableMap:

```
mysql> select * from LOCALSEQNO ;
+--------------+---------------+
| TABLENAME    | LASTUSEDSEQNO |
+--------------+---------------+
| *            |             0 |
| CalibFeeSpec |           113 |
| CalibPmtSpec |            29 |
| FeeCableMap  |             3 |
| CableMap     |           213 |   <<<<<<<<  213 <<<<<<
| HardwareID   |           172 |
+--------------+---------------+
6 rows in set (0.14 sec)
```

Overlay Versioning

VERSIONDATE is more VERSION than DATE

Is better thought of as a VERSION number than rather than a timestamp. Notice the artificial 1 minute jumps in the below VERSIONDATE values.

Overlay versioning is visible by the 1 min differences in VERSIONDATE between overlapping validities. These VERSIONDATE are filled in automatically by DBI when signalled to do so by the special context argument versiondate=TimeStamp(0,0) . As DBI validity queries are done in descending VERSIONDATE order with the SQL: ordered by VERSIONDATE desc this allows updates to prior entries to be simply achieved by re-writing with the same contextrange and with overlay versioning enabled.

Query to find overlapping validities, that are distinguished by VERSIONDATE:

```
mysql> select * from CableMapVld where sitemask=1 and subsite=1 ;
+-------+---------------------+---------------------+----------+---------+---------+------+----------
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATE
+-------+---------------------+---------------------+----------+---------+---------+------+----------
|    14 | 2009-03-16 11:27:43 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|    22 | 2009-06-03 21:36:27 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|    35 | 2010-12-07 19:14:20 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|    57 | 2011-02-08 15:49:51 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|    71 | 2011-02-22 12:38:11 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|    85 | 2011-02-22 17:08:51 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|    99 | 2011-02-22 18:07:45 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|   113 | 2011-02-23 10:49:36 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|   127 | 2011-03-25 19:31:49 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|   143 | 2011-04-01 17:29:23 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|   159 | 2011-04-18 03:42:40 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|   175 | 2011-04-19 23:56:10 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|   191 | 2011-05-03 02:35:09 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|   207 | 2011-05-05 17:42:22 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+------+----------
14 rows in set (0.09 sec)
```

21.2.6 DBI Q and A

Doesnt TIMEEND of EOT overshadow valid entries when we correct an earlier entry ?

This is the most frequently stated fallacy about DBI. See the above section *Overlay Versioning*. Essentially DBI always orders validities(Vld entries) by VERSIONDATE, **NOT** by INSERTDATE. This means that by virtue of overlay versioning (VERSIONDATE is derived from TIMESTART with minute offsets) you can go back and override a former commit (still using EOT) and not override your recent entries for subsequent times.

How do we make sure not to end up with SEQNO gaps ?

1. use DBI/DybDbi to prepare updates
2. avoid raw SQL fixes or doing nasty things like editing your ascii catalogs
3. be careful regards re-running updates more that once, you can always start with a fresh tmp_offline_db if you do this by mistake
4. check LOCALSEQNO table after updates, it should contain the LASTUSEDSEQNO for your updated tables

If my update has a given SEQNO in my tmp_offline_db, will it have the same in the offline_db ?

Yes, but it is unwise to do anything based on hardcoded SEQNO

Your table in tmp_offline_db is **rdumpcat** into *dybaux* then **rloadcat** into offline_db in a way that keeps the content exactly the same and SEQNO is preserved. The only thing that is changed is the INSERTDATE, which is fastforwarded to the UTC now date of the actual insert.

What are fastforward commits ? Why are they needed ?

Fastforward commits are changes to the `INSERTDATE` validities that are made by the script (`dbaux.py`) that DB managers use to propagate a `dybaux` catalog commits into `offline_db`. After updates are propagated these working copy changes are committed to `dybaux`.

This fastforwarding of `INSERTDATE` to the time of the actual `offline_db` insert in required to avoid windows of ambiguity between the time the insert is done into `tmp_offline_db` and the time that gets propagated into `offline_db`.

Or is the `offline_db` smart so that it automatically gives it the next number in the sequence ?

DBI supplies the next `SEQNO` in your `tmp_offline_db`, the steps from there to `offline_db` simply copy it.

How can `SEQNO` be missed?

Either directly by deletions or from failure modes, eg:

1. a re-run that doubles up your SEQNO in LOCALSEQNO, followed by cleanup of Payload and Vld but not LOCALSEQNO entry could result in missing many SEQNO

Automatic and manual validations should pick up such issues.

21.3 Rules for Code that writes to the Database

21.3.1 Scope of Rules

All code that writes into the Offline Database is required to abide by the regulations. This includes:

1. Calibration writers
2. Automated Scrapers

> **Warning:** code that prepares the parameters is also covered by the rules

21.3.2 DB Writing Code Management

- code must be reviewed by DB Managers or their delegates

Code reviewers must verify :

- code is housed(and developed) in dybsvn repository CMT packages
- packages have nosetests that can be run by everyone (including the slaves)
- uses DBI (either directly or via DybDbi), no raw SQL
- all times in UTC
- context range end validity times, standardized far future time as `TimeStamp::GetEOT()`
- **uses enums rather than bare integers**
  - if enums do not exist they need to be created
- ... (more suggestions)

21.3.3 Rationale for dybsvn rule

Housing and developing code in dybsvn has several advantages:

- allows referencing the the state of the code with a single integer : the revision number
- easy for all collaborators to see the code that prepared the update now and in the future

Abiding by this rule is a crucial requirement for the creation of reproducible calibration parameters (and by extension reproducible physics results).

21.3.4 Recording how DB updates were prepared

Good practices to adopt to record how an update was prepared

- include documentation (in any text based format) alongside code in SVN to provide a record of the algorithm used and any changes to it
- include simple "no argument" scripts in SVN that run your flexible scripts or executables in order to capture the arguments used. These "no argument" simple scripts can be named after the update and will prove useful for subsequent updates.
- ensure that your final values are created with a clean revision (svnversion needs to report an integer without an "M" for modified).
- record the revision number

21.3.5 Verification of reproducibility

Although time consuming the best way to ensure that results are reproducible is to test this by

- requesting collaborators from another cluster/continent to duplicate results using just what was obtained from an SVN checkout (at a defined revision) and data files (which presumably have standard naming that allows them to be accessed from different clusters).

21.3.6 Testing DB writing code

- development against *offline_db* is prohibited
- developing against local copies of *offline_db* is recommended

Follow the example provided by dybgaudi:Database/DBWriter/tests which demonstrate best working practices for testing DB Writing code, where every step is fully controlled.

- starts from the vacuum
- creates an empty DB
- creates tables descriptions in the DB
- populates DB with pre-requisite entries (a DaqRunInfo row in this case) using `DybDbi`
- invokes the DBWriter script in a separate process, using `dybtest.Run`
- does reference comparisons on the output of the script
- does reference comparisons on the mysqldumped database that results from the running of the script

This approach allows frequent automated running of the test

21.4 Configuring DB Access

- Create Simple DB configuration file
  - Standardized Section Names
  - Section dependent testing
- DBCONF envvar
  - Cascade configuration
  - Configuring access to ascii catalog
  - Using dybaux as ascii catalog
- N ways to set an envvar
  - bash
  - Inferior shells such as tcsh/csh
  - python
- Background Information
  - What is a mysql dump file ?
  - What is a DBI ascii catalog ?
- Hands-On Exercise 1 : Troubleshooting DB connection configuration
  - Check with mysql client
  - Check with db.py
  - Check with DBI
  - DBI error when DBCONF not defined
- Hands On Exercise 2 : Interactive DybDBI
  - Get into ipython
  - Interactively verify connection
  - Interactive Exploration with ipython TAB completion
  - DybDbi with some magic

As both DBI and db.py make heavy usage of the mysql configuration file and as this is the primary source of problems for beginners, the below elaborates on how to setup your configuration and troubleshoot problems.

21.4.1 Create Simple DB configuration file

CAUTION

Keep your configuration file clean and simple with obvious correspondence between section names and DB names.

Create a configuration file in your home directory ~/.my.cnf containing parameters to connect to relevant databases, for example:

```
[offline_db]
host     = dybdb2.ihep.ac.cn
database = offline_db
user     =  dayabay
password = youknowit

[tmp_offline_db]
host = dybdb2.ihep.ac.cn
database = tmp_wangzhm_offline_db
user = wangzhm
password = plaintestpw
```

```
[client]
host = dybdb2.ihep.ac.cn
database = tmp_wangzhm_offline_db
user = wangzhm
password = plaintextpw
```

Section Names

Note that the section names **offline_db**, **tmp_offline_db** do not exactly correspond to DB names, providing useful indirection : but keep it simple to avoid confusion.

Warning: At IHEP it is recommended that users connect to the slave machine dybdb2.ihep.ac.cn

The commandline `mysql` client by default reads the `client` section of the configuration file.

Note: localhost access

For localhost access, some systems are configured to use a location for the MySQL socket that is different than the hard-coded default of /tmp/mysql.sock and defining a "[client]" section will override this configuration. For such systems you must restore the "socket" directive by including it in your .my.cnf.

Standardized Section Names

section	references	role
offline_db	nearest slave copy of master	readonly access to content of central db
tmp_offline_db	temporary copy of `offline_db`	testing ground for updates, fair game to be dropped

transient nature of `tmp_offline_db`

make fresh copy from `offline_db` when working on updates : **avoiding merge problems**

Allows:

1. easy communication
2. scripts to have wider applicability, due to common roles
3. testing system to tailor tests based on sections available

Section dependent testing

The test is only run if all DBCONF sections are available in the configuration file.

```
from DybPython import DBConf
want_conf = 'cascade_0:cascade_1:cascade_2'
has_conf = DBConf.has_config( want_conf )

def setup():
   os.environ['DBCONF'] = want_conf

def test_cascade():
    for dbno in range(3):
```

```
        ...
test_cascade.__test__ = has_conf
```

21.4.2 DBCONF envvar

DBI uses the configuration section pointed to by the DBCONF environment variable. For example:

```
DBCONF=offline_db nuwa.py ...
DBCONF=tmp_offline_db nuwa.py ...
DBCONF=offline_db python -c "from DybDbi import gDbi ; gDbi.Status() "
```

For recommendations on how to set envvars on the commanline and in scripts, see below *N ways to set an envvar*

Further details on DBCONF and related envvars are in doc:5290.

Cascade configuration

Configuring a cascade is achieved by using multiple section names delimited by a colon, for example:

```
DBCONF=tmp_offline_db:offline_db nuwa.py ...
DBCONF=tmp_offline_db:offline_db python -c "from DybDbi import gDbi ; gDbi.Status() "
```

The first section name takes priority in the cascade.

Configuring access to ascii catalog

A config section like the below with a database value of dbname#/absolute/path/to/catalog/file.cat specifies the catalog to use and the database into which temporary tables are loaded:

```
[tmp_offline_db_ascii]
host = your.local.domain
user = joe
password = plaintextpw
database = tmp_joe_offline_db#/home/joe/tmp_offline_db/tmp_offline_db.cat
```

Including such a section name in DBCONF allows the content of the catalog to be accessed. For a quick test get into dybgaudi:Database/DybDbi and:

```
DBCONF=tmp_offline_db_ascii            python tests/test_feecablemap.py
DBCONF=tmp_offline_db_ascii            python -c "from DybDbi import gDbi ; gDbi.Status() "
DBCONF=tmp_offline_db_ascii:offline_db python -c "from DybDbi import gDbi ; gDbi.Status() "
```

mysql temporary tables can be inconvenient

The single session nature of MySQL temporary tables and their evaporation after a single usage means that they cannot be examined with the mysql client. An alternative approach is to use normal **browsable** tables in a non-standard DB and place the corresponding DBCONF string at the front of the DBI cascade.

Caveats arising from DBI ascii catalog implementation with MySQL temporary tables:

1. CREATE_TEMPORARY permission is required in the specified database
2. the temporary tables only exist for a single session, they are atomically loaded from the catalog at each DBI startup

Using dybaux as ascii catalog

Note that ascii catalog config can use a URL rather than the absolute path to a checkout:

```
[tmp_offline_db_ascii]
host = your.local.domain
user = joe
password = plaintextpw
database = tmp_joe_offline_db#http://dayabay:youknowit\@dayabay.ihep.ac.cn/svn/dybaux/!svn/bc/5070/c
```

The URL in the above example picks a particular revision of the catalog, to be loaded into temporary tables in the configured DB. This is equivalent to separately checking out dybaux to the desired revision and supplying the absolute path (or envvar prefixed) path in the config section.

21.4.3 N ways to set an envvar

bash

Pedestrian approach:

```
export DBCONF=tmp_offline_db
python myscript.py
```

Inline:

```
DBCONF=tmp_offline_db ipython
DBCONF=tmp_offline_db python myscript.py
DBCONF=tmp_offline_db nuwa.py ...
DBCONF=tmp_offline_db nosetests -v -s
DBCONF=tmp_offline_db ./dybinst trunk tests dbivalidate
DBCONF=tmp_offline_db ./dybinst trunk tests
DBCONF=tmp_offline_db ./dybinst trunk tests db_conditional
```

Inferior shells such as tcsh/csh

```
setenv DBCONF tmp_offline_db
python myscript.py
```

python

Convenient but Dangerous

The easily overridden `os.environ.setdefault` technique is not appropriate for scripts that write to Databases, but it is the recommended approach for readonly test scripts

```
import os
os.environ['DBCONF'] = "tmp_offline_db"
```

```
import os
os.environ.update( DBCONF="tmp_offline_db" )
```

```
import os
os.environ.setdefault( 'DBCONF', "tmp_offline_db" )
```

Question : what is the below going to return ?

```
export DBCONF=offline_db
python -c "import os ; os.environ.setdefault('DBCONF','tmp_offline_db') ; print os.environ['DBCONF']"
```

Using the easily overridden approach allows convenient testing against whatever Database or cascade:

```
DBCONF=tmp_offline_db:offline_db ./dybinst trunk tests dybdbi
```

Warning: tests that operate beneath DBI, eg `DbiValidate` which connects with `MySQL-python`, have not yet been modified to work in cascade.

21.4.4 Background Information

What is a mysql dump file ?

A text serialisation of a MySQL database that contains the SQL commands necessary to recreate the table structure and content. They are complex and not well suited to human consumption.

What is a DBI ascii catalog ?

DBI ascii catalogs are a serialization of database tables composed of a directory structure containing *.csv* files and *.cat* files to link them together:

```
/path/to/<catname>/
            <catname>.cat
            CalibFeeSpec/
                CalibFeeSpec.csv
                CalibFeeSpecVld.csv
            CalibPmtSpec/
                CalibPmtSpec.csv
                CalibPmtSpecVld.csv
            ...
            LOCALSEQNO/
                LOCALSEQNO.csv
```

DBI ascii catalogs have several advantages over mysqldump (.sql) files:

1. effectively native DBI format that can be used in ascii cascades allowing previewing of future database before real updates are made
2. very simple/easily parsable .csv that can be read by multiple tools
3. very simple diffs (DBI updates should be contiguous additional lines), unlike mysqldump, this means efficient storage in SVN
4. no-variants/options that change the format (unlike mysqldump)
5. no changes between versions of mysql

Mysqldump serialization has the advantage of being easily usable remotely.

21.4.5 Hands-On Exercise 1 : Troubleshooting DB connection configuration

- Check with mysql client
- Check with db.py
- Check with DBI
- DBI error when DBCONF not defined

DIY: Configuration Setup and Troubleshooting

Create your ~/.my.cnf with 2 sections : offline_db and client, work through the below steps to verify your config. **Everyone** can do this, no extra permissions required.

Warning: Protect ~/.my.cnf with chmod go-rwx and **never** commit it into a repository

Approaches to isolating connection problems.

Check with mysql client

Verify that the mysql client can connect and check you are talking to the expected DB:

```
echo status | mysql   ## only the client section of the config
```

Check with db.py

Verify that db.py (a sibling of nuwa.py) can connect using the client section

```
db.py client check
  dbconf : reading config from section "client" obtained from ['/etc/my.cnf', '/home/blyth/.my.cnf']
  {'VERSION()': '4.1.22-log', 'CURRENT_USER()': 'root@belle7.nuu.edu.tw', 'DATABASE()': 'offline_db_2
```

Verify that db.py can connect using other sections of the config:

```
db.py offline_db check
  dbconf : reading config from section "offline_db" obtained from ['/etc/my.cnf', '/home/blyth/.my.cn
  {'VERSION()': '5.0.45-community-log', 'CURRENT_USER()': 'dayabay@%', 'DATABASE()': 'offline_db', 'C
```

DIY: Determine row counts for all tables

Use another db.py command : **count** , also check db.py --help or oum:api/db/

Check with DBI

Verify that DBI (and DybDbi) can connect. Do not be concerned regarding the Closed status mentioned in the output, the connection is opened when needed:

```
DBCONF=client python -c "from DybDbi import gDbi ; gDbi.Status() "
   DybDbi ctor
   DybDbi activating DbiTableProxyRegistry
   Using DBConf.Export to prime environment with : from DybPython import DBConf ; DBConf.Export('clie
```

```
dbconf : reading config from section "client" obtained from ['/etc/my.cnf', '/home/blyth/.my.cnf']
dbconf:export_to_env from /etc/my.cnf:$SITEROOT/../.my.cnf:~/.my.cnf section client
Successfully opened connection to: mysql://cms01.phys.ntu.edu.tw/offline_db_20110103
This client, and MySQL server (MySQL 4.1.22-log) does support prepared statements.
DbiCascader Status:-
Status   URL

Closed         0 mysql://cms01.phys.ntu.edu.tw/offline_db_20110103
```

Similarly test other sections of the config with:

```
DBCONF=offline_db python -c "from DybDbi import gDbi ; gDbi.Status() "
```

DBI error when DBCONF not defined

To connect to a database with DBI (and thus DybDbi) requires the DBCONF envvar to be defined. If it is not defined or is invalid you will see an abort with error message.

```
( unset DBCONF ;  python -c "from DybDbi import gDbi ; gDbi.Status() "  ; )
  DybDbi activating DbiTableProxyRegistry
  Cannot open Database cascade as DBCONF envvar is not defined :
  search for "DBCONF" in the Offline User Manual
  ABORTING
```

21.4.6 Hands On Exercise 2 : Interactive DybDBI

- Get into ipython
- Interactively verify connection
- Interactive Exploration with ipython TAB completion
- DybDbi with some magic

Get into ipython

Get into NuWa environment and fire up ipython with DBCONF defined, with bash:

```
DBCONF=offline_db ipython
```

with (t)csh:

```
setenv DBCONF "offline_db"
ipython
```

Interactively verify connection

Duplicate the below to verify a DB connection:

```
In [1]: from DybDbi import gDbi
Warning in <TEnvRec::ChangeValue>: duplicate entry <Library.vector<short>=vector.dll> for level 0; ig
Warning in <TEnvRec::ChangeValue>: duplicate entry <Library.vector<unsigned-int>=vector.dll> for leve
(Bool_t)1
DybDbi ctor
```

```
In [2]: gDbi.Status()
DybDbi activating DbiTableProxyRegistry
Using DBConf.Export to prime environment with : from DybPython import DBConf ; DBConf.Export('offline
dbconf:export_to_env from $SITEROOT/../.my.cnf:~/.my.cnf section offline_db
Successfully opened connection to: mysql://dybdb2.ihep.ac.cn/offline_db
This client, and MySQL server (MySQL 5.0.45-community) does support prepared statements.
DbiCascader Status:-
Status   URL

Closed         0 mysql://dybdb2.ihep.ac.cn/offline_db

DbiCascader Status:-
Status   URL

Closed         0 mysql://dybdb2.ihep.ac.cn/offline_db
```

Interactive Exploration with `ipython` TAB completion

Use `ipython` tab completion to interactively explore:

```
In [3]: gDbi.<TAB>
gDbi.ClearRollbackDates  gDbi.IsA                gDbi.__class__          gDbi.__ge__              g
gDbi.ConfigRollback      gDbi.IsActive           gDbi.__delattr__        gDbi.__getattribute__    g
gDbi.GetCascader         gDbi.MakeTimeStamp      gDbi.__dict__           gDbi.__gt__              g
gDbi.GetOutputLevel      gDbi.SetOutputLevel     gDbi.__doc__            gDbi.__hash__            g
gDbi.GetRegistry         gDbi.ShowMembers        gDbi.__eq__             gDbi.__init__            g
gDbi.Instance
```

The name of a object followed by `<RETURN>` outputs the `repr` (representation) of the object:

DIY: call some methods

For example on the cascader instance: `len(gDbi.cascader)` or `gDbi.cascader[0]`

```
In [3]: gDbi.cascader
Out[3]:
DbiCascader numdb 1 authorisingdbno -1 (1st with GLOBALSEQNO)
Closed      offline_db           #0 tmp        closed     mysql://dybdb2.ihep.ac.cn/offline_db

In [4]: gDbi.cascader.__class__
Out[4]: <class 'DybDbi.DbiCascader'>

In [5]: gDbi.cascader.<TAB>
gDbi.cascader.AllocateSeqNo         gDbi.cascader.GetURL               gDbi.cascader.__delattr__
gDbi.cascader.CreateStatement       gDbi.cascader.HoldConnections      gDbi.cascader.__dict__
gDbi.cascader.CreateTemporaryTable  gDbi.cascader.IsA                  gDbi.cascader.__doc__
gDbi.cascader.GetAuthorisingDbNo    gDbi.cascader.IsTemporaryTable     gDbi.cascader.__eq__
gDbi.cascader.GetConnection         gDbi.cascader.ReleaseConnections   gDbi.cascader.__format__
gDbi.cascader.GetDbName             gDbi.cascader.SetAuthorisingEntry  gDbi.cascader.__ge__
gDbi.cascader.GetDbNo               gDbi.cascader.SetPermanent         gDbi.cascader.__getattribute_
gDbi.cascader.GetNumDb              gDbi.cascader.ShowMembers          gDbi.cascader.__getitem__
gDbi.cascader.GetStatus             gDbi.cascader.TableExists          gDbi.cascader.__gt__
gDbi.cascader.GetStatusAsString     gDbi.cascader.__assign__           gDbi.cascader.__hash__
gDbi.cascader.GetTableDbNo          gDbi.cascader.__class__            gDbi.cascader.__init__
```

`DybDbi` with some magic

DIY: taste some ipython magic

enter `?` or `??` after classnames eg `DybDbi.DBConf?`

Explore what `DybDbi` provides:

```
In [1]: import DybDbi

In [2]: DybDbi.<TAB>
Display all 117 possibilities? (y or n)
DybDbi.CSV                      DybDbi.DbiStatement__del__      DybDbi.GDbiLogEntry             DybDbi.T
DybDbi.Context                  DybDbi.DbiTableProxy            DybDbi.GDcsAdTemp               DybDbi.T
DybDbi.ContextRange             DybDbi.DbiTableProxyRegistry    DybDbi.GDcsPmtHv                DybDbi.U
DybDbi.Ctx                      DybDbi.DbiValRecSet             DybDbi.GFeeCableMap             DybDbi.W
DybDbi.DBCas                    DybDbi.DbiValidityRec           DybDbi.GNAMES                   DybDbi.Z
DybDbi.DBConf                   DybDbi.Detector                 DybDbi.GPhysAd                  DybDbi._
DybDbi.Dbi                      DybDbi.DetectorId               DybDbi.GSimPmtSpec              DybDbi._
DybDbi.DbiCache                 DybDbi.DetectorSensor           DybDbi.LOG                      DybDbi._
DybDbi.DbiCascader              DybDbi.DybDbi                   DybDbi.Level                    DybDbi._
DybDbi.DbiCascader__check       DybDbi.DybDbi__comment          DybDbi.MYSQLDUMP                DybDbi._
DybDbi.DbiCascader__getitem__   DybDbi.GCalibFeeSpec            DybDbi.Mapper                   DybDbi._
DybDbi.DbiCascader__repr__      DybDbi.GCalibPmtSpec            DybDbi.NullHandler              DybDbi._
DybDbi.DbiConnection            DybDbi.GDaqCalibRunInfo         DybDbi.POST                     DybDbi._
DybDbi.DbiConnection__repr__    DybDbi.GDaqRawDataFileInfo      DybDbi.ServiceMode              DybDbi._
DybDbi.DbiCtx                   DybDbi.GDaqRunInfo              DybDbi.SimFlag                  DybDbi._
DybDbi.DbiCtx__call__           DybDbi.GDbiConfigSet            DybDbi.Site                     DybDbi._
DybDbi.DbiCtx__repr__           DybDbi.GDbiDemoData1            DybDbi.Source                   DybDbi._
DybDbi.DbiSqlContext            DybDbi.GDbiDemoData2            DybDbi.TList                    DybDbi._
DybDbi.DbiSqlValPacket          DybDbi.GDbiDemoData3            DybDbi.TMap                     DybDbi._
DybDbi.DbiStatement             DybDbi.GDbiDemoData4            DybDbi.TObject                  DybDbi._
```

21.5 DB Table Updating Workflow

- Objectives
- Workflow Outline
- Rationale for this workflow
- Planning Update Size and Frequency
- workflow steps in detail
  - Copy `offline_db` to `tmp_offline_db`
  - Perform updates and validation on `tmp_offline_db`
  - Early Validations
  - Communicate updates via SVN repository
  - Decoupled Updating Workflow
  - Serialized Updating
  - How the SVN ascii catalog is primed
  - Annotating Updates
  - Pre-commit enforced validation : DBI Gatekeeper
  - Demonstrate tests and Request Propagation
  - Database Managers Propagate updates from `dybaux` into `offline_db`
  - Propagation of multiple commits with `dbaux.py`
  - Handling non-propagated dybaux commits
  - Post-propagation cross check
  - Quick Validations
- Exceptional Operating Procedures for Major Changes
- Hands On Exercise 3 : Copy Offline DB
- Nosetests of workflow steps
- Development History of Workflow

21.5.1 Objectives

The mission critical nature of calibration parameters requires DB updating procedures to be:

1. highly controlled
2. carefully recorded
3. easily reproducible

Also DB updating procedures should be:

1. straightforward and quick

Suggestions for amendments to the workflow steps presented should be made in dybsvn:ticket:607.

21.5.2 Workflow Outline

1. Calibration expert obtains values intended to be inserted into `offline_db`
2. Calibration expert makes a temporary copy of the central DB `tmp_offline_db`
3. Calibration expert inserts values into his/her copy of the central DB `tmp_offline_db`
4. Calibration expert validates new values inserted into their `tmp_offline_db`
5. Calibration expert contacts DB Managers (Liang/Simon B) and request update propagated from `tmp_offline_db` into `offline_db`, *Demonstrate tests and Request Propagation*
6. Following successful validation DB Managers propagate updates into Master `offline_db`
7. Master `offline_db` DB is propagated to slaves

21.5.3 Rationale for this workflow

Why such caution ? Why not just write directing into `offline_db` ?

1. Avoid inconsistent/conflicting updates
2. Avoid inconsistencies as a result of mysql slave propagation (it may be necessary to briefly halt propagation while updates are made)

21.5.4 Planning Update Size and Frequency

Points to bear in mind when planning update size and frequency:

1. not too big to cause handling problems, aim to not exceed ~few MB of csv change (guesswork yet to be informed by experience)
2. not too small, if that necessitates repetition - to avoid manual labor and delays
3. each `dybaux` commit is loaded into `offline_db` with a single `INSERTDATE`, that means that you cannot distinguish via ROLLBACK within a single *commit*

21.5.5 workflow steps in detail

Section Names or Database names

This documentation refers to databases by their configuration file section names such as `tmp_offline_db` rather than by the actual database name (eg **tmp_username_offline_db**), as this parallels the approach taken by the tools: `db.py` and `DBI`.

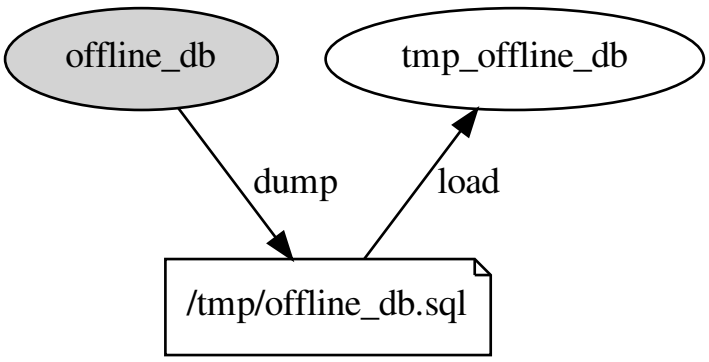
See *Configuring DB Access* for details of configuration file `~/.my.cnf` creation and troubleshooting.

Copy `offline_db` to `tmp_offline_db`

Working with a copy

facilitates rapid development without concern for causing damage by providing the option to start over as many times as needed.

The `db.py` script (a sibling of `nuwa.py`) is used to perform the copy, by loading and dumping tables.



Make the copy in 2 steps

db.py <sectname> <cmd> ...

the first argument references the section in the configuration file, details of `db.py` options and other commands are available at DybPython.db

1. Dump selection of `offline_db` tables to be updated into mysqldump file using the `-t/--tselect` option with a comma delimited list of payload table names

```
db.py -t CalibPmtSpec        offline_db dump offline_db.sql
db.py -t CableMap,HardwareID offline_db dump offline_db.sql
```

1. Load the mysqldump file into temporary database copy:

```
db.py tmp_offline_db load offline_db.sql
```

Note that no special privileges are needed in `offline_db` but *DATABASE DROP* and *DATABASE CREATE* privileges are needed in `tmp_offline_db`. Also the `tmp_offline_db` does **not** need to be local. Example of `tmp_offline_db` content after the **load** containing just the tables to be updated (and a partial LOCALSEQNO table):

```
mysql> show tables ;
+--------------------------+
| Tables_in_tmp_offline_db |
+--------------------------+
| CableMap                 |
| CableMapVld              |
| HardwareID               |
| HardwareIDVld            |
| LOCALSEQNO               |
+--------------------------+
5 rows in set (0.00 sec)

mysql> select * from LOCALSEQNO ;
+------------+---------------+
```

```
| TABLENAME   | LASTUSEDSEQNO |
+-------------+---------------+
| *           |             0 |
| HardwareID  |           386 |
| CableMap    |           475 |
+-------------+---------------+
3 rows in set (0.00 sec)
```

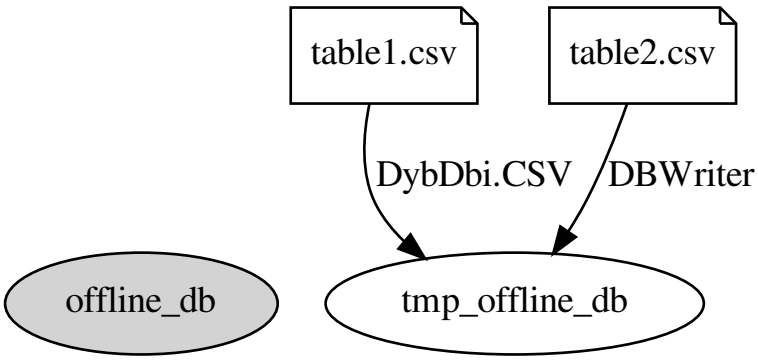
For readonly access to other tables such as `DaqRunInfo` use DBI cascades configured with a colon delimited `DBCONF`.

Perform updates and validation on `tmp_offline_db`

Warning: do not attempt to use raw SQL or hand edited .csv

DB Writing must use DBI eg

1. service approach dybgaudi:Database/DBWriter
2. python script using `DybDbi`, see *DB Table Writing*



flexibility unwise

Easily overridden `os.environ.setdefault` not appropriate for Writers see *N ways to set an envvar*

Configure writing scripts with:

```
import os
os.environ['DBCONF'] = 'tmp_offline_db'
```

Or invoke services:

```
DBCONF=tmp_offline_db nuwa.py ...
```

Early Validations

Warning: `dbupdatecheck` currently only contains `dbivalidate`, other packages with tests to be run before and after updates **need to be added**

The standard set of validation tests can be run by Table managers prior to checkin to SVN with:

```
DBCONF=tmp_offline_db:offline_db ./dybinst trunk tests dbupdatecheck
```

`dbupdatecheck` is a alias for a list of packages defined in installation:dybinst/scripts/dybinst-common.sh

After table managers commit the candidate update to `dybaux` anyone (with permissions in an available DB) can validate, using:

```
cd ; svn co http://dayabay.ihep.ac.cn/svn/dybaux/catalog/tmp_offline_db
svn up ~/tmp_offline_db
DBCONF=tmp_offline_db_ascii:offline_db ./dybinst trunk tests dbupdatecheck
```

Configuration details in *Configuring access to ascii catalog*

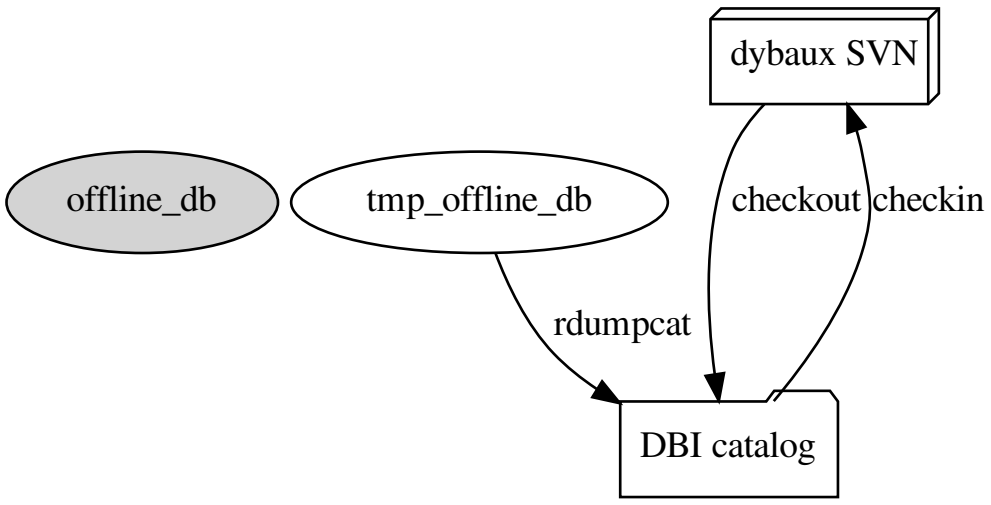
This allows any `os.environ.setdefault` nosetest to be run against the candidate update.

DB Validation includes ideas on update targeted tests.

Communicate updates via SVN repository

Using an SVN repository to funnel updates has advantages:

1. familiar system for storing the history of updates
2. Easy communication of changes
3. Trac web interface with timeline, presenting the history



Checkout the *tmp_offline_db* DBI ascii catalog from SVN repository:

```
mkdir -p ~/dybaux/catalog ; cd ~/dybaux/catalog
svn co http://dayabay.ihep.ac.cn/svn/dybaux/catalog/tmp_offline_db
```

Use `rdumpcat` to export updated database as DBI catalog on top of the SVN checkout, allowing the nature of the update to be checked with `svn diff` etc..:

```
db.py tmp_offline_db rdumpcat ~/dybaux/catalog/tmp_offline_db
svn status ~/dybaux/catalog/tmp_offline_db
svn diff ~/dybaux/catalog/tmp_offline_db
```

Try to commit the update to SVN:

```
svn ci ~/dybaux/catalog/tmp_offline_db \
 -m "New tables for CableSvc see dybsvn:source:dybgaudi/trunk/DybSvc/DybMetaDataSvc/src/DybCableSvc.t
```

For the rationale behind the link see *Annotating Updates*, note that:

1. the link path must start `dybsvn:source:dybgaudi/trunk`
2. when multiple links are included only the first is checked
3. use the Trac search box to check links, without the `dybsvn:` when using the `dybsvn` instance or with it when using `dybaux`

Decoupled Updating Workflow

Workflow Commands Essentially Unchanged

Primary difference is the initial **dump** which should now select only the tables being updated using `-t/--tselect` option with a comma delimited list of payload table names.

Features:

1. `db.py` adopts the `-d/--decoupled` option as default from dybsvn:r14289
2. `tmp_offline_db` contains only the tables being updated + a partial `LOCALSEQNO` metadata table.
3. partial `LOCALSEQNO` table is merged with the shared *real* one when doing **rdumpcat** into the `dybaux` catalog
4. (in principal) removes updating bottleneck by allowing parallel updating **assuming no cross table dependencies**

Tables are selected on the initial **dump** and subsequent **load** and **rdumpcat** operate on those selected tables:

```
db.py -t CableMap,HardwareID offline_db     dump     ~/offline_db.sql
db.py                        tmp_offline_db load     ~/offline_db.sql                      ## clobber
db.py                        tmp_offline_db rdumpcat ~/dybaux/catalog/tmp_offline_db
```

Note that the **rdumpcat** must be into into a pre-existing catalog such as `~/dybaux/catalog/tmp_offline_db` as decoupled tables are not viable on their own. Features of decoupled **rdumpcat**:

1. LOCALSEQNO entries are merged into the pre-existing LOCALSEQNO.csv
2. payload and validity table `.csv` changes must add to existing ones in the catalog
3. no catalog `.cat` file is written, permissable updates cannot change the catalog file

Before doing the **rdumpcat** it is good practice to check `LOCALSEQNO` in `tmp_offline_db` and in the catalog, and be aware of the changes:

```
cat ~/dybaux/catalog/tmp_offline_db/LOCALSEQNO/LOCALSEQNO.csv
TABLENAME char(64),LASTUSEDSEQNO int(11),PRIMARY KEY (TABLENAME)
"*",0
"CableMap",474
"CalibFeeSpec",113
"CalibPmtHighGain",6
"CalibPmtPedBias",1
"CalibPmtSpec",96
"CoordinateAd",1
"CoordinateReactor",1
"FeeCableMap",3
"HardwareID",386
"Reactor",372
```

Serialized Updating

Decoupled Updating Is Now Default

Prior to introduction of decoupled updating, updates had to be coordinated due to the shared **LOCALSEQNO** table. This section can be removed once decoupled operation is proven.

Note: you need to login to dybaux with your dybsvn identitity in order to see commits

In order to coordinate the serialized updating check the dybaux timeline http://dayabay.ihep.ac.cn/tracs/dybaux/timeline before making commits there. If you see a recent catalog commit that is not followed up a *fastforward OVERRIDE* commit by one of the DB managers then an update is queued up ahead of you in the final validation stage.

That means:

1. you will need to refresh(dump+load) your `tmp_offline_db` and rerun your updater script after the update ahead is completed (you will see the *fastforward OVERRIDE* commit on the timeline)
2. hold off making your dybaux catalog commit until the 1st step is done
3. continue testing in your `tmp_offline_db`, such that once you have a valid starting point your update is able to proceed smoothly and quickly and does not cause delays in the final validations stage

How the SVN ascii catalog is primed

ascii catalog is for communication

The `catalog/tmp_offline_db` exists to facilitate communication and checking of updates. It in no way detracts from the definitive nature of what is in `offline_db`. Essentially it is a shared `tmp_offline_db` that may need re-priming following candidate updates for which problems are found at the last hurdle of DB Manager validations.

Direct approach, using **rdumpcat** from `offline_db` into ascii catalog:

```
svn co http://dayabay.ihep.ac.cn/svn/dybaux/catalog       ## just empty tmp_offline_db created by zha
db.py offline_db rdumpcat ~/catalog/tmp_offline_db        ## dump non-scraped default subset of table
```

Check machinery and transfers (and prepare a local DB to work with as side effect) by going via local DB `tmp_offline_db`:

```
db.py offline_db dump ~/tmp_offline_db.sql
db.py tmp_offline_db load ~/tmp_offline_db.sql
db.py tmp_offline_db rdumpcat ~/tmp_offline_db_via_local
```

Compare the direct and via_local catalogs:

```
diff -r --brief ~/catalog/tmp_offline_db ~/tmp_offline_db_via_local | grep -v .svn
Only in /home/blyth/catalog/tmp_offline_db: tmp_offline_db.cat
Only in /home/blyth/tmp_offline_db_via_local: tmp_offline_db_via_local.cat
```

Add to repository, and commit with override:

```
svn add tmp_offline_db/*
svn status
svn ci -m "initial commit of ascii catalog prepared with {{{db.py offline_db rdumpcat ~/catalog/tmp_
```

Annotating Updates

When making updates it is required that brief documentation is provided in a text file housed in `dybsvn` . Appropriate locations for the documentation are:

- package containing the code that prepares the update (this code must be kept in `dybsvn`, see *Rules for Code that writes to the Database*).
- package containing the service that uses the updated tables

Expected features for the annotation of an update:

1. brief summary of nature/motivation, a few lines only (refer to more detailed descriptions)
2. include date of update
3. refer to related docdb documents
4. refer to related database tables
5. refer to dybsvn packages updated, name revision numbers where appropriate
6. refer to related tickets

In order to associate the annotation with the `dybaux` commit of the candidate DB update, it is required that the commit message provides a revisioned Trac Link that points at the updated document containing the annotation.

In the above example, the revisioned Trac link points to a real example of an annotation document.

- dybsvn:source:dybgaudi/trunk/DybSvc/DybMetaDataSvc/src/DybCableSvc.txt@12349

Pre-commit enforced validation : DBI Gatekeeper

The `dybaux` repository is configured to perform validations prior to allowing the commit to proceed. When commits are denied the validation error is returned. Validations are implemented in python module `DybPython.dbsvn`, currently:

1. Only expected tables are touched (LOCALSEQNO + DBI pair)
2. Only row additions are allowed, no deletions or alterations
3. Commit message includes valid revisioned `dybsvn` Trac Link, precisely identifying code/documentation for the update

Intended additions:

1. verify use of `versiondate=TimeStamp(0,0)` signaling overlay dates

Pre-commit validations must be quick and self-contained as cannot run tests on SVN server.

Test Locally

Validations can be run locally using `DybPython.dbsvn` script.

Demonstrate tests and Request Propagation

Send email to the Database Managers and the offline mailing list mailto:theta13-offline@lists.lbl.gov requesting that your dybaux revision is propagated. The email needs to contain:

1. dybaux revision to be propagated
2. proof of testing in the form of nosetest output from running tests against your *tmp_* DB and context information

Proof and context can conveniently be provided by copy and pasting the output from:

```
pwd ; date ; svnversion . ; nosetests -v
```

Detailed guidelines on update testing techniques and responsibilities are in *DB Testing*

Database Managers Propagate updates from `dybaux` into `offline_db`

After re-running validations as described in *Early Validations* are found to be successful DB managers can perform updates first on their `tmp_offline_db` and then on the central `offline_db`.

Prepare a fresh `tmp_offline_db`:

```
db.py offline_db dump ~/offline_db.sql
db.py tmp_offline_db load ~/offline_db.sql
```

Get uptodate with `dybaux`:

```
mkdir ~/dybaux ;  cd ~/dybaux ; svn co http://http://dayabay.ihep.ac.cn/svn/dybaux/catalog
svn up ~/dybaux/catalog
```

Use **rcmpcat** to see changed tables and added SEQNO in the `dybaux` ascii catalog relative to the DB `tmp_offline_db`:

```
db.py tmp_offline_db rcmpcat ~/dybaux/catalog/tmp_offline_db
```

Proceed to **rloadcat** into `tmp_offline_db`:

```
db.py tmp_offline_db rloadcat  ~/dybaux/catalog/tmp_offline_db
db.py tmp_offline_db rcmpcat ~/dybaux/catalog/tmp_offline_db     ## should report no updates
```

Repeating **rloadcat** should detect no updates and do nothing. Note that the catalog working copy is changed by the **rloadcat** due to INSERTDATE fastforwarding (dybsvn:ticket:844), check with:

```
svn status ~/dybaux/catalog/tmp_offline_db    ## will show Vld table changes
```

Following the definitive **rloadcat** into `offline_db` the changed `*Vld.csv` should be committed into `dybaux` with a commit message including `OVERRIDE` (only admin users configured in the pre-commit hook can do this).

Propagation of multiple commits with `dbaux.py`

When multiple commits need to be propagated the script `dbaux.py` should be used, it takes as arguments commit number ranges and internally invokes the `db.py` script described above.

Usage examples:

```
dbaux.py --help        ## for details on all options
dbaux.py -c -r --dbconf tmp_offline_db rloadcat 5036:5037 --logpath dbaux-rloadcat-5036-5037.log
```

dbaux `-r` option resets working copy

For reliable operation (avoiding svn merge/conflict difficulties) the `-r/--reset` option is used to force catalog working copy to be at clean revisions by deletion of any preexisting directories. A side effect of this is that, the working copy fast forward modifications are lost for all but the last commit propagated.

In order to make complete fastforward commits after using the `dbaux.py -r/--reset` it is necessary to do an rdumpcat to get all the fastforward changes first, for example with:

```
db.py offline_db rdumpcat ~/dybaux/catalog/tmp_offline_db
svn diff ~/dybaux/catalog/tmp_offline_db      ## INSERTDATE changes for all SEQNO added should be obs
svn ci -m "fastforward updates following offline_db rloadcat of r5036:r5037 OVERRIDE  " ~/dybaux/cata
```

Handling non-propagated dybaux commits

Commits to the `dybaux` catalog are sometimes not propagated to `offline_db`, eg due to finding a problem with validity ranges. In this case it is necessary to bring the `dybaux` catalog back into correspondence with the `offline_db` via returning to the state before the bad commit with an `OVERRIDE` commit backing out of the change. As an `OVERRIDE` is needed this must be done by a DB manager. In simple cases where the bad commit is the last one made:

```
cd ~/dybaux/catalog/tmp_offline_db
svn status
svn up -r <goodrev>
svnversion .
svn status    # check are at the intended clean revision
svn ci -m "return to r<goodrev> removing r<badrev> and r<otherbadrev> OVERRIDE"
svn up
svn status
```

In more involved cases a piecewise approach to returning to the desired state can be used, by doing updates restricted to particular tables.

Note that it is also possible to re-prime dybaux from `offline_db` by doing an **rdumpcat** into the working copy and committing the changes. Indeed this technique is used as part of the *Post-propagation cross check* where normally no changes are expected.

Post-propagation cross check

Get uptodate with `dybaux` and **rdumpcat** from `offline_db` ontop of it:

```
svn up ~/dybaux/catalog/tmp_offline_db
db.py offline_db rdumpcat ~/dybaux/catalog/tmp_offline_db
svn status  ~/dybaux/catalog/tmp_offline_db
```

The `svn status` is expected to return no output, indicating no differences. If differences are observed only in `*Vld.csv` tables `INSERTDATE` then Database managers omitted to commit the fastforwarded catalog.

Quick Validations

After getting into environment and directory of dybgaudi:Database/DbiValidate, run a collection of tests that traverse over all DBI tables, performing many queries:

```
DBCONF=offline_db nosetests -v
```

```
[blyth@cms01 DbiValidate]$ DBCONF=offline_db nosetests -v
test_dbi_tables.test_counts ... ok
test_dbi_tables.test_vld_description('CableMapVld', 'assert_fields') ... ok
...
DbiTimer:CableMap: Query done. 2592rows,   62.2Kb Cpu   0.1 , elapse   1.7
Caching new results: ResultKey: Table:CableMap row:GCableMap.  1 vrec (seqno;versiondate): 213;2011-(
DbiTimer:CableMap: Query done. 1728rows,   41.5Kb Cpu   0.1 , elapse   1.7
ok
----------------------------------------------------------------------
Ran 159 tests in 685.069s        ## MUCH FASTER WHEN LOCAL TO DB
OK
```

21.5.6 Exceptional Operating Procedures for Major Changes

Major changes need to be discussed with Database Managers. As such changes will not pass the SOP validations, a modified **Exceptional operating procedure** is used:

1. Table experts develop **zero** argument scripts (which can internally invoke more flexible scripts and capture arguments used) using their `tmp_offline_db`
2. Table experts communicate update to be made via dybsvn revision and path of their scripts
3. DB experts use the script to create tables in their `tmp_offline_db` and perform override commit of new tables into **dybaux**
4. table experts check that the tables in **dybaux** match those from their `tmp_offline_db` (eg via rdumpcat onto the working copy)
5. DB experts proceed to load into `offline_db` once table experts have confirmed the change

The steps are mostly the same, but who does what is modified.

21.5.7 Hands On Exercise 3 : Copy Offline DB

Warning: This exercise requires write permissions into a `tmp_username_offline_db` database

DIY steps:

1. Configure a `tmp_offline_db` section of your config file
2. Use `db.py` to dump and load into your `tmp_username_offline_db` database : which corresponds to section `tmp_offline_db`
3. Use techniques from exercises 1 and 2 to compare row counts in `offline_db` and `tmp_offline_db`

21.5.8 Nosetests of workflow steps

Note: these are tests of the workflow machinery, for other generic tests and more table specific validations see *DB Validation*

Nosetests covering most of the steps of the workflow are available in dybgaudi:DybPython/tests in particular:

- dybgaudi:DybPython/tests/test_dbsvn.py
- dybgaudi:DybPython/tests/test_dbops.py
- dybgaudi:DybPython/tests/test_write.py
- dybgaudi:DybPython/tests/test_write_cascade.py **WARNINGS ON USAGE STILL APPLY**

To run these tests, get into the directory and environment of dybgaudi:DybPython then:

1. Examine what the tests are going to do
2. Review the configuration section names used in the tests (typically `tmp_offline_db` and *offline_db*). Find these by looking for any *DBCONF=sectname* and first arguments to the `db.py` script
3. Review the corresponding sections of your configuration `~/.my.cnf` ensuring that **you are talking to the intended DB with identities holding appropriate permissions**
4. You may need to add/rename some sections of your configuration file if they are not present
5. Invoke the tests from the package directory, **not** the tests directory with the below commands

```
nosetests -v -s tests/test_dbops.py
nosetests -v -s tests/test_dbsvn.py
nosetests --help    ## for explanations of the options
```

21.5.9 Development History of Workflow

The general approach was first expounded in doc:5646, but has subsequently been improved substantially following feedback from Jiajie, Craig and Brett. The changes avoid some painful aspects of the initial suggestion.

1. Remove **local** restriction on the mysql server, enabling your NuWa installation and mysqld server to be on separate machines
2. Eliminate need for DB Managers to keep *dybaux* DBI catalog uptodate, as Table managers now start by copying the actual *offline_db*

21.6 Table Specific Instructions

The below tables have specific instructions on preparing updates and performing tests. It is necessary to understand the normal *DB Table Updating Workflow* in addition to the specific table instructions provided in the below sections.

21.6.1 CalibPmtFineGain

The source of this section is dybgaudi:Documentation/OfflineUserManual/tex/sop/tables/CalibPmtFineGain.rst

Below sub-sections outline steps required to prepare, verify and perform updates of the *CalibPmtFineGain* table.

- Environment setup
- Make temporary copy of *offline_db*
- Validation and uploading to *tmp_offline_db*
  - Before uploading to *tmp_offline_db* validation
  - Perform *tmp_offline_db* uploading
  - Valdation after uploading to *tmp_offline_db*
- Commit to *dybaux* SVN
  - Prepare annotation for the update

Environment setup

Have nuwa environment setup.:

```
cd $ROLLINGGAINROOT/aileron  ##  or equivalent dir with RollingGain/aileron checkout where you have w
svn update                   ##  ( Make backup if necessary )
```

Make temporary copy of *offline_db*

Prepare a *tmp_offline_db* copy of *offline_db*:

```
db.py offline_db dump offline_db.sql
db.py tmp_offline_db load offline_db.sql
```

Prepare dybaux svn checkout:

```
setenv CSVCAT http://dayabay.ihep.ac.cn/svn/dybaux/catalog
svn co $CSVCAT/tmp_offline_db tmp_offline_db
```

Verify that the contents of *tmp_offline_db* matches the dybaux checkout:

```
db.py tmp_offline_db rdumpcat tmp_offline_db/
svn diff tmp_offline_db/
```

Warning: No difference should be observed.

Validation and uploading to *tmp_offline_db*

Modify objLocations in *ScanFrames.py* to have the data table list

- dybgaudi:Calibration/RollingGain/aileron/RollingGainAi/ScanFrames.py

Before uploading to *tmp_offline_db* validation

The first round is to generate channel plots for validation. In *ScanFrames.py* set:

1. *runMode* to **ErrorCheck**
2. *PsOutput* to *True*

```
nuwa.py --dbconf tmp_offline_db -m ScanFrames
```

Look through the generated *frames.ps*

Perform *tmp_offline_db* uploading

Again in *ScanFrames.py* set:

1. *runMode* to **DbCommit**
2. *PsOutput* to *False*

```
nuwa.py --dbconf tmp_offline_db -m ScanFrames
```

Valdation after uploading to *tmp_offline_db*

```
cd $ROLLINGGAINROOT/tests     ##  or an equivalent dir with RollingGain/tests checkout where you have
svn update
setenv DBCONF tmp_offline_db
nosetests -v test_RG.py
```

NB. this step must be done within half a day of the database uploading.

> **Warning:** No failure is allowed.

Commit to *dybaux* SVN

Write out the DB as CSV files into the catalog working copy:

```
db.py tmp_offline_db rdumpcat tmp_offline_db/
cd tmp_offline_db/
svn status
svn diff LOCALSEQNO/LOCALSEQNO.csv
```

Prepare annotation for the update

Edit and commit dybgaudi:Calibration/DBUpdate/UPDATES.txt Remember the revision number and use it in the commit message:

```
svn ci tmp_offline_db -m "dybsvn:source:dybgaudi/trunk/Calibration/DBUpdate/UPDATES.txt@15615"
```

21.7 DB Table Writing

> **live ipython sessions**
>
> The below ipython output was generated when this documentation was built using *live ipython session with ipython directive*. So if you are using a revision close to that of these docs, you can expect to see almost the same output.

- Using DybDbi to write to tmp_offline_db
  - Configure Target DB
  - CSV handling
  - Map CSV fieldnames to DBI attributes
  - Create DbiWriter<T> and set ContextRange
  - Convert CSV rows and write to DB
  - Command line and filename Parsing
- Hands On Exercise 4 : Write $DBWRITERROOT/share/DYB_MC_AD1.txt into CalibPmtSpec
- Assigning Applicability of Constants
  - Context Range
  - Choosing TIMEEND
  - Determine run start time from a run number
  - Overlay Versioning Demonstration
- Many more examples of DB writing with DybDbi
- Using DBWriter to write to tmp_offline_db

Warning: **Always** check which Database you are connected to
Before doing any DB operations, avoid accidents/confusion by using `status` in mysql shell or `gDbi.Status()` in `ipython` or checking `DBCONF` settings used in scripts and the corresponding configuration in your configuration file `~/.my.cnf`, see *Configuring DB Access* for details.

21.7.1 Using DybDbi to write to tmp_offline_db

from DybDbi import ...

`DybDbi` works by wrapping `PyROOT` C++ proxy classes with additional functionality, to benefit access classes through `from Dybdbi import ..`

`DybDbi` enables usage of `DBI` from python in a simple way

Configure Target DB

Warning: do not use easily overridden config such as `os.environ.setdefault`

```
In [27]: import os

In [28]: os.environ['DBCONF'] = "tmp_offline_db"
```

CSV handling

`DybDbi.CSV` provides CSV reading/validation facilities, invalid `.csv` files throw exceptions

```
In [1]: from DybDbi import CSV

In [2]: src = CSV( "$DBWRITERROOT/share/DYB_MC_AD1.txt" )

In [3]: src.read()
```

```
In [4]: print len(src)

In [5]: print src[0]   ## first source csv row, note the srcline

In [5]: print src[-1]   ## last source csv row, note the srcline

In [6]: print src.fieldnames   ## fields
```

Map CSV fieldnames to DBI attributes

`DybDbi.Mapper` provides CSV fieldname to DBI attribute name mappings, and type conversions (CSV returns everything as a string)

Using the same CSV fieldnames as DBI attributes may allow auto mapping, otherwise manual mappings must be set.

Generic Advantage

Each `genDbi/DybDbi` generated class knows the full specification of itself and the corresponding database table, see *DB Table Creation* , thus given the mapping from CSV fieldname to DBI attribute the appropriate type conversions are used.

An incomplete mapping throws exceptions:

```
In [12]: from DybDbi import Mapper, GCalibPmtSpec

In [13]: mpr = Mapper( GCalibPmtSpec, src.fieldnames )
```

After interactively adding manual mappings, succeed to create the the mapper:

```
In [16]: mpr = Mapper(  GCalibPmtSpec, src.fieldnames , afterPulse='AfterPulseProb', sigmaSpe='SigmaS

In [17]: print mpr
```

All elements from a `.csv` are strings. Note the fieldname and type convertion after the `mpr` instance operates on one src `dict` item.

```
In [11]: print src[0]

In [12]: print mpr(src[0])
```

Apply the `mpr` instance over all items in the `src`:

```
In [13]: dst = map(mpr, src )

In [14]: len(dst)

In [16]: print dst[0]
```

Create `DbiWriter<T>` and set `ContextRange`

```
In [18]: from DybDbi import Site, SimFlag, TimeStamp, ContextRange

In [19]: wrt = GCalibPmtSpec.Wrt()

In [20]: cr = ContextRange( Site.kAll,  SimFlag.kData|SimFlag.kMC , TimeStamp.GetBOT() ,TimeStamp.Get
```

```
In [21]: wrt.ctx( contextrange=cr, dbno=0, versiondate=TimeStamp(0,0), subsite=0 , task=7, logcomment
```

Notes:

1. `dbno=0`, selects the slot in the DB cascade to write to
2. `logcomment="msg"` are currently ignored, as DBI is not operating in an **Authorising DB** manner with a `GLOBALSEQNO` table, dybsvn:ticket:803 seeks to assess the implications of migrating to **Authorising DB** usage
3. `versiondate=TimeStamp(0,0)` switches on overlay date validity handling

Todo

enforce usage of overlay date in pre-commmit hook

Convert CSV rows and write to DB

```
In [23]: for r in map(mpr,src):    ## __call__ method of mpr invoked on all src items
   ....:     instance = GCalibPmtSpec.Create( \*\*r )
   ....:     wrt.Write( instance )
```

Crucial last step that writes the DBI row instances from memory to the DB:

```
In [25]: assert wrt.Close()   ## DB is accessed here
DbiWrt<GCalibPmtSpec>::Close
```

(this step is skipped on building these docs)

Command line and filename Parsing

Using some simple python techniques for commandline parsing and filename parsing can avoid the anti-pattern of duplicating a writing script and making small changes.

See the examples:

- dybgaudi:Database/DybDbi/examples/GCalibPmtHighGain_.py
- dybgaudi:Database/DybDbi/examples/cnf.py

A simple regular expression is used to match the name of a .csv file, for example :

```
In [1]: import re

In [2]: ptt = "^(?P<site>All|DayaBay|Far|LingAo|Mid|SAB)_(?P<subsite>AD1|AD2|AD3|AD4|All|IWS|OWS|RPC

In [3]: ptn = re.compile( ptt )

In [4]: match = ptn.match( "SAB_AD2_Data.csv" )

In [5]: print match.groupdict()
{'subsite': 'AD2', 'simflag': 'Data', 'site': 'SAB'}
```

The script then converts these to enum values using the enum FromString functions.

Such an approach has several advantages:

1. standardized file names

2. reduced number of parameters/options on commandline
3. eliminates pointlessly duplicated code

21.7.2 Hands On Exercise 4 : Write `$DBWRITERROOT/share/DYB_MC_AD1.txt` into `CalibPmtSpec`

Warning: This exercise requires write permissions into a `tmp_username_offline_db` database, and a recent `NuWa` installation

DIY steps:

1. Use interactive `ipython` to perform the steps of the previous section
2. Remember to read the API help as you go along eg: `CSV? Mapper?`
3. Use `mysql` client to examine your additions to the copied DB

Note: Very little added code is required to complete this (hint: manual field name mappings), extra points for using a realistic contextrange

---

Hint to help with field mapping, `genDbi` classes know their `.spec` so ask the class with eg `SpecMap()`:

```
  In [12]: cls.Spec<TAB>
  cls.SpecKeys  cls.SpecList  cls.SpecMap

  In [12]: cls.SpecMap()
  Out[12]: <ROOT.TMap object ("TMap") at 0xb068dc0>

  In [13]: cls.SpecMap().asdod()
  Out[13]:
  {'AfterPulseProb': {'code2db': '',
                      'codetype': 'double',
                      'dbtype': 'float',
                      'description': 'Probability of afterpulsing',
                      'legacy': 'PMTAFTERPULSE',
                      'memb': 'm_afterPulseProb',
                      'name': 'AfterPulseProb'},
   'DarkRate': {'code2db': '',
                'codetype': 'double',
                'dbtype': 'float',
                'description': 'Dark Rate',
                'legacy': 'PMTDARKRATE',
                'memb': 'm_darkRate',
                'name': 'DarkRate'},
...

  In [14]: cls.SpecKeys().aslist()
  Out[14]:
  ['PmtId',
   'Describ',
   'Status',
   'SpeHigh',
   'SigmaSpeHigh',
   'SpeLow',
   'TimeOffset',
   'TimeSpread',
```

```
    'Efficiency',
    'PrePulseProb',
    'AfterPulseProb',
    'DarkRate']
```

21.7.3 Assigning Applicability of Constants

The arguments to the writer establish the range of applicability of the constants to be written.

```
from DybDbi import GCalibPmtSpec as cls
from DybDbi import Site, SimFlag, TimeStamp, ContextRange
wrt = cls.Wrt()
cr = ContextRange( Site.kAll,  SimFlag.kData|SimFlag.kMC , TimeStamp.GetBOT() ,TimeStamp.GetEOT())
wrt.ctx( contextrange=cr, dbno=0, versiondate=TimeStamp(0,0), subsite=0 , task=0, logcomment="DybDbi
```

The crucial line:

```
wrt.ctx( contextrange=cr, dbno=0, versiondate=TimeStamp(0,0), subsite=0 , task=7, logcomment="DybDbi
```

is python shorthand (via `DbiCtx.__call__()` and setter properties) for defining the attributes of the C++ class *DybDbi.DbiCtx* defined in dybgaudi:Database/DybDbi/DybDbi/DbiCtx.h The choice of attributes determines which underlying `DbiWriter<GTableName>` ctor is invoked.

DbiCtx attribute	notes
contextrange	object described below
dbno	slot in the cascade to write to, usually should be 0
versiondate	**always** use `TimeStamp(0,0)` to signify overlay versioning
subsite	`Dbi::SubSite` enum integer
task	`Dbi::Task` enum integer
logcomment	description of update, see dybsvn:ticket:803

Overlay Versioning

This is a date based versioning scheme that automatically distinguishes validity entries which have the same context range by offsetting of versiondate by minute increments. This scheme allows prior erroneous writes to be overridden. Discussed in dybsvn:ticket:611. Details on this including a demonstration below *Overlay Versioning Demonstration*

The `Dbi::` enums are defined in databaseinterface:Dbi.h

Todo

try changing implementation of enums to make them usable from python

Context Range

Example of instanciation from python:

```
from DybDbi import Site, SimFlag, TimeStamp, ContextRange
cr = ContextRange( Site.kAll,  SimFlag.kData|SimFlag.kMC , TimeStamp.GetBOT() ,TimeStamp.GetEOT())
```

Warning: All times stored in the offline database must be in UTC, this includes validity range times

For the details on these classes see the API docs `DybDbi.ContextRange`, `DybDbi.TimeStamp`

argument	notes
siteMask	An `OR` of site enum integers conventions:Site.h
simMask	An `OR` of simflag enum integers conventions:SimFlag.h
tstart	Start of validity, possibly corresponding to start of run time
tend	End of validity, this will very often be `TimeStamp::GetEOT()` signifying a far future time

Choosing `TIMEEND`

Recommendations :

1. when a definite end time is known use that
2. use `TimeStamp.GetEOT()` when the end time is not known
3. if constants need *decommissioning* this can be done with payload-less writes (in consultation with DB managers)

Do not adopt a policy of blindly using EOT, use the contextrange that best expresses the nature of that set of constants. Note that *decommissioning* allows particular context ranges to yield no constants. This is preferable to inappropriate constants as it is trivial to handle in services.

Things not to do:

1. use random far future times, instead standardize on `TimeStamp.GetEOT()`

Determine run start time from a run number

First approach that brings the full table into memory:

```
runNo = 5000
from DybDbi import GDaqRunInfo
rpt = GDaqRunInfo.Rpt()
rpt.ctx( sqlcontext="1=1" , task=-1 , subsite=-1 )  ## wideopen validity query
row = rpt.FirstRowWithIntValueForKey( "RunNo" , runNo )
vrec = rpt.GetValidityRec( row )
print vrec.seqno, vrec.contextrange.timestart, vrec.contextrange.timeend
```

Second approach that brings in only a single row into memory:

```
runNo = 5000
from DybDbi import GDaqRunInfo
rpt = GDaqRunInfo.Rpt()
rpt.ctx( sqlcontext="1=1", datasql="runNo = %s" % runNo , task=-1, subsite=-1 )
assert len(rpt) == 1 , "should only be a single entry for the runNo %s " % runNo
row = rpt[0]
vrec = rpt.GetValidityRec( row )
print vrec.seqno, vrec.contextrange.timestart, vrec.contextrange.timeend
```

A discussion of the relative merits of these approaches is in dybgaudi:Database/DybDbi/tests/test_find_vrec.py

Both techniques require the *DaqRunInfo* table to be accessible, you can make this so without copying the table to you DB (which would be painful to maintain) by using a DBI cascade. Your script could define a default cascade with:

```
os.environ.setdefault('DBCONF','tmp_offline_db:offline_db')
```

Using the above form of setting *DBCONF* defines the default cascade yet allows commandline environment overrides. More details on DBCONF can be found at *N ways to set an envvar*

Overlay Versioning Demonstration

The tests in dybgaudi:Database/DybDbi/tests/test_demo_overlay.py demonstrate overlay versioning in action:

test_write_ugly write a mixture of good and bad constants via GDemo class into table Demo

test_read_ugly verify read back what was written

test_write_good an overriding context to correct some the bad constants

test_read_good verify can read back the overriding constants

test_read_allgood verify can read back all good constants

By virtue of using overlay versioning, as enabled with versiondate in the write context:

```
versiondate=TimeStamp(0,0)
```

Synthetic VERSIONDATE are used which coincide with TIMESTART unless there is data present already, in which case one minute offsets are made in order to override prior writes. In the validity table, there is a one minute VERSIONDATE offset for SEQNO = 11:

```
mysql> select * from DemoVld ;
+-------+---------------------+---------------------+----------+---------+---------+-------+----------
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATI
+-------+---------------------+---------------------+----------+---------+---------+-------+----------
|     1 | 2010-01-01 00:00:00 | 2010-01-11 00:00:00 |      127 |       1 |       0 |    0 |
|     2 | 2010-01-11 00:00:00 | 2010-01-21 00:00:00 |      127 |       1 |       0 |    0 |
|     3 | 2010-01-21 00:00:00 | 2010-01-31 00:00:00 |      127 |       1 |       0 |    0 |
|     4 | 2010-01-31 00:00:00 | 2010-02-10 00:00:00 |      127 |       1 |       0 |    0 |
|     5 | 2010-02-10 00:00:00 | 2010-02-20 00:00:00 |      127 |       1 |       0 |    0 |
| **  6 | 2010-02-20 00:00:00 | 2010-03-02 00:00:00 |      127 |       1 |       0 |    0 |
|     7 | 2010-03-02 00:00:00 | 2010-03-12 00:00:00 |      127 |       1 |       0 |    0 |
|     8 | 2010-03-12 00:00:00 | 2010-03-22 00:00:00 |      127 |       1 |       0 |    0 |
|     9 | 2010-03-22 00:00:00 | 2010-04-01 00:00:00 |      127 |       1 |       0 |    0 |
|    10 | 2010-04-01 00:00:00 | 2010-04-11 00:00:00 |      127 |       1 |       0 |    0 |
| ** 11 | 2010-02-20 00:00:00 | 2010-03-02 00:00:00 |      127 |       1 |       0 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+-------+----------
11 rows in set (0.00 sec)
```

Payload table for the bad write and its override:

```
mysql> select * from Demo where seqno in (6,11) ;
+-------+-------------+------+------+
| SEQNO | ROW_COUNTER | Gain | Id   |
+-------+-------------+------+------+
|     6 |           1 | 5000 |    5 |
|     6 |           2 | 5000 |    5 |
|     6 |           3 | 5000 |    5 |
|    11 |           1 |  500 |    5 |
|    11 |           2 |  500 |    5 |
|    11 |           3 |  500 |    5 |
+-------+-------------+------+------+
6 rows in set (0.00 sec)
```

When not using overlay versioning, by setting versiondate=TimeStamp() or any other time than TimeStamp(0,0) the consequences are:

1. payload table is the same
2. test_read_good and test_read_allgood fail

3. validity table has `VERSIONDATE` (in this case aligned with `INSERTDATE`)

```
mysql> select * from DemoVld ;
+-------+---------------------+---------------------+----------+---------+---------+------+-----
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGR
+-------+---------------------+---------------------+----------+---------+---------+------+-----
|     1 | 2010-01-01 00:00:00 | 2010-01-11 00:00:00 |      127 |       1 |       0 |    0 |
|     2 | 2010-01-11 00:00:00 | 2010-01-21 00:00:00 |      127 |       1 |       0 |    0 |
|     3 | 2010-01-21 00:00:00 | 2010-01-31 00:00:00 |      127 |       1 |       0 |    0 |
|     4 | 2010-01-31 00:00:00 | 2010-02-10 00:00:00 |      127 |       1 |       0 |    0 |
|     5 | 2010-02-10 00:00:00 | 2010-02-20 00:00:00 |      127 |       1 |       0 |    0 |
|     6 | 2010-02-20 00:00:00 | 2010-03-02 00:00:00 |      127 |       1 |       0 |    0 |
|     7 | 2010-03-02 00:00:00 | 2010-03-12 00:00:00 |      127 |       1 |       0 |    0 |
|     8 | 2010-03-12 00:00:00 | 2010-03-22 00:00:00 |      127 |       1 |       0 |    0 |
|     9 | 2010-03-22 00:00:00 | 2010-04-01 00:00:00 |      127 |       1 |       0 |    0 |
|    10 | 2010-04-01 00:00:00 | 2010-04-11 00:00:00 |      127 |       1 |       0 |    0 |
|    11 | 2010-02-20 00:00:00 | 2010-03-02 00:00:00 |      127 |       1 |       0 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+------+-----
11 rows in set (0.00 sec)
```

Overlay versioning is the default if no `versiondate` is set in the write context.

21.7.4 Many more examples of DB writing with `DybDbi`

Many examples of writing to the DB using `DybDbi` are in dybgaudi:Database/DybDbiTest/tests/test_07.py The full range of DBI functionality is exercised from `DybDbi` by the tests in dybgaudi:Database/DybDbiTest/tests/

21.7.5 Using `DBWriter` to write to `tmp_offline_db`

The dybgaudi:Database/DBWriter is implemented mostly in C++ and is currently rather inflexible. dybsvn:ticket:???

21.8 DB Table Reading

- DB Reading with `DybDbi`
  - Default Context Reading
  - Examine Default Read Context
  - Change Read Context
- Using `mysql` client
- Hands On Exercise 5 : Read from DB with varying context
- Hands On Exercise 6 : Read run timestart/timeend from `DaqRunInfo` table
  - Default Context Query
  - Modify to use wideopen validity context
- Fixing this page if it breaks

21.8.1 DB Reading with `DybDbi`

`DybDbi` exposes most DBI functionality to python. Details in doc:5642. An example of using `DybDbi` to make a DBI query from *ipython*

Default Context Reading

A `DbiResultPtr<GCalibPmtSpec>` is constructed under the covers with a default context that is created from a string serialization obtained from the `.spec` file.

```
In [1]: from DybDbi import GCalibPmtSpec, TimeStamp
In [2]: r = GCalibPmtSpec.Rpt()         ## result pointer
```

On requesting the length the DB is queried and `GCalibPmtSpec` instances are created corresponding to the payload rows obtained by the query.

```
In [4]: len(r)             ## DB is accessed here
Out[4]: 208
```

Warning: When zero results are returned it means that the context does not match entries in the DB

Payload instances are accessible by list-like access on the result pointer.

```
In [19]: print(r[0].asdict)
{'Status': 1, 'PmtId': 536936705, 'Describ': 'SABAD1-ring01-column01', 'PrePulseProb': 0.0, 'SigmaSpe
In [6]: r[0]        # r[-1] array/slice access to T* Row objs
In [7]: r[0].spehigh
Out[5]: 20.0
```

Examine Default Read Context

```
In [4]: r.ctx     ## representation of default DbiCtx in use
Out[4]:
{   'CtorMask': 2097278,
    'DetectorId': 0,
    'Mask': 2097278,
    'SimFlag': 1,
    'Site': 127,
    'SubSite': 0,
    'TableName': 'CalibPmtSpec',
    'Task': 0,
    'TimeStamp': Tue, 12 Apr 2011 14:35:49 +0000 (GMT) +564713000 nsec,
    'UpdateMask': 0}

In [5]: GCalibPmtSpec.MetaRctx   ## the default DbiCtx supplied in the .spec file
Out[5]: 'Site.kAll,SimFlag.kData,TimeStamp.kNOW,DetectorId.kUnknown,SubSite.kDefaultSubSite,Task.kDe
```

Change Read Context

Under the covers changing the read context results in a new `DbiResultPtr<T>` being instanciated, and the old one being cleaned up.

```
In [6]: r.ctx(timestamp=TimeStamp(2010,8,10,18,30,0))  ## anything back then ?
Out[6]:
{   'CtorMask': 2097278,
    'DetectorId': 0,
    'Mask': 2097278,
    'SimFlag': 1,
    'Site': 127,
    'SubSite': 0,
```

```
    'TableName': 'CalibPmtSpec',
    'Task': 0,
    'TimeStamp': Tue, 10 Aug 2010 18:30:00 +0000 (GMT) +        0 nsec,
    'UpdateMask': 16}

In [7]: len(r)
DbiRpt<GCalibPmtSpec>::Delete
DbiRpt<GCalibPmtSpec>::MakeResultPtr tablename variant of standard ctor, tablename: CalibPmtSpec
Caching new results: ResultKey: Table: row: No vrecs
DbiCtx::RegisterCreation [DbiRpt<GCalibPmtSpec>] mask:2097278 Site,SimFlag,DetectorId,TimeStamp,SubSi
Out[7]: 0     ## nope

In [8]: r.ctx(timestamp=TimeStamp())   ## default timestamp is now
Out[8]:
{   'CtorMask': 2097278,
    'DetectorId': 0,
    'Mask': 2097278,
    'SimFlag': 1,
    'Site': 127,
    'SubSite': 0,
    'TableName': 'CalibPmtSpec',
    'Task': 0,
    'TimeStamp': Tue, 12 Apr 2011 14:37:29 +0000 (GMT) +443074000 nsec,
    'UpdateMask': 16}

In [9]: len(r)
DbiRpt<GCalibPmtSpec>::Delete
DbiRpt<GCalibPmtSpec>::MakeResultPtr tablename variant of standard ctor, tablename: CalibPmtSpec
Caching new results: ResultKey: Table:CalibPmtSpec row:GCalibPmtSpec.  1 vrec (seqno;versiondate): 20
DbiTimer:CalibPmtSpec: Query done. 208rows,   19.1Kb Cpu   0.0 , elapse   0.0
DbiCtx::RegisterCreation [DbiRpt<GCalibPmtSpec>] mask:2097278 Site,SimFlag,DetectorId,TimeStamp,SubSi
Out[9]: 208
```

21.8.2 Using `mysql` client

Note: Interactive examination of the Database is an invaluable first step to validating updates.

By virtue of the `client` section, in the configuration `~/.my.cnf`, which is read by the client, the **mysql** command with no arguments starts an interactive command line interface allowing you to query your configured database (this is not the server, that runs as **mysqld**).

See *Configuring DB Access* for an example of the `client` section, which will typically correspond to the `tmp_offline_db` section.

Example mysql client session:

```
[blyth@belle7 DybPython]$ mysql                    ## reads from client section
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 32808
Server version: 5.0.77-log Source distribution

Type 'help;' or '\h' for help. Type '\c' to clear the buffer.
```

```
mysql> status             ##  verify are connected with expected DB and identity
--------------
mysql  Ver 14.12 Distrib 5.0.67, for redhat-linux-gnu (i686) using  EditLine wrapper

Connection id:          32808
Current database:       tmp_offline_db
Current user:           noddy@belle7.nuu.edu.tw
...


mysql> show tables ;
+--------------------------+
| Tables_in_tmp_offline_db |
+--------------------------+
| CalibFeeSpec             |
| CalibFeeSpecVld          |
| CalibPmtSpec             |
| CalibPmtSpecVld          |
| DaqRunInfo               |
..

mysql> select * from CalibPmtSpecVld ;          ## examine changes made
+-------+---------------------+---------------------+----------+---------+---------+------+----------
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATE
+-------+---------------------+---------------------+----------+---------+---------+------+----------
|    26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 |      127 |       1 |       0 |    0 |
|    18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 |       32 |       1 |       1 |    0 |
|    27 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 |      127 |       2 |       0 |    0 |
|    28 | 2011-01-22 08:15:17 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|    29 | 2011-01-22 08:15:17 | 2038-01-19 03:14:07 |       32 |       1 |       1 |    0 |
|    23 | 2010-09-16 06:31:34 | 2038-01-19 03:14:07 |       32 |       1 |       1 |    0 |
|    24 | 2010-09-21 05:48:57 | 2038-01-19 03:14:07 |       32 |       1 |       2 |    0 |
|    25 | 2010-09-22 04:26:59 | 2038-01-19 03:14:07 |       32 |       1 |       2 |    0 |
|    30 | 2010-09-22 12:26:59 | 2038-01-19 03:14:07 |      127 |       3 |       0 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+------+----------
9 rows in set (0.00 sec)

mysql> select * from CalibPmtSpec where seqno = 30  ;           ## seqno provides the link between pa
+-------+-------------+-----------+------------------------+-----------+------------+-----------------
| SEQNO | ROW_COUNTER | PMTID     | PMTDESCRIB             | PMTSTATUS | PMTSPEHIGH | PMTSIGMASPEHIGH
+-------+-------------+-----------+------------------------+-----------+------------+-----------------
|    30 |           1 | 536936705 | SABAD1-ring01-column01 |         1 |    41.0905 |         11.3568
|    30 |           2 | 536936705 | SABAD1-ring01-column01 |         1 |    41.0905 |         11.3568
|    30 |           3 | 536936705 | SABAD1-ring01-column01 |         1 |    41.0905 |         11.3568
+-------+-------------+-----------+------------------------+-----------+------------+-----------------
3 rows in set (0.00 sec)
```

21.8.3 Hands On Exercise 5 : Read from DB with varying context

Note: this can be performed either on a copy `tmp_offline_db` or on `offline_db`

Follow the examples of the previous two sections to perform, DIY steps:

1. Use mysql client to query the Vld table, eg `select * from CalibPmtSpecVld ;`
2. Perform queries with varying contexts : with timestamps to distinguish between sets of parameters

3. Contrast row counts obtained with expectations from mysql client selects

Hint, the `vrec DbiValidityRec` attribute on a `cls.Rpt()` provides access to the `SEQNO` of the query which allows a payload query using a **where clause** to select payload rows corresponding to a particular validity.

```
In [12]: r.vrec
Out[12]:
DbiValidityRec
{   'AggregateNo': -1,
    'ContextRange': |site 0x007f|sim 0x007f
        2011-01-22 08:15:17.000000000Z
        2020-12-30 16:00:00.000000000Z,
    'DatabaseLayout': 'NULL',
    'DbNo': 0L,
    'InsertDate': Fri, 25 Feb 2011 08:10:15 +0000 (GMT) +        0 nsec,
    'L2CacheName': '26_2011-01-22_08:15:17',
    'SeqNo': 26L,
    'SubSite': 0,
    'Task': 0,
    'VersionDate': Sat, 22 Jan 2011 08:15:17 +0000 (GMT) +        0 nsec}

In [13]: r.vrec.seqno
Out[13]: 26L
```

21.8.4 Hands On Exercise 6 : Read run timestart/timeend from `DaqRunInfo` table

Note: this can be performed either on a copy `tmp_offline_db` or on `offline_db`

Default Context Query

`DaqRunInfo` has moved

As a scraped table `DaqRunInfo` does not belong in the `db.py` default set that gets copied to `tmp_offline_db` Due to this some of the below will no longer work, an adjustment using cacades needs to be tested.

Default context will probably yield no results:

```
In [27]: import os

In [28]: os.environ['DBCONF'] = "tmp_offline_db"

In [30]: from DybDbi import GDaqRunInfo

In [31]: rpt = GDaqRunInfo.Rpt()

In [32]: len(rpt)
DbiRpt<GDaqRunInfo>::MakeResultPtr tablename variant of standard ctor, tablename: DaqRunInfo
Caching new results: ResultKey: Table: row: No vrecs
DbiCtx::RegisterCreation [DbiRpt<GDaqRunInfo>] mask:2097278 Site,SimFlag,DetectorId,TimeStamp,SubSite
Out[32]: 0
```

Modify to use wideopen validity context

Use exceedingly low level technique to access the `DaqRunInfo` row for a particular run number:

```
In [32]: run = 5647

In [33]: rpt.ctx( sqlcontext="1=1" , task=-1 , subsite=-1 )

In [34]: len(rpt)
```

21.8.5 Fixing this page if it breaks

On building the docs some of the `ipython` sessions listed above are actually performed, making live DB queries etc... This leaves the possibility of failure, to debug this just build a single page with eg:

```
sphinx-build -b dirhtml -d _build/doctrees   . _build/dirhtml sop/dbread.rst
```

21.9 Debugging unexpected parameters

Context Mismatch

When you do not get what you expect, the overwhelming most likely cause is a query context that does not match the DB entries

The key to debugging is isolation of issues. The recommended first steps to locate where problems are:

- Configuration check
- ipython `DybDbi` session
- DbiDataSvc test
- mysql client session
- Following the mysql tail
- GDB Debugging of Template Laden DBI

21.9.1 Configuration check

When operating at the service level first verify that you are using the desired services, ie that you are not using `StaticCalibDataSvc` when you intend to use the DB with `DbiCalibDataSvc`. An example of switching services is provided by dybsvn:r11843

Verify that you are connecting to the DB you expect. Avoid confusing config such as having multiple updates of `DBCONF`

```
[blyth@belle7 dbtest]$ grep DBCONF \*.py
runCalib.py:os.environ['DBCONF'] = "offline_db"
testCalibDirectly.py:os.environ.update( DBCONF="tmp_wangzm_offline_db" )
```

For reading use of `os.environ.setdefault("DBCONF", "offline_db")` is recommended, allowing external overriding.

21.9.2 ipython `DybDbi` session

Get into ipython either with `DBCONF` set externally or internally. Adjust the default context (for example to correspond to the timestamp of a data file) and do a DBI query:

```
In [1]: import os

In [1]: os.environ['DBCONF'] = "tmp_offline_db"

In [1]: from DybDbi import GCalibPmtSpec, TimeStamp

In [2]: rpt = GCalibPmtSpec.Rpt()

In [3]: from DybDbi import TimeStamp

In [4]: rpt.ctx(timestamp=TimeStamp(2011, 1, 22, 10,0,0 ) )

In [5]: len(rpt)

In [6]: rpt[0]
```

21.9.3 DbiDataSvc test

Try running the standard `DbiDataSvc.TestDbiDataSvc` with an appropriate timestamp.

```
DBCONF="tmp_offline_db" nuwa.py -A none --history=off -n 1 -m "DbiDataSvc.TestDbiDataSvc --timeStrin
```

Note: additional context flexibility for this tool would improve it's usefulness as a debugging tool

21.9.4 mysql client session

Check your `[client]` section is pointed to the same DB and perform some simple queries:

```
mysql> select * from CalibPmtSpecVld order by TIMESTART ;
+-------+---------------------+---------------------+----------+---------+---------+------+----------
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATE
+-------+---------------------+---------------------+----------+---------+---------+------+----------
|    31 | 1970-01-01 00:00:00 | 2038-01-19 03:14:07 |      127 |       3 |       0 |    7 |
|    30 | 1970-01-01 00:00:00 | 2038-01-19 03:14:07 |      127 |       3 |       0 |    7 |
|    18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 |       32 |       1 |       1 |    0 |
|    23 | 2010-09-16 06:31:34 | 2038-01-19 03:14:07 |       32 |       1 |       1 |    0 |
|    24 | 2010-09-21 05:48:57 | 2038-01-19 03:14:07 |       32 |       1 |       2 |    0 |
|    25 | 2010-09-22 04:26:59 | 2038-01-19 03:14:07 |       32 |       1 |       2 |    0 |
|    29 | 2011-01-22 08:15:17 | 2038-01-19 03:14:07 |       32 |       1 |       1 |    0 |
|    28 | 2011-01-22 08:15:17 | 2038-01-19 03:14:07 |        1 |       2 |       1 |    0 |
|    27 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 |      127 |       2 |       0 |    0 |
|    26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 |      127 |       1 |       0 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+------+----------
10 rows in set (0.00 sec)
```

21.9.5 Following the mysql tail

If you have access to the DB server machine and have privileges to access the mysql log file it is exceedingly informative to leave a process tailing the mysql log. For example with:

```
sudo tail -f /var/log/mysql.log
```

This allows observation of the mysql commands performed as you interactively make queries from ipython:

```
[blyth@belle7 ~]$ mysql-tail
                  64352 Query       SHOW COLUMNS FROM `CalibPmtSpecVld`
                  64352 Query       SHOW TABLE STATUS LIKE 'CalibPmtSpecVld'
                  64352 Prepare     [1] select * from CalibPmtSpecVld where     TimeStart <= '2011-02
                  64352 Execute     [1] select * from CalibPmtSpecVld where     TimeStart <= '2011-02
                  64352 Prepare     [2] select min(TIMESTART) from CalibPmtSpecVld where TIMESTART >
                  64352 Execute     [2] select min(TIMESTART) from CalibPmtSpecVld where TIMESTART >
                  64352 Prepare     [3] select min(TIMEEND) from CalibPmtSpecVld where TIMEEND > '201
                  64352 Execute     [3] select min(TIMEEND) from CalibPmtSpecVld where TIMEEND > '201
                  64352 Prepare     [4] select max(TIMESTART) from CalibPmtSpecVld where TIMESTART <
                  64352 Execute     [4] select max(TIMESTART) from CalibPmtSpecVld where TIMESTART <
                  64352 Prepare     [5] select max(TIMEEND) from CalibPmtSpecVld where TIMEEND < '201
                  64352 Execute     [5] select max(TIMEEND) from CalibPmtSpecVld where TIMEEND < '201
                  64352 Prepare     [6] select * from CalibPmtSpec where     SEQNO= 26
                  64352 Execute     [6] select * from CalibPmtSpec where     SEQNO= 26
                  64352 Quit
```

The SQL queries from the log can then be copy-and-pasted to a mysql client session for interactive examination.

Todo

Provide a way for non-administrators to do this style of debugging, perhaps with an extra DBI log file ?

21.9.6 GDB Debugging of Template Laden DBI

Isolate issue into small python test, then:

```
gdb $(which python)
(gdb) set args test_dybdbi_write.py
(gdb) b "DbiWriter<GDcsPmtHv>::operator<<(GDcsPmtHv const&)"
Function "DbiWriter<GDcsPmtHv>::operator<<(GDcsPmtHv const&)" not defined.
Make breakpoint pending on future shared library load? (y or [n]) y
(gdb) r
```

Determining the symbol names (especially when templated) can be painful.:

```
(gdb) b "DbiWriter<GDcsPmtHv>&
Display all 378426 possibilities? (y or n)
(gdb) b DbiWriter.tpl:100
```

Hunting for symbols inside the .so much is faster than attempting to use tab completion, or manually compose the magic symbol names:

```
objdump -t ./i686-slc4-gcc34-dbg/libDybDbiLib.so | c++filt | grep DbiWriter\<GDcsPmtHv\>::operator
0014b0ae  w    F .text  000002ca              DbiWriter<GDcsPmtHv>::operator<<(GDcsPmtHv const&)
```

21.10 DB Table Creation

- Workflow Outline for Adding Tables
- Design Tables
- Prepare `.spec` File
- Generate Row Classes from `.spec`
  - Ensuring Consistency When Changing Spec
- Copy `offline_db` to `tmp_offline_db`
- Create New Tables in `tmp_offline_db`
- Populate New Table With Dummy Data
- Verify tables using the mysql client

21.10.1 Workflow Outline for Adding Tables

The Row classes needed to interact with the database and the Database table descriptions are generated from specification files (`.spec`) stored in dybgaudi:Database/DybDbi/spec. The generation is done when the CMT **DybDbi** package is built.

Commit early and often

Building **DybDbi** never creates tables or even connects to any DB, so share your *.spec* while you are working on them

1. create the `.spec`
2. generate the code and table descriptions by building dybgaudi:Database/DybDbi
3. create the test tables in a copy of `offline_db`
4. populate the table with some dummy data using DybDbi
5. make queries against the table using DybDbi and services

These last 2 steps in python can then be rearranged into a nosetest.

21.10.2 Design Tables

When considering how to divide parameters into tables bear in mind:

- Quantities that are not updated together should not be stored together in the same table
- Joins between tables are not supported by DBI; simplicity is mandatory

Things to avoid in tables:

- duplication, for example integer codes accompanied by a human readable string might seem nice for users but in the long run is a bug magnet
- strings where integer codes are more appropriate, integer columns are easier and more efficient to query against
- varchar when other types can be used, especially in frequently accessed tables

21.10.3 Prepare `.spec` File

Spec files need to be created in dybgaudi:Database/DybDbi/spec and named after the table name prefixed with a **G**. An example of a spec file dybgaudi:Database/DybDbi/spec/GCalibFeeSpec.spec:

```
"""
docstring
"""
;
 table                          | meta                           | legacy                         | CanL
 CalibFeeSpec                   | 1                              | CalibFeeSpec                   | kFAL
;
 meta                           | rctx
 2                              | Site.kAll,SimFlag.kData,TimeStamp.kNOW,DetectorId.kUnknown,SubSite.k
;
 meta                           | wctx
 3                              | SiteMask.kAll,SimMask.kData,TimeStart.kBOT,TimeEnd.kEOT,AggNo.k-1,Su
;
 name                  | codetype              | dbtype           | legacy            | memb
 ChannelId             | DayaBay::FeeChannelId | int(10) unsigned | channelId         | m_channelId
 Status                | int                   | int(10) unsigned | status            | m_status
 AdcPedestalHigh       | double                | double           | pedestalHigh      | m_adcPedestalH
 AdcPedestalHighSigma  | double                | double           | sigmaPedestalHigh | m_adcPedestalH
 AdcPedestalLow        | double                | double           | pedestalLow       | m_adcPedestall
 AdcPedestalLowSigma   | double                | double           | sigmaPedestalLow  | m_adcPedestall
 AdcThresholdHigh      | double                | double           | thresholdHigh     | m_adcThresholo
 AdcThresholdLow       | double                | double           | thresholdLow      | m_adcThresholo
```

Spec files are structured into sections divided by semicolons in the first column of otherwise blank lines. The sections comprise:

1. documentation string in triple quotes : which is propagated thru the C++ to the python commandline and used in generated documentation oum:genDbi/GCalibFeeSpec/
2. class level quantities (identified by the presence of the meta key)
3. row level quantities (without the meta key)

Within each section a vertical bar delimited format is used that is parsed into python dicts and lists of dicts by oum:api/dybdbipre/. These objects are made available within the context used to fill the django templates dybgaudi:Database/DybDbi/templates for the various derived files : classes, headers, documentation , sql descriptions. Further details are in the API docs linked above.

Specified quantities:

class level qty	notes
table	Name of the table in Database, by convention without the G prefix
meta	Simply used to identify class level properties, values are meaningless
legacy	Name of table again, can be used for migrations but in typical usage use the same string as the table qty
CanL2Cache	leave as kFALSE, enabling L2Cache is not recommended
class	Name of the generated class, use table name prefixed with a G
rctx	Default DBI read context, make sure the TableName.kName is correct
wctx	Default DBI write contextrange, make sure the TableName.kName is correct

Default DBI Read/Write Contexts

The default context qtys use a comma delimited string representation of DBI context and contextrange based on enum value labels. While these are conveniences that can easily be subsequently changed, it is important to ensure that the NAME in TableName.kNAME corresponds to the name of the database table.

Row level quantities are mostly self explanatory, and are detailed in oum:api/dybdbipre/.

Capitalized Attribute Names

To conform to the C++/ROOT convention for Getters/Setters, the column `name` should be capitalized.

The ones that might be confusing are:

row level qty	notes
name	column name as used in the C++ Getter and Setter methods
legacy	name of the field in the database table
memb	name of the C++ instance variable

When creating new specifications that do not need to conform to existing tables, using the same string for all the above three quantities is recommended.

Todo

plant internal reference targets to genDbi documentation

21.10.4 Generate Row Classes from `.spec`

On building the CMT package dybgaudi:Database/DybDbi the classes corresponding to the `.spec` are generated in the `Database/DybDbi/genDbi` directory. Typically the build will fail with compilation errors in the event of problems.

Ensuring Consistency When Changing Spec

DatabaseInterface and *DybDbi* packages make strong use of templates and generated code. Because of this the 1st thing to try when meeting crashes such as segv is to ensure full consistency by cleaning all generated files and rebuilding from scratch.

Deep cleaning can be done by:

```
#DBI
echo rm -rf $CMTCONFIG            ## check
echo rm -rf $CMTCONFIG  | sh      ## do

##DybDbi
echo rm -rf genDbi genDict $CMTCONFIG
echo rm -rf genDbi genDict $CMTCONFIG   | sh
```

Rebuild *DatabaseInterface* and then *DybDbi*

21.10.5 Copy `offline_db` to `tmp_offline_db`

Instructions at *Copy offline_db to tmp_offline_db*

21.10.6 Create New Tables in `tmp_offline_db`

Configure the DB to connect to with the `DBCONF` envvar, see *Configuring DB Access*

```
[blyth@belle7 DybDbi]$ DBCONF=tmp_offline_db ipython
Python 2.7 (r27:82500, Feb 16 2011, 11:40:18)
IPython 0.9.1 -- An enhanced Interactive Python.
...
In [1]: from DybDbi import gDbi, GPhysAd
In [2]: gDbi.Status()
DybDbi activating DbiTableProxyRegistry
Using DBConf.Export to prime environment with : from DybPython import DBConf ; DBConf.Export('tmp_of
dbconf:export_to_env from $SITEROOT/../.my.cnf:~/.my.cnf section tmp_offline_db
Successfully opened connection to: mysql://belle7.nuu.edu.tw/tmp_offline_db
This client, and MySQL server (MySQL 5.0.77-log) does support prepared statements.
DbiCascader Status:-
Status   URL

Closed         0 mysql://belle7.nuu.edu.tw/tmp_offline_db

In [3]: GPhysAd().CreateDatabaseTables(0,"PhysAd")   ## dbno in cascade and tablename withou the G pr
Out[3]: 1
```

Notes:

- `DBCONF=tmp_offline_db ipython` sets the configuration for the ipython session
- The call to `gDbi.Status()` is used to verify are talking to the intended Database !

Only for new tables

As `CreateDatabaseTables` uses `create table if not exists` a pre-existing table must be manually dropped (**loosing all entries**) before this will work.

21.10.7 Populate New Table With Dummy Data

Get into ipython again, with `DBCONF=tmp_offline_db ipython` and add some dummy entries:

```
In [1]: from DybDbi import gDbi, GPhysAd

In [2]: GPhysAd?     ## lookup attribute names

In [3]: r = GPhysAd.Create( AdSerial=1,PhysAdId=10,Describ="red" )
In [4]: g = GPhysAd.Create( AdSerial=2,PhysAdId=20,Describ="green" )
In [5]: b = GPhysAd.Create( AdSerial=3,PhysAdId=30,Describ="blue" )

In [6]: wrt = GPhysAd.Wrt()

In [5]: wrt.Write( r )
DbiWrt<GPhysAd>::MakeWriter standard ctor, contextrange: |site 0x007f|sim 0x007f
        1970-01-01 00:00:00.000000000Z
        2038-01-19 03:14:07.000000000Z
Using DBConf.Export to prime environment with : from DybPython import DBConf ; DBConf.Export('tmp_of
dbconf:export_to_env from $SITEROOT/../.my.cnf:~/.my.cnf section tmp_offline_db
Successfully opened connection to: mysql://belle7.nuu.edu.tw/tmp_offline_db
This client, and MySQL server (MySQL 5.0.77-log) does support prepared statements.
DbiCascader Status:-
Status   URL

Closed         0 mysql://belle7.nuu.edu.tw/tmp_offline_db
```

```
DbiCtx::RegisterCreation [DbiWrt<GPhysAd>] mask:2128992 SubSite,Task,TimeStart,TimeEnd,SiteMask,SimMa
DbiWrt<GPhysAd>::Write

In [5]: wrt.Write( g )
In [6]: wrt.Write( b )

In [7]: wrt.Close()    ## DB is written to here
DbiWrt<GPhysAd>::Close
Out[8]: 1

In [8]: rpt = GPhysAd.Rpt()

In [9]: len(rpt)
DbiRpt<GPhysAd>::MakeResultPtr tablename variant of standard ctor, tablename: PhysAd
Caching new results: ResultKey: Table:PhysAd row:GPhysAd.  1 vrec (seqno;versiondate): 1;1970-01-01 0
DbiTimer:PhysAd: Query done. 3rows,    0.0Kb Cpu   0.0 , elapse   0.0
DbiCtx::RegisterCreation [DbiRpt<GPhysAd>] mask:2097278 Site,SimFlag,DetectorId,TimeStamp,SubSite,Tas
Out[9]: 3

In [10]: rpt[0].asdict
Out[10]: {'AdSerial': 1, 'Describ': 'red', 'PhysAdId': 10}
```

Get Real

More realistic testing would modify the writers context range and readers context from their defaults.

21.10.8 Verify tables using the mysql client

After adding tables check them with the `mysql` client. Use the `status` command to check are connected to the expected database, see *Configuring DB Access* if not.

Example mysql shell session:

```
mysql> status

    mysql> show tables ;
    +--------------------------+
    | Tables_in_tmp_offline_db |
    +--------------------------+
    | CalibFeeSpec             |
    | CalibFeeSpecVld          |
    | CalibPmtSpec             |
    | CalibPmtSpecVld          |
    | DaqRunInfo               |
    | DaqRunInfoVld            |
    | FeeCableMap              |
    | FeeCableMapVld           |
    | LOCALSEQNO               |
    | PhysAd                   |
    | PhysAdVld                |
    | SimPmtSpec               |
    | SimPmtSpecVld            |
    +--------------------------+
    13 rows in set (0.00 sec)
```

```
mysql> select * from PhysAd ;
+-------+-------------+----------+----------+------------+
| SEQNO | ROW_COUNTER | ADSERIAL | PHYSADID | DESCRIB    |
+-------+-------------+----------+----------+------------+
|     1 |           1 |        1 |       10 | red        |
|     1 |           2 |        2 |       20 | green      |
|     1 |           3 |        3 |       30 | blue       |
+-------+-------------+----------+----------+------------+
2 rows in set (0.00 sec)

mysql> select * from PhysAdVld ;
+-------+---------------------+---------------------+----------+---------+---------+------+------
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGR
+-------+---------------------+---------------------+----------+---------+---------+------+------
|     1 | 1970-01-01 00:00:00 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+------+------
1 row in set (0.00 sec)
```

21.11 DB Validation

This section covers basic checks of the DBI integrity of updates done by the SVN pre-commit hook when attempting to commit into dybaux, *Pre-commit enforced validation : DBI Gatekeeper* and also generic DBI validation done on *offline_db* entries as part of the autorun nosetests, *Generic Validation*.

These generic checks of the DBI mechanics have been found to rarely fail. For the more critical and fragile testing of the meaning of updates see *DB Testing*.

- Interactive Checking with ipython
  - DB Checking
  - Ascii Catalog Checking
- Workflow Checks
- Generic Validation

21.11.1 Interactive Checking with ipython

DB Checking

Simple select on `LOCALSEQNO` table, provides same info as the `.seqno` methods below:

```
mysql> select * from LOCALSEQNO ;
+--------------+---------------+
| TABLENAME    | LASTUSEDSEQNO |
+--------------+---------------+
| *            |             0 |
| CalibFeeSpec |           113 |
| CalibPmtSpec |            50 |
| FeeCableMap  |             3 |
| HardwareID   |           372 |
| CableMap     |           460 |
| Reactor      |           372 |
+--------------+---------------+
7 rows in set (0.07 sec)
```

```
In [1]: from DybPython import DB

In [2]: db = DB("offline_db")          ## the DBCONF section name

In [3]: db.seqno          ## obtained from LOCALSEQNO table, providing LASTUSEDSEQNO values
Out[3]:
{'CableMap': 460,
 'CalibFeeSpec': 113,
 'CalibPmtSpec': 50,
 'FeeCableMap': 3,
 'HardwareID': 372,
 'Reactor': 372}

In [4]: db.fabseqno       ## fabricated from .allseqno with SEQNO counts
Out[4]:
{'CableMap': 460,
 'CalibFeeSpec': 111,
 'CalibPmtSpec': 29,
 'FeeCableMap': 3,
 'HardwareID': 372,
 'Reactor': 372}

     ## legacy tables : CalibFeeSpec CalibPmtSpec have know SEQNO irregularities
     ## .. all other tables must be consistent

In [5]: db.allseqno        ## obtained via SQL queries on validity tables
Out[5]:
{'CableMap': [1,
              2,
              3,
              4,
              5,
              6,
              7,
  ... too long to show ...
             370,
             371,
             372]}

In [6]: db.allseqno.keys()
Out[6]:
['Reactor',
 'CalibFeeSpec',
 'HardwareID',
 'CalibPmtSpec',
 'FeeCableMap',
 'CableMap']
```

Ascii Catalog Checking

Simple cat of `LOCALSEQNO.csv` table, provides same info as the `.seqno` methods below:

```
[blyth@belle7 ~]$ svnversion ~/dybaux/catalog/tmp_offline_db
4974
[blyth@belle7 ~]$ cat ~/dybaux/catalog/tmp_offline_db/LOCALSEQNO/LOCALSEQNO.csv
TABLENAME char(64),LASTUSEDSEQNO int(11),PRIMARY KEY (TABLENAME)
"*",0
```

```
"CableMap",460
"CalibFeeSpec",113
"CalibPmtSpec",50
"CoordinateAd",1
"CoordinateReactor",1
"FeeCableMap",3
"HardwareID",372
"Reactor",372

In [8]: from DybPython.asciicat import AsciiCat

In [9]: cat = AsciiCat("~/dybaux/catalog/tmp_offline_db")      ## reads all entries into memory

In [10]: cat.seqno
Out[10]:
{'CableMap': 460,
 'CalibFeeSpec': 113,
 'CalibPmtSpec': 50,
 'CoordinateAd': 1,
 'CoordinateReactor': 1,
 'FeeCableMap': 3,
 'HardwareID': 372,
 'Reactor': 372}

In [11]: cat.fabseqno
Out[11]:
{'CableMap': 460,
 'CalibFeeSpec': 111,
 'CalibPmtSpec': 29,
 'CoordinateAd': 1,
 'CoordinateReactor': 1,
 'FeeCableMap': 3,
 'HardwareID': 372,
 'Reactor': 372}
```

21.11.2 Workflow Checks

At each step of the workflow the tools, such as `db.py` and `dbaux.py` perform DBI integrity checks, checking things like:

1. `SEQNO` consistency between `LOCALSEQNO` table and actual payload and validity tables
2. table existance
3. payload/validity consistency

Furthermore when performing operations such as **rloadcat** or **rcmpcat** that involve both an ascii catalog and the DB the differences present in the ascii catalog are checked to be valid DBI updates with the expected tables and `SEQNO` values.

21.11.3 Generic Validation

Packages containing tests that focus on DB access/function testing

package	notes on tests
dybgaudi:DybPython	operation of `db.py` and `dbsvn.py`, and workflow steps
dybgaudi:Database/DybDbi	simple readonly access to a variety of tables
dybgaudi:Database/DbiTest	DBI supplied C++ tests of most DBI functionality
dybgaudi:Database/DybDbiTest	`DybDbi` equivalents of all relevant `DbiTest`
dybgaudi:Database/DbiValidate	generic tests of DBI table structure : integers inside enums, PK etc..

21.12 DB Testing

This section covers the testing of the meaning of DB update entries. Generic machinery validations are described in *DB Validation*

Numerous very time/CPU expensive problems have occured with the meanings of DB update entries. Furthermore exactly the same problems have occured multiple times and in several cases trivial errors have managed to get into *offline_db* that have required subsequent re-processing to be abandoned.

In the light of these time wasting mistakes, strict enforcement of the testing of DB updates has been deemed to be necessary.

- Nosetesting reminder
- When and where
- Standardized testing
- Responsibility for maintaining tests
- Responsibility for running tests
- Proof of testing
- Dealing with mistakes
- Checking entries make sense
- Status of packages with tests
- Comparing python datetimes with DBI TimeStamps

21.12.1 Nosetesting reminder

As an introduction to nosetesting see *Nosetests Introduction* which lists references and examples.

21.12.2 When and where

The appropriate time and place for checking the meaning/correctness of DB updates is within the *tmp_<username>_offline_db* of the updaters immediately after updates are performed there.

Checks prior to propagation

Allowing full checking prior to propagation to *offline_db* is the reason that the SOP requires all updates to be made first into a *tmp_* DB.

The appropriate way to perform such checks is via nosetests that can be directed at the the desired DB via the DBCONF mechanism, typically (for bash shell):

```
DBCONF=tmp_<username>_offline_db nosetests -v
DBCONF=offline_db                nosetests -v
```

OR for csh(tcsh):

```
setenv DBCONF tmp_<username>_offline_db
nosetests -v
```

More details on DBCONF can be found at *N ways to set an envvar*. For how testing fits in with the SOP workflow, see *Workflow Outline*.

21.12.3 Standardized testing

The nosetests corresponding to DB table updating follow the same standard layout as all NuWa nosetests. They are required to be maintained in the *tests* directory of the package that contains the scripts that perform the update and it should be a sibling to the "cmt" directory of the package. For example:

- dybgaudi:Calibration/DBUpdate/tests/
- dybgaudi:Calibration/DBUpdate/tests/test_calibpmtfinegain.py

Automation of testing relies on adherence to standards for test naming and layout.

21.12.4 Responsibility for maintaining tests

The roster of responsibility for maintaining these DB updating tests are, in decreasing order of responsibility:

1. DB updaters + authors of DB updating scripts, who know best how the results were derived and likely problems
2. Direct downstream users, typically authors of services that use the results who are well placed to know the constraints that should be applied.
3. Working group conveners, responsible to steer the above workers and set expectations for testing
4. Database/testing experts, who know best how testing can be efficiently structured and can advise on techniques to improve test coverage.
5. Anybody else who finds a problem with results, should add tests encapsulating the finding

21.12.5 Responsibility for running tests

Although multiple persons are involved with maintaining the tests of DB updates the responsibility to run the tests and demonstrate that the tests were run remains with the DB updaters.

21.12.6 Proof of testing

In order to prove that testing has been done, run commands such as the below and copy and paste the text output to be included into your email requesting propagation to *offline_db*:

```
date ; pwd ; svnversion .
```

Note: Arrange a **clean** SVN revision, by committing any changes and updating working copy

---

For bash shell:

```
DBCONF=tmp_offline_db nosetests -v
DBCONF=tmp_<username>_offline_db nosetests -v      ## depends on ~/.my.cnf section names
```

For csh(tcsh) shell:

```
setenv DBCONF tmp_offline_db
setenv DBCONF tmp_<username>_offline_db    ## depends on ~/.my.cnf section names
nosetests -v
```

If deemed appropriate the coordinates of your *tmp_* DB can be shared to allow other stakeholders to run the tests.

Once the tests run without error, you can proceed to making **dybaux** commits The text output proving successful test runs **must be included** in your mail to Liang requesting the propagation of **dybaux** commits into *offline_db*.

21.12.7 Dealing with mistakes

Even with these procedures problems will inevitably continue to get through. When they do the requirement will be to add nosetests that capture the issue. This should avoid past issues coming back to haunt us, as experienced in dybsvn:ticket:1282

21.12.8 Checking entries make sense

Constraining entries to meet expectations of *normality* will vary greatly by table. However some simple starting points could include constraints on

1. number of distinct values of identity entries
2. mean/min/max values of parameters
3. values of quantities derived from fits to the parameters
4. differences in parameters between updates expectations on allowable mean/min/max and deltas

21.12.9 Status of packages with tests

Packages containing tests and commentry on the nature of the tests, remember that tests should be sensitive to external DBCONF envvar.

- dybgaudi:Database/TableTests/TestCableMap/tests
  - follows conventions, uses asserts, good quality, **someone gets it** at least
- dybgaudi:Calibration/DBUpdate/tests
  - currently many task 0 FAILs, need SEQNO range control to avoid know FAILs
  - needs adoption by domain experts
  - needs addition of tests than capture the issues of dybsvn:ticket:1282
- dybgaudi:Database/TableTests/McsTable/python/McsTable
  - non-standard layout, no asserts
- dybgaudi:Calibration/CalibParam/tests
  - seed test only
- dybgaudi:Database/TableTests/PhysAd/tests
  - stub main, ready for the updater to turn into real *def test_<name>():* functions

21.12.10 Comparing python datetimes with DBI TimeStamps

For some tables such as *CalibPmtFineGain* the CWG has a policy of requiring validity *TIMEEND* to normally be *TimeStamp.GetEOT()* a standard far in the future date, corresponding to *INTMAX = (1<<31)-1*. Often tests use *DybPython.DB* which returns python datetimes. The below approach sidesteps timezone complications by converting the datetimes into *TimeStamp* with *TimeStamp.fromAssumedUTCDatetime*:

```
[blyth@belle7 ~]$ DBCONF=tmp_offline_db ipython
Python 2.7 (r27:82500, Feb 16 2011, 11:40:18)
Type "copyright", "credits" or "license" for more information.

IPython 0.9.1 -- An enhanced Interactive Python.
?         -> Introduction and overview of IPython's features.
%quickref -> Quick reference.
help      -> Python's own help system.
object?   -> Details about 'object'. ?object also works, ?? prints more.

In [1]: from DybPython import DB

In [2]: db = DB()

In [3]: rec = db("select * from CalibPmtFineGainVld order by SEQNO desc limit 1 ")[0]

In [4]: rec['TIMEEND']
Out[4]: datetime.datetime(2038, 1, 19, 3, 14, 7)

In [5]: from DybDbi import TimeStamp
(Bool_t)1

In [6]: TimeStamp.fromAssumedUTCDatetime( rec['TIMEEND'] )
Out[6]: Tue, 19 Jan 2038 03:14:07 +0000 (GMT) +        0 nsec

In [7]: TimeStamp.fromAssumedUTCDatetime( rec['TIMEEND'] ).GetSeconds()
Out[7]: 2147483647.0

In [8]: TimeStamp.GetEOT()
Out[8]: Tue, 19 Jan 2038 03:14:07 +0000 (GMT) +        0 nsec

In [9]: TimeStamp.GetEOT().GetSeconds()
Out[9]: 2147483647.0

In [10]: TimeStamp.GetEOT().GetSeconds() == TimeStamp.fromAssumedUTCDatetime( rec['TIMEEND'] ).GetSec
Out[10]: True
```

21.13 DB Administration

- Temporary DB Setup by MySQL Administrators

21.13.1 Temporary DB Setup by MySQL Administrators

For non-central temporary databases of a short lived nature it is very convenient to give table experts substantial permissions in temporary databases of specific names. Database names based on SVN user account names (listed at

dybsvn:report:11) are recommended. The names must be prefixed with **tmp_** as the `db.py` script enforces this as a safeguard for **load** and **loadcat** commands eg:

```
tmp_wangzm_offline_db
tmp_jpochoa_offline_db
tmp_ww_offline_db
tmp_blyth_offline_db
tmp_zhanl_offline_db
```

To grant permissions mysql administrators need to perform something like the below, which give all privileges except *Grant_Priv*:

```
mysql> grant all on tmp_wangzm_offline_db.* to 'wangzm'@'%' identified by 'realplaintextpassword' ;
```

Adminstrators can list existing database level permissions with:

```
mysql> select * from mysql.db ;
+-----------------------+----------------------+---------+-------------+-------------+-------------+
| Host                  | Db                   | User    | Select_priv | Insert_priv | Update_priv |
+-----------------------+----------------------+---------+-------------+-------------+-------------+
| %                     | offline_db_20101125  | dayabay | Y           | N           | N           |
| %                     | offline_db_20101124  | dayabay | Y           | N           | N           |
| %                     | tmp_blyth_offline_db | blyth   | Y           | Y           | Y           |
...
```

21.14 Custom DB Operations

On rare occasions it is expedient to perform DB operations without following SOP approaches. For example when jumpstarting large or expensive to create tables such as the *DcsAdWpHv* table. Typically tables are communicated via mysqldump files in this case.

Mostly such custom operations are performed by DB managers, although table updaters can benefit from being aware of how things are done.

- Tools to manipulate mysqldump files
- Preparing and Comparing Dump files
  - Table renaming in DB
  - Dump using extended insert
  - Compare extended insert dumps
  - communicating dumps via website
- Download mysqldump file and load into DB
  - download dump and verify digest
  - Checking the dump
  - Testing loading into *tmp_copy_db*
  - Simple checks on loaded table
  - Fixup DBI metadata table LOCALSEQNO
  - Verifying offline_db load by another dump
- Copying a few DBI tables between DBs using rdumpcat, rloadcat
  - Non-decoupled rdumpcat into empty folder
  - Loading of partial ascii catalog into target DB with fastforwarding of INSERTDATEs
- Jumpstarting *offline_db.DqChannelPacked* table
  - Create mysqldump file
  - Record size/digest of dump
  - Check its viable by creating a DB from it
  - Position that for web accessibility (admin reminder)
  - Download the dump and check digest
- CQScraper testing
  - Create a test DB to check CQScraper Operation
  - Load the mysqldump creating the new new tables
  - Fixup LOCALSEQNO
  - Configure a node to run the CQScraper cron task
  - Repeat for *offline_db*

21.14.1 Tools to manipulate mysqldump files

Scripts to facilitate non-SOP operations:

dbdumpload.py dump provided simple interface to the full mysqldump command, load does similar for loading using mysql client NB this script simply emits command strings to stdout is does not run them

mysql.py simple interface to mysql client that is DBCONF aware, avoids reentering tedious connection parameters

Many examples of using these are provided below.

21.14.2 Preparing and Comparing Dump files

Table renaming in DB

After using interactive mysql to rename the shunted tables in *tmp_offline_db*:

```
mysql> drop table  DcsAdWpHv, DcsAdWpHvVld ;
Query OK, 0 rows affected (0.10 sec)

mysql> rename table DcsAdWpHvShunted  to DcsAdWpHv ;
Query OK, 0 rows affected (0.00 sec)
```

```
mysql> rename table DcsAdWpHvShuntedVld to DcsAdWpHvVld ;
Query OK, 0 rows affected (0.00 sec)
```

Dump using extended insert

Using extended insert (the default emitted by dbdumpload.py) is regarded as safer as it produces smaller dumps and faster loads and dumps. The disadvantage is very few newlines in the dump making *diff* and *vi* unusable:

```
dbdumpload.py tmp_offline_db          dump          ~/tmp_offline_db.DcsAdWpHv.xi.sql -t "DcsAdWpHv D
dbdumpload.py tmp_ynakajim_offline_db dump ~/tmp_ynakajim_offline_db.DcsAdWpHv.xi.sql -t "DcsAdWpHv D
```

Compare extended insert dumps

Try comparison against dump from Yasu's DB:

```
du -h  ~/tmp_offline_db.DcsAdWpHv.xi.sql ~/tmp_ynakajim_offline_db.DcsAdWpHv.xi.sql
25M     /home/blyth/tmp_offline_db.DcsAdWpHv.xi.sql
25M     /home/blyth/tmp_ynakajim_offline_db.DcsAdWpHv.xi.sql

wc  ~/tmp_offline_db.DcsAdWpHv.xi.sql ~/tmp_ynakajim_offline_db.DcsAdWpHv.xi.sql
      94    16043 26050743 /home/blyth/tmp_offline_db.DcsAdWpHv.xi.sql
      94    16043 26050752 /home/blyth/tmp_ynakajim_offline_db.DcsAdWpHv.xi.sql
     188    32086 52101495 total
```

Insert dates in vld tables differ but they all have similar dates in the *2** of Aug so make em all the same:

```
perl -p -e 's,2012-08-2\d \d\d:\d\d:\d\d,2012-08-2X XX:XX:XX,g' ~/tmp_offline_db.DcsAdWpHv.xi.sql > ~
perl -p -e 's,2012-08-2\d \d\d:\d\d:\d\d,2012-08-2X XX:XX:XX,g' ~/tmp_ynakajim_offline_db.DcsAdWpHv.x
```

Check that did not change size:

```
[blyth@belle7 DybDbi]$ wc ~/tmp_offline_db.DcsAdWpHv.xi.sql* ~/tmp_ynakajim_offline_db.DcsAdWpHv.xi.s
       94     16043  26050743 /home/blyth/tmp_offline_db.DcsAdWpHv.xi.sql
       94     16043  26050743 /home/blyth/tmp_offline_db.DcsAdWpHv.xi.sql.cf
       94     16043  26050752 /home/blyth/tmp_ynakajim_offline_db.DcsAdWpHv.xi.sql
       94     16043  26050752 /home/blyth/tmp_ynakajim_offline_db.DcsAdWpHv.xi.sql.cf
      376     64172 104202990 total
```

Now can diff:

```
diff  ~/tmp_offline_db.DcsAdWpHv.xi.sql.cf ~/tmp_ynakajim_offline_db.DcsAdWpHv.xi.sql.cf
3c3
< -- Host: belle7.nuu.edu.tw    Database: tmp_offline_db
---
> -- Host: dayabaydb.lbl.gov    Database: tmp_ynakajim_offline_db
5c5
< -- Server version     5.0.77-log
---
> -- Server version     5.0.95-log
94c94
< -- Dump completed on 2012-08-30  4:09:09
---
> -- Dump completed on 2012-08-30  4:13:45
```

communicating dumps via website

Distributing large files via email is inefficient its is must preferable to use DocDB or other webserver that you control.

On source machine, record the digest of the dump:

```
[blyth@belle7 utils]$ du -h /home/blyth/tmp_offline_db.DcsAdWpHv.xi.sql
25M     /home/blyth/tmp_offline_db.DcsAdWpHv.xi.sql
[blyth@belle7 utils]$ md5sum /home/blyth/tmp_offline_db.DcsAdWpHv.xi.sql
90ac4649f5ae3f2a94f187e1885819d8  /home/blyth/tmp_offline_db.DcsAdWpHv.xi.sql
```

Transfers to publish via nginx:

```
simon:lode blyth$ scp N:tmp_offline_db.DcsAdWpHv.xi.sql .
simon:lode blyth$ scp tmp_offline_db.DcsAdWpHv.xi.sql WW:local/nginx/html/data/
```

21.14.3 Download mysqldump file and load into DB

download dump and verify digest

Check the digest matches after downloading elsewhere:

```
[blyth@cms01 ~]$ curl -O http://dayabay.ihep.ac.cn:8080/data/tmp_offline_db.DcsAdWpHv.xi.sql
[blyth@cms01 ~]$
[blyth@cms01 ~]$ md5sum tmp_offline_db.DcsAdWpHv.xi.sql
90ac4649f5ae3f2a94f187e1885819d8  tmp_offline_db.DcsAdWpHv.xi.sql
```

Checking the dump

Check the head and tail of the dump, use *-c* option to avoid problems of very long lines:

```
[blyth@cms01 ~]$ head -c 2000 tmp_offline_db.DcsAdWpHv.xi.sql
-- MySQL dump 10.11
--
-- Host: belle7.nuu.edu.tw    Database: tmp_offline_db
-- ------------------------------------------------------


[blyth@cms01 ~]$ tail -c 2000 tmp_offline_db.DcsAdWpHv.xi.sql
-- Dump completed on 2012-08-30  4:09:09
```

Check that the dump has **CREATE** only for the expected new tables and has no **DROP**:

```
[blyth@belle7 DybDbi]$ grep CREATE  ~/tmp_offline_db.DcsAdWpHv.xi.sql
CREATE TABLE `DcsAdWpHv` (
CREATE TABLE `DcsAdWpHvVld` (
[blyth@belle7 DybDbi]$ grep DROP  ~/tmp_offline_db.DcsAdWpHv.xi.sql
[blyth@belle7 DybDbi]$
```

Warning: DANGER OF BLASTING ALL TABLES IN DB HERE : BE DOUBLY CERTAIN THAT ONLY DESIRED NEW TABLES ARE THERE

Testing loading into *tmp_copy_db*

The *dbdumpload.py* script simply emits a string to stdout with the command to check before running by piping to *sh*, when loading this command cats the dump to the mysql client.

```
[blyth@belle7 DybDbi]$ dbdumpload.py tmp_copy_db load ~/tmp_offline_db.DcsAdWpHv.xi.sql    ## check c
cat /home/blyth/tmp_offline_db.DcsAdWpHv.sql | /data1/env/local/dyb/external/mysql/5.0.67/i686-slc5-g
[blyth@belle7 DybDbi]$
[blyth@belle7 DybDbi]$ dbdumpload.py tmp_copy_db load ~/tmp_offline_db.DcsAdWpHv.xi.sql | sh    ## ru
```

Warning: the tables must not exist already for the load to succeed

Simple checks on loaded table

Check see expected number of SEQNO in the loaded table:

```
[blyth@belle7 DybDbi]$ echo "select min(SEQNO),max(SEQNO),max(SEQNO)-min(SEQNO)+1,count(*) as N from
+------------+------------+--------------------------+---------+
| min(SEQNO) | max(SEQNO) | max(SEQNO)-min(SEQNO)+1 | N       |
+------------+------------+--------------------------+---------+
|          1 |       3926 |                     3926 | 1003200 |
+------------+------------+--------------------------+---------+
[blyth@belle7 DybDbi]$ echo "select min(SEQNO),max(SEQNO),max(SEQNO)-min(SEQNO)+1,count(*) as N from
+------------+------------+--------------------------+------+
| min(SEQNO) | max(SEQNO) | max(SEQNO)-min(SEQNO)+1 | N    |
+------------+------------+--------------------------+------+
|          1 |       3926 |                     3926 | 3926 |
+------------+------------+--------------------------+------+
```

Fixup DBI metadata table LOCALSEQNO

Fixup the LOCALSEQNO metdata table setting the LASTUSEDSEQNO for the jumpstarted table using interactive mysql:

```
mysql> use tmp_copy_db

Database changed
mysql> select * from LOCALSEQNO ;
+------------------+---------------+
| TABLENAME        | LASTUSEDSEQNO |
+------------------+---------------+
| *                |             0 |
| CalibFeeSpec     |           113 |
| CalibPmtSpec     |           713 |
| FeeCableMap      |             3 |
| HardwareID       |           386 |
| CableMap         |           509 |
| Reactor          |           960 |
| CoordinateAd     |             1 |
| CoordinateReactor |             2 |
| CalibPmtHighGain |          1268 |
| CalibPmtPedBias  |             1 |
| EnergyRecon      |           914 |
| CalibPmtFineGain |          7943 |
+------------------+---------------+
```

```
13 rows in set (0.00 sec)


mysql> insert into LOCALSEQNO values ('DcsAdWpHv', 3926 ) ;
Query OK, 1 row affected (0.00 sec)

mysql> select * from LOCALSEQNO ;
+------------------+---------------+
| TABLENAME        | LASTUSEDSEQNO |
+------------------+---------------+
| *                |             0 |
| CalibFeeSpec     |           113 |
| CalibPmtSpec     |           713 |
| FeeCableMap      |             3 |
| HardwareID       |           386 |
| CableMap         |           509 |
| Reactor          |           960 |
| CoordinateAd     |             1 |
| CoordinateReactor |             2 |
| CalibPmtHighGain |          1268 |
| CalibPmtPedBias  |             1 |
| EnergyRecon      |           914 |
| CalibPmtFineGain |          7943 |
| DcsAdWpHv        |          3926 |
+------------------+---------------+
14 rows in set (0.00 sec)
```

Verifying offline_db load by another dump

```
[blyth@belle7 DybDbi]$ dbdumpload.py offline_db dump ~/offline_db.DcsAdWpHv.sql -t "DcsAdWpHv DcsAdWp
real    0m29.624s

[blyth@belle7 DybDbi]$ diff  ~/offline_db.DcsAdWpHv.sql ~/tmp_offline_db.DcsAdWpHv.xi.sql
3c3
< -- Host: dybdb2.ihep.ac.cn    Database: offline_db
---
> -- Host: belle7.nuu.edu.tw    Database: tmp_offline_db
5c5
< -- Server version     5.0.45-community
---
> -- Server version     5.0.77-log
94c94
< -- Dump completed on 2012-08-31  3:58:24
---
> -- Dump completed on 2012-08-30  4:09:09
[blyth@belle7 DybDbi]$
[blyth@belle7 DybDbi]$
[blyth@belle7 DybDbi]$ du  ~/offline_db.DcsAdWpHv.sql ~/tmp_offline_db.DcsAdWpHv.xi.sql
25476   /home/blyth/offline_db.DcsAdWpHv.sql
25476   /home/blyth/tmp_offline_db.DcsAdWpHv.xi.sql
[blyth@belle7 DybDbi]$
[blyth@belle7 DybDbi]$ echo select \* from LOCALSEQNO where TABLENAME=\'DcsAdWpHv\' | $(mysql.py offl
+-----------+---------------+
| TABLENAME | LASTUSEDSEQNO |
+-----------+---------------+
| DcsAdWpHv |          3926 |
+-----------+---------------+
```

21.14.4 Copying a few DBI tables between DBs using rdumpcat, rloadcat

Note that the procedure presented in this section relies on options added to the *db.py* script in dybsvn:r18671, (circa Nov 10th, 2012) thus ensure your version of *db.py* is at that revision or later before attempting the below.:

```
db.py --help   ## check revision of script in use
```

Talking to two or more DBI cascades from the same process is not easily achievable, thus it is expedient and actually rather efficient to copy DBI tables between Databases by means of serializations in the form of ascii catalogs.

The normal SOP procedure to create a partial copy of *offline_db* in each users *tmp_offline_db* by design creates the target DB anew. This policy is adopted as the *tmp_offline_db* should be regarded as **temporary** expedients of limited lifetime created while working on an update.

Experts wishing to copy a few DBI tables between Databases without blasting the target DB can do so using special options to the same *rdumpcat* and *rloadcat* commands of the *db.py* script.

Non-decoupled rdumpcat into empty folder

Serialize one or more DBI tables specified using comma delimited *-t,–tselect* option from a DB specified by DBCONF a section name into a partial ascii catalog created in an empty folder:

```
rm -rf ~/dbicopy ; mkdir ~/dbicopy
db.py -D -t PhysAd tmp_offline_db rdumpcat ~/dbicopy/tmp_offline_db
```

The option *-D,–nodecoupled* is required to avoid: *AssertionError: decoupled rdumpcat must be done into a preexisting catalog*

Loading of partial ascii catalog into target DB with fastforwarding of INSERTDATEs

```
db.py -P -t PhysAd tmp_offline_db  rloadcat ~/dbicopy/tmp_offline_db
```

The option *-P,–ALLOW_PARTIAL* is required to allow dealing with partial catalogs. Normally the integrity of the catalog is checked by verifying that all expected tables are present, this option skips these checks.

If the *tmp_offline_db* has a preexisting version of the table which matches that in the ascii catalog then the *rloadcat* command does nothing, and warns:

```
WARNING:DybPython.db:no updates (new tables or new SEQNO) are detected, nothing to do
```

In order to test the load, first remove some entries eg using the below bash functions.

```
#!/bin/sh
tab-usage(){ cat << EOU

Bash Functions for chopping DBI tables
======================================

.. warning:: **ONLY** for test usage in `tmp_offline_db`

Functions::

   tab-chop- <payload-table-name> <max-seqno-to-keep>
   tab-meta- <payload-table-name>


Usage::
```

```
16
17     . tab.sh                    # source the functions
18     echo status | mysql       # verify are talking to desired DB (in the client section of .my.cnf)
19
20     echo select \* from LOCALSEQNO | mysql -t
21     echo select \* from PhysAdVld  | mysql -t     # check tables before chopping
22     echo select \* from PhysAd     | mysql -t
23
24     tab-chop- PhysAd 4 | mysql       # remove all SEQNO from PhysAd and PhysAdVld with SEQNO > 4
25     tab-fixmeta- PhysAd  | mysql     # adjust LOCALSEQNO metadata table, changing LASTUSEDSEQNO for Ph
26
27
28 EOU
29 }
30 tab-chop-(){
31     local tab=${1:-PhysAd}
32     local seqno=${2:-1000000}
33     cat << EOC
34 delete from $tab, ${tab}Vld using $tab inner join ${tab}Vld where ${tab}.SEQNO = ${tab}Vld.SEQNO and
35 EOC
36 }
37 tab-fixmeta-(){
38     local tab=${1:-PhysAd}
39     cat << EOC
40 update LOCALSEQNO set LASTUSEDSEQNO=(select max(SEQNO) from $tab) where TABLENAME='$tab' ;
41 EOC
42 }
```

Then run the *rloadcat* command, and enter **YES** in response to the prompt.

```
[blyth@belle7 DybPython]$ db.py -P -t PhysAd tmp_offline_db  rloadcat ~/dbicopy/tmp_offline_db
INFO:DybPython.db:{'VERSION()': '5.0.77-log', 'CURRENT_USER()': 'root@belle7.nuu.edu.tw', 'DATABA
INFO:DybPython.asciicat:read /home/blyth/dbicopy/tmp_offline_db/tmp_offline_db.cat
INFO:DybPython.asciicat:reading table LOCALSEQNO
INFO:DybPython.asciicat:reading table PhysAdVld
INFO:DybPython.asciicat:done AsciiCat [3    ] /home/blyth/dbicopy/tmp_offline_db {'PhysAd': 9, 'I
INFO:DybPython.asciicat:seqno_updates : ascii catalog LASTUSEDSEQNO changes relative to target :
INFO:DybPython.db: PhysAd               has 5 new SEQNO : [5, 6, 7, 8, 9]
INFO:DybPython.db:changed tables ['PhysAd']
Enter YES to proceed with rloadcat for  : ['PhysAd']
INFO:DybPython.db:user consents to update tables ['PhysAd']
INFO:DybPython.asciicat:seqno_updates : ascii catalog LASTUSEDSEQNO changes relative to target :
INFO:DybPython.asciicat:fastforward 5 validity rows of PhysAd to 2012-11-26 08:45:14
WARNING:DybPython.asciicat:inplace overwriting /home/blyth/dbicopy/tmp_offline_db/PhysAd/PhysAdVl
INFO:DybPython.db:loadcsv_  PhysAd loading paths ['/home/blyth/dbicopy/tmp_offline_db/PhysAd/Phys
INFO:DybPython.dbcmd:MySQLImport time /data1/env/local/dyb/external/mysql/5.0.67/i686-slc5-gcc41-

real    0m0.020s
user    0m0.005s
sys     0m0.005s
INFO:DybPython.db:Connecting to belle7.nuu.edu.tw
Selecting database tmp_offline_db
Locking tables for write
Loading data from LOCAL file: /home/blyth/dbicopy/tmp_offline_db/PhysAd/PhysAd.csv into PhysAd
tmp_offline_db.PhysAd: Records: 9  Deleted: 0  Skipped: 4  Warnings: 0
Loading data from LOCAL file: /home/blyth/dbicopy/tmp_offline_db/PhysAd/PhysAdVld.csv into PhysAd
tmp_offline_db.PhysAdVld: Records: 9  Deleted: 0  Skipped: 4  Warnings: 0
Disconnecting from belle7.nuu.edu.tw
```

```
INFO:DybPython.db:loadcsv_  LOCALSEQNO loading paths ['/home/blyth/dbicopy/tmp_offline_db/LOCALSE
INFO:DybPython.dbcmd:MySQLImport time /data1/env/local/dyb/external/mysql/5.0.67/i686-slc5-gcc41-

real    0m0.010s
user    0m0.004s
sys     0m0.005s
INFO:DybPython.db:Connecting to belle7.nuu.edu.tw
Selecting database tmp_offline_db
Locking tables for write
Loading data from LOCAL file: /home/blyth/dbicopy/tmp_offline_db/LOCALSEQNO/LOCALSEQNO.csv into
tmp_offline_db.LOCALSEQNO: Records: 8  Deleted: 8  Skipped: 0  Warnings: 0
Disconnecting from belle7.nuu.edu.tw
```

In the above output notice confirmation required that reports the additional SEQNO to be loaded and the fastforwarding of the validity dates to the time of the insert. The *rloadcat* internally uses **mysqlimport** command to efficiently load the ascii catalog into the DB. Note the different *–replace* and *–ignore* options used for the LOCALSEQNO table and the others. These options to **mysqlimport** control handling of input rows that duplicate existing rows on unique key values.

–replace new rows replace existing rows that have the same unique key value, used for LOCALSEQNO which has PK the TABLENAME as the metadata table needed to have LASTUSEDSEQNO values updated.

–ignore input rows that duplicate an existing row on a unique key value are skipped, used for DBI payload and validity tables with PK *(SEQNO)* or *(SEQNO,ROW_COUNTER)*. This means that *rloadcat* cannot change pre-existing DBI table content, it can only add new entries.

Warning: All LOCALSEQNO entries from the ascii catalog are loaded and will **replace** any preceeding entries. Thus make sure only expected SEQNO changes are propagated.

21.14.5 Jumpstarting *offline_db.DqChannelPacked* table

The DqChannelPacked tables were prepared by compressing the *channelquality_db.DqChannelStatus* table.

Create mysqldump file

Local mysqldump of 396202 packed entries is quick, less than 3 seconds:

```
[blyth@belle7 ~]$ dbdumpload.py tmp_testpack_offline_db dump ~/tmp_testpack_offline_db.DqChannelPacke
[blyth@belle7 ~]$ dbdumpload.py tmp_testpack_offline_db dump ~/tmp_testpack_offline_db.DqChannelPacke
real    0m2.494s
user    0m1.973s
sys     0m0.241s
```

Use *head -c tail -c* and *grep -i create*:

```
[blyth@belle7 ~]$ grep -i create  ~/tmp_testpack_offline_db.DqChannelPacked.sql
CREATE TABLE `DqChannelPacked` (
CREATE TABLE `DqChannelPackedVld` (
```

Record size/digest of dump

Check the dumpfile:

```
[blyth@belle7 ~]$ du -h ~/tmp_testpack_offline_db.DqChannelPacked.sql     ## only 75M
75M     /home/blyth/tmp_testpack_offline_db.DqChannelPacked.sql

[blyth@belle7 ~]$ md5sum ~/tmp_testpack_offline_db.DqChannelPacked.sql
60c66fce91b760a3e8865c4c60f4f86c  /home/blyth/tmp_testpack_offline_db.DqChannelPacked.sql

[blyth@belle7 ~]$ ls -l ~/tmp_testpack_offline_db.DqChannelPacked.sql
-rw-rw-r-- 1 blyth blyth 77746774 Jul 29 16:56 /home/blyth/tmp_testpack_offline_db.DqChannelPacked.sq
```

Check its viable by creating a DB from it

Create and populate *tmp_checkpack_offline_db* section:

```
[blyth@belle7 ~]$ vi ~/.my.cnf       # add a tmp_checkpack_offline_db section pointing at DB of that
[blyth@belle7 ~]$ echo status | mysql     #  make sure the client section of ~/.my.cnf is pointing at
[blyth@belle7 ~]$ echo "create database tmp_checkpack_offline_db" | mysql      # create the check DB,
[blyth@belle7 ~]$ dbdumpload.py tmp_checkpack_offline_db load ~/tmp_testpack_offline_db.DqChannelPack
[blyth@belle7 ~]$ dbdumpload.py tmp_checkpack_offline_db load ~/tmp_testpack_offline_db.DqChannelPack
```

Sanity checking the dump via the DB created from it:

```
[blyth@belle7 ~]$ echo "select count(*) from DqChannelPacked" | mysql tmp_testpack_offline_db  -N
396202
[blyth@belle7 ~]$ echo "select count(*) from DqChannelPackedVld" | mysql tmp_testpack_offline_db  -N
396202
[blyth@belle7 ~]$ echo "select count(*) from DqChannelPacked" | mysql tmp_checkpack_offline_db  -N
396202
[blyth@belle7 ~]$ echo "select count(*) from DqChannelPackedVld" | mysql tmp_checkpack_offline_db  -N
396202
```

Position that for web accessibility (admin reminder)

Make the dump available at http://dayabay.ihep.ac.cn:8080/data/tmp_testpack_offline_db.DqChannelPacked.sql:

```
simon:~ blyth$ scp N:tmp_testpack_offline_db.DqChannelPacked.sql .
simon:~ blyth$ scp tmp_testpack_offline_db.DqChannelPacked.sql WW:/home/blyth/local/nginx/html/data/
simon:~ blyth$ curl -s http://dayabay.ihep.ac.cn:8080/data/tmp_testpack_offline_db.DqChannelPacked.sq
60c66fce91b760a3e8865c4c60f4f86c
```

Download the dump and check digest

Digest and size matches expectations:

```
-bash-3.2$ curl -s -O http://dayabay.ihep.ac.cn:8080/data/tmp_testpack_offline_db.DqChannelPacked.sql

-bash-3.2$ md5sum tmp_testpack_offline_db.DqChannelPacked.sql
60c66fce91b760a3e8865c4c60f4f86c  tmp_testpack_offline_db.DqChannelPacked.sql

-bash-3.2$ ll tmp_testpack_offline_db.DqChannelPacked.sql
-rw-r--r-- 1 blyth dyw 77746774 Jul 29 18:24 tmp_testpack_offline_db.DqChannelPacked.sql
```

21.14.6 CQScraper testing

The *CQScraper* reads from *channelquality_db.DqChannelStatus* using MySQL-python and writes to the DB pointed to by DBCONF using DBI. The target DB needs to contain the *CableMap* table, in order for the canonical channel ordering to be accessible.

Create a test DB to check CQScraper Operation

Use *db.py* dump/load in the normal manner to make a copy of *offline_db* into eg *tmp_cqscrapertest_offline_db*

Load the mysqldump creating the new new tables

Use the techniques described above to add the pre-cooked *DqChannelPacked* and *DqChannelPackedVld* tables to the test DB. If pre-existing empty tables are present, they will need to be dropped first.:

```
mysql> drop tables DqChannelPacked, DqChannelPackedVld ;
Query OK, 0 rows affected (0.02 sec)

mysql> delete from LOCALSEQNO where TABLENAME='DqChannelPacked' ;     # remove any pre-existing entry
Query OK, 1 row affected (0.00 sec)
```

Fixup LOCALSEQNO

Using the maximum SEQNO in the mysqldump, to fixup the LOCALSEQNO for the new table:

```
mysql> insert into LOCALSEQNO VALUES ('DqChannelPacked',396202 ) ;
Query OK, 1 row affected (0.00 sec)

mysql> insert into LOCALSEQNO VALUES ('DqChannelPacked',396202 ) ;      # cannot change this way, wou
ERROR 1062 (23000): Duplicate entry 'DqChannelPacked' for key 1
mysql>
```

Configure a node to run the CQScraper cron task

The node requires

1. recent NuWa installation (one of the IHEP slave nodes perhaps ?)
2. crontab permissions to add the cron commandline

An example cron command line, that invokes the dybinst command every hour:

```
SHELL=/bin/bash
CRONLOG_DIR=/home/blyth/cronlog
DYBINST_DIR=/data1/env/local/dyb
#
15 * * * * ( cd $DYBINST_DIR ; DBCONF=tmp_cqscrapertest_offline_db ./dybinst trunk scrape CQScraper )
#
# after good behaviour is confirmed the log writing can be scaled back to just keeping the last month
```

The scraper checks where it is up to in the target DB and propagates any new entries from source into target. See the docstring for details dybgaudi:Database/Scraper/python/Scraper/dq/CQScraper.py

Repeat for *offline_db*

If a test run of a few days into the *tmp_* DB is OK then Liang/Qiumei can repeat the steps for *offline_db* Catching up a few days worth of entries is not prohibitive, so starting from the initial mysqldump will be simpler that creating a new one.

21.15 DB Services

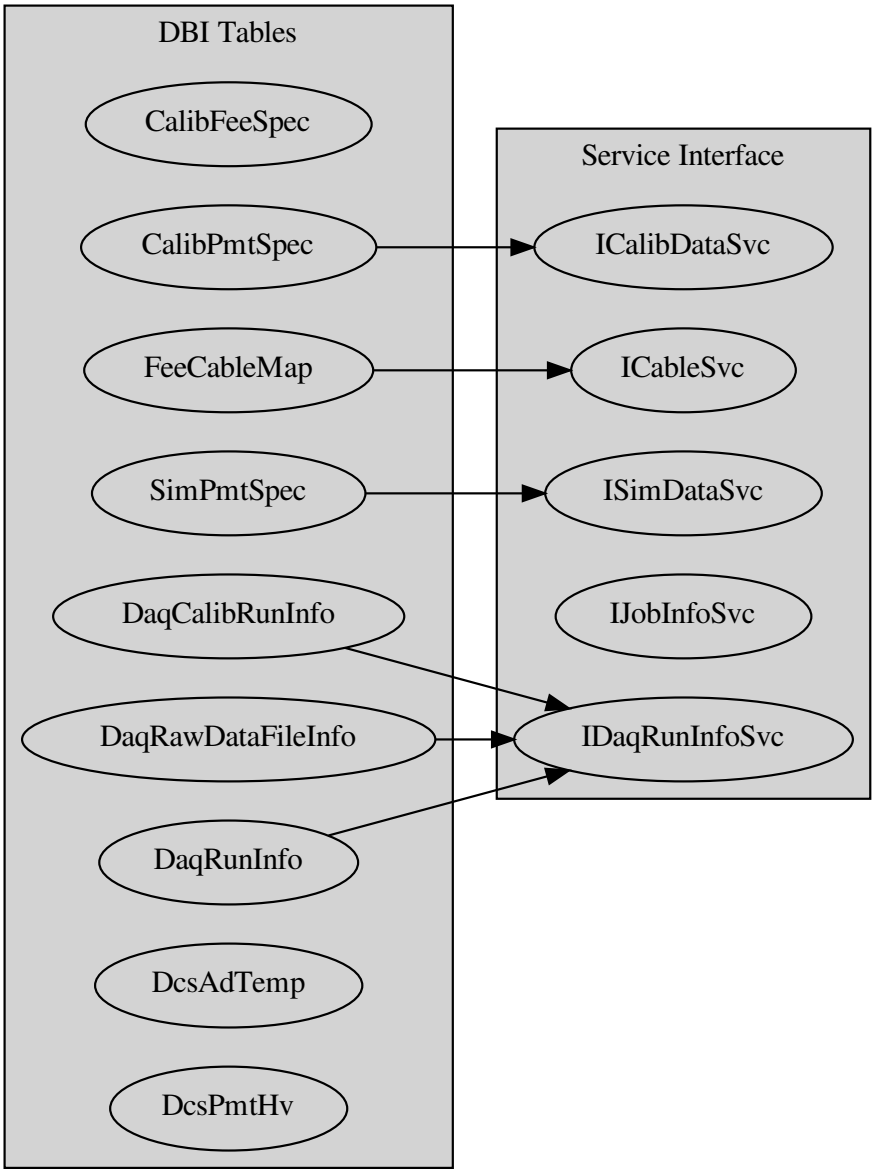
- User Interfaces to DBI Data
- Tables which are Missing something

21.15.1 User Interfaces to DBI Data

To a large degree the low level access to DBI tables is shielded from users by the service layer. The intention is to isolate changes in the underlying DBI tables from user analysis code. From the user's perspective, a series of Interfaces are defined:

Interface	Description
ICableSvc	Cable mapping
ICalibDataSvc	Calibration parameters
ISimDataSvc	PMT/Electronics input parameters for simulation
IJobInfoSvc	NuWa Job Information
IDaqRunInfoSvc	DAQ Run information

These interfaces are defined in dybgaudi:DataModel/DataSvc/DataSvc



Please Correct/Update Connections

Commit updates to dybgaudi:Documentation/OfflineUserManual/tex/sop/dbserv.rst in graphviz/dot language

21.15.2 Tables which are Missing something

Table	DBI service	DBI Writer
CalibFeeSpec	NO	
SimPmtSpec		NO

21.16 DCS tables grouped/ordered by schema

- SAB_TEMP
- DBNS_ACU_HV_SlotTemp
- DBNS_Temp
- AD1_TEMP
- DBNS_HALL5_TEMP
- config_table
- DYBAlarm
- DBNS_AD1_HV_Imon
- DBNS_AD2_HV_Imon
- SAB_AD1_HV_Imon
- SAB_AD2_HV_Imon
- SAB_AD2_HV_SlotTemp
- DBNS_AD1_HV_SlotTemp
- DBNS_AD2_HV_SlotTemp
- SAB_AD1_HV_SlotTemp
- DBNS_SAB_TEMP
- site_table
- DBNS_MUON_PMT_HV_Imon
- DBNS_MUON_PMT_HV_SlotTemp
- status_table
- DBNS_AD_HV_SlotTemp
- dyb_muoncal
- DBNS_ACU_HV_Pw
- DBNS_ACU_HV_Imon
- DBNS_ACU_HV_Vmon
- EH1_ENV_RadonMonitor
- DBNS_AD1_LidSensor
- DBNS_AD2_LidSensor
- DBNS_AD1_VME
- DBNS_AD2_VME
- DBNS_IW_VME
- DBNS_Muon_PMT_VME
- DBNS_OW_VME
- DBNS_RPC_VME
- SAB_AD1_VME
- DBNS_AD1_HV
- DBNS_AD2_HV
- SAB_AD1_HV_Vmon
- SAB_AD2_HV_Vmon
- SAB_AD2_HV_Pw
- DBNS_AD1_HVPw
- DBNS_AD2_HV_Pw
- SAB_AD1_HV_Pw
- DBNS_MUON_PMT_HV_Vmon
- DBNS_MUON_PMT_HV_Pw
- DBNS_AD_HV_Imon
- DBNS_AD_HV_Vmon
- DBNS_AD_HV_Pw

21.16.1 SAB_TEMP

```
+--------------+------------------+-----+-----+------+--+
| id           | int(10) unsigned | NO  | PRI | NULL |  |
| date_time    | datetime         | NO  | MUL | NULL |  |
| SAB_TEMP_PT1 | decimal(6,2)     | YES |     | NULL |  |
+--------------+------------------+-----+-----+------+--+
```

21.16.2 DBNS_ACU_HV_SlotTemp

```
+-----------------------+------------------+-----+-----+------+--+
| id                    | int(10) unsigned | NO  | PRI | NULL |  |
| date_time             | datetime         | NO  | MUL | NULL |  |
| DBNS_AD_HV.Slot11.Temp | decimal(4,2)     | YES |     | NULL |  |
+-----------------------+------------------+-----+-----+------+--+
```

21.16.3 DBNS_Temp

```
+---------------+------------------+-----+-----+------+--+
| id            | int(10) unsigned | NO  | PRI | NULL |  |
| date_time     | datetime         | NO  | MUL | NULL |  |
| DBNS_Temp_PT1 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_Temp_PT2 | decimal(6,2)     | YES |     | NULL |  |
+---------------+------------------+-----+-----+------+--+
```

21.16.4 AD1_TEMP

```
+--------------+------------------+-----+-----+------+--+
| id           | int(10) unsigned | NO  | PRI | NULL |  |
| date_time    | datetime         | NO  | MUL | NULL |  |
| AD1_temp_pt1 | decimal(6,2)     | YES |     | NULL |  |
| AD1_temp_pt2 | decimal(6,2)     | YES |     | NULL |  |
| AD1_temp_pt3 | decimal(6,2)     | YES |     | NULL |  |
| AD1_temp_pt4 | decimal(6,2)     | YES |     | NULL |  |
+--------------+------------------+-----+-----+------+--+
```

21.16.5 DBNS_HALL5_TEMP

```
+------------------+------------------+-----+-----+------+--+
| id               | int(10) unsigned | NO  | PRI | NULL |  |
| date_time        | datetime         | NO  | MUL | NULL |  |
| DBNS_H5_Temp_PT1 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_H5_Temp_PT2 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_H5_Temp_PT3 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_H5_Temp_PT4 | decimal(6,2)     | YES |     | NULL |  |
+------------------+------------------+-----+-----+------+--+
```

21.16.6 config_table

```
+---------------+---------------+-----+-----+------+--+
| ParaName      | varchar(45)   | NO  | PRI | NULL |  |
| Site          | varchar(45)   | YES |     | NULL |  |
| MainSys       | varchar(45)   | YES |     | NULL |  |
| SubSys        | varchar(45)   | YES |     | NULL |  |
| TableName     | varchar(45)   | NO  | PRI | NULL |  |
| Description   | varchar(1023) | YES |     | NULL |  |
| ReferenceValue | varchar(45)  | YES |     | NULL |  |
+---------------+---------------+-----+-----+------+--+
```

21.16.7 DYBAlarm

```
+------------+-----------------+-----+-----+------+--+
| id         | int(10) unsigned | NO  | PRI | NULL |  |
| date_time  | datetime         | NO  | MUL | NULL |  |
| TableName  | char(30)         | YES |     | NULL |  |
| Parameter  | char(30)         | YES |     | NULL |  |
| Value      | char(10)         | YES |     | NULL |  |
| Description | char(50)        | YES |     | NULL |  |
| Status     | char(1)          | YES |     | NULL |  |
+------------+-----------------+-----+-----+------+--+
```

21.16.8 DBNS_AD1_HV_Imon

21.16.9 DBNS_AD2_HV_Imon

```
+--------------------+-----------------+-----+-----+------+--+
| id                 | int(10) unsigned | NO  | PRI | NULL |  |
| date_time          | datetime         | NO  | MUL | NULL |  |
| DBNS_AD_HV.Slot0.I0 | decimal(6,2)    | YES |     | NULL |  |
| DBNS_AD_HV.Slot2.I0 | decimal(6,2)    | YES |     | NULL |  |
| DBNS_AD_HV.Slot4.I0 | decimal(6,2)    | YES |     | NULL |  |
| DBNS_AD_HV.Slot6.I0 | decimal(6,2)    | YES |     | NULL |  |
+--------------------+-----------------+-----+-----+------+--+
```

21.16.10 SAB_AD1_HV_Imon

```
+--------------------+-----------------+-----+-----+------+--+
| id                 | int(10) unsigned | NO  | PRI | NULL |  |
| date_time          | datetime         | NO  | MUL | NULL |  |
| SAB_AD1_HV.Slot0.I0 | decimal(6,2)    | YES |     | NULL |  |
| SAB_AD1_HV.Slot2.I0 | decimal(6,2)    | YES |     | NULL |  |
| SAB_AD1_HV.Slot4.I0 | decimal(6,2)    | YES |     | NULL |  |
| SAB_AD1_HV.Slot6.I0 | decimal(6,2)    | YES |     | NULL |  |
+--------------------+-----------------+-----+-----+------+--+
```

21.16.11 SAB_AD2_HV_Imon

```
+--------------------+-----------------+-----+-----+------+--+
| id                 | int(10) unsigned | NO  | PRI | NULL |  |
| date_time          | datetime         | NO  | MUL | NULL |  |
| SAB_AD2_HV.Slot0.I0 | decimal(6,2)    | YES |     | NULL |  |
```

```
| SAB_AD2_HV.Slot2.I0 | decimal(6,2)      | YES |     | NULL |   |
| SAB_AD2_HV.Slot4.I0 | decimal(6,2)      | YES |     | NULL |   |
| SAB_AD2_HV.Slot6.I0 | decimal(6,2)      | YES |     | NULL |   |
+---------------------+-------------------+-----+-----+------+--+
```

21.16.12 SAB_AD2_HV_SlotTemp

```
+----------------------+------------------+-----+-----+------+--+
| id                   | int(10) unsigned | NO  | PRI | NULL |  |
| date_time            | datetime         | NO  | MUL | NULL |  |
| SAB_AD2_HV.Slot0.Temp | decimal(4,2)     | YES |     | NULL |  |
| SAB_AD2_HV.Slot2.Temp | decimal(4,2)     | YES |     | NULL |  |
| SAB_AD2_HV.Slot4.Temp | decimal(4,2)     | YES |     | NULL |  |
| SAB_AD2_HV.Slot6.Temp | decimal(4,2)     | YES |     | NULL |  |
+----------------------+------------------+-----+-----+------+--+
```

21.16.13 DBNS_AD1_HV_SlotTemp

21.16.14 DBNS_AD2_HV_SlotTemp

```
+----------------------+------------------+-----+-----+------+--+
| id                   | int(10) unsigned | NO  | PRI | NULL |  |
| date_time            | datetime         | NO  | MUL | NULL |  |
| DBNS_AD_HV.Slot0.Temp | decimal(4,2)     | YES |     | NULL |  |
| DBNS_AD_HV.Slot2.Temp | decimal(4,2)     | YES |     | NULL |  |
| DBNS_AD_HV.Slot4.Temp | decimal(4,2)     | YES |     | NULL |  |
| DBNS_AD_HV.Slot6.Temp | decimal(4,2)     | YES |     | NULL |  |
+----------------------+------------------+-----+-----+------+--+
```

21.16.15 SAB_AD1_HV_SlotTemp

```
+----------------------+------------------+-----+-----+------+--+
| id                   | int(10) unsigned | NO  | PRI | NULL |  |
| date_time            | datetime         | NO  | MUL | NULL |  |
| SAB_AD1_HV.Slot0.Temp | decimal(4,2)     | YES |     | NULL |  |
| SAB_AD1_HV.Slot2.Temp | decimal(4,2)     | YES |     | NULL |  |
| SAB_AD1_HV.Slot4.Temp | decimal(4,2)     | YES |     | NULL |  |
| SAB_AD1_HV.Slot6.Temp | decimal(4,2)     | YES |     | NULL |  |
+----------------------+------------------+-----+-----+------+--+
```

21.16.16 DBNS_SAB_TEMP

```
+------------------+------------------+-----+-----+------+--+
| id               | int(10) unsigned | NO  | PRI | NULL |  |
| date_time        | datetime         | NO  | MUL | NULL |  |
| DBNS_SAB_Temp_PT1 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_SAB_Temp_PT2 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_SAB_Temp_PT3 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_SAB_Temp_PT4 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_SAB_Temp_PT5 | decimal(6,2)     | YES |     | NULL |  |
+------------------+------------------+-----+-----+------+--+
```

21.16.17 site_table

```
+-----------+------------------+-----+-----+------+--+
| id        | int(10) unsigned | NO  | PRI | NULL |  |
| date_time | datetime         | NO  | MUL | NULL |  |
| DBNS      | varchar(20)      | NO  |     | NULL |  |
| LANS      | varchar(20)      | NO  |     | NULL |  |
| FARS      | varchar(20)      | NO  |     | NULL |  |
| MIDS      | varchar(20)      | NO  |     | NULL |  |
| LSH       | varchar(20)      | NO  |     | NULL |  |
| SAB       | varchar(20)      | NO  |     | NULL |  |
| DCS_GCS   | varchar(20)      | YES |     | NULL |  |
+-----------+------------------+-----+-----+------+--+
```

21.16.18 DBNS_MUON_PMT_HV_Imon

```
+--------------------+------------------+-----+-----+------+--+
| id                 | int(10) unsigned | NO  | PRI | NULL |  |
| date_time          | datetime         | NO  | MUL | NULL |  |
| MuonPMTHV.Slot0.I0 | decimal(6,2)     | YES |     | NULL |  |
| MuonPMTHV.Slot2.I0 | decimal(6,2)     | YES |     | NULL |  |
| MuonPMTHV.Slot4.I0 | decimal(6,2)     | YES |     | NULL |  |
| MuonPMTHV.Slot6.I0 | decimal(6,2)     | YES |     | NULL |  |
| MuonPMTHV.Slot8.I0 | decimal(6,2)     | YES |     | NULL |  |
| MuonPMTHV.Slot10.I0| decimal(6,2)     | YES |     | NULL |  |
+--------------------+------------------+-----+-----+------+--+
```

21.16.19 DBNS_MUON_PMT_HV_SlotTemp

```
+----------------------+------------------+-----+-----+------+--+
| id                   | int(10) unsigned | NO  | PRI | NULL |  |
| date_time            | datetime         | NO  | MUL | NULL |  |
| MuonPMTHV.Slot0.Temp | decimal(4,2)     | YES |     | NULL |  |
| MuonPMTHV.Slot2.Temp | decimal(4,2)     | YES |     | NULL |  |
| MuonPMTHV.Slot4.Temp | decimal(4,2)     | YES |     | NULL |  |
| MuonPMTHV.Slot6.Temp | decimal(4,2)     | YES |     | NULL |  |
| MuonPMTHV.Slot8.Temp | decimal(4,2)     | YES |     | NULL |  |
| MuonPMTHV.Slot10.Temp| decimal(4,2)     | YES |     | NULL |  |
+----------------------+------------------+-----+-----+------+--+
```

21.16.20 status_table

```
+--------------------+------------------+----+-----+------+--+
| id                 | int(10) unsigned | NO | PRI | NULL |  |
| date_time          | datetime         | NO | MUL | NULL |  |
| DBNS_AD_HV         | char(4)          | NO |     | NULL |  |
| DBNS_RPC_HV        | char(4)          | NO |     | NULL |  |
| FARS               | char(4)          | NO |     | NULL |  |
| Safety Interlocking| char(4)          | NO |     | NULL |  |
| GAS                | char(4)          | NO |     | NULL |  |
| Background         | char(4)          | NO |     | NULL |  |
| DCS_GCS            | char(4)          | NO |     | NULL |  |
| DAQ_RUNINFO        | char(4)          | NO |     | NULL |  |
+--------------------+------------------+----+-----+------+--+
```

21.16.21 DBNS_AD_HV_SlotTemp

```
+----------------------+------------------+-----+-----+------+--+
| id                   | int(10) unsigned | NO  | PRI | NULL |  |
| date_time            | datetime         | NO  | MUL | NULL |  |
| DBNS_AD_HV.Slot0.Temp | decimal(4,2)     | YES |     | NULL |  |
| DBNS_AD_HV.Slot1.Temp | decimal(4,2)     | YES |     | NULL |  |
| DBNS_AD_HV.Slot2.Temp | decimal(4,2)     | YES |     | NULL |  |
| DBNS_AD_HV.Slot3.Temp | decimal(4,2)     | YES |     | NULL |  |
| DBNS_AD_HV.Slot4.Temp | decimal(4,2)     | YES |     | NULL |  |
| DBNS_AD_HV.Slot5.Temp | decimal(4,2)     | YES |     | NULL |  |
| DBNS_AD_HV.Slot6.Temp | decimal(4,2)     | YES |     | NULL |  |
| DBNS_AD_HV.Slot7.Temp | decimal(4,2)     | YES |     | NULL |  |
+----------------------+------------------+-----+-----+------+--+
```

21.16.22 dyb_muoncal

```
+-------------------------------+------------------+-----+-----+------+--+
| id                            | int(10) unsigned | NO  | PRI | NULL |  |
| date_time                     | datetime         | NO  | MUL | NULL |  |
| IOW_CAL_LED_ID                | int(5)           | YES |     | NULL |  |
| IOW_CAL_LED_ID_timestamp_begin | datetime         | YES |     | NULL |  |
| IOW_CAL_LED_ID_timestamp_end  | datetime         | YES |     | NULL |  |
| IOW_CAL_LED_ID_duration_time  | int(11)          | YES |     | NULL |  |
| IOW_CAL_LED_ID_Voltage        | float(5,3)       | YES |     | NULL |  |
| IOW_CAL_LED_ID_Frequency      | float(4,1)       | YES |     | NULL |  |
| IOW_CAL_Channel_ID            | int(11)          | YES |     | NULL |  |
| IOW_CAL_ErrorCode             | int(11)          | YES |     | NULL |  |
+-------------------------------+------------------+-----+-----+------+--+
```

21.16.23 DBNS_ACU_HV_Pw

```
+-----------------------+------------------+-----+-----+------+--+
| id                    | int(10) unsigned | NO  | PRI | NULL |  |
| date_time             | datetime         | NO  | MUL | NULL |  |
| DBNS_AD_HV_Board0_Ch0  | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch1  | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch2  | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch3  | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch4  | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch5  | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch6  | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch7  | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch8  | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch9  | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch10 | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch11 | tinyint(1)       | YES |     | NULL |  |
+-----------------------+------------------+-----+-----+------+--+
```

21.16.24 DBNS_ACU_HV_Imon

21.16.25 DBNS_ACU_HV_Vmon

id	int(10) unsigned	NO	PRI	NULL	
date_time	datetime	NO	MUL	NULL	
DBNS_AD_HV_Board0_Ch0	decimal(6,2)	YES		NULL	
DBNS_AD_HV_Board0_Ch1	decimal(6,2)	YES		NULL	
DBNS_AD_HV_Board0_Ch2	decimal(6,2)	YES		NULL	
DBNS_AD_HV_Board0_Ch3	decimal(6,2)	YES		NULL	
DBNS_AD_HV_Board0_Ch4	decimal(6,2)	YES		NULL	
DBNS_AD_HV_Board0_Ch5	decimal(6,2)	YES		NULL	
DBNS_AD_HV_Board0_Ch6	decimal(6,2)	YES		NULL	
DBNS_AD_HV_Board0_Ch7	decimal(6,2)	YES		NULL	
DBNS_AD_HV_Board0_Ch8	decimal(6,2)	YES		NULL	
DBNS_AD_HV_Board0_Ch9	decimal(6,2)	YES		NULL	
DBNS_AD_HV_Board0_Ch10	decimal(6,2)	YES		NULL	
DBNS_AD_HV_Board0_Ch11	decimal(6,2)	YES		NULL	

21.16.26 EH1_ENV_RadonMonitor

id	int(10) unsigned	NO	PRI	NULL	
date_time	datetime	NO	MUL	NULL	
RunNumber	int(11)	YES		NULL	
CycleNumber	int(11)	YES		NULL	
RunStartTime	int(11)	YES		NULL	
LastUpdateTime	int(11)	YES		NULL	
RunEndTime	int(11)	YES		NULL	
Temperature	int(11)	YES		NULL	
Humidity	int(11)	YES		NULL	
Rn222Conc._Po218	int(11)	YES		NULL	
Rn222Conc._Po218_StatErr	int(11)	YES		NULL	
Rn222Conc._Po214	int(11)	YES		NULL	
Rn222Conc._Po214_StatErr	int(11)	YES		NULL	
LiveTime	int(11)	YES		NULL	
AreaA	int(11)	YES		NULL	
AreaB	int(11)	YES		NULL	
AreaC	int(11)	YES		NULL	
AreaD	int(11)	YES		NULL	

21.16.27 DBNS_AD1_LidSensor

21.16.28 DBNS_AD2_LidSensor

id	int(10) unsigned	NO	PRI	NULL	
date_time	datetime	NO	MUL	NULL	
Ultrasonic_GdLS	decimal(6,2)	YES		NULL	
Ultrasonic_LS	decimal(6,2)	YES		NULL	
Temp_GdLS	decimal(6,2)	YES		NULL	
Temp_LS	decimal(6,2)	YES		NULL	

```
| Tiltx_Sensor1          | decimal(6,2)      | YES |     | NULL |   |
| Tilty_Sensor1          | decimal(6,2)      | YES |     | NULL |   |
| Tiltx_Sensor2          | decimal(6,2)      | YES |     | NULL |   |
| Tilty_Sensor2          | decimal(6,2)      | YES |     | NULL |   |
| Tiltx_Sensor3          | decimal(6,2)      | YES |     | NULL |   |
| Tilty_Sensor3          | decimal(6,2)      | YES |     | NULL |   |
| Capacitance_GdLS       | decimal(6,2)      | YES |     | NULL |   |
| Capacitance_Temp_GdLS | decimal(6,2)      | YES |     | NULL |   |
| Capacitance_LS         | decimal(6,2)      | YES |     | NULL |   |
| Capacitance_Temp_LS    | decimal(6,2)      | YES |     | NULL |   |
| Capacitance_MO         | decimal(6,2)      | YES |     | NULL |   |
| Capacitance_Temp_MO    | decimal(6,2)      | YES |     | NULL |   |
| PS_Output_V            | decimal(6,2)      | YES |     | NULL |   |
| PS_Output_I            | decimal(6,2)      | YES |     | NULL |   |
+------------------------+-------------------+-----+-----+------+--+
```

21.16.29 DBNS_AD1_VME

21.16.30 DBNS_AD2_VME

21.16.31 DBNS_IW_VME

21.16.32 DBNS_Muon_PMT_VME

21.16.33 DBNS_OW_VME

21.16.34 DBNS_RPC_VME

21.16.35 SAB_AD1_VME

```
+----------------+------------------+-----+-----+------+--+
| id             | int(10) unsigned | NO  | PRI | NULL |  |
| date_time      | datetime         | NO  | MUL | NULL |  |
| Voltage_5V     | decimal(6,2)     | YES |     | NULL |  |
| Current_5V     | decimal(6,2)     | YES |     | NULL |  |
| Voltage_N5V2   | decimal(6,2)     | YES |     | NULL |  |
| Current_N5V2   | decimal(6,2)     | YES |     | NULL |  |
| Voltage_12V    | decimal(6,2)     | YES |     | NULL |  |
| Current_12V    | decimal(6,2)     | YES |     | NULL |  |
| Voltage_N12V   | decimal(6,2)     | YES |     | NULL |  |
| Current_N12V   | decimal(6,2)     | YES |     | NULL |  |
| Voltage_3V3    | decimal(6,2)     | YES |     | NULL |  |
| Current_3V3    | decimal(6,2)     | YES |     | NULL |  |
| Temperature1   | decimal(6,2)     | YES |     | NULL |  |
| Temperature2   | decimal(6,2)     | YES |     | NULL |  |
| Temperature3   | decimal(6,2)     | YES |     | NULL |  |
| Temperature4   | decimal(6,2)     | YES |     | NULL |  |
| Temperature5   | decimal(6,2)     | YES |     | NULL |  |
| Temperature6   | decimal(6,2)     | YES |     | NULL |  |
| Temperature7   | decimal(6,2)     | YES |     | NULL |  |
...
| FanTemperature | decimal(6,2)     | YES |     | NULL |  |
| Fanspeed       | decimal(6,2)     | YES |     | NULL |  |
```

```
| PowerStatus    | tinyint(1)       | YES |     | NULL |   |
+----------------+------------------+-----+-----+------+---+
```

21.16.36 DBNS_AD1_HV

21.16.37 DBNS_AD2_HV

21.16.38 SAB_AD1_HV_Vmon

```
+-----------+------------------+-----+-----+------+---+
| id        | int(10) unsigned | NO  | PRI | NULL |   |
| date_time | datetime         | NO  | MUL | NULL |   |
| L8C3R8    | decimal(6,2)     | YES |     | NULL |   |
| L8C3R7    | decimal(6,2)     | YES |     | NULL |   |
| L8C3R6    | decimal(6,2)     | YES |     | NULL |   |
| L8C3R5    | decimal(6,2)     | YES |     | NULL |   |
| L8C3R4    | decimal(6,2)     | YES |     | NULL |   |
| L8C3R3    | decimal(6,2)     | YES |     | NULL |   |
| L8C3R2    | decimal(6,2)     | YES |     | NULL |   |
| L8C3R1    | decimal(6,2)     | YES |     | NULL |   |
| L8C2R8    | decimal(6,2)     | YES |     | NULL |   |
| L8C2R7    | decimal(6,2)     | YES |     | NULL |   |
| L8C2R6    | decimal(6,2)     | YES |     | NULL |   |
| L8C2R5    | decimal(6,2)     | YES |     | NULL |   |
| L8C2R4    | decimal(6,2)     | YES |     | NULL |   |
| L8C2R3    | decimal(6,2)     | YES |     | NULL |   |
| L8C2R2    | decimal(6,2)     | YES |     | NULL |   |
| L8C2R1    | decimal(6,2)     | YES |     | NULL |   |
| L8C1R8    | decimal(6,2)     | YES |     | NULL |   |
...
| L1C1R3    | decimal(6,2)     | YES |     | NULL |   |
| L1C1R2    | decimal(6,2)     | YES |     | NULL |   |
| L1C1R1    | decimal(6,2)     | YES |     | NULL |   |
+-----------+------------------+-----+-----+------+---+
```

21.16.39 SAB_AD2_HV_Vmon

```
+-----------+------------------+-----+-----+------+---+
| id        | int(10) unsigned | NO  | PRI | NULL |   |
| date_time | datetime         | NO  | MUL | NULL |   |
| L1C1R1    | decimal(6,2)     | YES |     | NULL |   |
| L1C1R2    | decimal(6,2)     | YES |     | NULL |   |
| L1C1R3    | decimal(6,2)     | YES |     | NULL |   |
| L1C1R4    | decimal(6,2)     | YES |     | NULL |   |
| L1C1R5    | decimal(6,2)     | YES |     | NULL |   |
| L1C1R6    | decimal(6,2)     | YES |     | NULL |   |
| L1C1R7    | decimal(6,2)     | YES |     | NULL |   |
| L1C1R8    | decimal(6,2)     | YES |     | NULL |   |
| L1C2R1    | decimal(6,2)     | YES |     | NULL |   |
| L1C2R2    | decimal(6,2)     | YES |     | NULL |   |
| L1C2R3    | decimal(6,2)     | YES |     | NULL |   |
| L1C2R4    | decimal(6,2)     | YES |     | NULL |   |
| L1C2R5    | decimal(6,2)     | YES |     | NULL |   |
| L1C2R6    | decimal(6,2)     | YES |     | NULL |   |
```

```
| L1C2R7     | decimal(6,2)      | YES |      | NULL |   |
| L1C2R8     | decimal(6,2)      | YES |      | NULL |   |
| L1C3R1     | decimal(6,2)      | YES |      | NULL |   |
...
| L8C3R6     | decimal(6,2)      | YES |      | NULL |   |
| L8C3R7     | decimal(6,2)      | YES |      | NULL |   |
| L8C3R8     | decimal(6,2)      | YES |      | NULL |   |
+------------+-------------------+-----+------+------+---+
```

21.16.40 SAB_AD2_HV_Pw

```
+------------+-------------------+-----+------+------+---+
| id         | int(10) unsigned  | NO  | PRI  | NULL |   |
| date_time  | datetime          | NO  | MUL  | NULL |   |
| L1C1R1     | tinyint(1)        | YES |      | NULL |   |
| L1C1R2     | tinyint(1)        | YES |      | NULL |   |
| L1C1R3     | tinyint(1)        | YES |      | NULL |   |
| L1C1R4     | tinyint(1)        | YES |      | NULL |   |
| L1C1R5     | tinyint(1)        | YES |      | NULL |   |
| L1C1R6     | tinyint(1)        | YES |      | NULL |   |
| L1C1R7     | tinyint(1)        | YES |      | NULL |   |
| L1C1R8     | tinyint(1)        | YES |      | NULL |   |
| L1C2R1     | tinyint(1)        | YES |      | NULL |   |
| L1C2R2     | tinyint(1)        | YES |      | NULL |   |
| L1C2R3     | tinyint(1)        | YES |      | NULL |   |
| L1C2R4     | tinyint(1)        | YES |      | NULL |   |
| L1C2R5     | tinyint(1)        | YES |      | NULL |   |
| L1C2R6     | tinyint(1)        | YES |      | NULL |   |
| L1C2R7     | tinyint(1)        | YES |      | NULL |   |
| L1C2R8     | tinyint(1)        | YES |      | NULL |   |
| L1C3R1     | tinyint(1)        | YES |      | NULL |   |
...
| L8C3R6     | tinyint(1)        | YES |      | NULL |   |
| L8C3R7     | tinyint(1)        | YES |      | NULL |   |
| L8C3R8     | tinyint(1)        | YES |      | NULL |   |
+------------+-------------------+-----+------+------+---+
```

21.16.41 DBNS_AD1_HVPw

21.16.42 DBNS_AD2_HV_Pw

21.16.43 SAB_AD1_HV_Pw

```
+------------+-------------------+-----+------+------+---+
| id         | int(10) unsigned  | NO  | PRI  | NULL |   |
| date_time  | datetime          | NO  | MUL  | NULL |   |
| L8C3R8     | tinyint(1)        | YES |      | NULL |   |
| L8C3R7     | tinyint(1)        | YES |      | NULL |   |
| L8C3R6     | tinyint(1)        | YES |      | NULL |   |
| L8C3R5     | tinyint(1)        | YES |      | NULL |   |
| L8C3R4     | tinyint(1)        | YES |      | NULL |   |
| L8C3R3     | tinyint(1)        | YES |      | NULL |   |
| L8C3R2     | tinyint(1)        | YES |      | NULL |   |
| L8C3R1     | tinyint(1)        | YES |      | NULL |   |
```

```
| L8C2R8     | tinyint(1)        | YES |      | NULL |   |
| L8C2R7     | tinyint(1)        | YES |      | NULL |   |
| L8C2R6     | tinyint(1)        | YES |      | NULL |   |
| L8C2R5     | tinyint(1)        | YES |      | NULL |   |
| L8C2R4     | tinyint(1)        | YES |      | NULL |   |
| L8C2R3     | tinyint(1)        | YES |      | NULL |   |
| L8C2R2     | tinyint(1)        | YES |      | NULL |   |
| L8C2R1     | tinyint(1)        | YES |      | NULL |   |
| L8C1R8     | tinyint(1)        | YES |      | NULL |   |
...
| L1C1R3     | tinyint(1)        | YES |      | NULL |   |
| L1C1R2     | tinyint(1)        | YES |      | NULL |   |
| L1C1R1     | tinyint(1)        | YES |      | NULL |   |
+------------+-------------------+-----+------+------+---+
```

21.16.44 DBNS_MUON_PMT_HV_Vmon

```
+------------+-------------------+-----+-----+------+---+
| id         | int(10) unsigned  | NO  | PRI | NULL |   |
| date_time  | datetime          | NO  | MUL | NULL |   |
| DCIU3G     | decimal(6,2)      | YES |     | NULL |   |
| DCIU3F     | decimal(6,2)      | YES |     | NULL |   |
| DCIU3E     | decimal(6,2)      | YES |     | NULL |   |
| DCIU3D     | decimal(6,2)      | YES |     | NULL |   |
| DCIU3C     | decimal(6,2)      | YES |     | NULL |   |
| DCIU3B     | decimal(6,2)      | YES |     | NULL |   |
| DCIU3A     | decimal(6,2)      | YES |     | NULL |   |
| DCIU39     | decimal(6,2)      | YES |     | NULL |   |
| DCIU38     | decimal(6,2)      | YES |     | NULL |   |
| DCIU37     | decimal(6,2)      | YES |     | NULL |   |
| DCIU36     | decimal(6,2)      | YES |     | NULL |   |
| DCIU35     | decimal(6,2)      | YES |     | NULL |   |
| DCIU34     | decimal(6,2)      | YES |     | NULL |   |
| DCIU33     | decimal(6,2)      | YES |     | NULL |   |
| DCIU32     | decimal(6,2)      | YES |     | NULL |   |
| DCIU31     | decimal(6,2)      | YES |     | NULL |   |
| DCIU24     | decimal(6,2)      | YES |     | NULL |   |
...
| DVIA13     | decimal(6,2)      | YES |     | NULL |   |
| DVIA12     | decimal(6,2)      | YES |     | NULL |   |
| DVIA11     | decimal(6,2)      | YES |     | NULL |   |
+------------+-------------------+-----+-----+------+---+
```

21.16.45 DBNS_MUON_PMT_HV_Pw

```
+------------+-------------------+-----+-----+------+---+
| id         | int(10) unsigned  | NO  | PRI | NULL |   |
| date_time  | datetime          | NO  | MUL | NULL |   |
| DCIU3G     | tinyint(1)        | YES |     | NULL |   |
| DCIU3F     | tinyint(1)        | YES |     | NULL |   |
| DCIU3E     | tinyint(1)        | YES |     | NULL |   |
| DCIU3D     | tinyint(1)        | YES |     | NULL |   |
| DCIU3C     | tinyint(1)        | YES |     | NULL |   |
| DCIU3B     | tinyint(1)        | YES |     | NULL |   |
| DCIU3A     | tinyint(1)        | YES |     | NULL |   |
```

```
| DCIU39    | tinyint(1)        | YES |     | NULL |   |
| DCIU38    | tinyint(1)        | YES |     | NULL |   |
| DCIU37    | tinyint(1)        | YES |     | NULL |   |
| DCIU36    | tinyint(1)        | YES |     | NULL |   |
| DCIU35    | tinyint(1)        | YES |     | NULL |   |
| DCIU34    | tinyint(1)        | YES |     | NULL |   |
| DCIU33    | tinyint(1)        | YES |     | NULL |   |
| DCIU32    | tinyint(1)        | YES |     | NULL |   |
| DCIU31    | tinyint(1)        | YES |     | NULL |   |
| DCIU24    | tinyint(1)        | YES |     | NULL |   |
...
| DVIA13    | tinyint(1)        | YES |     | NULL |   |
| DVIA12    | tinyint(1)        | YES |     | NULL |   |
| DVIA11    | tinyint(1)        | YES |     | NULL |   |
+-----------+-------------------+-----+-----+------+--+
```

21.16.46 DBNS_AD_HV_Imon

21.16.47 DBNS_AD_HV_Vmon

```
+-----------------------+------------------+-----+-----+------+--+
| id                    | int(10) unsigned | NO  | PRI | NULL |  |
| date_time             | datetime         | NO  | MUL | NULL |  |
| DBNS_AD_HV_Board0_Ch0 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch1 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch2 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch3 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch4 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch5 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch6 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch7 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch8 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch9 | decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch10| decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch11| decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch12| decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch13| decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch14| decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch15| decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch16| decimal(6,2)     | YES |     | NULL |  |
...
| DBNS_AD_HV_Board7_Ch45| decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board7_Ch46| decimal(6,2)     | YES |     | NULL |  |
| DBNS_AD_HV_Board7_Ch47| decimal(6,2)     | YES |     | NULL |  |
+-----------------------+------------------+-----+-----+------+--+
```

21.16.48 DBNS_AD_HV_Pw

```
+-----------------------+------------------+-----+-----+------+--+
| id                    | int(10) unsigned | NO  | PRI | NULL |  |
| date_time             | datetime         | NO  | MUL | NULL |  |
| DBNS_AD_HV_Board0_Ch0 | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch1 | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch2 | tinyint(1)       | YES |     | NULL |  |
| DBNS_AD_HV_Board0_Ch3 | tinyint(1)       | YES |     | NULL |  |
```

```
| DBNS_AD_HV_Board0_Ch4  | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board0_Ch5  | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board0_Ch6  | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board0_Ch7  | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board0_Ch8  | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board0_Ch9  | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board0_Ch10 | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board0_Ch11 | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board0_Ch12 | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board0_Ch13 | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board0_Ch14 | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board0_Ch15 | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board0_Ch16 | tinyint(1)        | YES |     | NULL |   |
...
| DBNS_AD_HV_Board7_Ch45 | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board7_Ch46 | tinyint(1)        | YES |     | NULL |   |
| DBNS_AD_HV_Board7_Ch47 | tinyint(1)        | YES |     | NULL |   |
+------------------------+-------------------+-----+-----+------+---+
```

21.17 Non DBI access to DBI and other tables

- Summary of Non DBI approaches
  - Python ORMs (Django, SQLAlchemy)
  - ROOT `TSQL`
  - High Performance Approaches
- SQLAlchemy access to DBI tables with NonDbi

Standard access to the content of `offline_db` (eg for analysis) should be made using DBI, DybDbi or via services that use these. However some usage of the content is better achieved without DBI.

This is not contrary to the rules *Rules for Code that writes to the Database* as although all writing to `offline_db` **must** use DBI, reading from `offline_db` can use whatever approach works best for the application.

Warning: Non-DBI access to DBI tables is for **READING ONLY**

Examples:

1. monitoring historical variations, for example of DataQuality paramters or monitored temperatures
2. presenting tables (eg ODM)

Reading from DBI is designed around getting the results for a particular context (at a particular time). When the usage does not fit into this pattern alternative access approaches should be considered.

DBI Extended Context

DBI Extended Context queries allows full control of the validity portion of the DBI query. As control of the validity query is the central point of DBI, this means that DBI is then not helping much. Thus if your application revolves around using DBI extended context queries you may find that alternate approaches are more efficient and straightforward.

21.17.1 Summary of Non DBI approaches

Python ORMs (Django, SQLAlchemy)

Object relational mappers (ORMs) provide flexible and simple access to Database content, providing row entries as python objects. It is also possible to map to joins between tables with `SQLAlchemy`.

Note however a limitation of `Django`, it does not support composite primary keys. As DBI uses composite primary keys `(SEQNO,ROW_COUNTER)` for payload tables, these cannot be mapped to `Django` ORM objects in the general case. However if `ROW_COUNTER` only ever takes one value the mapping can be kludged to work.

`SQLAlchemy` does not have this limitation. The dybgaudi:Database/NonDbi package provides some infrastructure that facilitates access to DBI tables with `SQLAlchemy`. For example:

```
from NonDbi import session_
session = session_("tmp_offline_db")
YReactor = session.dbikls_("Reactor")    ## class mapped to join of payload and validity tables
n = session.query(YReactor).count()
a = session.query(YReactor).filter(YReactor.SEQNO==1).one()    ## both payload and validity attributes
print vars(a)
```

For details examples see `NonDbi`

> **Warning:** NB when connecting to multiple DB the above direct *session_* approach encounters issue dyb-svn:ticket:1254. The workaround is to use *NonDbi.MetaDB*, usage examples are provided in the API docs `NonDbi.MetaDB` (which are derived from the source).

ROOT `TSQL`

Low level access requiring raw SQL, lots of flexibility but is re-inventing the wheel.

High Performance Approaches

When dealing with many thousands/millions of entries the above approaches are slow.

An experimental fork (from Simon) of `MySQL-python` that provides NumPy arrays from MySQL queries.

- https://github.com/scb-/mysql_numpy

This rather simple patch to `MySQL-python` succeeds to integrate the primary python tools for MySQL access and large array manipulation.

- **MySQL-Python** http://sourceforge.net/projects/mysql-python/ basis of python ORM approaches
- **NumPy** http://numpy.scipy.org/ high performance array manipulations
- **Matplotlib** http://matplotlib.sourceforge.net/ plotting library based on **NumPy**

21.17.2 SQLAlchemy access to DBI tables with NonDbi

How can I access the `TIMESTART` for a particular run ?

```
In [1]: from NonDbi import session_

In [2]: session_??          ## read docstring + code
```

```
In [3]: session = session_("offline_db")

In [4]: YDaqRunInfo = session.dbikls_("DaqRunInfo")

In [5]: session.query(YDaqRunInfo).count()
Out[5]: 11402L

In [6]: YDaqRunInfo.<TAB>
YDaqRunInfo.AGGREGATENO          YDaqRunInfo.TIMESTART            YDaqRunInfo.__dict__             YD
YDaqRunInfo.INSERTDATE           YDaqRunInfo.VERSIONDATE          YDaqRunInfo.__dictoffset__       YD
YDaqRunInfo.ROW_COUNTER          YDaqRunInfo.__abstractmethods__  YDaqRunInfo.__doc__               YD
YDaqRunInfo.SEQNO                YDaqRunInfo.__base__             YDaqRunInfo.__eq__               YD
YDaqRunInfo.SIMMASK              YDaqRunInfo.__bases__            YDaqRunInfo.__flags__            YD
YDaqRunInfo.SITEMASK             YDaqRunInfo.__basicsize__        YDaqRunInfo.__format__           YD
YDaqRunInfo.SUBSITE              YDaqRunInfo.__call__             YDaqRunInfo.__ge__               YD
YDaqRunInfo.TASK                 YDaqRunInfo.__class__            YDaqRunInfo.__getattribute__     YD
YDaqRunInfo.TIMEEND              YDaqRunInfo.__delattr__          YDaqRunInfo.__gt__               YD

In [6]: q = session.query(YDaqRunInfo)

In [7]: q
Out[7]: <sqlalchemy.orm.query.Query object at 0x920058c>

In [8]: q.count()
Out[8]: 11408L

In [9]: q[0]
Out[9]: <NonDbi.YDaqRunInfo object at 0x9214f8c>

In [11]: p vars(q[-1])
         ...

In [17]: q.filter_by(runNo=12400).one()
Out[17]: <NonDbi.YDaqRunInfo object at 0x91fd4ac>

In [18]: vars(q.filter_by(runNo=12400).one())
Out[18]:
{u'AGGREGATENO': -1L,
 u'INSERTDATE': datetime.datetime(2011, 8, 16, 0, 0, 53),
 u'ROW_COUNTER': 1L,
 'SEQNO': 11185L,
 u'SIMMASK': 1,
 u'SITEMASK': 127,
 u'SUBSITE': 0,
 u'TASK': 0,
 u'TIMEEND': datetime.datetime(2011, 8, 15, 23, 57, 19),
 u'TIMESTART': datetime.datetime(2011, 8, 15, 6, 55, 55),
 u'VERSIONDATE': datetime.datetime(2011, 8, 15, 6, 55, 55),
 '_sa_instance_state': <sqlalchemy.orm.state.InstanceState object at 0x91fd4cc>,
 u'baseVersion': 1L,
 u'dataVersion': 813L,
 u'detectorMask': 230L,
 u'partitionName': 'part_eh1',
 u'runNo': 12400L,
 u'runType': 'Physics',
 u'schemaVersion': 17L,
 u'triggerType': 0L}
```

```
In [19]: o = q.filter_by(runNo=12400).one()

In [21]: o.TIMESTART
Out[21]: datetime.datetime(2011, 8, 15, 6, 55, 55)
```

Note that this SQLAlchmey access to DBI tables is entirely general. For the common task of run lookups DybDbi.IRunLookup has dedicated functionality to allow this.

```
In [23]: import os

In [24]: os.environ['DBCONF'] = 'offline_db'

In [25]: from DybDbi import IRunLookup

In [26]: irl = IRunLookup( 12400, 12681 )
DbiRpt<GDaqRunInfo>::MakeResultPtr extended query ctor, sqlcontext: 1=1 datasql:runNo in (12400, 1268
Using DBConf.Export to prime environment with : from DybPython import DBConf ; DBConf.Export('offline
dbconf:export_to_env from $SITEROOT/../.my.cnf:~/.my.cnf section offline_db
Successfully opened connection to: mysql://dybdb2.ihep.ac.cn/offline_db
This client, and MySQL server (MySQL 5.0.45-community) does support prepared statements.
DbiCascader Status:-
Status   URL

Closed         0 mysql://dybdb2.ihep.ac.cn/offline_db

In table DaqRunInfo row 0 column 4 (TRIGGERTYPE) value "0" of type Long may be truncated before stori
Caching new results: ResultKey: Table:DaqRunInfo row:GDaqRunInfo.  2 vrecs (seqno min..max;versiondat
DbiTimer:DaqRunInfo: Query done. 2rows,    0.1Kb Cpu   0.5 , elapse   2.0


In [33]: irl[12400].vrec.contextrange
Out[33]:
|site 0x007f|sim 0x007f
        2011-08-15 06:55:55.000000000Z
        2011-08-15 23:57:19.000000000Z
```

21.18 Scraping source databases into *offline_db*

In addition to this introductory documentation see also the API reference documentation at Scraper

- Generic Scraping Introduction
- Scraper Status
- DCS peculiarities
  - Time zones and scraping
- TODO
  - Framework Level
  - Specific Regimes
- Running Scrapers
  - Dybinst Level
  - Package Level
- Implementing Scrapers
  - Outline Steps
  - Create Scraper Module
  - Implementing `changed`
  - Implementing `propagate`
  - Generic Aggregation
  - Error Handling
- Configuring Scrapers
  - Understanding Scraper Operation
  - Catchup and Sleep Auto-Tuning
  - Configuration Mechanics
  - Configuration Tuning
- Testing Scraper Operation
  - Test Scraper With Faker
  - Faker configuration
  - Preparing Target DB for testing
  - Seeding Target Database
  - Scraper Logging
- Continuous running under supervisord
  - Initial Setup
  - Supervisorctl CLI
- Steps to Deployment
- Development Tips
  - Obtain mysqldump of DCS DB to populate fake source DB
  - Single table mysqldump for averager testing
  - Append capable mysqldumps
  - Multi-source table test
  - Start from scratch following schema changes to DCS
  - Interactive SQLAlchemy Querying

21.18.1 Generic Scraping Introduction

Pragmatic Goals

- eliminate duplication in scraper code
- make it easy to scrape new tables with little additional code to develop/debug
- use DybDbi for writing to *offline_db*, eliminate problems arising from incomplete DBI spoofing by using real DBI for all writing

Assumptions/features of each scraper

- 2 databases : source and target

- *target* is represented by DybDbi generated classes
- *source(s)* are represented by SQLAlchemy mapped classes which can correspond to entries in single source tables or entries from the result of joins to multiple source tables
- one source instance corresponds to 1 or more DybDbi writes under a single DBI writer/contextrange

21.18.2 Scraper Status

regime	target table	notes
pmthv	GDcsPmtHv GDcsAdPmtHv	duplicates old scraper with new framework, needs testing by Liang before deployment
adtemp	GDcsAdTemp	duplicates old scraper with new framework, needs testing by Liang before deployment
adlid-sensor	GDcsAdLidSensor	development started end August by David Webber
muon-calib?	GDcsMuonCalib	interest expressed by Deb Mohapatra
wppmt?	GDcsWpPmtHv	?
adgas?	?	Raymond named as responible by Wei, doc:7005

Existing scraper modules are visible at dybgaudi:Database/Scraper/python/Scraper

Existing target table specifications dybgaudi:Database/DybDbi/spec

21.18.3 DCS peculiarities

DCS tables grouped/ordered by schema

DCS tables have the nasty habit of encoding content (stuff that should be in rows) into table and column names. As a result mapping from source to target in code must interpret these names and sometimes one row of source DCS table will become many rows of destination table.

The task of developing scrapers is much easier when:

- source and target tables are developed with scraping in mind

Time zones and scraping

Local times and Databases

By their very nature of being accessible from any timezone, it is patently obvious that time stamps in Databases should never be in local time. However as this bad practice is rife in the DCS and DAQ it is pragmatically assumed that this bad practice is always followed in the DCS and DAQ DB.

Time zone conventions assumed by the generic scraper:

- All timestamps in *offline_db* and *tmp_offline_db* are in UTC, hardcoded into DBI: **cannot be changed**
- All timestamps in DCS and DAQ DB are in local(Beijing) time

If the 2nd assumption is not true for your tables, you must either change it to follow the local standard of bad practice or request special handling in the scraper framework.

21.18.4 TODO

Framework Level

1. scraper catchup feature needs documenting and further testing
2. DAQ support ? probably no new DAQ tables coming down pipe, but still needs DBI writing
3. confirm assumption : all DCS times local, all DBI times UTC
4. more precise testing, will fully controlled faking/scraping and comparison against expectations (not high priority as this kind of precision is not really expected from a scraper)

Specific Regimes

1. in old scraper code : table names do not match current *offline_db* : DcsPmtHv
2. in old scraper code : apparently no timezone handling ?

21.18.5 Running Scrapers

Warning: scraper config include source and target `DBCONF`, thus ensure that the corresponding entries in `~/.my.cnf` are pointing at the intended Databases before running scrapers or fakers

- Dybinst Level
- Package Level

Dybinst Level

To allow use of scrapers and fakers from a pristine environment, such as when invoked under supervisord control, a *dybinst* level interface is provided:

```
./dybinst trunk scrape adtemp_scraper
./dybinst trunk scrape pmthv_scraper
```

The last argument specifies a named section in `$SCRAPERROOT/python/Scraper/.scraper.cfg` When testing fake entries can be written to a fake source DB using a **faker** config section, with for example:

```
./dybinst trunk scrape adtemp_faker
./dybinst trunk scrape pmthv_faker
```

Package Level

The *dybinst* interface has the advantage of operating from an empty environment but is not convenient for debugging/testing. When within the environment of dybgaudi:Database/Scraper package (included in standard `DybRelease` environment) it is preferable to directly use:

```
scr.py --help               ## uses a default section
scr.py -s adtemp_scraper
scr.py -s adtemp_faker
```

Examining the help is useful for seeing the config defaults for each config section:

```
scr.py -s adtemp_faker --help
scr.py -s adtemp_scraper --help
```

21.18.6 Implementing Scrapers

The generic scraper framework enables the addition of new scrapers with only code that is specific to the source and target tables concerned. The essential tasks are to judge sufficient change to warrant propagation and to translate from source instances to one or more target DBI table instances. Note that the source instances can be joins between multiple source tables.

- Outline Steps
- Create Scraper Module
- Implementing `changed`
- Implementing `propagate`
- Generic Aggregation
- Error Handling

Outline Steps

1. Create *offline_db* target table by committing a `.spec` file and building *DybDbi*, *DB Table Creation*
2. Create scraper module, implementing only the table specifics: *Create Scraper Module*
3. Test scraper operation into a copy of *offline_db*, *Copy offline_db to tmp_offline_db*

Create Scraper Module

Scraper modules live in dybgaudi:Database/Scraper/python/Scraper. To eliminate duplication they only handle the specifics of transitioning source DCS/DAQ table(s) columns into target *offline_db* table columns as specified in your .spec

Compare and contrast the example scraper modules:

- dybgaudi:Database/Scraper/python/Scraper/pmthv.py `Scraper.pmthv`
- dybgaudi:Database/Scraper/python/Scraper/adtemp.py `Scraper.adtemp`

Note the structure of classes, using *PmtHv* as an example:

1. *PmtHv(Regime)* umbrella sub-class
2. *PmtHvSource(list)* list of source tables (or joins of tables)
3. *PmtHvScraper(Scraper)* sub-class that implements two methods, both taking single `SourceVector` **sv** argument
   (a) *changed(self,sv)* returns `True/False` indicating if there is sufficient change to justify calling the *propagate* method
   (b) *propagate(self,sv)* converts source vector into one or more yielded target *dicts* with keys corresponding to `.spec` file attribute names
4. *PmtHvFaker(Faker)* sub-class used to Fake entries in the source DB table(s) to allow fully controlled testing

Further implementation details are documented in the API docs `Scraper`

Implementing `changed`

The simplest `changed` implementation:

```
def changed(self, sv ):
    return False
```

The source vector `sv` holds 2 source instances, accessible with `sv[0]` and `sv[-1]` corresponding to the last propagated instance and the latest one. Even with a changed implementation that always returns `False` the propagate will still be called when the age differences between `sv[0]` and `sv[-1]` exceed the `maxage` configuration setting.

Note: `changed()` is not intended for age checking, instead just use config setting such as `maxage=1h` for that

---

If *Generic Aggregation* can be used it is easier and more efficient to do so. However if the required aggregation can not be performed with MySQL aggregation functions then the `changed()` method could be used to collect samples as shown in the below example. Note that `self.state` is entirely created/updated/used within the `changed` and `propagate` methods. This is just an example of how to maintain state, entirely separately from the underlying framework:

```
def changed(self, sv):

     if not hasattr(self, 'state'):          ## only on 1st call when no state
         kls = self.target.kls               ## the genDbi target  class
         keys = kls.SpecKeys().aslist()
         state = dict(zip(keys,map(lambda _:0, keys)))    ## state dict with all values 0
         self.state = state

     ## work of associating source to target attributes
     for k in self.state:
         sk = ..some_fn..( k )       ## source key from target key
         ## do running aggregates  min/max/avg
         self.state[k] += sv[-1][sk]

     return False    ## True if sufficient changes to warrant non-age based propagation
```

Implementing `propagate`

The main work of `changed` and `propagate` is translating between the source instances eg `sv[-1]` and the target dict ready to be written using target genDbi class. The ease with which this can be done depends on the design of source and target.

Example implementation, when do accumulation at each `changed` sampling:

```
def propagate(self, sv ):
    yield self.state
```

Alternatively if do not need to accumulate over samples and want to write just based on the last values can see examples:

1. `Scraper.pmthv.PmtHvScraper`
2. `Scraper.adtemp.AdTempScraper`

Generic Aggregation

Aggregation is configured via config keys beginning with **aggregate**. Presence of a non-empty `aggregate` key switches on an extra aggregation query, performed at every sample immediately after the normal entry query. The

`aggregate` key must specify a comma delimited list naming MySQL aggregate/group-by functions:

```
aggregate = avg,min,max,std
aggregate_count = count
aggregate_skips = id,date_time
aggregate_filter = Quality != 0
```

Meanings of the settings:

setting	notes
`aggregate`	comma delimited list of MySQL aggregation functions
`aggregate_count`	name of attribute that holds the sample count, default **count**
`aggregate_skips`	comma delimited attributes to skip aggregating, default **None**
`aggregate_filter`	SQL `where` clause applied in addition to time filtering, default **None**

Note: Most MySQL group_by functions do not work well with times, if that is a major problem workarounds could be developed

The functions are called for every source attribute within a single query that is performed on the source DB after the simple row query. The results are provided in the **aggd** `dict` with keys such as `DBNS_SAB_Temp_PT1_avg`, `DBNS_SAB_Temp_PT1_min` etc..

The aggregation query is over all source DB entries within a timerange that excludes the time of the last instance:

```
sv[0].date_time <= t < sv[-1].date_time
```

The **aggd** dict are available from the `sv[0].aggd` and `sv[-1].aggd` within the `changed` and `propagate` methods, but existance of `sv[0].aggd` should be checked as will not be available at startup:

```
aggz = sv[0].aggd
if aggz:
    for k,v in aggz.items():
        print k,v
else:
    print "no aggz at startup"

aggd = sv[-1].aggd
assert aggd, "missing aggd - this should always be present"
for k,v in aggd.items():
    print k,v
```

When using the docs virtual python *Build Instructions for Sphinx based documentation* the aggregate can be dumped `print str(aggd)` as an rst table like:

att [2]	avg	max	min	std
DBNS_SAB_Temp_PT1	48.500000	49.00	48.00	0.5
DBNS_SAB_Temp_PT2	28.500000	29.00	28.00	0.5
DBNS_SAB_Temp_PT3	38.500000	39.00	38.00	0.5
DBNS_SAB_Temp_PT4	48.500000	49.00	48.00	0.5
DBNS_SAB_Temp_PT5	58.500000	59.00	58.00	0.5
date_time	2.01102010008e+13	2011-02-01 00:08:10	2011-02-01 00:08:00	5.0
id	48.5000	49	48	0.5

Error Handling

Possibles error cases that must be handled:

- aggregation query may yield zero samples, resulting in the configured **aggregate_count** value coming back as zero and all aggregates being **None**

  - occurs when the configured **aggregate_filter** (typically a source quality requirement) results in no entries
  - most likely to occur on the first sample after a propagation
  - having a very short **interval** compared to the source **heartbeat** will make this more likely to occur
  - if not trapped the scraper will crash when attempting to coerce **None** into the float/int attributes of the `DybDbi` instance, eg:

```
File "/home/dwebber/NuWa/NuWa-trunk/dybgaudi/InstallArea/python/DybDbi/wrap.py", line 98, in
  Set( instance, v )
TypeError: void GDcsAdLidSensor::SetTemp_LS_avg(double Temp_LS_avg) => could not convert arg
```

- options to handle this is under consideration
  - replace the None with an **aggregate_none** configured value

21.18.7 Configuring Scrapers

- Understanding Scraper Operation
- Catchup and Sleep Auto-Tuning
- Configuration Mechanics
- Configuration Tuning

Understanding Scraper Operation

heartbeat parameter

The source DB updating period is not under the control of the scraper, however scraper configuration should include this approximate **heartbeat** setting in order to inform the scraper to allow appropriate sleep tuning.

Scrapers distinguish between the notions:

1. **actual time** ticking by, at which actual DB queries are made
2. **DB time** populated by *date_time* stamps on DB entries

This allows the scraper to catch up, on being restarted after a hiatus and not substantially impact the resulting scraped target table.

Ascii art, each lines corresponding to a sample:

```
tc0      tc1
|         |
|1        |
|1 2      |
|1 . 3    |    propagation can be triggerd for any
|1 . . 4  |    of these if sufficient change in value or date_time
|1 . . . 5|
|         |6
|         |6 7
|         |6 . 8
|         |6 . . 9
|         |6 . . . a
```

```
|          |6 . . . . b
|          |6 . . . . . c
```

The scrapers region of interest in DB time is controlled by:

- the time cursor `tcursor`
- *date_time* of last collected instance in the source vector

The first entry beyond the `tcursor` and any already collected entries is read. In this way the scraper is always looking for the next entry. Following a propagation the `tcursor` is moved ahead to the time of the last propagated entry plus the **interval**.

Note: to avoid excessive querying scraper parameters must be tuned, *Configuration Tuning*

Sampling activity in actual time is controlled by:

offset mechanics and interplay with aggregation

Using an `offset = N` where `N > 0` effectively means the scraper only sees every `N` th entry in the source database. This does not effect the source DB samples that contribute to the aggregation, all source samples that pass the `aggregate_filter` contribute to the aggregation. The `offset` however directly reduces the frequency with which aggregate (and normal) sampling is performed.

- **sleep** config setting, initial value for sleep that is subsequently tuned depending on lag
- **heartbeat** config setting, guidance to scraper regards source updating period : used to constrain other parameters in sleep tuning
- **offset** config setting, allows skipping of source entries : default of zero reads all entries, set to 10 to only read every 10th

Propagation is controlled by:

- value changes between source vector instances, optionally parameterized by the **threshold** config setting
- the **maxage** config setting compared to the difference in *date_time* between sourve verctor instances

Features of this approach:

1. reproducible re-running of the scraper (target entries made should depend on the source not details of scraper running)
2. allows the scraper to catch up with missed entries after a hiatus
3. realistic testing

The **heartbeat** setting should correspond approximately to the actual source table updating period. (**sleep** setting should be the same as the **heartbeat** , it is subsequently tuned depending on detected lags behind the source).

See the below *Scraper Logging* section to see how this works in practice.

Note: some of the config parameters can probably be merged/eliminated, however while development of scrapers is ongoing retaining flexibility is useful

---

Catchup and Sleep Auto-Tuning

Relevant config parameters:

parameter	notes
tunesleepmod	how often to tune the sleep time, default of 1 tunes after every propagation, 10 for every 10th etc..
interval	quantum of DB time, controls `tcursor` step after propagation
offset	integer sampling tone down, default of 0 samples almost all source entries. 10 would sample only every 10th entry.
heartbeat	guidance regarding the raw source tables updating period (without regard for any **offset**) used to control sleep tuning
timefloor	time prior to which the scraper has no interest

A restarted scrapers first actions include checking the DBI validity table in the target DB to determine the **target last validity**, a DBI Validity Record which allows the **tcursor** from the prior run of the scraper to be recovered. Hence the scraper determines where it is up to and resumes from that point.

Following some propagations the scraper queries to determine *date_time* of the last entry in the source table. Comparing this with the **tcursor** yields a lag for each source `Scraper.base.sourcevector.SourceVector.lag()`, the maximum lag over all sources `Scraper.base.Scraper.maxlag()` is obtained.

The extent of this maximum lag time is translated into units of the *effective heartbeat* (namely `heartbeat*(offset+1)`). This number of effective heartbearts lag is used within `Scraper.base.Scraper.tunesleep()` to adjust the sleep time. This algorithm is currently very primitive; it may need to be informed by real world operational experience.

Configuration Mechanics

All scrapers are configured from a single config file, which is arranged into sections for each scraper/faker. The path of the config file can be controlled by `SCRAPER_CFG`, the default value:

```
echo $SCRAPER_CFG      ## path of default config file
    -->  $SITEROOT/dybgaudi/Database/Scraper/python/Scraper/.scraper.cfg
    -->  $SCRAPERROOT/python/Scraper/.scraper.cfg
```

Generality of scraper frontends is achieved by including a specification of the *Regime* subclass with the configuration, for example an extract from:

```
[adtemp_scraper]

regime = Scraper.adtemp:AdTemp
kls = GDcsAdTemp
mode = scraper
source = fake_dcs
target = tmp_offline_db

interval = 10s
sleep = 3s
heartbeat = 3s
offset = 0
maxage = 10m
threshold = 1.0
maxiter = 0

dbi_loglevel = INFO
```

Settings defining **what and where**:

regime	python dotted import path and Regime subclass name
kls	target DybDbi class name
mode	must be *scraper*, can be *faker* for a Faker
source	name of dbconf section in `~/.my.cnf`, pointing to origin DB typically `fake_dcs`
target	name of dbconf section in `~/.my.cnf`, pointing to DBI database typically `tmp_offline_db` while testing

Settings impacting **how and when**:

interval	DB time quantum, minimum sampling step size (DB time)
heartbeat	approximate source table updating period, used by sleep tuning.
offset	Integer specifying source table offsets. The default of 0 reads all source entries, 1 for every other, 10 for every 10th, etc.. **This is the best setting to increase to reduce excessive sampling.**
sleep	Initial period to sleep in the scraper loop (is subsequently auto-tuned depending on lag to the‘ source)
maxage	maximum period after which entries are propagated even if unchanged (DB time)
threshold	optional parameter accessed within scrapers via `self.threshold`, typically used within `def changed()` method
maxiter	number of interations to scrape, usually 0 for no limit

Time durations such as **interval**, **sleep** and **maxage** are all expressed with strings such as `10s, 1m or 1h` representings periods in seconds, minutes or hours.

Other configuration settings for scrapers:

```
## time before which the scraper is not interested,  used to limit expense of lastvld query at startu
timefloor      = 2010-01-01 00:00:00

## see below section on seeding the target, seeding is not allowed when targeting offline_db
seed_target_tables = True
seed_timestart = 2011-02-01 00:00:00
seed_timeend   = 2011-02-01 00:01:00
```

See `Scraper.base.main()` for further details on configuation.

Configuration Tuning

Consider scraping wildly varying source quantities that always leads to a propagation, the 1st entry beyond the `tcursor` would immediately be propagated and the `tcursor` moved ahead to the time of the last propagated entry plus the `interval` leading to another propagation of the 1st entry beyond the new `tcursor`.

In this situation:

- **offset** could be increased to avoid sampling all source entries
- **interval** must be tuned to achieve desired propagation frequency/value tracking

Alternatively consider almost constant source quantities, that never cause a `def changed()` to return `True`. In this case samples are dutifully made of entries beyond the `tcursor` until the time difference between the first and last

exceeded the **maxage** and a propagation results and `tcursor` is moved forwards to the time of the last propagated entry plus the **interval**.

In this situation:

- **maxage** dominates what is scraped
- **offset** should be increased to avoid pointless unchanged sampling within the `maxage` period

---

Note: setting **offset** only impacts the raw querying, it does not influence the aggregate query which aggregates over all source entries within the time range defined by the raw queries.

21.18.8 Testing Scraper Operation

- Test Scraper With Faker
- Faker configuration
- Preparing Target DB for testing
- Seeding Target Database
- Scraper Logging

Test Scraper With Faker

Fakers exist in order allow testing of Scrapers via fully controlled population of a fake source DB, typically `fake_dcs`. At each faker iteration an instance for each source class (an SQLAlchemy dynamic class) is created and passed to the fakers `fake` method, for example:

```
class AdTempFaker(Faker):
    def fake(self, inst , id , dt ):
        """
        Invoked from base class, sets source instance attributes to form a fake

        :param inst: source instance
        :param id: id to assign to the instance
        """
        if dt==None:
            dt = datetime.now()
        for k,v in inst.asdict.items():
            if k == 'id':
                setattr( inst, k, id )
            elif k == 'date_time':
                setattr( inst, k, dt )
            else:
                setattr( inst, k, float(id%10))     ## silly example of setting attribute values based
```

This allows the attributes of the fake instance to be set as desired. It is necessary to set the `id` and `date_time` attributes as shown to mimic expect source DB behaviour.

Faker configuration

Fakers are configured similarly to scrapers. An example configuration:

```
[adtemp_faker]

regime = Scraper.adtemp:AdTemp
mode = faker

source = fake_dcs
faker_dropsrc = True

timeformat = %Y-%m-%d %H:%M:%S
faker_timestart = 2011-02-01 00:00:00
profile = modulo_ramp
interval = 10s
sleep = 3s
maxiter = 0
```

Warning: When running in `mode = faker` the `faker_dropsrc = True` wipes the DB pointed to by `source = fake_dcs`

The `faker_dropsrc=True` key causes the fake source DB to be dropped and then recreated from a mysql dump file `~/fake_dcs.sql` that must reside with `$HOME`. This dropping and reloading is done at each start of the **faker**.

Preparing Target DB for testing

The database specified in the *target* config parameter of scrapers must be existing and accessible to the scraper identity, as defined in the `~/.my.cnf`. Create the target DB and grant permissions with:

```
mysql> create database offline_db_dummy
mysql> grant select,insert,create,drop,lock tables,delete on offline_db_dummy.* to 'dayabay'@'%' iden
```

Privileges are needed for DBI operartions used by the Scraper:

priv	first fail without it
`lock tables`	locks around updating `LOCALSEQNO`
`insert`	inserting `('*',0)` into `LOCALSEQNO`
`delete`	`LASTUSEDSEQNO` updating deletes then inserts

Seeding Target Database

Scraping requires an entry in the target DB table in order to discern where in time the scraping is up to. When testing into empty DB/Tables a seed entry needs to be planted using DybDbi for each source table. This can be done using the config settings like:

```
seed_target_tables = True
seed_timestart = 2011-02-01 00:00:00
seed_timeend   = 2011-02-01 00:01:00
```

Together with implementing the `def seed(src):` method in the scraper to return a dict of attributes appropriate to the genDbi target class. If the target has many attributes, a programmatic approach can be used, eg starting from:

```
In [1]: from DybDbi import GDcsAdLidSensor as kls

In [2]: kls.SpecKeys().aslist()
Out[2]:
 ['PhysAdId',
  'Ultrasonic_GdLS',
  'Ultrasonic_GdLS_SD',
```

```
  'Ultrasonic_GdLS_min',
  'Ultrasonic_GdLS_max',
  'Ultrasonic_LS',
  'Ultrasonic_LS_SD',
  'Ultrasonic_LS_min',
  'Ultrasonic_LS_max',
   ...
```

Scraper Logging

The bulk of the output comes from the `smry` method of `Scraper.base.sourcevector` which displays the *id* and *date_time* of the source instances held by the `SourceVector` as well as the **time cursor** of the source vector which corresponds to the time of last propagation. An extract from a scraper log, showing the startup:

```
INFO:Scraper.base.scraper:timecursor(local) {'subsite': 1, 'sitemask': 32} Tue Feb  1 00:01:00 2011
INFO:Scraper.base.sourcevector:SV 1   (6,)     2011-02-01 00:01:00 partial    notfull    (00:01:00 +
INFO:Scraper.base.sourcevector:SV 2   (6, 7)   2011-02-01 00:01:00 full       unchanged  (00:01:00 00
INFO:Scraper.base.sourcevector:SV 3   (6, 8)   2011-02-01 00:01:00 full       unchanged  (00:01:00 00
INFO:Scraper.base.sourcevector:SV 4   (6, 9)   2011-02-01 00:01:00 full       unchanged  (00:01:00 00
INFO:Scraper.base.sourcevector:SV 5   (6, 10)  2011-02-01 00:01:00 full       unchanged  (00:01:00 00
INFO:Scraper.base.sourcevector:SV 6   (6, 11)  2011-02-01 00:01:00 full       unchanged  (00:01:00 00
INFO:Scraper.base.sourcevector:SV 7   (6, 12)  2011-02-01 00:01:00 full       unchanged  (00:01:00 00
INFO:Scraper.base.sourcevector:SV 8   (6, 13)  2011-02-01 00:01:00 full       overage    (00:01:00 00
Warning in <TClass::TClass>: no dictionary for class DbiWriter<GDcsPmtHv> is available
Proceeding despite Non-unique versionDate: 2011-01-31 16:01:00 collides with that of SEQNO: 2 for tab
INFO:Scraper.base.scraper: 0 tune detects maxlag 9 minutes behind namely 59 intervals ... sleep 0:00:
INFO:Scraper.base.sourcevector:SV 9   (13, 14) 2011-02-01 00:02:20 full       unchanged  (00:02:10 00
INFO:Scraper.base.sourcevector:SV 10  (13, 15) 2011-02-01 00:02:20 full       unchanged  (00:02:10 00
INFO:Scraper.base.sourcevector:SV 11  (13, 16) 2011-02-01 00:02:20 full       unchanged  (00:02:10 00
INFO:Scraper.base.sourcevector:SV 12  (13, 17) 2011-02-01 00:02:20 full       unchanged  (00:02:10 00
INFO:Scraper.base.sourcevector:SV 13  (13, 18) 2011-02-01 00:02:20 full       unchanged  (00:02:10 00
INFO:Scraper.base.sourcevector:SV 14  (13, 19) 2011-02-01 00:02:20 full       unchanged  (00:02:10 00
INFO:Scraper.base.sourcevector:SV 15  (13, 20) 2011-02-01 00:02:20 full       overage    (00:02:10 00
INFO:Scraper.base.scraper: 1 tune detects maxlag 8 minutes behind namely 52 intervals ... sleep 0:00:
INFO:Scraper.base.sourcevector:SV 16  (20, 21) 2011-02-01 00:03:30 full       unchanged  (00:03:20 00
INFO:Scraper.base.sourcevector:SV 17  (20, 22) 2011-02-01 00:03:30 full       unchanged  (00:03:20 00
INFO:Scraper.base.sourcevector:SV 18  (20, 23) 2011-02-01 00:03:30 full       unchanged  (00:03:20 00
INFO:Scraper.base.sourcevector:SV 19  (20, 24) 2011-02-01 00:03:30 full       unchanged  (00:03:20 00
INFO:Scraper.base.sourcevector:SV 20  (20, 25) 2011-02-01 00:03:30 full       unchanged  (00:03:20 00
INFO:Scraper.base.sourcevector:SV 21  (20, 26) 2011-02-01 00:03:30 full       unchanged  (00:03:20 00
INFO:Scraper.base.sourcevector:SV 22  (20, 27) 2011-02-01 00:03:30 full       overage    (00:03:20 00
INFO:Scraper.base.scraper: 2 tune detects maxlag 7 minutes behind namely 45 intervals ... sleep 0:00:
INFO:Scraper.base.sourcevector:SV 23  (27, 28) 2011-02-01 00:04:40 full       unchanged  (00:04:30 00
INFO:Scraper.base.sourcevector:SV 24  (27, 29) 2011-02-01 00:04:40 full       unchanged  (00:04:30 00
```

This is with config settings:

```
interval = 10s
sleep = 3s
maxage = 1m
threshold = 1.0
maxiter = 0
task = 0
```

Note: while testing it is convenient to sample/propagate far faster that would be appropriate in production

Points to note:

1. initially the source vector contains only one sample and is marked `partial/notfull`, there is no possibility of propagation
2. at the 2nd sample (10s later in DB time, **not necessarily the same in real time**) the source vector becomes `full/unchanged` and the source *id* held are *(6,7)* at times *(00:01:00 00:01:10)*
3. for the 3rd to 7th samples the `sv[0]` stays the same but `sv[-1]` gets replaced by new sampled instances
4. at the 8th sample a sufficient change between `sv[0]` and `sv[-1]` is detected (in this example due to `maxage = 1m` being exceeded) leading to a **PROCEED** which indicates a propagation into the target DB
5. at the 9th sample, the `sv[0]` is replaced by the former `sv[-1]` which led to the propagation, correspondingly note the change in *id* held to *(13,14)* and times *(00:02:10 00:02:20)*

In this case propagation as marked by the **PROCEED** is occurring due to **overage** arising from config. If aggregation were to be configured in this example the aggregation would have been performed:

1. at 2nd sample for all entries between `(00:01:00 00:01:10)`
2. for 3rd to 7th samples for all entries betweenn `(00:01:00 00:01:20)` and so on
3. at the 8th sample the aggregation is between `(00:01:00 00:02:10)` which would have then been propagated
4. at the 9th sample the aggregation is between `(00:02:10 00:02:20)` with starting point corresponding to the former endpoint

21.18.9 Continuous running under supervisord

- Initial Setup
- Supervisorctl CLI

Initial Setup

Prepare example supervisord config file using `-S` option:

```
./dybinst -S /tmp/adtemp_scraper.ini trunk scrape adtemp_scraper
sudo cp /tmp/adtemp_scraper.ini /etc/conf/
```

Prepare the configs for all named section of the file using special cased **ALL** argument:

```
mkdir /tmp/scr
./dybinst -S /tmp/scr trunk scrape ALL
sv- ; sudo cp /tmp/scr/*.ini $(sv-confdir)/          ## when using option sv- bash functions
```

NB the location to place supervisord `.ini` depends on details of the supervisord installation and in particular settings in `supervisord.conf`, for background see http://supervisord.org/configuration.html The config simply specifies details of how to run the command, and can define the expected exit return codes that allow auto-restarting. For example:

```
[program:adtemp_scraper]
environment=HOME='/home/scraper',SCRAPER_CFG='/home/scraper/adtemp_scraper_production.cfg'
directory=/data1/env/local/dyb
command=/data1/env/local/dyb/dybinst trunk scrape adtemp_scraper
redirect_stderr=true
redirect_stdout=true
autostart=true
```

```
autorestart=true
priority=999
user=blyth
```

Note:

1. program name `adtemp_scraper`, which is used in *supervisorctl* commands to control and examine the process.
2. environment setting pointing the production scraper to read config from a separate file:

   ```
   ``environment=HOME='/home/scraper',SCRAPER_CFG='/home/scraper/adtemp_scraper_production.cfg'``
   ```

   NB the single quotes which is a workaround for svenvparsebug needed in some supervisord versions.

Supervisorctl CLI

Start the process from `supervisorctl` command line as shown:

```
[blyth@belle7 conf]$ sv                    ## OR supervisorctl if not using sv- bash functions
dybslv                           RUNNING    pid 2990, uptime 5:39:59
hgweb                            RUNNING    pid 2992, uptime 5:39:59
mysql                            RUNNING    pid 2993, uptime 5:39:59
nginx                            RUNNING    pid 2991, uptime 5:39:59

N> help

default commands (type help <topic>):
=====================================
add    clear  fg        open  quit    remove  restart   start   stop  update
avail  exit   maintail  pid   reload  reread  shutdown  status  tail  version


N> reread
adtemp_faker: available
adtemp_scraper: available
pmthv_faker: available
pmthv_scraper: available

N> avail
adtemp_faker                     avail     auto      999:999
adtemp_scraper                   avail     auto      999:999
dybslv                           in use    auto      999:999
hgweb                            in use    auto      999:999
mysql                            in use    auto      999:999
nginx                            in use    auto      999:999
pmthv_faker                      avail     auto      999:999
pmthv_scraper                    avail     auto      999:999

N> add adtemp_faker
adtemp_faker: added process group

N> status
adtemp_faker                     STARTING
dybslv                           RUNNING    pid 2990, uptime 5:41:46
hgweb                            RUNNING    pid 2992, uptime 5:41:46
mysql                            RUNNING    pid 2993, uptime 5:41:46
nginx                            RUNNING    pid 2991, uptime 5:41:46
```

```
N> status
adtemp_faker                     RUNNING    pid 22822, uptime 0:00:01
dybslv                           RUNNING    pid 2990, uptime 5:41:50
hgweb                            RUNNING    pid 2992, uptime 5:41:50
mysql                            RUNNING    pid 2993, uptime 5:41:50
nginx                            RUNNING    pid 2991, uptime 5:41:50
```

Subsequently can start/stop/restart/tail in normal manner. Following changes to supervisord configuration, such as environment changes, using just **start** for stopped process does not pick up the changed config. Ensure changes are picked up by using **remove**, **reread** and **add** which typically also starts the child process.

21.18.10 Steps to Deployment

Separate Testing and Production Config

Convenient testing requires far more rapid scraping that is needed in production, thus avoid having to change config by separating config for testing and production. The scraper can be instructed to read a different config file via `SCRAPER_CFG`, as described above *Configuration Mechanics*. This envvar can be set within the **supervisord** control file as described above *Continuous running under supervisord*.

Recommended steps towards scraper deployment:

1. setup a **faker** to write into `fake_dcs` with one process while the corresponding scraper is run in another process `fake_dcs -> tmp_offline_db`, as described above *Testing Scraper Operation*, this allows testing:
   (a) live running
   (b) catchup : by stop/start of the scraper
   (c) scraper parameter tuning
2. test from real `dcs -> tmp_offline_db`
   (a) make sure you have readonly permissions in the DBCONF "dcs" source section first!
   (b) get supervisord setup *Continuous running under supervisord* to allow long term running over multiple days
   (c) check the scraper can run continuously,
      i. look for sustainability (eg avoid dumping huge logs)
      ii. check responses to expected problems (eg network outtages), possibly **supervisord** config can be adjusted to auto-restart scrapers

21.18.11 Development Tips

Obtain mysqldump of DCS DB to populate fake source DB

Dumping just the table creation commands from the replicated DCS DB into file `~/fake_dcs.sql` (password read from a file):

```
mysqldump --no-defaults --no-data --lock-tables=false --host=202.122.37.89 --user=dayabay --password=
```

Note:

1. `--no-data` option must be used, to avoid creation of unusably large dump files

2. `--lock-tables=false` is typically needed to avoid permission failures

Single table mysqldump for averager testing

Averager testing requires a large dataset, so rather than add batch capability to the faker to generate this it is simpler and more realistic to just dump real tables from the replicated DCS DB. For example:

```
time mysqldump --no-defaults  --lock-tables=false --host=202.122.37.89 --user=dayabay --password=$(ca
  ## 27 min yielded 207MB of truncated dump up to 1420760,'2011-02-19 10:19:10'

time mysqldump --no-defaults  --lock-tables=false --host=202.122.37.89 --user=dayabay --password=$(ca
  ## cut the dump down to size with where clause :   10 seconds, 2.1M, full range

time mysqldump --no-defaults  --lock-tables=false --host=202.122.37.89 --user=dayabay --password=$(ca
  ## 84 seconds, 21M, full range

time mysqldump --no-defaults  --lock-tables=false --host=202.122.37.89 --user=dayabay --password=$(ca

time mysqldump --no-defaults  --lock-tables=false --host=202.122.37.89 --user=dayabay --password=$(ca
  ## 462 seconds, 203M, full range
```

Check progress of the dump with:

```
tail --bytes=200  ~/AD1_LidSensor_10.sql       ## use bytes option as very few newlines in mysqldumps
```

Replace any pre-existing `fake_dcs.AD1_LidSensor` table with:

```
cat ~/AD1_LidSensor_10.sql   | mysql fake_dcs
cat ~/AD1_LidSensor_100.sql  | mysql fake_dcs
cat ~/AD1_LidSensor_1000.sql | mysql fake_dcs
```

Check ranges in the table with group by year query:

```
echo "select count(*),min(id),max(id),min(date_time),max(date_time) from AD1_LidSensor group by year

count(*)        min(id) max(id)    min(date_time)         max(date_time)
13697                 1   3685338  0000-00-00 00:00:00     0000-00-00 00:00:00
151             9941588  13544749  1970-01-01 08:00:00     1970-01-01 08:00:00
11032689             43  11046429  2011-01-10 10:34:28     2011-12-31 23:59:58
2508947        11046430  13555485  2012-01-01 00:00:00     2012-02-29 15:19:43
```

If seeding is used, the range of averaging will be artificially truncated. For rerunnable test averages over full range:

```
time ./scr.py -s adlid_averager --ALLOW_DROP_CREATE_TABLE --DROP_TARGET_TABLES
    ## full average of modulo 10  single AD1_LidSensor table : ~6m
    ## full average of modulo 100 single AD1_LidSensor table : ~4m35s
```

Append capable mysqldumps

The dumps created as described above have structure:

```
DROP TABLE IF EXISTS `AD1_LidSensor`;
..
CREATE TABLE `AD1_LidSensor` (
  `id` int(10) unsigned NOT NULL AUTO_INCREMENT,
  `date_time` datetime NOT NULL,
   ...
```

```
);
LOCK TABLES `AD1_LidSensor` WRITE;
INSERT INTO `AD1_LidSensor` VALUES
(10,'0000-00-00 00:00:00',237,301,'18.77','18.95','-0.77','0.24','0.01','-0.44','-0.57','1.12',5,'19
(20,'0000-00-00 00:00:00',237,302,'18.77','18.90','-0.77','0.24','0.02','-0.44','-0.57','1.12',5,'19
...
(13558330,'2012-02-29 16:54:33',2277,2103,'22.30','22.42','-1.01','0.27','-0.28','-0.42','-0.75','1.2
UNLOCK TABLES;
```

Skip the `DROP+CREATE` with `--no-create-info`, restrict to new `id` and pipe the dump directly into dev DB to bring uptodate (modulo 100):

```
maxid=$(echo "select max(id) from AD1_LidSensor" | mysql --skip-column-names fake_dcs ) ; echo $maxid
time mysqldump --no-defaults  --no-create-info --lock-tables=false --host=202.122.37.89 --user=dayaba
```

Test append running of averager:

```
time ./scr.py -s adlid_averager
```

Catches up with 2 bins:

```
INFO:Scraper.base.datetimebin: [0  ] ['Wed Feb 29 15:00:00 2012', 'Thu Mar  1 00:00:00 2012'] 9:00:00
INFO:Scraper.base.datetimebin: [1  ] ['Thu Mar  1 00:00:00 2012', 'Thu Mar  1 11:00:00 2012'] 11:00:0
INFO:Scraper.base.averager:looping over 2 territory bins performing grouped aggregate queries in each
INFO:Scraper.base.sourcevector:SV 1   (0, 1)               2012-02-29 15:00:00=>00:00:00 full       r
INFO:Scraper.base.sourcevector:SV 2   (0, 1)               2012-03-01 00:00:00=>11:00:00 full       r
```

Checking target, shows no seams:

```
echo "select * from DcsAdLidSensorVld where TIMESTART > DATE_SUB(UTC_TIMESTAMP(),INTERVAL 36 HOUR)"

6515    2012-02-29 02:00:13     2012-02-29 02:56:53     1       1       1       0       -1      2012-
6516    2012-02-29 03:00:13     2012-02-29 03:56:53     1       1       1       0       -1      2012-
6517    2012-02-29 04:00:13     2012-02-29 04:56:53     1       1       1       0       -1      2012-
6518    2012-02-29 05:00:13     2012-02-29 05:56:53     1       1       1       0       -1      2012-
6519    2012-02-29 06:00:13     2012-02-29 06:56:53     1       1       1       0       -1      2012-
6520    2012-02-29 07:00:13     2012-02-29 07:56:53     1       1       1       0       -1      2012-
6521    2012-02-29 08:00:13     2012-02-29 08:56:53     1       1       1       0       -1      2012-
6522    2012-02-29 09:00:13     2012-02-29 09:56:57     1       1       1       0       -1      2012-
6523    2012-02-29 10:00:17     2012-02-29 10:56:57     1       1       1       0       -1      2012-
6524    2012-02-29 11:00:17     2012-02-29 11:56:57     1       1       1       0       -1      2012-
6525    2012-02-29 12:00:17     2012-02-29 12:56:57     1       1       1       0       -1      2012-
```

Multi-source table test

Start from scratch following schema changes to DCS

Drop pre-existing **fake_dcs** DB and recreate from the nodata mysqldump:

```
mysql> status                                ## verify connected to local development server
mysql> drop database if exists fake_dcs ;
mysql> create database fake_dcs ;
mysql> use fake_dcs
mysql> source ~/fake_dcs.sql                 ## use nodata dump to duplicate table definitions
mysql> show tables
```

> **Warning:** only use the below approach on local development server when confident of mysql config

Quick (and **DANGEROUS**) way of doing the above which works as mysqldump defaults to including `DROP TABLE IF EXISTS` prior to `CREATE TABLE` allowing emptying data from all tables without having to drop/recreate the DB. **CAUTION:** this assumes that the **client** section of `~/.my.cnf` is on the same server as the DB called **fake_dcs**

```
cat ~/fake_dcs.sql | mysql fake_dcs
```

Interactive SQLAlchemy Querying

Use `NonDbi` to pull up a session and dynamic SQLAlchemy class to query with ipython:

```
[blyth@belle7 Scraper]$ ipython
Python 2.7 (r27:82500, Feb 16 2011, 11:40:18)
Type "copyright", "credits" or "license" for more information.

IPython 0.9.1 -- An enhanced Interactive Python.
?         -> Introduction and overview of IPython's features.
%quickref -> Quick reference.
help      -> Python's own help system.
object?   -> Details about 'object'. ?object also works, ?? prints more.

In [1]: from NonDbi import session_

In [2]: session = session_("fake_dcs")   ## dbconf

In [3]: kls = session.kls_("DBNS_AD1_HV")   ## table name

In [4]: q = session.query(kls).order_by(kls.date_time)  ## does not touch DB yet

In [5]: q.count()         ## hits DB now
Out[5]: 74L

In [6]: q.first()         ## LIMIT 0, 1    same as q[0:1][0]    (maybe different errors if empty thou
Out[6]: <NonDbi.YDBNS_AD1_HV object at 0xa7a404c>

In [7]: q[70:74]          ## LIMIT 70,4
Out[7]:
[<NonDbi.YDBNS_AD1_HV object at 0xa7bea4c>,
 <NonDbi.YDBNS_AD1_HV object at 0xa7beaac>,
 <NonDbi.YDBNS_AD1_HV object at 0xa7bea8c>,
 <NonDbi.YDBNS_AD1_HV object at 0xa7beb2c>]

In [8]: q[70:75]         ## LIMIT 70,5
Out[8]:
[<NonDbi.YDBNS_AD1_HV object at 0xa7bea4c>,
 <NonDbi.YDBNS_AD1_HV object at 0xa7beaac>,
 <NonDbi.YDBNS_AD1_HV object at 0xa7bea8c>,
 <NonDbi.YDBNS_AD1_HV object at 0xa7beb2c>]

In [9]: q[74:75]         ## LIMIT 74,1
Out[9]: []

In [10]: q[73:74]        ## LIMIT 73,1
Out[10]: [<NonDbi.YDBNS_AD1_HV object at 0xa7beb2c>]
```

21.19 DBI Internals

- Overlay versioning implementation
- Overlay overriding problem
- Fix attempt A
  - Possible Workaround
  - Possible Solution
  - Looking for preexisting manifestations
  - Problem with this fix A
- Write single entry into empty table
- Write two entries at same validity range ts:EOT into empty table
- Write 3 entries for different runs into empty table
- Delving into overlay detection and `DbiValidityRecBuilder`
- fGap : special vrec holding trim results
- Trimming in Builder ctor
  - AndTimeWindow : overlap range
  - FindTimeBoundaries
  - Bracketed Trimming : effective range reduced to overlap other
  - Non bracketed trim : effective range reduced to exclude the other
  - Double Overlay Example
  - Trim In full

Bug hunting inside DBI, not for users.

21.19.1 Overlay versioning implementation

Driven by the writer `Close` dybgaudi:Database/DatabaseInterface/DatabaseInterface/DbiWriter.tpl

```
template<class T>
Bool_t DbiWriter<T>::Close(const char* fileSpec)

... snipped ...

//  Use overlay version date if required.
      if ( fUseOverlayVersionDate &&  fValidRec )
         fPacket->SetVersionDate(fTableProxy->QueryOverlayVersionDate(fValidRec,fDbNo));

//  Set SEQNO and perform I/O.
      fPacket->SetSeqNo(seqNo);
      ... snip ...
      ok = fPacket->Store(fDbNo);
```

From the various `Open`:

```
fUseOverlayVersionDate = vrec.GetVersionDate() == TimeStamp(0,0);
```

Quoting comments from `QueryOverlayVersionDate` of dybgaudi:Database/DatabaseInterface/src/DbiTableProxy.cxx:

```
TimeStamp DbiTableProxy::QueryOverlayVersionDate(const DbiValidityRec& vrec,
                                                 UInt_t dbNo)
{

//
//  Purpose:  Determine a suitable Version Date so that this validity
//            record, if written to the selected DB, will overlay
//            correctly.
//
```

```
//  Specification:-
//  ==============
//
//  o Determine optimal Version Date to overlay new data.  See Program Notes.

//  Program Notes:-
//  ==============


// It is normal practice, particularly for calibration data, to have
// overlapping the validity records.  Each time a new set of runs are
// processed the start time of the validity is set to the start time of
// the first run and the end time is set beyond the start time by an
// interval that characterises the stability of the constants.  So long
// as a new set of constants is created before the end time is reached
// there will be no gap.  Where there is an overlap the Version Date is
// used to select the later constants on the basis that later is better.
// However, if reprocessing old data it is also normal practice to
// process recent data first and in this case the constants for earlier
// data get later version dates and overlay works the wrong way.  To
// solve this, the version date is faked as follows:-
//
//
//   1.  For new data i.e. data that does not overlay any existing data,
//       the version date is set to the validity start time.
//
//   2.  For replacement data i.e. data that does overlay existing data,
//       the version date is set to be one minute greater than the Version
//       Date on the current best data.
//
// This scheme ensures that new data will overlay existing data at the
// start of its validity but will be itself overlaid by data that has
// a later start time (assuming validity record start times are more
// than a few minutes apart)


  //  Create a context that corresponds to the start time of the validity
  //  range.  Note that it is O.K. to use SimFlag and Site masks
  //  even though this could make the context ambiguous because the
  //  context is only to be used to query the database and the SimFlag and
  //  Site values will be ORed against existing data so will match
  //  all possible data that this validity range could overlay which is
  //  just what we want.


  const ContextRange& vr(vrec.GetContextRange());
  Context vc((Site::Site_t) vr.GetSiteMask(),
                 (SimFlag::SimFlag_t) vr.GetSimMask(),
                                      vr.GetTimeStart());

  DbiConnectionMaintainer cm(fCascader);  //Stack object to hold connections

  // Build a complete set of effective validity records from the
  // selected database.
  DbiValidityRecBuilder builder(fDBProxy,vc,vrec.GetSubSite(),vrec.GetTask(),dbNo);

  // Pick up the validity record for the current aggregate.
  const DbiValidityRec& vrecOvlay(builder.GetValidityRecFromAggNo(vrec.GetAggregateNo()));
```

```
// If its a gap i.e. nothing is overlayed, return the start time, otherwise
// return its Version Date plus one minute.
TimeStamp ovlayTS(vr.GetTimeStart());
if ( ! vrecOvlay.IsGap() ) {
  time_t overlaySecs = vrecOvlay.GetVersionDate().GetSec();
  ovlayTS = TimeStamp(overlaySecs + 60,0);
}

LOG(dbi,Logging::kDebug1) << "Looking for overlay version date for: "
                  << vrec << "found it would overlap: "
                  << vrecOvlay << " so overlay version date set to "
                  << ovlayTS.AsString("s") << std::endl;
return ovlayTS;
```

21.19.2 Overlay overriding problem

Consider overlay usage in a run-by-run to EOT regime:

```
                                        EOT
100  ---------------------------------------
101        -----------------------------------
102                  -------------------------
103                           ---------------
```

Other than for the first entry (run 100) in the table there will always be pre-existing data as each subsequent run record gets written. Thus the VERSIONDATE will always get incremented off the TIMESTART of the last entry. This is will cause problems as in the case of overriding overrides there will be VERSIONDATE clashes.

Clearly the solution is to somehow distinguish between an *intended* overlay:

```
                                        EOT
100  ---------------------------------------
101        -----------------------------------
102                  -------------------------
102                  -------------------------     <<< real overlay in need of VERSIONDATE = ts102+1mi
103                           ---------------
```

As opposed to a *technical* overlay:

```
                                        EOT
100  ---------------------------------------
101        -----------------------------------
102                  -------------------------
102                  -------------------------
103                           ---------------
104                                ----------      <<<< new entry that needs VERSIONDATE = ts104
                                                        rather than  ts103 + 1min
                                                                 aka ts102 + 1min + 1min
                                                                 aka ts101 + 1min + 1min + 1min
                                                                 aka ts100 + 1min + 1min + 1min + 1mi
```

21.19.3 Fix attempt A

Possible Workaround

Do not use overlay versioning on the first pass... instead force the versiondate to be the timestart `versiondate = cr.timestart`

Possible Solution

Modify the feeler query to make the distinction, maybe as simple as adding clause `and VERSIONDATE >= ts` Simulate this solution by applying an SqlCondition during the writer close.

```
if fixcondition:
    condition = "VERSIONDATE >= '%s'" % cr.timestart.AsString("s")
    log.debug( "write_ fixcondition %s during writer close " % condition  )
    gDbi.registry.SetSqlCondition(condition)    ## CAUTION THIS IS A GLOBAL CONDITION

assert wrt.Close()

if fixcondition:
    log.debug( "write_ fixcondition clear after writer close " )
    gDbi.registry.SetSqlCondition("")
```

This succeeds without requiring special treatment on the first pass.

Looking for preexisting manifestations

Find duplicate versiondates:

```
SELECT SEQNO,VERSIONDATE,COUNT(VERSIONDATE) AS dupe  FROM CalibFeeSpecVld GROUP BY VERSIONDATE HAVINC
```

Added a `db.py` command to do this over all validity tables, usage:

```
db.py tmp_offline_db vdupe
db.py offline_db     vdupe        ## there are many
```

Problem with this fix A

Approach A will usually delay manifestation of the problem, but it does not fix it... as apparently the logic that is finding overlays is throwing up VERSIONDATEs that are duplicated within the same context.

21.19.4 Write single entry into empty table

Using starttime of run 11717 and EOT and forced timegate of 60s (tg):

```
mysql> select p.runNo, v.TIMESTART, v.TIMEEND, v.VERSIONDATE, v.INSERTDATE from DaqRunInfo as p, DaqR
+-------+---------------------+---------------------+---------------------+---------------------+
| runNo | TIMESTART           | TIMEEND             | VERSIONDATE         | INSERTDATE          |
+-------+---------------------+---------------------+---------------------+---------------------+
...
| 11717 | 2011-08-04 05:54:47 | 2011-08-04 05:59:51 | 2011-08-04 05:54:47 | 2011-08-04 06:09:15 |
...
```

The pre-write query on empty table is:

```
select * from DemoVld where
       TimeStart <= '2011-08-04 05:55:47'                    ##       timestart <= ts + tg
  and  TimeEnd    > '2011-08-04 05:53:47'                    ##   and   timeend > ts - tg

  and  SiteMask & 127 and SimMask & 1 and  Task = 0 and SubSite = 0
  order by VERSIONDATE desc
```

Source is `QueryValidity` from dybgaudi:Database/DatabaseInterface/src/DbiDBProxy.cxx

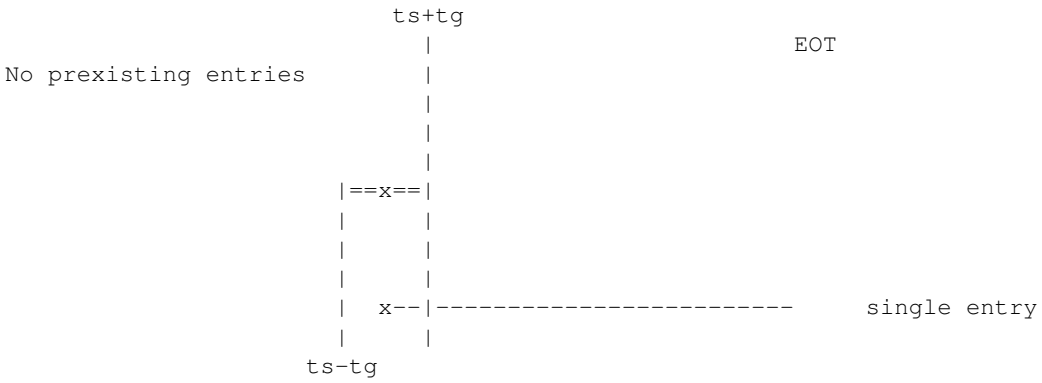
I suspect that the unhealthy VERSIONDATE coupling when employing overlay versioning to override priors can be avoided with an additional requirement on the feeler query:

```
VERSIONDATE >= '2011-08-04 05:54:47'    ##    VERSIONDATE >= ts
```

When all entries use TIMEEND of EOT, the pre-write query collapses to:

```
TIMESTART <= ts + tg
```

Ascii art:



Following vld peeking, some min-maxing is done... the VERSIONDATE is wideopen as no-preexisting data found by first query.

First Vld-start after gate:

```
select min(TIMESTART) from DemoVld where
            TIMESTART > '2011-08-04 05:55:47'                          ##         timestart >
      and VERSIONDATE >= '1970-01-01 00:00:00'                         ##   and versiondate >=
      and SiteMask & 127 and SimMask & 1 and  SubSite = 0 and  Task = 0
```

First Vld-end after gate:

```
select min(TIMEEND) from DemoVld where
           TIMEEND > '2011-08-04 05:55:47'                           ##     timeend > ts + tg
     and VERSIONDATE >= '1970-01-01 00:00:00'                        ## and versiondate >= 0
     and SiteMask & 127 and SimMask & 1 and  SubSite = 0 and  Task = 0
```

Last Vld-start before gate:

```
select max(TIMESTART) from DemoVld where
            TIMESTART < '2011-08-04 05:53:47'                          ##      timestart < ts
      and VERSIONDATE >= '1970-01-01 00:00:00'                         ##  and versiondate >=
     and SiteMask & 127 and SimMask & 1 and SubSite = 0 and  Task = 0
```

Last Vld-end before gate:

```
select max(TIMEEND) from DemoVld where
               TIMEEND < '2011-08-04 05:53:47'                                  ##     timeend < ts - t
       and VERSIONDATE >= '1970-01-01 00:00:00'                                 ## and versiondate >= (
      and SiteMask & 127 and SimMask & 1 and  SubSite = 0 and  Task = 0
```

Source is `FindTimeBoundaries` from dybgaudi:Database/DatabaseInterface/src/DbiDBProxy.cxx which is driven from `DbiValidityRecBuilder` ctor dybgaudi:Database/DatabaseInterface/src/DbiValidityRecBuilder.cxx and is controllable by argument **findFullTimeWindow**

Resulting insert goes in with `VERSIONDATE == TIMESTART`:

```
INSERT INTO DemoVld VALUES      ## TIMESTART              TIMEEND                          VERSIONDA
                           (31,'2011-08-04 05:54:47','2038-01-19 03:14:07',127,1,0,0,-1,'2011-08-04 0
INSERT INTO Demo VALUES
                           (31,1,10,11717)
```

21.19.5 Write two entries at same validity range ts:EOT into empty table

1st entry proceeds precisely as above. The feeler query of 2nd entry is the same but this time it yields the 1st entry:

```
+-------+---------------------+---------------------+----------+---------+---------+------+----------
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATE
+-------+---------------------+---------------------+----------+---------+---------+------+----------
|    31 | 2011-08-04 05:54:47 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+------+----------
```

The min-maxing proceeds similarly but this time with `VERSIONDATE >= '2011-08-04 05:54:47'`

Resulting insert goes in with `VERSIONDATE == TIMESTART + 1min`:

```
INSERT INTO DemoVld VALUES        ##                                                 VERSIONDA
                           (32,'2011-08-04 05:54:47','2038-01-19 03:14:07',127,1,0,0,-1,'2011-08-04 0
INSERT INTO Demo VALUES
                           (32,1,11,11717)
```

21.19.6 Write 3 entries for different runs into empty table

Result is coupled VERSIONDATE:

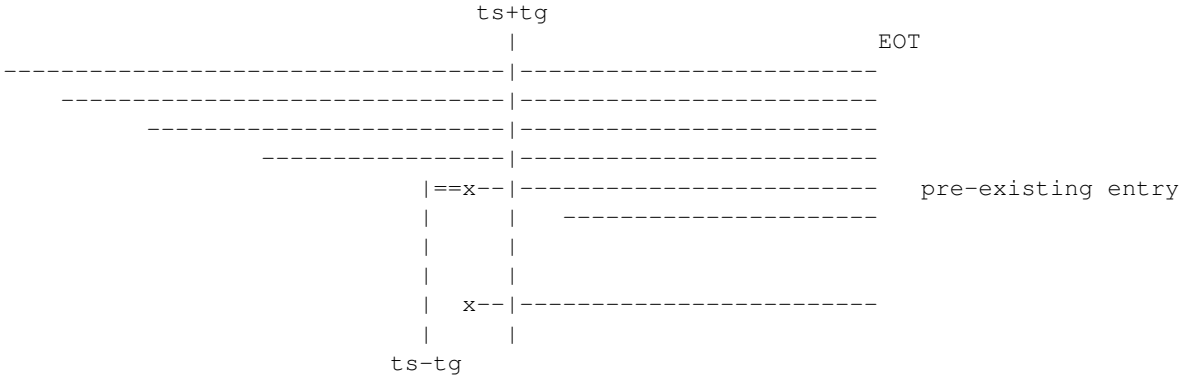
```
mysql> select * from DemoVld ;
+-------+---------------------+---------------------+----------+---------+---------+------+----------
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATE
+-------+---------------------+---------------------+----------+---------+---------+------+----------
|    33 | 2011-08-04 05:54:47 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
|    34 | 2011-08-04 06:15:46 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
|    35 | 2011-08-04 07:02:51 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+------+----------
3 rows in set (0.00 sec)

mysql> select * from Demo ;
+-------+-------------+------+-------+
| SEQNO | ROW_COUNTER | Gain | Id    |
+-------+-------------+------+-------+
|    33 |           1 |   10 | 11717 |
|    34 |           1 |   10 | 11718 |
|    35 |           1 |   10 | 11719 |
```

```
+-------+-------------+------+-------+
3 rows in set (0.00 sec)
```

The feeler query prior to the 2nd write sees the 1st write (as effectively just doing `timestart < ts + tg and timeend > ts - tg`) and grabs the VERSIONDATE from the last and offsets from there:

```
mysql> select * from DemoVld where     TimeStart <= '2011-08-04 06:16:46' and TimeEnd    > '2011-08-0
+-------+---------------------+---------------------+----------+---------+---------+------+----------
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATE
+-------+---------------------+---------------------+----------+---------+---------+------+----------
|    33 | 2011-08-04 05:54:47 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+------+----------
2 rows in set (0.00 sec)
```

Ascii art:



21.19.7 Delving into overlay detection and `DbiValidityRecBuilder`

The crucial `VERSIONDATE` is supplied by `TimeStamp DbiTableProxy::QueryOverlayVersionDate(const DbiValidityRec& vrec,UInt_t dbNo)` is

```
// Build a complete set of effective validity records from the
 // selected database.
 DbiValidityRecBuilder builder(fDBProxy,vc,vrec.GetSubSite(),vrec.GetTask(),dbNo);

 // Pick up the validity record for the current aggregate.
 const DbiValidityRec& vrecOvlay(builder.GetValidityRecFromAggNo(vrec.GetAggregateNo()));

 // If its a gap i.e. nothing is overlayed, return the start time, otherwise
 // return its Version Date plus one minute.
 TimeStamp ovlayTS(vr.GetTimeStart());
 if ( ! vrecOvlay.IsGap() ) {
   time_t overlaySecs = vrecOvlay.GetVersionDate().GetSec();
   ovlayTS = TimeStamp(overlaySecs + 60,0);
 }
```

Which is primarily determined by the `DbiValidityRecBuilder::GetValidityRecFromAggNo`, namely

```
const DbiValidityRec& GetValidityRecFromAggNo(Int_t aggNo) const { return this->GetValidityRec(this->
```

Non-aggregated case of `aggNo=-1` is treated as single-slice aggregate.

`DbiValidityRecBuilder` is DBIs summarization of a Validity query, revolving around `fVRecs` vector of `DbiValidityRec` **for each aggregate** (or only one when non-aggregate). For non-extended queries the `DVRB` is

quite lightweight with just entries that start off as Gaps for each aggregate in the vector (contrary for first impressions and very different extended context behaviour) and are trimmed by the Vld query entries (which are not stored).

21.19.8 fGap : special vrec holding trim results

Created by `DbiValidityRecBuilder::MakeGapRec(const Context& vc, const string& tableName,Bool_t findFullTimeWindow)` essentially:

```
ContextRange gapVR(vc.GetSite(), vc.GetSimFlag(), startGate, endGate);    ##
fGap =  DbiValidityRec(gapVR, fSubSite, fTask, -2, 0, 0, kTRUE);
                    ## range subsite task aggNo seqNo dbNo isGap
```

Gate is `BOT:EOT` when `findFullTimeWindow=True` otherwise tis `ts-tg:ts+tg`, `Dbi::GetTimeGate(tableName)` defaults are big ~10days

21.19.9 Trimming in Builder ctor

Prior to vld row loop

```
const TimeStamp curVTS = vc.GetTimeStamp();
TimeStamp earliestCreate(0);     //    Set earliest version date to infinite past - the right value
```

Within the vld row loop

```
const DbiValidityRec* vr = dynamic_cast<const DbiValidityRec*>(result.GetTableRow(row));

//        Trim the validity record for the current aggregate number by this record and see if we have
DbiValidityRec& curRec = fVRecs[index];   // curRec summarizes all the validities within an aggregate

curRec.Trim( curVTS, \*vr );


     ####
     #### only while curRec is still a gap does Trim do anything
     ####       ... it becomes non gap when bracketing validity is hit
     ####       ... the ordering is VERSIONDATE desc, so that means the highest VERSIONDATE with vali
     ####       ...  becomes non-gap first, there-after no more trimming is done
     ####
     ####
     #### if curVTS is within \*vr range (ie \*vr brackets curVTS)
     ####         curRec becomes \*vr                                    (that includes the VERSIONDAT
     ####         range is trimmed to the overlap with the other
     ####  otherwise
     ####         range is trimmed to exclude the other
     ####
     ####


if ( ! curRec.IsGap() ) {  foundData = kTRUE; curRec.SetDbNo(dbNo); }

//      Find the earliest non-gap version date that is used
if ( curRec.GetSeqNo() == vr->GetSeqNo() &&  ( earliestCreate > vr->GetVersionDate() || earliestCreat

     ######### no non-gap restriction ?
     #########     .... implicitly done as while curRec is a gap it has SEQNO 0
     ######### WHY SEQNO EQUALITY ?
     #########           WILL ONLY FIND ONE ENTRY IN ENTIRE VECTOR
```

```
     #########            so earliestCreate will become just the resultant VERSIONDATE ?

//      Count the number used and sum the time windows
++numVRecIn;
const ContextRange range = vr->GetContextRange();
Int_t timeInterval =   range.GetTimeEnd().GetSec() - range.GetTimeStart().GetSec();

sumTimeWindows += timeInterval;
++numTimeWindows;
```

After vld loop

```
//    If finding findFullTimeWindow then find bounding limits
//    for the cascade and sim flag and trim all validity records

             ############### including the crucial curRec ????

if ( findFullTimeWindow ) {
    TimeStamp start, end;
    proxy.FindTimeBoundaries(vcTry,fSubSite,fTask,dbNo,earliestCreate,start,end);
    LOG(dbi,Logging::kDebug1) << "Trimming validity records to " << start << " .. " << end << std::en
    std::vector<DbiValidityRec>::iterator itr(fVRecs.begin()), itrEnd(fVRecs.end());
    for( ; itr != itrEnd; ++itr ) itr->AndTimeWindow(start,end);
}
```

AndTimeWindow : overlap range

Greater start and lower end:

```
st                    en
    |-----------------|

         |-------|
       so        eo

         |=======|
       st'       en'
```

FindTimeBoundaries

Provides (start,end) representing proximity to validity regions before and after the gate, which have no overlap into the gate:

```
                              |
                              |                    ----------
                              |               -----------
                              |          -----------
                              |     1--------2
                              |     .        .
                         ts   |     .        .
                   |----x----|     .        .
                   sg        eg    .
                   |               .
                   |               .
     3------4      |               .
-------     .      |               .
```

```
          .     |               .
        start                 end


      1    min(ts) where ts > eg
      2    min(te) where te > eg
      3    max(ts) where ts < sg
      4    max(te) where te < sg
```

But with restriction: `VERSIONDATE >= earliestCreate`

```
void DbiDBProxy::FindTimeBoundaries(const Context& vc,
                                    const Dbi::SubSite& subsite,
                                    const Dbi::Task& task,
                                    UInt_t dbNo,
                                    TimeStamp earliestCreate,
                                    TimeStamp& start,
                                    TimeStamp& end) const {
//
//
//  Purpose: Find next time boundaries beyond standard time gate.
//
//  Arguments:
//    vc             in    The Validity Context for the query.
//    subsite        in    The subsite of the query.
//    task           in    The task of the query.
//    dbNo           in    Database number in cascade (starting at 0).
//    earliestCreate in    Earliest version date of data in the time gate
//    start          out   Lower time boundary or TimeStamp(0,0) if none
//    end            out   Upper time boundary or TimeStamp(0x7FFFFFFF,0) if none
//
//  Specification:-
//  ==============
//
//  o Find the next time boundary (either TIMESTART or TIMEEND)
//    outside the current time gate with a version date >= earliestCreate.

  LOG(dbi,Logging::kMonitor) << "FindTimeBoundaries for table " <<  fTableName
                        << " context " << vc
                        << " subsite " << subsite
                        << " task " << task
                        << " Earliest version date " <<  earliestCreate
                        << " database " << dbNo << std::endl;

//  Set the limits wide open
  start = TimeStamp(0,0);
  end   = TimeStamp(0x7FFFFFFF,0);

//  Construct a Time Gate on the current date.

  const TimeStamp curVTS = vc.GetTimeStamp();
  Int_t timeGate = Dbi::GetTimeGate(this->GetTableName());
  time_t vcSec = curVTS.GetSec() - timeGate;

  TimeStamp startGate(vcSec,0);
  vcSec += 2*timeGate;
  TimeStamp endGate(vcSec,0);
```

```
  string earliestCreateString(Dbi::MakeDateTimeString(earliestCreate));
  string startGateString(Dbi::MakeDateTimeString(startGate));
  string endGateString(Dbi::MakeDateTimeString(endGate));

// Extract information for Context.

  Site::Site_t    detType(vc.GetSite());
  SimFlag::SimFlag_t       simFlg(vc.GetSimFlag());

// Use an auto_ptr to manage ownership of DbiStatement and TSQLStatement
  std::auto_ptr<DbiStatement> stmtDb(fCascader.CreateStatement(dbNo));

  for (int i_limit =1; i_limit <= 4; ++i_limit ) {

    DbiString sql("select ");
    if ( i_limit == 1 ) sql  << "min(TIMESTART) from " << fTableName << "Vld where TIMESTART > '" <<
    if ( i_limit == 2 ) sql  << "min(TIMEEND)   from " << fTableName << "Vld where TIMEEND > '"   <<
    if ( i_limit == 3 ) sql  << "max(TIMESTART) from " << fTableName << "Vld where TIMESTART < '" <<
    if ( i_limit == 4 ) sql  << "max(TIMEEND)   from " << fTableName << "Vld where TIMEEND < '" << st

    sql << " and SiteMask & " << static_cast<unsigned int>(detType) << " and SimMask & " << static_ca
    << " and VERSIONDATE >= '" << earliestCreateString << "'"
    << " and  SubSite = " << subsite
    << " and  Task = " << task;

    LOG(dbi,Logging::kMonitor) << "  FindTimeBoundaries query no. " << i_limit  << " SQL:" <<sql.c_st

    std::auto_ptr<TSQLStatement> stmt(stmtDb->ExecuteQuery(sql.c_str()));
    stmtDb->PrintExceptions(Logging::kDebug1);

//  If the query returns data, convert to a time stamp and trim the limits
    TString date;
    if ( ! stmt.get() || ! stmt->NextResultRow() || stmt->IsNull(0) ) continue;
    date = stmt->GetString(0);

    if ( date.IsNull() ) continue;
    TimeStamp ts(Dbi::MakeTimeStamp(date.Data()));

    LOG(dbi,Logging::kMonitor) << "  FindTimeBoundaries query result: " << ts << std::endl;
    if ( i_limit <= 2 && ts < end   ) end   = ts;
    if ( i_limit >= 3 && ts > start ) start = ts;

  }

  LOG(dbi,Logging::kMonitor) << "FindTimeBoundaries for table " <<  fTableName
                   << " found " << start << " .. " << end << std::endl;

}
```

Bracketed Trimming : effective range reduced to overlap other

Both ranges have validity, but **Caution**

1. **other becomes this** with range chopped by the initial **this**
   (a) ‘’‘VERSIONDATE gets transferred from other to this!!’‘’

```
//  If this record is not a gap then the other record can be ignore
//  as it is of lower priority.

if ( ! IsGap() ) return;

   // If entry brackets query date, then use it but with a validity that
   // is trimmed by the current record.

     if ( startOther <= queryTime && endOther > queryTime ) {
       if ( start < startOther ) start = startOther;
       if ( end   > endOther   ) end   = endOther;
       \*this = other;
       SetTimeWindow(start,end);
     }
```

Pictorially:

```
                  queryTime
                       |
start                  |     end
  --------------------|-------
         -------------|------------------------
      startOther      |      .             endOther
         .            |      .
         .                   .
         .                   .
         |===================|
       start*               end*
```

Consider the equal range trim, tis bracketing so VERSIONDATE will adopt the others:

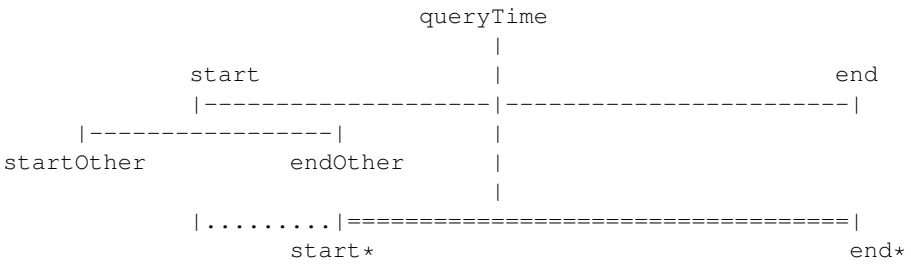
```
               queryTime
                  |
 start            |                    end
   -------------|---------------------
   -------------|---------------------
startOther      |                    endOther
   .            |
   .
   .
   |================================|
 start*                            end*
```

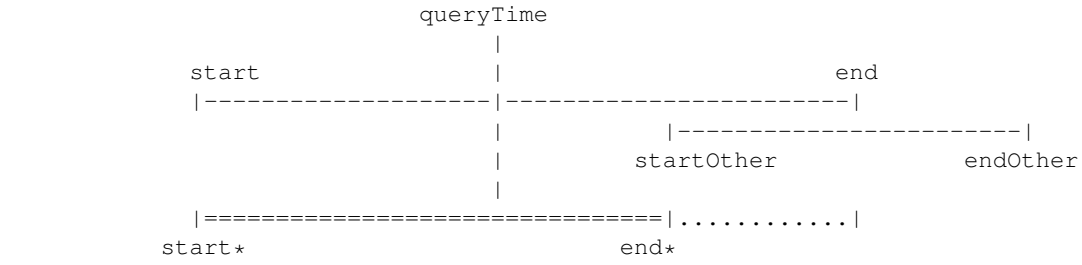
Non bracketed trim : effective range reduced to exclude the other

Other range is not valid for the queryTime but the current validity range is impinged by the other. Before and after overlap trims with no identity/VERSIONDATE change.

```
     // It doesn't bracket, so use it to trim the window

if ( endOther <= queryTime ) {
   if ( start < endOther   ) SetTimeWindow(endOther,end);
 }
 else if ( startOther > queryTime ) {
   if ( end   > startOther ) SetTimeWindow(start, startOther);
 }
```

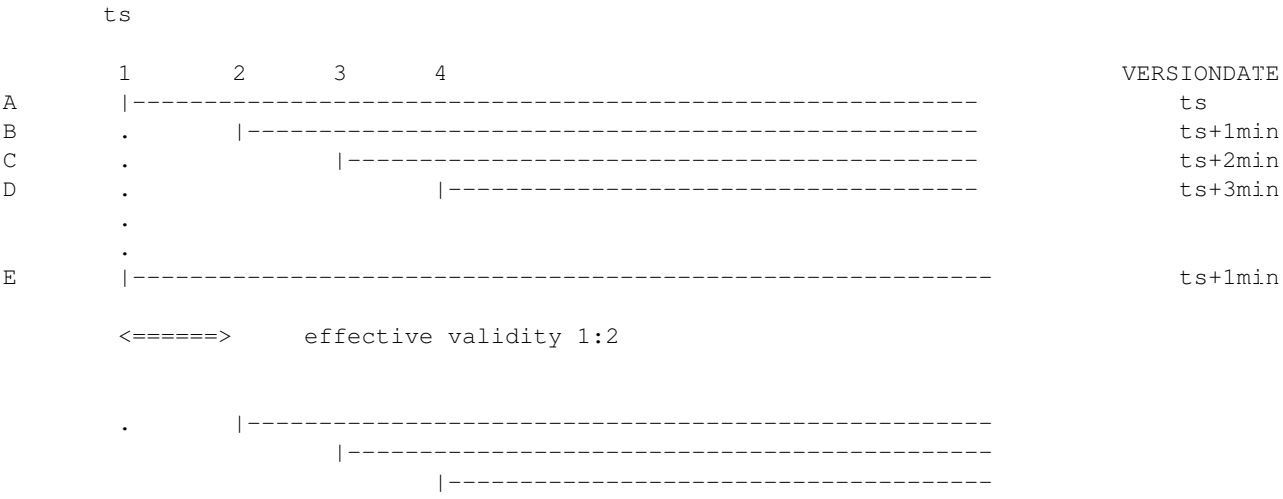
Other before (will never occur with endOther at EOT) and other after:





Double Overlay Example

Consider writing 4 runs with timeend to EOT and then going back an overlaying on top:



When checking for overlay prior to 5th write a `VERSIONDATE desc` loop causes gap trimming until strike validity at A.

D	1970-01-01 00:00:00 .. 2010-01-01 04:00:00
C	1970-01-01 00:00:00 .. 2010-01-01 03:00:00
B	1970-01-01 00:00:00 .. 2010-01-01 02:00:00
A	2010-01-01 01:00:00 .. 2010-01-01 02:00:00

Debugging:

```
[12 /79 ] check_write          ('b', (11717,), 'a')                              ==>
DVRB rowvr  row:0 seqNo:4 ts:2010-01-01 04:00:00.000000000Z vd:2010-01-01 01:03:00.000000000Z
DVRB rowvr  row:1 seqNo:3 ts:2010-01-01 03:00:00.000000000Z vd:2010-01-01 01:02:00.000000000Z
```

```
DVRB rowvr  row:2 seqNo:2 ts:2010-01-01 02:00:00.000000000Z vd:2010-01-01 01:01:00.000000000Z
DVRB rowvr  row:3 seqNo:1 ts:2010-01-01 01:00:00.000000000Z vd:2010-01-01 01:00:00.000000000Z
DVRB curRec SeqNo: 0  AggNo: -1  DbNo: 0 (gap)  ContextRange: |0x07f|0x  1| 1970-01-01 00:00:00 .. 20
DVRB curRec SeqNo: 0  AggNo: -1  DbNo: 0 (gap)  ContextRange: |0x07f|0x  1| 1970-01-01 00:00:00 .. 20
DVRB curRec SeqNo: 0  AggNo: -1  DbNo: 0 (gap)  ContextRange: |0x07f|0x  1| 1970-01-01 00:00:00 .. 20
DVRB curRec SeqNo: 1  AggNo: -1  DbNo: 0        ContextRange: |0x07f|0x  1| 2010-01-01 01:00:00 .. 20
Traceback (most recent call last):
  File "test_overlay_versioning.py", line 382, in <module>
    ret = fn(\*args)
  File "test_overlay_versioning.py", line 293, in check_write
    dwrite = write_( cr_(g['Id']) , **g )
  File "test_overlay_versioning.py", line 195, in write_
    assert lvd not in lvds.values(), "lvd %s is already present %r " %(lvd,lvds)
AssertionError: lvd 2010-01-01 01:01:00 is already present {1L: '2010-01-01 01:00:00', 2L: '2010-01-0
```

Trim In full

```
void DbiValidityRec::Trim(const TimeStamp& queryTime, const DbiValidityRec& other) {
//
//
//  Purpose:  Trim this validity record so that represents
//            best validity record for query.
//
//  Arguments:
//    queryTime    in    Time of query
//    other        in    DbiValidity record satisfying query
//
//  Return:    None.
//
//  Contact:   N. Tagg        Original Author: N. West, Oxford
//
//  Specification:-
//  ==============
//
//  o Update this validity record so that it remains the best
//    validity record taking into account the supplied record.


//  Program Notes:-
//  ==============

//  This is the function that deal with validity management.
//  It takes into account that several validity records may
//  overlap and that the best one is the one with the latest
//  version date that brackets the query date.  Other entries
//  with later version dates may trim start or end times.

//  Assumptions:-
//  ============
//
//  That entries are submitted in strict descending priority i.e.:-
//
//  1)  Entries for a higher priority database precede those from a
//      lower priority one.
//
//  2)  Within a database entries are in descending version date order.
```

```
//  Ignore other records that are either gaps or have wrong
//  aggregate number.

  if ( fAggregateNo != other.fAggregateNo || other.IsGap() ) return;

//  If this record is not a gap then the other record can be ignore
//  as it is of lower priority.

  if ( ! IsGap() ) return;

  TimeStamp start      = fContextRange.GetTimeStart();
  TimeStamp end        = fContextRange.GetTimeEnd();
  TimeStamp startOther = other.GetContextRange().GetTimeStart();
  TimeStamp endOther   = other.GetContextRange().GetTimeEnd();

// If entry brackets query date, then use it but with a validity that
// is trimmed by the current record.

  if ( startOther <= queryTime && endOther > queryTime ) {
    if ( start < startOther ) start = startOther;
    if ( end   > endOther   ) end   = endOther;
    *this = other;
    SetTimeWindow(start,end);
  }

// It doesn't bracket, so use it to trim the window

  else {

    if ( endOther <= queryTime ) {
      if ( start < endOther   ) SetTimeWindow(endOther,end);
    }
    else if ( startOther > queryTime ) {
      if ( end   > startOther ) SetTimeWindow(start, startOther);
    }
  }

}
```

21.20 DBI Overlay Versioning Bug

- Background
  - Root Cause of Issue
  - Ordering of validity queries
  - Validity Look Up Tables
  - DBI Scanning
- Current Intended code/SOP changes
  - Planned rollout of DBI modifications
    - Extra Ordering Fix
    - Timestart Flooring and Collision Avoidance
- Intended Migration of Existing DB entries
  - Rebuild Approach
    - Table Rebuilding and Insertdates
    - Table Summary
      - CableMap/HardwareID
      - CalibPmtSpec
      - CalibPmtHighGain
    - Test Rebuilding
  - Fixup Validity Approach
    - Current Transfixion Approach
- VLUT Comparisons
  - Summary Examination
    - tmp_offline_db (copy of offline_db)
    - fix_offline_db (with VERSIONDATE TIMESTART flooring)
    - tmp_offline_db_cf_fix_offline_db
  - Observations
  - Sampling VLUT extracts
    - tmp_offline_db_cf_fix_offline_db vlut orderingSEQNOdesc `insertdates:19 timestarts:18 ndif:19`
- Alternative to Recreat Rather Than Fix Approach
  - CableMap/HardwareID
    - Pumping dybaux history with `auxlog.py`
    - Re-creation Discrepancy in FEC loading : resolved with takebogus option
    - Relevant Tickets
    - Bogus Logic
    - Whole table groupby INSERTDATE for overview
- DBI Validity Ordering Change
- Payload Digest Rather than SEQNO comparison
  - CableMap
  - HardwareID

See also dybsvn:ticket:948

21.20.1 Background

Root Cause of Issue

When assigning versiondates DBI considers prior validity corresponding only to the `TIMESTART` of the new entry. In anything but the simplest of overlay histories this leads to a `VERSIONDATE` that collide with those from subsequent `TIMESTART`, this does **not** cause an issue at the initial `TIMESTART` but it does at later ones.

Validity queries at latter times see multiple validities tied in `VERSIONDATE`. Which wins is kinda undefined.

Earlier validity can leak forwards in time.

Ordering of validity queries

The ordering of DBI validity queries crucially determines which of overlayed validities wins. Problems with the ordering such as caused by duplicated VERSIONDATE lead to **insidous** DBI behavior of silently returning wrong values in some regions of (INSERTDATE,TIME).

Validity Query Ordering	
a VERSIONDATE desc	historical DBI default : OK without VERSIONDATE duplications
b VERSIONDATE desc, SEQNO desc	makes the higher SEQNO of degenerate sets win (**intended fix**)
c VERSIONDATE desc, SEQNO asc	makes the lower SEQNO of degenerate sets win (canary to see problems)

MySQL has implicit *SEQNO asc* as *SEQNO* is the PK. But observed diffences between *VERSIONDATE desc* and *VERSIONDATE desc, SEQNO asc* indicates this does not follow thru to multi-column orderings.

Comparing VLUT created with different validity query ordering allows ambiguities to be located by varying the way that VERSIONDATE degeneracy is broken. Interpreting differences:

Difference	Interpretation
`a-b`	smoking-gun for affliction
`b-c/a-c`	skating on thin-ice

Validity Look Up Tables

DBI Validity Look Up Tables (VLUTs) express all possible DBI validity results(SEQNO) determined by performing DBI queries at all TIMESTARTs with rollbacks to all INSERTDATES. They are presented as SEQNO values within tables with INSERTDATE vertically and TIMESTART horizontally.

Comparisons between such VLUTs enable problem periods to be identified, such comparisons lists the SEQNO values in the cell when differences are found.

DBI Scanning

Scanning scripts to create VLUTs for all contexts in all tables `DybDbi.vld.vlut` (dybgaudi:Database/DybDbi/python/DybDbi/vld/vlut.py) The results are accessible beneath http://belle7.nuu.edu.tw/dbiscan/ DBI scanning is an expensive operation that should not be done to production DB, instead copy tables from *offline_db* into local *tmp_offline_db*.

Within each context variations to default DBI validity ordering are made, and the resulting VLUTs compared for 2 DBCONF:

21.20.2 Current Intended code/SOP changes

1. extra ordering to break validity degeneracy from VERSIONDATE collisions is mandatory, how to do that fairly clear:
   (a) SEQNO desc (**best** approach as follows in spirit of VERSIONDATE, and makes future degeneracy impossible)
   (b) SEQNO asc (lower SEQNO wins in VERSIONDATE collisions, good canary)
   (c) TIMESTART asc (future possibilities of degeneracy are not eliminated when using TIMESTART, must use SEQNO for that)

2. adopt timestart floored VERSIONDATE
   (a) reduces occurence of degeneracy, and makes VERSIONDATEs more understandable
3. enforce no VERSIONDATE collisions
   (a) DBI will refuse to write entries with collisions in the written context
   (b) table experts will have to manually set VERSIONDATEs to achieve the desired overlaying, this cannot be automated as DBI cannot read the mind of the expert as to the intended overlaying
   (c) there is still possibility of collisions when reading from wider contexts than written, thus must still pin down the extra ordering

Planned rollout of DBI modifications

As multiple people need to check tables as migration is done it is not practical to change all tables at once.

Extra Ordering Fix

The extra ordering fix is a fundamental change to DBI:

1. it touches almost all DBI operations, including reading and writing
2. it changes the results of validity queries and thus DBI results in many rollback/time regions
3. almost by definition changes are restricted to afflicted tables `CableMap,HardwareID,CalibPmtSpec`
4. implemented within DBI, in the `DbiDBProxy.cxx` ctor
5. `DybDbi` spec key `CanFixOrdering = [kTRUE|kFALSE]` allows per-table testing/rollout

Note: to minimise behaviour transitions the change in standard table .spec it is preferable to be done in concert with a DB rebuild

---

The ordering can be overridden (for test purposes only) with:

```
kls.GetTableProxy().GetDBProxy().SetExtraOrdering("SEQNO desc")
```

Timestart Flooring and Collision Avoidance

These changes effect writing only and can be controlled table-by-table either:

1. via the spec writer default `wctx` strings:
   (a) `RequireUniqueVersionDate.kTRUE`
   (b) `TimeStartFlooredVersionDate.kTRUE`
2. dynamically on configuring the writer, `wrt.ctx( requireuniqueversiondate=True )`

`DybDbi` propagates these **ctx** settings in `void DbiWrt<T>::MakeWriter()`:

```
m_wrt->SetTimeStartFlooredVersionDate(m_ctx.GetTimeStartFlooredVersionDate()) ;
m_wrt->SetRequireUniqueVersionDate(m_ctx.GetRequireUniqueVersionDate()) ;
m_wrt->SetUniqueVersionDateSiteMask(m_ctx.GetUniqueVersionDateSiteMask()) ;
m_wrt->SetUniqueVersionDateSimMask( m_ctx.GetUniqueVersionDateSimMask()) ;
```

21.20.3 Intended Migration of Existing DB entries

Rebuild Approach

Where possible it is much preferable to correct DBI and rerun over source loadfiles rather than attempting to **fix** things up and risk inconsistencies/confusion/doubts.

Tables that have been recreated from source reloading, listed with dybaux revision numbers:

```
CableMap                    31    [4898, 4913, 4914, 4915, 4916, 4917, 4918, 4919, 4920, 4921, 492
CalibPmtSpec                71    [4942, 4943, 4944, 4945, 4946, 4947, 4948, 4949, 4950, 4951, 495
HardwareID                  22    [4898, 4913, 4914, 4917, 4919, 4920, 4921, 4922, 4923, 4924, 492
```

Other tables that need taming:

```
CalibPmtHighGain            4     [5019, 5042, 5048, 5063]     ## rollinggain entries may be probl
CalibPmtPedBias             1     [5034]

CoordinateAd                1     [4974]
CoordinateReactor           1     [4974]
Reactor                     1     [5065]
```

Table Rebuilding and Insertdates

Implications of slated approach for table rebuilding *Exceptional Operating Procedures for Major Changes*

1. changes `INSERTDATE` to the times of the re-insertions
2. simplest approach would even clump everything under one `INSERTDATE` **MUST AVOID THIS**

What to do with insertdates ?

1. staying honest with `INSERTDATE`, is important part of DBI *contract* do not want to kludge this
2. some tables **CableMap/HardwareID** hold little information in `INSERTDATE`
3. avoid everything going in under a single `INSERTDATE`
   (a) when employing SOP loading with `dbaux.py` this requires separate **dybaux** commits (eg for each loaded file)
   (b) a long sequence of **OVERRIDE** commits ? actually only the start scratching commit needs to be **OVERRIDE**
4. other tables with significant information in `INSERTDATE` ?
   (a) compromise and forgo rebuilding these : just code changes and future write protections

Table Summary

Table	Recreation?	Notes
CableMap/HardwareID	OK	Many duplicated loads and little information in INSERTDATEs (as they recreate prior static history) **MOST IN NEED OF REBUILD**
CalibPmtSpec	OK(?) Sept 30th load not verified	2 ctx with issues, but fairly localized
CalibPmtHighGain	not-OK rollinggain entries not easily recreatable	

CableMap/HardwareID Done:

1. developed blind duplication script/driver file, which succeeds to precisely recreate tables (warts and all)
2. developed simple all in one (de-duped) recreation script/driver file that uses the *G*Fix* classes in *dybgaudi/Database/TableTests/TestCableMap/python/TestCableMap* to load de-duped driver in fixed mode
   (a) see no collisions, ie no need to set manual VERSIONDATEs **db.py sssta checks confirm this**
3. payload digest comparisons (at last INSERTDATE) between de-duped *tmp_offline_db* and current *tmp_copy_db*
   (a) no digest differences for *CableMap* and *HardwareID*, thus no difference between payloads returned (at last INSERTDATE)

Todo:

1. chopped **dybaux-rebuild** commit script (one commit per input loadfile)
   (a) **chopping is essential to avoid all under one INSERTDATE**
   (b) test into an NTU repository

Testing auxcommited updating:

```
catdir=~/ntudybaux/catalog/tmp_offline_db
svn st $catdir

## just drops and recreates empty tables from dir with exports
cd t
../share/load_static.py -r 0:0 -l INFO --DROP ../recreate/driver_fix.txt

## rdumpcat empties into catalog, as clobbering must use OVERRIDE
db.py tmp_offline_db rdumpcat $catdir  --OVERRIDE

svn st $catdir   ## check only expected chaneged to CableMap/HardwareID/LOCALSEQNO

## as find PhysAd diffs due to local PhysAd testing not in catalog, recreate tmp_offline_db and try a
db.py offline_db dump ~/offline_db.sql
db.py tmp_offline_db load ~/offline_db.sql

## 1st check that current offline_db and the catalog are in sync
db.py tmp_offline_db rdumpcat $catdir
##    ==> find not in sync due to prior dump with local PhysAd tests

## checkout fresh catalog wc
rm -rf $catdir/*        ## leaves .svn to allowing "svn up"
svn up $catdir/..

## OR from scratch approach
( rm -rf $catdir ; cd $(dirname $catdir)  ; svn co http://dayabay.phys.ntu.edu.tw/svn/dybaux/catalog/

## huh, svn checkout is hanging half way through
```

maybe corruption in recovered dybaux repo, as lsof is pointing to getting stuck on a single rev:

```
[root@cms02 log]# lsof | grep dybaux
httpd     22803  nobody   16r      REG        3,2   3056650    2667632 /var/scm/svn/dybaux/db/revs/49
```

from Trac http://dayabay.phys.ntu.edu.tw/tracs/dybaux/changeset/4970 that is a full catalog recreation revision checkout eventually fails:

```
A    tmp_offline_db/SimPmtSpec/SimPmtSpecVld.csv
svn: REPORT of '/svn/dybaux/!svn/vcc/default': Could not read response body: Connection reset by peer
```

repeating, reveals that /var/scm/svn/dybaux/db/revs/4970 again gets stuck in craw * http://subversion.apache.org/faq.html#stuck-bdb-repos * http://svnbook.red-bean.com/en/1.6/svn.reposadmin.maint.html#svn.reposadmin.maint.tk

Note **crucial** points:

1. prevent other access to repo while using svnadmin, by `sv stop apache`
2. use the appropriate apache user, to avoid subsequenct permission issues

Verification goes thru every revision, taking ~second for each:

```
sudo -u nobody svnadmin verify /var/scm/svn/dybaux
```

Tarball appears normal:

```
tar ztvf  /data/var/scm/backup/dayabay/svn/dybaux/last/dybaux-5069.tar.gz
```

CalibPmtSpec The 2 problem **CalibPmtSpec** contexts

1. http://belle7.nuu.edu.tw/dbiscan/CalibPmtSpec/aggno-1_simflag1_site32_subsite1_task0/tmp_offline_db/vlut_cf_orderingSEQN
   (a) Broad ambiguity (many TIMESTARTs) between (29L, 39L), but only for 2 INSERTDATEs:

   ```
   2011-06-27 13:34:26
   2011-06-27 13:35:00
   ```

2. http://belle7.nuu.edu.tw/dbiscan/CalibPmtSpec/aggno-1_simflag1_site1_subsite1_task0/tmp_offline_db/vlut_cf_orderingSEQNC

1. Narrow ambiguity for TIMESTARTs:

   ```
   2011-07-07 03:17:21
   2011-07-08 06:23:13
   2011-07-09 05:58:01
   ```

   for 3 INSERTDATES:

   ```
   (85L, 89L)        2011-07-26 07:22:30
   (86L, 90L)        2011-07-26 07:22:56
   (87L, 91L)        2011-07-26 07:23:23
   ```

CalibPmtHighGain Live(without rollback) ambiguity for **CalibPmtHighGain**, with 4 smoking guns from the `INSERTDATE 2011-09-30 01:12:27` mixing SEQNO `(66L, 390L)`

- http://belle7.nuu.edu.tw/dbiscan/CalibPmtHighGain/aggno-1_simflag1_site1_subsite1_task0/tmp_offline_db/vlut_cf_orderingSE
- http://belle7.nuu.edu.tw/dbiscan/CalibPmtHighGain/aggno-1_simflag1_site1_subsite1_task0/tmp_offline_db/vlut_cf_orderingSE

For TIMESTARTs:

```
2011-07-31 18:59:05
2011-07-31 19:58:03
2011-07-31 19:59:05
2011-07-31 20:58:03
```

Test Rebuilding

Test rebuilds using non-standard switched on .spec to determine:

1. how many collisions occur ?

2. can they be reduced by re-ordering loads ? eg TIMESTART ordering (backdating is know to increase degeneracy liklihood)
3. how to supply manual VERSIONDATEs ?

Fixup Validity Approach

Appling a correction to all VERSIONDATEs to become TIMESTART floored reducing degeneracy etc.. is easy to do. It is also possible to devise *clever* schemes that attempt to replicate what DBI would have done with a changed policy.

While easy to go behind DBIs back and diddle with the VERSIONDATEs, it is not easy to know that the resulting changes in DBI results are OK. There are too many changes for it be feasible to confirm that the changes match the requirements of the table experts.

The extent and location of changes are visible from scans and summaries thereof.

Current Transfixion Approach

Done by `DybDbi.vld.versiondate` (dybgaudi:Database/DybDbi/python/DybDbi/vld/versiondate.py)

1. copies all DBI tables from *tmp_offline_db* into *fix_offline_db* with *VERSIONDATE* changed to timestart floored scheme.
   (a) uses `kls.GetTableProxy().QueryOverlayVersionDate` DBI call (with timestart floored option) to arrive at the *VERSIONDATE*
   (b) this DBI call is done in the *fix_* DB with a `SEQNO asc` growing validity table

21.20.4 VLUT Comparisons

Summary tables created from the full DBI scan by `DybDbi.vld.vsmry` (dybgaudi:Database/DybDbi/python/DybDbi/vld/vsmry.py)

Summary Examination

The dynamically derived version of this context summary is at * http://belle7.nuu.edu.tw/dbiscan/Summary/ctxsmry/

An intermediate presentation listing contexts with differences, and including TIME and INSERTDATE ranges afflicted by differences is at * http://belle7.nuu.edu.tw/dbiscan/Summary/difctx/

These summaries reference the full VLUT tables, such as * http://belle7.nuu.edu.tw/dbiscan/CableMap/aggno-1_simflag2_site2_subsite2_task0/tmp_offline_db/vlutorderingSEQNOasc_cf_orderingSEQNOdesc/

tmp_offline_db (copy of offline_db)

Cells show number of ctxs with differences over total number of ctxs.

tn	vlut_cf_orderingSEQNOasc.rst	vlut_cf_orderingSE-QNOasc_cf_orderingSEQNOdesc.rst	vlut_cf_orderingSEQNOdesc.rst
CableMap	16/35	19/35	19/35
CalibFeeSpec	0/1	0/1	0/1
CalibPmtHighGain	0/6	0/6	0/6
CalibPmtPedBias	0/1	0/1	0/1
CalibPmtSpec	2/9	2/9	2/9
CoordinateAd	0/1	0/1	0/1
CoordinateReactor	0/1	0/1	0/1
Demo	1/1	1/1	1/1
FeeCableMap	0/3	0/3	0/3
HardwareID	14/33	19/33	19/33
Reactor	0/6	0/6	0/6
SimPmtSpec	0/1	0/1	0/1
alltn	33/98	41/98	41/98

1. Impact of changing from default to controlled 2ndary ordering is apparent
2. issue is restricted to tables with significant overlaying : CableMap, CalibPmtSpec, HardwareID

fix_offline_db (with VERSIONDATE TIMESTART flooring)

tn	vlut_cf_orderingSEQNOasc.rst	vlut_cf_orderingSE-QNOasc_cf_orderingSEQNOdesc.rst	vlut_cf_orderingSEQNOdesc.rst
CableMap	0/35	0/35	0/35
Cal-ibFeeSpec	1/1	1/1	1/1
Cal-ibPmtHigh-Gain	0/6	0/6	0/6
Cal-ibPmtPed-Bias	0/1	0/1	0/1
CalibPmt-Spec	0/9	0/9	0/9
Coordi-nateAd	0/1	0/1	0/1
Coordi-nateReactor	0/1	0/1	0/1
Demo	0/1	0/1	0/1
FeeCa-bleMap	0/3	0/3	0/3
HardwareID	0/33	0/33	0/33
Reactor	0/6	0/6	0/6
SimPmtSpec	0/1	0/1	0/1
alltn	1/98	1/98	1/98

1. very little ordering dependency as almost all degeneracy has been eliminated
2. a single pathalogical context, with a single pair of SEQNO causing issue.
   - http://belle7.nuu.edu.tw/dbiscan/CalibFeeSpec/
   - http://belle7.nuu.edu.tw/dbiscan/CalibFeeSpec/aggno-1_simflag1_site32_subsite1_task0/fix_offline_db/vlut_cf_orderingSE ndif:2 (97,99)
   - http://belle7.nuu.edu.tw/dbiscan/CalibFeeSpec/aggno-1_simflag1_site32_subsite1_task0/fix_offline_db/vlut_cf_orderingSE ndif:16 (99,97)

Two timestarts with only 40s between em:

```
mysql> select * from tmp_offline_db.CalibFeeSpecVld where SEQNO in (97,99)  ;
+-------+---------------------+---------------------+----------+---------+---------+------+----------
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATE
+-------+---------------------+---------------------+----------+---------+---------+------+----------
|    97 | 2010-01-07 06:45:28 | 2038-01-19 03:14:07 |       32 |       1 |       1 |    0 |
|    99 | 2010-01-07 06:44:12 | 2038-01-19 03:14:07 |       32 |       1 |       1 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+------+----------
2 rows in set (0.01 sec)

mysql> select * from fix_offline_db.CalibFeeSpecVld where SEQNO in (97,99)  ;
+-------+---------------------+---------------------+----------+---------+---------+------+----------
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATE
+-------+---------------------+---------------------+----------+---------+---------+------+----------
|    97 | 2010-01-07 06:45:28 | 2038-01-19 03:14:07 |       32 |       1 |       1 |    0 |
|    99 | 2010-01-07 06:44:12 | 2038-01-19 03:14:07 |       32 |       1 |       1 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+------+----------
2 rows in set (0.00 sec)
```

1. check this corresponds to transfixion error

Check this corresponds to the error during transfixion of `CalibFeeSpec`, TODO: avoid this:

```
INFO:__main__:transfix_tab CalibFeeSpec
WARNING:__main__:transfixion of 89 sees collidingSeqno 83
WARNING:__main__:transfixion of 90 sees collidingSeqno 84
WARNING:__main__:transfixion of 91 sees collidingSeqno 77
WARNING:__main__:transfixion of 92 sees collidingSeqno 85
WARNING:__main__:transfixion of 94 sees collidingSeqno 78
WARNING:__main__:transfixion of 95 sees collidingSeqno 86
WARNING:__main__:transfixion of 96 sees collidingSeqno 87
WARNING:__main__:transfixion of 98 sees collidingSeqno 88
WARNING:__main__:transfixion of 99 sees collidingSeqno 97
WARNING:__main__:transfixion of 100 sees collidingSeqno 79
WARNING:__main__:transfixion of 101 sees collidingSeqno 80
```

tmp_offline_db_cf_fix_offline_db

It is straightforward to devise a fix, that has this better order change behavior (by removing degeneracy) ... but this is changing the results of DBI validity queries in some regions of (INSERTDATE, TIME).

Counting ctx with difference/totals when comparing *tmp_offline_db* with *fix_offline_db* , the corresponding orderings are used. Although that is fairly mute for *fix_offline_db* as it has very little extra ordering dependency, it is very relevant for *tmp_offline_db*

tn	vlut.rst	vlutorderingSEQNOasc.rst	vlutorderingSEQNOdesc.rst
CableMap	16/35	1/35	19/35
CalibFeeSpec	1/1	1/1	1/1
CalibPmtHighGain	0/6	0/6	0/6
CalibPmtPedBias	0/1	0/1	0/1
CalibPmtSpec	3/9	1/9	3/9
CoordinateAd	0/1	0/1	0/1
CoordinateReactor	0/1	0/1	0/1
Demo	1/1	1/1	1/1
FeeCableMap	0/3	0/3	0/3
HardwareID	14/33	0/33	19/33
Reactor	0/6	0/6	0/6
SimPmtSpec	0/1	0/1	0/1
alltn	35/98	4/98	43/98

1. `vlutorderingSEQNOasc` favors lower `SEQNO` in degenerate collisions (in `tmp_`)
   (a) this almost matches between `tmp_` and `fix_` **WHY?**
   (b) because in `fix_` degeneracies are almost eliminated, the effect is that lower SEQNO results are peeking out that formerly were improperly overlayed
2. `vlutorderingSEQNOdesc` favors higher `SEQNO` in degenerate collisions #. I initially expected `vlutorderingSEQNOdesc.rst` would be most matched... #. But on further consideration, this is due to the breaking apart of degeneracy done by the fix
   (a) timestart flooring used to create `fix_` almost eliminates degenerates (so in cases where
   (b) `SEQNOasc` plucks lower `SEQNO` from degenerate `tmp_offline_db` ... which corresponds to the un-degenerated `fix_offline_db`
   (a) all academic, the important one is `vlut.rst` as this comparing current DBI with intended future (modulo fix ordering , but that should not matter)

   (b) `tmp_offline_db/vlutorderingSEQNOdesc.rst` is kinda current *offline_db* with degenerates fixed in place

3. Three/Four red herrings ?

   (a) http://belle7.nuu.edu.tw/dbiscan/CableMap/aggno-1_simflag2_site32_subsite1_task0/tmp_offline_db_cf_fix_offline_db/vlu ndif:23

   (b) http://belle7.nuu.edu.tw/dbiscan/CalibFeeSpec/aggno-1_simflag1_site32_subsite1_task0/tmp_offline_db_cf_fix_offline_db/ ndif:94

   (c) http://belle7.nuu.edu.tw/dbiscan/CalibPmtSpec/aggno-1_simflag1_site32_subsite2_task0/tmp_offline_db_cf_fix_offline_db ndif:305 !!!

      i. overlapping with very close TIMESTARTs is suspected to be implicated

4. better to do the cross comparisons

   (a) tmp_offline_db/vlut cf fix_offline_db/SEQNOdesc

   (b) tmp_offline_db/vlut cf fix_offline_db/SEQNOasc

5. BUT these are expected to match the first column however....

   (a) need to present 35/98 ctxs with differences palatably ... (need mismatch fractions within each)

Observations

1. in `tmp_` cf `fix_` comparisons tis notable that `fix_` usually comes up with lower `SEQNO` : check generality of this

Sampling VLUT extracts

tmp_offline_db_cf_fix_offline_db vlut orderingSEQNOdesc `insertdates:19 timestarts:18 ndif:19`

insert-date	2009-03-16 11:27:43	2009-06-03 21:36:27	2010-12-07 19:14:20	2011-02-08 15:49:51	2011-02-22 21:38:17	2011-02-22 17:08:58	2011-02-22 18:07:45	2011-02-23 15:49:36	2011-03-25 16:31:49	2011-04-01 17:29:23	2011-04-18 23:42:43	2011-04-19 23:56:12	2011-05-03 12:35:07	2011-05-05 17:42:28	2011-05-23 22:22:13	2011-05-23 19:09:43	2011-06-01 00:00:00
2011-06-24 05:02:54	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
2011-06-24 05:03:04	29	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51
2011-06-24 05:03:39	29	51	59	*73*	73	73	73	73	73	123	139	155	171	187	187	187	187
2011-06-24 05:04:21	29	51	*209*	(209L,73L)	(209L,73L)	(209L,73L)	(209L,73L)	(209L,73L)	(209L,73L)	123	139	155	171	187	187	187	187
2011-06-24 05:04:44	29	51	209	223	223	223	223	223	223	(223L,123L)	139	155	171	187	187	187	187
2011-06-24 05:05:08	29	51	209	223	223	223	223	223	223	(223L,123L)	139	155	171	187	187	187	187

The first pair:

```
mysql> select * from tmp_offline_db.HardwareIDVld where SEQNO in (209,73) ;
+-------+---------------------+---------------------+----------+---------+---------+------+---------
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATE
+-------+---------------------+---------------------+----------+---------+---------+------+---------
|    73 | 2011-02-08 15:49:51 | 2038-01-19 03:14:07 |        1 |       2 |       2 |    0 |
|   209 | 2010-12-07 19:14:20 | 2038-01-19 03:14:07 |        1 |       2 |       2 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+------+---------
2 rows in set (0.00 sec)
```

Observe:

1. a later insert is doing a backdated(earlier TIMESTART) override, this is prone to degeneracy issues
2. looks like the fix might be scrubbing an intended backdated override in this case ?
3. Earlier validity can leak forwards in time, but that is sometimes the desired.

21.20.5 Alternative to Recreat Rather Than Fix Approach

CableMap/HardwareID

CableMap + HardwareID can be recreated (after quite a bit of detective work dealing with duplications and code changes impacting results: **takebogus**) with:

```
../share/recreate_from_scratch.sh
```

1. http://dayabay.ihep.ac.cn/tracs/dybsvn/ticket/880
2. http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/Database/TableTests/TestCableMap/share/dlfcrs.sh?rev=12754
3. http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/Database/TableTests/TestCableMap/doc/notes.rst?rev=12373
4. http://dayabay.ihep.ac.cn/tracs/dybsvn/log/dybgaudi/trunk/DataModel/DataSvc/share/feeCableMap.txt log of **feeCableMap.txt**

Pumping dybaux history with `auxlog.py`

#. Most INSERTDATE groupings correspond to single TIMESTARTs, except h3#14, c2#2, c5#16 Notes:

1. the hN and cN correlate these auxlog commits with the INSERTDATE groupings below, indicating consistent SEQNO
   (a) multi-timestart
   (b) INSERTDATE correspondence only when both CableMap and HardwareID updated together
   (c) need to make association between load files and commits
   (d) INSERTDATE groupings works well for `tmp_copy_db` (a copy of `offline_db`) due to artificial ff alignment, not so clear for local recreation in `tmp_offline_db`
   (e) Most INSERTDATE groupings correspond to single TIMESTARTs, except h3:14, c2:2, c5:16

Re-creation Discrepancy in FEC loading : resolved with takebogus option

are in lock step until hit the **fec**:

```
CableMap   : left TIMESTART 2011-05-23 08:22:19 [18][6 ][r12183:fecCableMap_fake_old.txt:viktor:6] ha
HardwareID : left TIMESTART 2011-05-23 08:22:19 [18][6 ][r12183:fecCableMap_fake_old.txt:viktor:6] ha
```

1. confirmed that RPC bogosity code changes are changing selection of entries ?

Relevant Tickets

1. dybsvn:ticket:892 fixing feeCableMap.txt using Database/TableTests/TestCableMap/share/fix_static_feeCableMap.py. The fix is in dybsvn:r12820
2. dybsvn:ticket:928 tracing warning
3. dybsvn:ticket:937 bogus reporting due to not yet committed to DB
4. dybsvn:ticket:940 splitting a dybaux commit

Bogus Logic

Change in bogus logic confirmed to explain the differnces

- http://dayabay.ihep.ac.cn/tracs/dybsvn/log/dybgaudi/trunk/DataModel/Conventions/src/Detectors.cc
- http://dayabay.ihep.ac.cn/tracs/dybsvn/log/dybgaudi/trunk/DataModel/Conventions/src/Electronics.cc
- http://dayabay.ihep.ac.cn/tracs/dybsvn/changeset/13643/dybgaudi/trunk/DataModel/Conventions/src/Electronics.cc
- http://dayabay.ihep.ac.cn/tracs/dybsvn/changeset/13258/dybgaudi/trunk/DataModel/Conventions/src/Electronics.cc returning undefined bool !
- http://dayabay.ihep.ac.cn/tracs/dybsvn/changeset/13213/dybgaudi/trunk/DataModel/Conventions/src/Electronics.cc RPC specific bogosity check

Relevant insertdate 2011-06-24 05:03:39 is before RPC bogosity developments circa end of July

Whole table groupby INSERTDATE for overview

Grouping by INSERTDATE is informative for `tmp_copy_db` but not for the locally recreated, due to the fastforward clumping under a single INSERTDATE done by SOP.

Groupings:

```
mysql> select min(SEQNO),max(SEQNO),min(TIMESTART),max(TIMESTART),count(distinct(TIMESTART)) as dTS,
+------------+------------+---------------------+---------------------+-----+---------------------+
| min(SEQNO) | max(SEQNO) | min(TIMESTART)      | max(TIMESTART)      | dTS | INSERTDATE          |
+------------+------------+---------------------+---------------------+-----+---------------------+
|          1 |         42 | 2009-03-16 11:27:43 | 2009-03-16 11:27:43 |   1 | 2011-06-24 05:02:54 |
|         43 |         58 | 2009-06-03 21:36:27 | 2009-06-03 21:36:27 |   1 | 2011-06-24 05:03:04 |
|         59 |        208 | 2010-12-07 19:14:20 | 2011-05-23 13:09:43 |  14 | 2011-06-24 05:03:39 |
|        209 |        222 | 2010-12-07 19:14:20 | 2010-12-07 19:14:20 |   1 | 2011-06-24 05:04:21 |
|        223 |        236 | 2011-02-08 15:49:51 | 2011-02-08 15:49:51 |   1 | 2011-06-24 05:04:44 |
|        237 |        248 | 2011-02-22 12:38:11 | 2011-02-22 12:38:11 |   1 | 2011-06-24 05:05:08 |
|        249 |        254 | 2011-02-22 17:08:51 | 2011-02-22 17:08:51 |   1 | 2011-06-24 05:05:34 |
|        255 |        260 | 2011-02-22 18:07:45 | 2011-02-22 18:07:45 |   1 | 2011-06-24 05:05:58 |
|        261 |        266 | 2011-02-23 10:49:36 | 2011-02-23 10:49:36 |   1 | 2011-06-24 05:06:24 |
|        267 |        272 | 2011-03-25 19:31:49 | 2011-03-25 19:31:49 |   1 | 2011-06-24 05:06:52 |
|        273 |        288 | 2011-04-01 17:29:23 | 2011-04-01 17:29:23 |   1 | 2011-06-24 05:07:18 |
|        289 |        304 | 2011-04-18 03:42:40 | 2011-04-18 03:42:40 |   1 | 2011-06-24 05:07:47 |
|        305 |        320 | 2011-04-19 23:56:10 | 2011-04-19 23:56:10 |   1 | 2011-06-24 05:08:15 |
|        321 |        336 | 2011-05-03 02:35:09 | 2011-05-03 02:35:09 |   1 | 2011-06-24 05:08:46 |
|        337 |        352 | 2011-05-05 17:42:22 | 2011-05-05 17:42:22 |   1 | 2011-06-24 05:09:17 |
|        353 |        355 | 2011-05-23 08:22:19 | 2011-05-23 08:22:19 |   1 | 2011-06-24 05:09:47 |
|        356 |        358 | 2011-05-23 13:09:43 | 2011-05-23 13:09:43 |   1 | 2011-06-24 05:10:23 |
|        359 |        372 | 2010-12-07 19:14:20 | 2010-12-07 19:14:20 |   1 | 2011-06-28 02:26:02 |
|        373 |        386 | 2011-06-01 00:00:00 | 2011-06-01 00:00:00 |   1 | 2011-08-09 06:35:49 |
+------------+------------+---------------------+---------------------+-----+---------------------+
19 rows in set (0.00 sec)

mysql> select min(SEQNO),max(SEQNO),min(TIMESTART),max(TIMESTART),count(distinct(TIMESTART)) as dTS,
+------------+------------+---------------------+---------------------+-----+---------------------+
| min(SEQNO) | max(SEQNO) | min(TIMESTART)      | max(TIMESTART)      | dTS | INSERTDATE          |
+------------+------------+---------------------+---------------------+-----+---------------------+
|          1 |         42 | 2009-03-16 11:27:43 | 2009-03-16 11:27:43 |   1 | 2011-06-24 05:02:54 |
|         43 |         59 | 2009-06-03 21:36:27 | 2009-12-27 23:52:51 |   2 | 2011-06-24 05:03:04 |
|         60 |         60 | 2009-12-27 23:52:51 | 2009-12-27 23:52:51 |   1 | 2011-06-24 05:03:14 |
|         61 |         61 | 2010-03-02 11:34:36 | 2010-03-02 11:34:36 |   1 | 2011-06-24 05:03:24 |
```

```
|          62 |         252 | 2010-06-11 23:28:25 | 2011-05-23 13:09:43 |  16 | 2011-06-24 05:03:39 |
|         253 |         254 | 2010-09-08 17:12:31 | 2010-09-08 17:12:31 |   1 | 2011-06-24 05:03:59 |
|         255 |         270 | 2010-12-07 19:14:20 | 2010-12-07 19:14:20 |   1 | 2011-06-24 05:04:21 |
|         271 |         284 | 2011-02-08 15:49:51 | 2011-02-08 15:49:51 |   1 | 2011-06-24 05:04:44 |
|         285 |         298 | 2011-02-22 12:38:11 | 2011-02-22 12:38:11 |   1 | 2011-06-24 05:05:08 |
|         299 |         312 | 2011-02-22 17:08:51 | 2011-02-22 17:08:51 |   1 | 2011-06-24 05:05:34 |
|         313 |         326 | 2011-02-22 18:07:45 | 2011-02-22 18:07:45 |   1 | 2011-06-24 05:05:58 |
|         327 |         340 | 2011-02-23 10:49:36 | 2011-02-23 10:49:36 |   1 | 2011-06-24 05:06:24 |
|         341 |         354 | 2011-03-25 19:31:49 | 2011-03-25 19:31:49 |   1 | 2011-06-24 05:06:52 |
|         355 |         370 | 2011-04-01 17:29:23 | 2011-04-01 17:29:23 |   1 | 2011-06-24 05:07:18 |
|         371 |         386 | 2011-04-18 03:42:40 | 2011-04-18 03:42:40 |   1 | 2011-06-24 05:07:47 |
|         387 |         402 | 2011-04-19 23:56:10 | 2011-04-19 23:56:10 |   1 | 2011-06-24 05:08:15 |
|         403 |         418 | 2011-05-03 02:35:09 | 2011-05-03 02:35:09 |   1 | 2011-06-24 05:08:46 |
|         419 |         434 | 2011-05-05 17:42:22 | 2011-05-05 17:42:22 |   1 | 2011-06-24 05:09:17 |
|         435 |         437 | 2011-05-23 08:22:19 | 2011-05-23 08:22:19 |   1 | 2011-06-24 05:09:47 |
|         438 |         440 | 2011-05-23 13:09:43 | 2011-05-23 13:09:43 |   1 | 2011-06-24 05:10:23 |
|         441 |         441 | 2010-03-02 11:34:36 | 2010-03-02 11:34:36 |   1 | 2011-06-28 02:24:13 |
|         442 |         442 | 2010-06-11 23:28:25 | 2010-06-11 23:28:25 |   1 | 2011-06-28 02:24:50 |
|         443 |         444 | 2010-09-08 17:12:31 | 2010-09-08 17:12:31 |   1 | 2011-06-28 02:25:25 |
|         445 |         460 | 2010-12-07 19:14:20 | 2010-12-07 19:14:20 |   1 | 2011-06-28 02:26:02 |
|         461 |         474 | 2011-06-01 00:00:00 | 2011-06-01 00:00:00 |   1 | 2011-08-09 06:35:22 |
|         475 |         475 | 2011-06-22 03:02:52 | 2011-06-22 03:02:52 |   1 | 2011-09-01 02:22:58 |
+-------------+-------------+---------------------+---------------------+-----+---------------------+
26 rows in set (0.00 sec)
```

21.20.6 DBI Validity Ordering Change

dybsvn:r14814 changes DBI reading and writing, now validity ordering uses `VERSIONDATE desc, SEQNO desc` rather than `VERSIONDATE desc`

This means:

1. higher SEQNO breaks ties in VERSIONDATE collisions, making overlay versioning do what it meant to do
2. the fix changes many SEQNO returned by DBI queries, in small pockets of the INSERTDATE/TIMESTART plane
3. some actual payloads returned are changed, in very small regions of INSERTDATE/TIMESTART

The regions of INSERTDATE/TIMESTART impacted are reported below

21.20.7 Payload Digest Rather than SEQNO comparison

Created with:

```
dybdbi
cd python/DybDbi/vld
~/rst/bin/python vlut.py --table CableMap --ctx ALL
~/rst/bin/python vlut.py --table HardwareID --ctx ALL

## machinery  misbehaviour regards index overwriting, and self recursive index,  but re-running with
```

CableMap

- http://belle7.nuu.edu.tw/dbiscan/CableMap/

Listing ctx and VLUT regions of payload change between legacy and extra ordering fixed **SEQNO desc**

1. http://belle7.nuu.edu.tw/dbiscan/CableMap/aggno-1_simflag2_site1_subsite7_task0/tmp_offline_db/vlut_cf_orderingSEQNOdes
   (a) INSERTDATE 2011-06-24 05:09:47 3 ambi-cells (250L, 437L) from TIMES: 2011-05-23 13:09:43 2011-06-01 00:00:00 2011-06-22 03:02:52
2. http://belle7.nuu.edu.tw/dbiscan/CableMap/aggno-1_simflag2_site2_subsite7_task0/tmp_offline_db/vlut_cf_orderingSEQNOdes
   (a) INSERTDATE 2011-06-24 05:09:47 3 ambi-cells (248L, 435L) from TIMES: 2011-05-23 13:09:43 2011-06-01 00:00:00 2011-06-22 03:02:52
3. http://belle7.nuu.edu.tw/dbiscan/CableMap/aggno-1_simflag2_site4_subsite7_task0/tmp_offline_db/vlut_cf_orderingSEQNOdes
   (a) INSERTDATE 2011-06-24 05:09:47 3 ambi-cells (249L, 436L) TIMES 2011-05-23 13:09:43 2011-06-01 00:00:00 2011-06-22 03:02:52
4. http://belle7.nuu.edu.tw/dbiscan/CableMap/aggno-1_simflag2_site2_subsite5_task0/tmp_offline_db/vlut_cf_orderingSEQNOdes
   (a) INSERTDATE 2011-06-24 05:04:21 1 ambi-cell (92L,268L) 2011-02-08 15:49:51
5. http://belle7.nuu.edu.tw/dbiscan/CableMap/aggno-1_simflag2_site1_subsite5_task0/tmp_offline_db/vlut_cf_orderingSEQNOdes
   (a) INSERTDATE 2011-06-24 05:04:21 1 ambi-cell 87L, 263L) 2011-02-08 15:49:51

HardwareID

- http://belle7.nuu.edu.tw/dbiscan/HardwareID/

1. http://belle7.nuu.edu.tw/dbiscan/HardwareID/aggno-1_simflag2_site1_subsite6_task0/tmp_offline_db/vlut_cf_orderingSEQNOd
   (a) I 2011-06-24 05:04:21 T 2011-02-08 15:49:51 (80L, 217L)
2. http://belle7.nuu.edu.tw/dbiscan/HardwareID/aggno-1_simflag2_site1_subsite7_task0/tmp_offline_db/vlut_cf_orderingSEQNOd
   (a) I 2011-06-24 05:09:47 T 2011-05-23 13:09:43 2011-06-01 00:00:00 (208L, 355L)
3. http://belle7.nuu.edu.tw/dbiscan/HardwareID/aggno-1_simflag2_site1_subsite5_task0/tmp_offline_db/vlut_cf_orderingSEQNOd
   (a) I 2011-06-24 05:04:21 T 2011-02-08 15:49:51 (79L, 216L)
4. http://belle7.nuu.edu.tw/dbiscan/HardwareID/aggno-1_simflag2_site2_subsite5_task0/tmp_offline_db/vlut_cf_orderingSEQNOd

1. I 2011-06-24 05:04:21 T 2011-02-08 15:49:51 (84L, 221L)

1. http://belle7.nuu.edu.tw/dbiscan/HardwareID/aggno-1_simflag2_site2_subsite6_task0/tmp_offline_db/vlut_cf_orderingSEQNOd

1. I 2011-06-24 05:04:21 T 2011-02-08 15:49:51 (74L, 210L)

1. http://belle7.nuu.edu.tw/dbiscan/HardwareID/aggno-1_simflag2_site2_subsite7_task0/tmp_offline_db/vlut_cf_orderingSEQNOd

1. I 2011-06-24 05:09:47 T 2011-05-23 13:09:43 2011-06-01 00:00:00 (206L, 353L)

1. http://belle7.nuu.edu.tw/dbiscan/HardwareID/aggno-1_simflag2_site4_subsite5_task0/tmp_offline_db/vlut_cf_orderingSEQNOd

1. I 2011-06-24 05:04:21 T 2011-02-08 15:49:51 (76L, 212L)

1. http://belle7.nuu.edu.tw/dbiscan/HardwareID/aggno-1_simflag2_site4_subsite6_task0/tmp_offline_db/vlut_cf_orderingSEQNOd

1. I 2011-06-24 05:04:21 T 2011-02-08 15:49:51 (75L, 211L)

1. http://belle7.nuu.edu.tw/dbiscan/HardwareID/aggno-1_simflag2_site4_subsite7_task0/tmp_offline_db/vlut_cf_orderingSEQNOd

1. I 2011-06-24 05:09:47 T 2011-05-23 13:09:43 2011-06-01 00:00:00 (207L, 354L)

21.21 DBI from C++

What not python DybDbi ?

There is no faster way to learn DBI and develop your script than with the DybDbi ipython interface. In some cases you can use that script from C++ with *TPython::Exec*, eg dybgaudi:Database/DatabaseInterface/src/DbiCascader.cxx#L84

Almost all of DBI is usable from python using the DybDbi interface. It is unwise to use C++ when python can be used instead.

21.21.1 Primer for C++ usage of DBI

All table row instances are subclasses of DbiTableRow

- dybgaudi:Database/DatabaseInterface/DatabaseInterface/DbiTableRow.h#L47

These subclasses are generated from *.spec* by building DybDbi, include the generated header with:

```
#include "genDbi/GSupernovaTrigger.h"
```

Instanciate one of those and use API inherited from *DbiTableRow.h* to for example create the DB tables.

```
GSupernovaTrigger* st = GSupernovaTrigger();
st->CreateDatabaseTables( 0, "SupernovaTrigger" );
```

Raw C++ DBI

It is possible to use DBI from C++ entirely without DybDbi (other than *DbiTableRow* subclass generation). This is verbosely documented at *Database*

Such an approach would be based on the below classes, eg

```
#include "DatabaseInterface/DbiResultPtr.tpl"
template class  DbiResultPtr<GSupernovaTrigger>;

#include "DatabaseInterface/DbiWriter.tpl"
template class  DbiWriter<GSupernovaTrigger>;
```

C++ DybDbi

It is also possible to use the C++ DybDbi helper classes

- *DybRpt<T>*
- *DybWrt<T>*
- *DbiCtx*

where T corresponds to a table row subclass such as *GSupernovaTrigger*

These classes were designed to be easy to use from python, eg by hiding their template nature and providing default contexts etc... and thus enable easy DBI usage.

Using these from C++ is not documented, as no one has had the need to do this, and the only example of usage is that by python DybDbi itself. Examine the generated classes to see what is provided.

- *Database/DybDbi/genDbi/GSupernovaTrigger.cc*
- *Database/DybDbi/genDbi/GSupernovaTrigger.h*

C++ DybDbi headers

```
#include "genDbi/GSupernovaTrigger.h"

#include "DybDbi/DbiRpt.tpl"
template class DybRpt<GSupernovaTrigger>

#include "DybDbi/DbiWrt.tpl"
template class DybWrt<GSupernovaTrigger>

#include "DybDbi/DbiCtx.h"
```

About the SOP

The SOP is sourced from reStructuredText in dybgaudi:Documentation/OfflineUserManual/tex/sop, and html and pdf versions are derived as part of the automated Offline User Manual build. For help with building see *Build Instructions for Sphinx based documentation*

CHAPTER

TWENTYTWO

ADMIN OPERATING PROCEDURES FOR SVN/TRAC/MYSQL

Release 22909

Date May 16, 2014

This documentation attempts to provide the practical knowledge needed to perform admin operations required for Dayabay Offline Infrastructure. It is divided into three levels. *Implementation details* can be skimmed until you need to know and *Reference* skipped until arriving by search.

Introductory:

1. *Tasks Summary*
2. *Backups Overview*
3. *Monitoring*
4. *DbiMonitor package : cron invoked nosetests*
5. *Env Repository : Admin Infrastructure Sources*

Implementation details and troubleshooting:

1. *Trac+SVN backup/transfer*
2. *SSH Setup For Automated transfers*
3. *Offline DB Backup*
4. *DBSVN : dybaux SVN pre-commit hook*

Reference:

1. *Bitten Debugging*
2. *MySQL DB Repair*

Introductory:

22.1 Tasks Summary

This page is intended to provide an overview and brief summary of the range of support tasks that need to be performed to maintain operation of Daya Bay Offline Infrastructure. Links to more detailed documentation are provided.

Although there is overlap the tasks have been divided into SVN/Trac and Database related areas to facilitate task sharing.

22.1.1 Subversion/Trac/Autobuild/test Support

Overview

The routine operations are generally not time-consuming, and several of them could be automated further to reduce time consumption further. Maintaining near continuous operation of remote servers and heeding and acting upon monitoring emails are the most demanding aspects. This page is arranged in three main sections.

Responsibilities Summary

Lin Tao (IHEP)

Mainly responsible for technical/sys-admin aspects.

- migrations (successfully migrated dybsvn+dybaux repositories in December)
- backups setup and monitoring

tasks

- setup LBNL as a backup tarball target
- setup Trac/SVN on LBNL machine and test via recovery of backup tarball (possibly using python virtualenv, to avoid need for root access)

Jimmy Ngai (HKU)

Responsible for "Dayabay aspects"

- followup problems reported on mailing lists OR in trac tickets, and work with Tao to resolve them
- help new users of Trac/SVN
- familiarity with dybinst operation, which is the basis for the auto-testing
- familiarity with bitten operation, how the recipes work
- have some idea of which test failures can be ignored and which need to be chased and who to chase

tasks

- Migrate Aberdeen repository (identical machinery to dybsvn) from NTU to HKU by ~end Feb
- setup repository backups from HKU to CUHK with monitoring
- setup/test a bitten slave at HKU,
- Tao can help with configuring the Trac master and giving needed permissions through the Trac master web interface
- include generation of the OUM docs (Sphinx generated documentation) done as one of the build steps

resources

- http://dayabay.ihep.ac.cn/tracs/dybsvn/wiki/NuWa_Slave
- bitten server setup/usage
- http://dayabay.phys.ntu.edu.tw/tracs/env
- Trac instance covering all non-dybsvn code used for infrastructure
- http://dayabay.phys.ntu.edu.tw/repos/env/trunk/scm/
- are of env with backup and transfer scripts, especially scm-backup.bash, altbackup.py
- http://dayabay.phys.ntu.edu.tw/repos/env/trunk/db/valmon.py
- highly configurable value monitoring with email notifications, allows to add new monitoring very quickly and in a standardized manner
- http://dayabay.bnl.gov/oum/aop/

Routine Operations

Subversion/Trac maintenance

- occasionally review timeline http://dayabay.ihep.ac.cn/tracs/dybsvn/timeline look for signs of mis-use, advise on proper SVN usage via private emails initially, escalating to public ones. Look for mis-usage:
  - committing large binary files
  - not including informative commit messages
  - excessive use of dayabay account
  - adding files when copy is more appropriate

Automation Suggestion An svn pre-commit hook that checks file names and sizes within an intended commit and which disallows commits that exceed the limits would allow prevention of user mistakes (eg committing a.out .exe .so .a .o etc..) and do this maintenance task better than it has ever been done.

Bitten slave autobuild/test system

- occasional monitoring of builds
  - http://dayabay.ihep.ac.cn/tracs/dybsvn/build/dybinst
- request slave managers to investigate when their slave builds have not completed cleanly for more than a few weeks
- help the slave managers to debug issues that arise
- suggest reref OR clean commit messages where appropriate
- bump the base revisions in bitten admin web interface, following slave hiatus
- occasional help with changing the tests that are standardly run

Automation Suggestion The trac.db is available for SQLite querying on the backup node. Queries could be developed that monitor the state of the builds, looking for such things as no recent builds, or no clean builds for a few weeks.

Maintain dybinst

The Bitten build/test system is integrated to NuWa via the dybinst installation script, requiring the autobuild/test system maintainer to also maintain dybinst *Dybinst : Dayabay Offline Software Installer*

Offline User Manual Mechanics

The mechanics of the Offline User Manual (OUM) latex to reStructured text conversion and subsequent Sphinx builds of HTML and PDF versions. The content of the OUM documentation needs to be maintained by relevant subsystem experts.

- Check that the documentation continues to be built, chase local node responsibles if no update for more than a few weeks. Debug when it fails to update.
  - http://dayabay.bnl.gov/oum/ Brett
  - http://belle7.nuu.edu.tw/oum/ SimonB

Maintain remote monitor node (non-NuWa)

The remote monitor node (currently *cms01.phys.ntu.edu.tw*), performs multiple cron monitoring tasks daily. This node does not need a NuWa installation, only an *env* checkout is needed. Checks include:

- SVN+Trac backup tarballs have arrived
- *offline_db* database tarballs arrived and are valid
- *channelquality_db* large database segmented tarballs have arrived and are valid
- *env* server continues to respond.

Error conditions result in emails being sent, which must be investigated to ensure the ongoing operation. Details in *Monitoring*

Maintain remote source node

The remote source node (currently http://dayabay.phys.ntu.edu.tw/tracs/env), is a Trac/SVN instance that houses the source code for installation/customization of the Trac/SVN instances *dybsvn* and *dybaux* together with monitoring and backup scripts for the instances and mysql databases *offline_db* and *channelquality_db*.

This node runs the same versions of Trac and dependencies as those used at IHEP. The aberdeen SVN+Trac repository is colocated on this node. Backups are performed daily *Backups Overview*.

Exceptional Tasks

Debugging bitten build system

Glitches have occured with problems unfixed for long periods. Part of the blame for this is the primitive web interface, that is tedious to to use for many types of checks. Improving the monitoring of the build via queries against the daily backup SQLite *trac.db* would allow more automation. Some example queries in *Bitten Debugging*

Migrations

Moving servers to new hardware requires extensive preparation and testing. The backup/restore system is used to test for incompatibility problems on test instances prior to making the actual migration. Retaining precisely the same versions is highly preferable, although sometimes this is too inconvenient and version migrations are forced.

Bloated Trac SQLite DB

Possible adverse implications from the increasing size of the *dybsvn/dybaux* SQLite instances suggest that remedial trimming of the fat would be advisable. Non-trivial development work is required.

Backup

1. note Trac tendency to fail to return pages during backups, should be investigated

22.1.2 Offline Database Support Tasks

- Overview
- Routine Operations
  - Database Management
  - Documentation
  - Maintain SOP tools
  - Other tools
  - SOP Policing
  - DBI/DybDbi Tech Support
  - Custom Scripts Advice/Help
  - Custom Operations
  - Remote NuWa monitor node
- Tour of dybgaudi/Database
- Exceptional Tasks
  - Scraper additions
  - DBI/DybDbi/NonDbi debugging
  - Database Interventions
  - Corruption Recovery

Overview

Generally the routine operations take little time, but expertise needs to be developed in order to be able to react quickly to error conditions. The most time consuming task is maintaining near continuous operation of a remote monitoring node and acting on monitoring emails that it sends.

Routine Operations

Database Management

1. Review proposed new table *.spec*
   - advise on alternative table designs, avoid repetition, strings, varchars when inappropriate

- ensure intended tables are not excessively large, veto excessive tables and advise on data reduction techniques
- push for full chain testing of tables before they enter *offline_db*
- http://dayabay.bnl.gov/oum/sop/dbspec/
- http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/Database/DybDbi/spec

2. Review DB writing Scraper code
   - ensure full testing on *tmp_* DB before move to *offline_db*
   - http://dayabay.bnl.gov/oum/sop/scraper/

Documentation

1. Maintain SOP documentation generation and sources
   - http://dayabay.bnl.gov/oum/sop/
   - http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/Documentation/OfflineUserManual/tex/sop/

SOP is built as part of the OfflineUserManual (OUM), hence also need to maintain OUM documentation generation.

Note that latex sources are converted into RST at every build by a *cnv.py* invoked from the Makefile. Incompatible latex changes have broken this conversion in the past, easiest solution is to find the latex change in the docs and modify it to correspond with the latex subset understood by the converter.

- http://dayabay.bnl.gov/oum/
- http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/Documentation/OfflineUserManual/tex/

Maintain SOP tools

The SOP is based upon several scripts, including:

- *db.py* mysql-python based DB access,
  - usage described http://dayabay.bnl.gov/oum/sop/dbops/
  - autodoc presentation http://dayabay.bnl.gov/oum/api/db/
- *dbsvn.py DBSVN : dybaux SVN pre-commit hook* used as SVN pre-commit hook for dybaux repository
  - http://dayabay.bnl.gov/oum/api/dbsvn/
  - http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/DybPython/python/DybPython/dbsvn.py
- *dbaux.py* used by Liang to propagate DB updates from dybaux SVN into offline_db
  - http://dayabay.bnl.gov/oum/api/dbaux/
  - http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/DybPython/python/DybPython/dbaux.py
  - http://dayabay.ihep.ac.cn/tracs/dybaux
  - http://dayabay.ihep.ac.cn/tracs/dybaux/browser/catalog/tmp_offline_db

No significant work is expected to maintain these tools however an expert is needed to be aware of their operation and able to assist in their usage and fix issues that might arise.

Other tools

Many other tools have be created, that are more for expert usage, such as:

- *dbsrv.py* provides partitioned backups in SEQNO chunks, allowing fast archive/transfer/restore operations on very large tables such as those in the Channel Quality DB. Used from daily cron script on *dybdb2* to backup the CQDB.
  - http://dayabay.bnl.gov/oum/api/dbsrv/

SOP Policing

Verify that DB users are following the SOP, remind them when they forget, eg:

- http://dayabay.bnl.gov/oum/sop/dbops/
- occasionally review timeline http://dayabay.ihep.ac.cn/tracs/dybaux/timeline
- proof of testing prior to dybaux commits
- code managed in subversion

DBI/DybDbi Tech Support

Provide advice/help on:

- custom DB scripts, Pedro/Gaosong for CWG and DQWG are the usual customers
- nosetests for checking DB updates
- DybDbi usage techniques

Custom Scripts Advice/Help

The SOP stipulates that all writing to DBI Databases should be done by DBI or DybDbi, to avoid incorrect faking of what DBI expects. Reading should be done by the most convenient approach, often reading with *DybPython.DB* (mysql-python based) and writing with *DybDbi* is a good approach to take.

This avoids the problem of handling multiple DBI connections simulataneously.

Custom Operations

On rare occasions it is expedient to perform DB operations without following SOP approaches. For example when:

1. jumpstarting large or expensive to create tables such as the DcsAdWpHv table
2. fixing bugs in scraped tables, eg the HV time shunt problem
3. fixing database corruption

Simple incorrect calibrations are insufficient cause to suffer the effort and risk of developing, testing and performing custom operations.

When performing custom operations, tables are often communicated via mysqldump files. Tools to handle these are documented

- http://dayabay.bnl.gov/oum/sop/dbdumpload/

The approach taken to perform custom operations is:

1. develop and test python scripts that perform the operation
2. test these scripts on full copies of the relevant databases
3. document the usage of the scripts
4. train Qiumei/Liang at IHEP on how to first test then perform the operations and then ask them to proceed

Even simple fixes are handled in this laborious manner.

Remote NuWa monitor node

Maintain remote NuWa monitor node that performs daily Database Update and Replication tests

- The remote NuWa node (currently *belle7.nuu.edu.tw*), performs **dybinst** based cron monitoring tasks daily. As this requires a recent NuWa installation and benefits from easy updating, it makes sense for one of the slave nodes to perform this duty..
- *offline_db* and *dcsdb(IHEP mirror)* are checked for table updates
- replication along the *offline_db* chain is checked by comparing updates along the chain
- irregularities result in nosetest failures and the sending of notification emails.
  - requests to Scraper operation experts (Liang) and DCS experts (Mei) to investigate abnormalities
- Details: *DbiMonitor package : cron invoked nosetests*

Tour of dybgaudi/Database

http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/Database

- *DatabaseInterface*
  - C++ implementation of DBI, based on ROOT TMySQL
- *DbiTest*, historical DBI C++ unittests
- *DybDbiTest*, reimplementation of most of the C++ tests from DbiTest in python using DybDbi
  - http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/Database/DybDbiTest/tests/README
- *DybDbi*, python wrapper around DBI, that does DBI boilerplate C++ class generation based on the .spec file definitions. The generation is steered using CMT gymnastics in the requirements file, providing automated generation on building DybDbi.
  - http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/Database/DybDbi/cmt/requirements
  - http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/Database/DybDbi/python/DybDbi/__init__.py
- *DybDbiPre*, used from DybDbi CMT requirements for *.spec* file parsing
- *DbiMonitor*, collection of tests used to monitor offline_db replication and DCS DB updates
  - http://dayabay.bnl.gov/oum/aop/dbimonitor/
  - http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/Database/DbiMonitor/tests
- *DbiValidate*, table validity testing in offline_db
  - http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/Database/DbiValidate/README.txt

- ***Scraper*, framework for developing online to offline table scrapers.** Implemented with SQLAlchemy for reading from DCS/DAQ DB and DybDbi for writing to offline_db
  - http://dayabay.bnl.gov/oum/sop/scraper/
- NonDbi, SQLAlchemy based ORM access to any DB table, including dynamic class creation
  - http://dayabay.bnl.gov/oum/api/nondbi/
  - http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/Database/NonDbi/python/NonDbi/__init__.py

Exceptional Tasks

Finding solutions to exceptional problems benefits greatly from a willingness to develop MySQL expertise. For example using *group by* querying and *group_concat* to construct python dict strings proved to be game changer when dealing with the large *channelquality_db* tables.

Scraper additions

Adding new scrapers requires familiarity with the scraper framework in order to advise table experts on appropriate implementations and testing techniques.

Details *Scraping source databases into offline_db*

DBI/DybDbi/NonDbi debugging

DBI and the various DB interfaces have required little maintenance. Due to the code generation (via django templates) done by DybDbi package builds it is possible for invalid *.spec* files for new tables to break the build in ways that would be difficult to debug without deep debugging skills or CMT experience.

Database Interventions

Custom DB fixing scripts to deal with issues encountered, using MySQL-python and/or DybDbi as appropriate have been required on many occasions. For example reacting to a bug in a Scraper causing timeshifted entries.

Corruption Recovery

Recovering from *channelquality_db* corruption (when it was still called *tmp_ligs_offline_db*) required implementation of new tools to work with large tables) *MySQL DB Repair*.

22.1.3 Channel Quality DB Maintenance

- backup/transfer script
- monitoring script
- Responsibilties for maintainer
- preparatory task
- tasks

backup/transfer script

- http://dayabay.ihep.ac.cn/svn/dybsvn/dybgaudi/trunk/DybPython/python/DybPython/dbsrv.py

Single script runs in a daily crontab on the DB server *dybdb2.ihep.ac.cn* under the control of Qiumei *maqm@ihep.ac.cn* (Tao Lin, *lint@ihep.ac.cn* can help also).

The above script has an extensive docstring describing its usage, with examples. Although available in NuWa, *dbsrv.py –help* usage with the system python and MySQLdb is the more usual operation environment. Due to incremental operation and use of table partitioning (into 10k SEQNO chunks) each tarball transfered to remote nodes is less than 100M each.

monitoring script

Runs in a daily crontab on the target node, to check that the backups continue to arrive. The *valmon.py* and *digest-path.py* scripts used are housed in the *env* repository

- http://dayabay.phys.ntu.edu.tw/repos/env/trunk/db/valmon.py
- http://dayabay.phys.ntu.edu.tw/repos/env/trunk/base/digestpath.py

Usage and configuration are described in the "Transfer Monitoring" section of the dbsrv.py docstring. Note that an email address must also be configured to switch on notifications when the constraints are violated.

Responsibilties for maintainer

- know how the backup/transfer script operates, familiarity with ssh keys and passwordless automated transfers and how to debug them when they fail is required
- maintain the daily remote cron task that monitors backup operation, and receive monitoring notification emails
- act on irregularities, instruct/help Qiumei to fix issues on the server side
  - most commonly starting ssh-agents after reboots, which cause off-box transfers to fail.

preparatory task

Use the backup/transfer script interactively to transfer a few tables from a *tmp_* DB to a remote node in a partitioned manner and recover the tables from the partitioned tarballs (using dbsrv.py on the remote node with different options).

For fast testing use options to make the backup/transfer/recover complete in seconds by controlling the partition sizes/counts.

tasks

- work with Qiumei to change backup target to SJTU (or elsewhere), this will entail
  - add ssh config section on server identifying the remote target node
  - positioning ssh keys to allow automated scp of tarballs from server to target
  - changing cron commandline argument or envvar to point at a new target
- setup daily target monitoring crontab that runs the monitor script,
- maintain near continuous daily monitoring, act on monitoring notifications
- test validity of backup system by doing a full recover of the CQDB on the target node and making comparisons against the source DB

22.2 SVN/Trac

Placeholder document, to be fleshed out with the recipe for replicating a Trac+SVN instance from one node to another.

22.3 Backups Overview

- Availability of Backups
- SVN/Trac backups
- MySQL backups

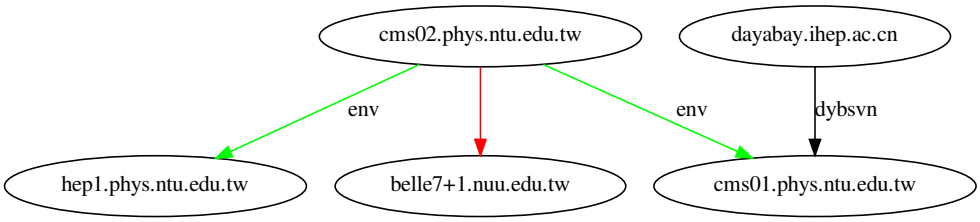
22.3.1 Availability of Backups

Although IHEP claims to perform file level backup, simple file copying is not a reliable way to backup databases (or Trac/SVN repositories) as no locking is done. Also as far as I am aware there is no way that users can verify the backups. For me, backups that are not auto-verified and rapidly accessible are effectively useless.

Anyone who is responsible for a server should be in control of the backups of that server. It is invaluable to be able to recover the server onto a remote node as a debugging aid to help to check a migration for example.

Backup requires creation of archive tarballs and scp/rsync-ing them off the original servers.

22.3.2 SVN/Trac backups

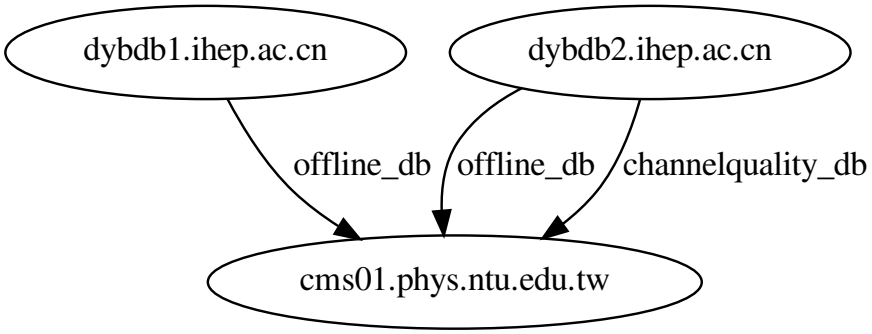


- **dybsvn** instance is backed up and the tarballs transferred to NTU daily
- **dybaux** is not currently backed up
- **env aberdeen** instances are backed up and transferred to several other NTU nodes daily

Trac+SVN backup/transfer describes in detail how the scripts for backup/transfer/monitoring operate. *Monitoring* describes how these are automated with cron tasks.

22.3.3 MySQL backups

- **offline_db** is backed up daily and tarballs transferred to NTU with scp
- **channelquality_db** is backed up in a partitioned manner due to its large size and the tarballs transferred to NTU daily



22.4 Monitoring

A system of infrastructure servers at IHEP, NTU and NUU are setup to automatically cooperate via sending/receiving backup tarballs and monitoring the operation of each other. The servers involved are outlined *Backups Overview*.

Monitoring requires reaction to notification emails that are sent when error conditions or monitoring irregularities are seen by a large number of cron invoked scripts. The objective being to maintain continuous daily operation of the scripts,

Issues normally occur following IHEP server reboots, requiring Qiumei to be notifified and aided with getting scripts back into operation. These common issues are detailed in *SSH Setup For Automated transfers*.

Debugging/scripting skills and dogged persistence are required to chase the causes of problems and perform remote sys admin debugging via proxy. IHEP rules prevent root access being conferred on foreign collaborators, thus debugging tends to be a laborious process performed via email exchanges with Qiumei.

22.4.1 crontabs

The collection of crontabs from the collaborating nodes provides the best reference to the tasks being performed. The typical first action to take on receiving notification email is to examine cron logs.

blyth@cms01.phys.ntu.edu.tw

```
[blyth@cms01 cronlog]$ crontab -l
#  see roots crontab
SHELL=/bin/bash
HOME=/home/blyth
ENV_HOME=/home/blyth/env
CRONLOG_DIR=/home/blyth/cronlog
DAILY_SCRIPTS=/data/env/local/dyb/trunk/daily/scripts
MAILTO=blyth@hep1.phys.ntu.edu.tw
PATH=/home/blyth/env/bin:/data/env/system/python/Python-2.5.1/bin:/usr/bin:/bin
LD_LIBRARY_PATH=/data/env/system/python/Python-2.5.1/lib
#
# dybsvn altbackup (using scp) [NB another cron job at IHEP uses other arguments with the altbackup s
30 15 * * * ( . $ENV_HOME/env.bash ; env- ; python- source ; ssh-- ; $ENV_HOME/scm/altbackup.sh $HOME

# offline_db backup monitoring
08 09 * * * ( . $ENV_HOME/env.bash ; env- ; python- source ; db- ; db-backup-recover offline_db dybdb
40 05 * * * ( . $ENV_HOME/env.bash ; db- ; db-backup-rsync-monitor )

# planting of daily symbolic links
15 18 * * * ( cd /data/env/local/dyb/trunk ; python installation/trunk/dybinst/scripts/slvmgr.py --di

# env repo monitoring
42 * * * * ( valmon.py -s envmon rec rep mon ) > $CRONLOG_DIR/envmon.log 2>&1

# disk space monitoring
52 * * * * ( valmon.py -s diskmon rec rep mon ) > $CRONLOG_DIR/diskmon.log 2>&1
20 * * * * ( valmon.py -s diskmon_slash rec rep mon ) > $CRONLOG_DIR/diskmon_slash.log 2>&1

# channelquality_db backup monitoring
05 13 * * * ( valmon.py -s dbsrvmon rec rep mon ) > $CRONLOG_DIR/dbsrvmon.log 2>&1
```

root@cms01.phys.ntu.edu.tw

```
[blyth@cms01 cronlog]$ sudo crontab -l
SHELL = /bin/bash
# avoid huge logs from the daily recovery clogging the disk
50 18 * * * ( cd /var/log/mysql ; echo root-cron-truncate-$(date) > log )
40 17 * * * /usr/sbin/ntpdate pool.ntp.org
```

root@cms02.phys.ntu.edu.tw

```
[root@cms02 log]# crontab -l
SHELL = /bin/bash
#
# backup and offbox transfers of env+aberdeen+.. SVN/Trac instances
31 15 * * *  ( export HOME=/root ; export NODE=cms02 ; export MAILTO=blyth@hep1.phys.ntu.edu.tw ; exp
31 16 * * *  ( export HOME=/root ; export NODE=cms02 ; export MAILTO=blyth@hep1.phys.ntu.edu.tw ; exp
#
# monitoring for an out-of-memory issue that strikes every few months
50 * * * * ( export HOME=/root ; /home/blyth/env/db/valmon.py -s oomon rec mon ; ) > /var/scm/log/oom
```

blyth@dayabay.ihep.ac.cn

```
[dayabay] /home/blyth > crontab -l
SHELL=/bin/bash
HOME=/home/blyth
ENV_HOME=/home/blyth/env
CRONLOG_DIR=/home/blyth/cronlog
NODE_TAG_OVERRIDE=WW
#
# backup of Trac+SVN tarballs to NTU
00 13 * * * ( . $ENV_HOME/env.bash ; env- ; python- source ; ssh-- ; $ENV_HOME/scm/altbackup.sh $HOME
#
# checking the ssh-agent, the usual cause of
21 14 * * * ( . $ENV_HOME/env.bash ; env- ; python- source ; ssh-- ; ssh--agent-monitor root ) > $CRO
#
# former backup approach, no longer used as rsync is too susceptable to network gnome blockages
##01 04 * * * ( . $ENV_HOME/env.bash ; env- ; python- source ; scm-backup- ; scm-backup-checkscp ; sc
```

root@dybdb1.ihep.ac.cn managed by Qiumei

1. *offline_db* backup and rsync

root@dybdb2.ihep.ac.cn managed by Qiumei

1. *offline_db* backup and rsync
2. *channelquality_db* backup and rsync

22.5 DbiMonitor package : cron invoked nosetests

The **DbiMonitor** package contains dybgaudi:Database/DbiMonitor/tests that check the updates being made to various databases, and send notification mails when update expectations are not met.

22.5.1 `DbiMonitor.tests.test_dcs`

Checking update age of tables in IHEP DCS mirror

The expectations for the table ages are set in dybgaudi:Database/DbiMonitor/tests/test_dcs.py

Usage:

```
DBCONF=womble nosetests -v test_dcs.py    # tests are skipped if DBConf section is not available
VERBOSE=1 nosetests -v test_dcs.py        # default is to only list OVERAGE tables, to see all use VE
python test_dcs.py                        # runs the test and presents the table of ages
nosetests -v test_dcs.py                  # runs test, only get table presentation when OVERAGE table
```

Update Expectations

See dybgaudi:Database/DbiMonitor/tests/test_dcs.py for the current expectations. Update expectations for each table or group of tables specified by name regular expressions are defined by the *maxage* list of tuples structure.

```
class DcsUpdates(Updates):
    date_time = 'date_time'
    abandoned = timedelta(weeks=19)
    maxage = [
                (re.compile('^AD\d_Calibration$'), timedelta(hours=1)),
                (re.compile('^\S*_ADCoverGas$'), timedelta(hours=1)),
                (re.compile('^FARS_RPC_GAS_10[12]$'),timedelta(days=5)),
                (re.compile('^\S*_RadonMonitor$'), timedelta(days=5)),
                (re.compile('^\S*_MUCAL$'), timedelta(days=10)),
                (re.compile('^dybalar\S*$'), timedelta(days=10)),
                (re.compile('.*'), timedelta(minutes=30)),
            ]
```

DB connection config

The script uses default DBCONF section of *ihep_dcs* requiring config parameters within your `~/.my.cnf` of form:

```
[ihep_dcs]
host = 202.122.37.89
database = dybdcsdb
user = dayabay
password = %(youknowit)s
```

python module running

As *DbiMonitor* requirements does *apply_pattern install_dybtests* the tests are installed, allowing the following running technique:

```
python -m DbiMonitor.tests.test_dcs
```

OR with more verbosity:

```
VERBOSE=1 python -m DbiMonitor.tests.test_dcs
```

dybinst level running

```
./dybinst -l /dev/stdout trunk tests dbimonitor:tests/test_dcs.py
```

crontab automation

This uses a feature of *dybinst* where in the event of test failures notification emails are sent to addresses in the `MAILTO` which can be a space delimited list of email addesses

```
SHELL=/bin/bash
CRONLOG_DIR=/home/blyth/cronlog
PATH=/home/blyth/env/bin:/usr/bin:/bin
DYBINST_DIR=/data1/env/local/dyb
#
45 20 * * * ( cd $DYBINST_DIR ; MAILTO="blyth@hep1.phys.ntu.edu.tw joe@example.com" ./dybinst -L -l $
```

nosetests and logging issue

When run as nosetests getting DEBUG level output despite INFO setting in setup. This issue is apparently fixed in a future version of nose:

```
* https://github.com/nose-devs/nose/issues/21
* https://github.com/nose-devs/nose/pull/493
```

Meanwhile just comment the DEBUG logging.

22.5.2 DbiMonitor.tests.test_offline

Checking update age of tables in offline_db

For a more detailed description see *test_dcs.py* which uses the same *Updates* base class.

Usage:

```
DBCONF=womble nosetests -v test_offline.py    # tests are skipped if DBConf section is not available
VERBOSE=1 nosetests -v test_offline.py        # default is to only list OVERAGE tables, to see all us
python test_offline.py                        # runs the test and presents the table of ages
nosetests -v test_offline.py                  # runs test, only get table presentation when OVERAGE t
```

The default DB checked is offline_db, that can be overridden with the DBCONF envvar pointing to a section in your `~/.my.cnf`. The default is to only report problems, for more detailed summaries use the VERBOSE envvar.

```
[blyth@belle7 tests]$ DBCONF=offline_db1 python test_offline.py
INFO:updates:reading from DB offline_db1
WARNING:updates:missing fields prevents age check for table DcsPmtHvVld : {'msg': 'MISSKEY', 'N': 943
DBCONF offline_db1 ie offline_db [dayabay@dybdb1.ihep.ac.cn]
table                                  count        last                 look                 : ag

[blyth@belle7 tests]$ DBCONF=offline_db1 VERBOSE=1 python test_offline.py
INFO:updates:reading from DB offline_db1
WARNING:updates:missing fields prevents age check for table DcsPmtHvVld : {'msg': 'MISSKEY', 'N': 943
DBCONF offline_db1 ie offline_db [dayabay@dybdb1.ihep.ac.cn]
table                                  count        last                 look                 : ag
DcsPmtHvVld                            94347        -                    -                    : -
DaqRawDataFileInfoVld                  335485       2013-07-29 15:18:46  2013-07-29 15:29:23  : 0
DcsAdLidSensorVld                      111592       2013-07-29 14:46:11  2013-07-29 15:29:23  : 0
DcsAdTempVld                           104439       2013-07-29 14:39:30  2013-07-29 15:29:23  : 0
DaqRunInfoVld                          38572        2013-07-29 09:57:41  2013-07-29 15:29:23  : 5
EnergyReconVld                         2919         2013-07-29 03:24:14  2013-07-29 15:29:24  : 12
DcsAdWpHvVld                           7877         2013-07-28 13:51:02  2013-07-29 15:29:24  : 1
DaqCalibRunInfoVld                     43584        2013-07-26 11:38:56  2013-07-29 15:29:23  : 3
CalibPmtFineGainVld                    18192        2013-06-25 11:55:41  2013-07-29 15:29:22  : 34
ReactorVld                             1152         2013-03-21 02:41:19  2013-07-29 15:29:24  : 13
McsPosVld                              1755         2012-10-08 14:53:00  2013-07-29 15:29:24  : 29
CalibPmtHighGainVld                    1268         2012-04-26 03:10:48  2013-07-29 15:29:22  : 45
```

Technical issue regards logging and nosetests

1. nosetests and logging not working together, getting DEBUG level despite the INFO setting in setup
    - fixed in future version https://github.com/nose-devs/nose/issues/21 https://github.com/nose-devs/nose/pull/493

- meanwhile just comment the DEBUG logging

22.6 Env Repository : Admin Infrastructure Sources

- Installing Env
- Heirarchy of Bash Functions
- Node Characterisation

Most of the development history and documentation (commits, tickets, wikipages) of the admin infrastructure is managed in the **env** SVN/Trac instance at NTU env:wiki:WikiStart . This includes:

1. scripts for backup/recovery of the MySQL DB `offline_db`
2. scripts for backup/recovery of the SVN repository and Trac instance
3. patches against Trac and various Trac plugins such as *bitten*

Using the Trac tags is the best way to locate this documentation, for example:

- env:tag:SCM provides a list of Source Code Management related pages

22.6.1 Installing Env

bash shell is mandatory

The Admin sources are composed primarily of a large number of bash functions. Use with any other shell is **condemned**, and will not be supported in any way.

Follow the instructions on the front page env:wiki:WikiStart to install **env**, starting from:

```
cd $HOME ; svn checkout http://dayabay.phys.ntu.edu.tw/repos/env/trunk/ env
cd $HOME/env ; svn update
```

Hook up **env** to the bash shell of the user by adding the below to the `.bash_profile`:

```
export ENV_HOME=$HOME/env
env-(){  . $ENV_HOME/env.bash  && env-env $* ; }
env-     ## precursor function
```

22.6.2 Heirarchy of Bash Functions

The *env- precursor* function defines other precursor functions such as

1. `scm-`
2. `scm-backup-`
3. `db-`

These precursor functions are very simple, all following the form of defining a set of related functions and setting up any environmenrt with eg `scm-env`:

```
scm-(){          . $(env-home)/scm/scm.bash && scm-env $* ; }
scm-backup-(){   . $(env-home)/scm/scm-backup.bash && scm-backup-env $* ; }
```

Certain conventions are followed:

1. precursor function names end with a hyphen: **-**
2. functions defined by precursor functions like `scm-` are named to extend that name, ie `scm-create` and `scm-wipe`
3. certain standard functions are included for all eg `scm-vi`, `scm-backup-vi`, `db-vi` all open the functions source in the **vi** editor
4. other standard endings include `*-usage`, `*-source` etc

Conventional naming structure provides convenient tab completion:

```
[blyth@belle7 ~]$ scm-
[blyth@belle7 ~]$ scm-<TAB>
scm-                 scm-create           scm-env              scm-postcommit-      scm-rename
scm-backup-          scm-eggcache         scm-postcommit       scm-postcommit-test  scm-source
```

interactively examine unfamiliar functions before usage

The bash functions themselves are always the best and most uptodate documentation. It is **very** important to understand what functions are going to do before usage. For example `scm-wipe <name>` deletes the svn repository and Trac instance called **name**.

The `env-` function defines some aliases such as **t** which provides interactive access to function definitions from the commandline:

```
[blyth@belle7 ~]$ t t
t is aliased to 'type'
[blyth@belle7 ~]$ t scm-create
scm-create is a function
scm-create ()
{
    local msg="=== $FUNCNAME :";
    local name=$1;
    shift;
    [ -z "$name" ] && echo $msg an instance name must be provided && return 1;
    svn-;
    svn-create $name $*;
    trac-;
    trac-create $name
}
[blyth@belle7 ~]$ t scm-vi
scm-vi is a function
scm-vi ()
{
    vim $(scm-source)
}
[blyth@belle7 ~]$ scm-source
/data1/env/local/env/home/scm/scm.bash
[blyth@belle7 ~]$ scm-vi
```

As far as possible the functions seek to abstract away node specific details, such as directory paths and basis application layout (eg different versions of apache have files in different places). The functions should shield the user from these node specifics.

Warning: the functions are used on many different nodes, this requires care to avoid breaking things for other nodes by ignoring the node agnostic approach

22.6.3 Node Characterisation

Node abstraction is achieved by node detection and the setting of standard envvars such as `NODE_TAG` by the `elocal-` precursor:

```
[blyth@belle7 home]$ t elocal-
elocal- is a function
elocal- ()
{
    . $(env-home)/base/local.bash && local-env $*
}
[blyth@belle7 home]$ t local-env
local-env is a function
local-env ()
{
    local dbg=${1:-0};
    local msg="=== $FUNCNAME :";
    [ "$dbg" == "1" ] && echo $msg;
    export SOURCE_NODE="g4pb";
    export SOURCE_TAG="G";
    export LOCAL_ARCH=$(uname);
    export LOCAL_NODE=$(local-node);
    export NODE_TAG=$(local-nodetag);
    export BACKUP_TAG=$(local-backup-tag);
    export SUDO=$(local-sudo);
    export SYSTEM_BASE=$(local-system-base);
    export LOCAL_BASE=$(local-base);
    export ENV_PREFIX=$(local-prefix);
    export VAR_BASE=$(local-var-base);
    export SCM_FOLD=$(local-scm-fold);
    export VAR_BASE_BACKUP=$(local-var-base $BACKUP_TAG);
    export USER_BASE=$(local-user-base);
    export OUTPUT_BASE=$(local-output-base);
    local-userprefs
}
```

Note: simple usage of `echo` from bash functions to return values to other functions, requires care regards extraneous output

The **NODE_TAG** is very widely used for branching on node specifics:

```
[blyth@belle7 home]$ local-nodetag
N
```

For example the `local-scm-fold` emits the path used as the base for backups:

```
[blyth@belle7 home]$ local-scm-fold
/var/scm

[blyth@belle7 home]$ t local-scm-fold
local-scm-fold is a function
local-scm-fold ()
{
```

```
    case ${1:-$NODE_TAG} in
        WW)
            echo /home/scm
        ;;
        *)
            echo $(local-var-base $*)/scm
        ;;
    esac
}
[blyth@belle7 home]$ t local-var-base
local-var-base is a function
local-var-base ()
{
    local t=${1:-$NODE_TAG};
    case $t in
        U)
            echo /var
        ;;
        P)
            echo /disk/d3/var
        ;;
        G1)
            echo /disk/d3/var
        ;;
...etc...
```

A `case` function is used on the **NODE_TAG** to locate the different places on

22.7 Dybinst : Dayabay Offline Software Installer

- dybsvn:source:installation/trunk/dybinst/dybinst

Implementation details and troubleshooting:

22.8 Trac+SVN backup/transfer

- Backups with `scm-backup-all`
- Offbox Transfers with `scm-backup-rsync`
- Recovery using `scm-recover-all`
- Distributed backup monitoring
- Adding a new target node for backups
  - Node characterization
  - Placement of SSH keys
  - Add target tag to `BACKUP_TAG` of source node

Backups/transfers and recovery of Trac/SVN instances are implemented in bash functions `scm-backup-*` env:source:trunk/scm/scm-backup.bash to interactively examine these functions use the normal **env** discovery approach *Heirarchy of Bash Functions*, for example:

```
env-
scm-backup-
scm-backup-<TAB>
```

```
type scm-backup-all
t scm-backup-trac      ## env- defines alias "t" for type
scm-backup-vi
```

22.8.1 Backups with `scm-backup-all`

Performs `scm-backup-trac` and `scm-backup-repo` for all instances/repositories under `$SCM_FOLD/{repos,svn,tracs}`. The `SCM_FOLD` is node dependent: `/home/scm` on the **dybsvn** server, `/var/scm` on the **env** server. Such node dependent details are defined in `local-*` bash functions.

The backups are performed using *hotcopy* techniques/scripts provided by the Trac and Subversion projects, and result in tarballs in dated folders beneath `$SCM_FOLD/backup/$LOCAL_NODE` where `LOCAL_NODE` is eg `dayabay` or `cms01` : the node on which the instances reside.

Additional tasks are performed by `scm-backup-all`:

1. `$(svn-setupdir)` which contains config details such as users lists are backed up by `scm-backup-folder` into a separate tarball
2. a digest of each tarball is made and the resulting 32 char hex code is stored in `.dna` sidecar files
3. tarballs are purged by `scm-backup-purge` to retain a configured number
4. locks are planted and cleared during backups

22.8.2 Offbox Transfers with `scm-backup-rsync`

SSH Node tags

Node tags are short aliases for SSH connected nodes such as **C** that are listed in the `~/.ssh/config` file of form:

```
host C
    user blyth
    hostname 140.112.101.190
    protocol 2
```

First the SSH agent on the source node is checked with `ssh--agent-check` , then for each target node tag listed in `$BACKUP_TAG`, an rsync command is composed and run. The target directory for each node is provided by an echoing bash function `scm-backup-dir`:

```
[blyth@cms02 ~]$ scm-backup-dir       ## defaults to current node
/var/scm/backup
[blyth@cms02 ~]$ scm-backup-dir C     ## knows about other nodes
/data/var/scm/backup
[blyth@cms02 ~]$ scm-backup-dir N
/var/scm/backup
```

Locks are planted and cleared during transfers in order to avoid usage of incomplete tarballs.

When the target account has the **env** functions installed additional DNA checks are performed following this transfer. This recalculate the tarball digests on the target machines and compares values with those written in the sidecar `.dna` files.

The most problematic part of adding new nodes as backup targets, is usually configuring the SSH connections that allows passwordless rsync transfers to be performed using SSH keys *SSH Setup For Automated transfers*.

22.8.3 Recovery using `scm-recover-all`

Requires a **fromnode** argument, recovers all Trac/SVN tarballs with `scm-recover-repo` and users with `scm-recover-users`, performs apache required ownerwhip changes and syncronises the trac instances with corresponding svn repositories `scm-backup-synctrac`.

22.8.4 Distributed backup monitoring

See also:

dybsvn:ticket:1242

Repeated incidents of failure to perform backups and tarball transfers for the Trac/SVN dybsvn, dybaux, env and heprez repositories for extended periods motivated development of a more robust distributed monitoring approach. The pre-existing monitoring used a self monitoring approach which was ineffective for many causes of failure, including the common one of failure to properly restart SSH agents after server reboots.

A distributed monitoring approach was implemented whereby the central server collects tarball information from all remote backup nodes into a central SQLite database and publishes the data as a web accessible JSON data file. Subsequently cron jobs on any node are able to access the JSON data file and check the state of the backup tarballs on all the backup nodes, for example checking the size and age of the last backup tarballs and sending email if notification is required. In this way the monitoring is made robust to the failure of the central server and the backup nodes. The only way for the distributed monitoring to fail to provide notification of problems is for all nodes to fail simultaneously.

The same JSON data files are used from monitoring web pages such as http://dayabay.ihep.ac.cn/e/scm/monitor/ihep/ where users web browsers access the JSON data files and present them as time series charts showing the backup history using the HighCharts Javascript framework.

env:source:trunk/scm/monitor.py server collection of tarball data and creation of JSON data file, invoked by `scm-backup-monitor`

env:source:trunk/scm/tgzmon.py standalone monitoring of remote JSON data, invoked by `scm-backup-tgzmon`

22.8.5 Adding a new target node for backups

The administrator of the source node will need to:

1. create a new node tag in `~/.ssh/config` with the nodename and user identity of the new target, an unused tag must be chosen: check with `local-vi` to see tags that have been used already

Node characterization

The target node administrator will need to update the **env** node characterisation of the new node, using the `local-vi` function and commit changes into the **env** repository. The changes required are mostly just additional lines in `case` statements, providing for example:

1. `local-scm-fold`
2. `local-var-base` used by `local-scm-fold`

Placement of SSH keys

If policy or lack of trust prevents such intimacy

If the **target** node adminstrator is not willing to afford such trust in the **source** node adminstrator, alternatives are possible using a special **scponly** env:wiki:RestrictedShell but this is not straightforward to setup.

Source account public keys `~/.ssh/id_dsa.pub` or `~/.ssh/id_rsa.pub` need to be **appended** to the target account `~/.ssh/authorized_keys2` on the target node. This affords access from the source account to the target account allowing the `scm-backup-rsync` to automatically perform its transfers.

Add target tag to `BACKUP_TAG` of source node

Once the **env** working copy is updated on the source node to pick up the new target node characterization the new backup node for the source node is configured by modifiying the `case` statement in the `local-backup-tag` function.

22.9 SSH Setup For Automated transfers

- Debugging Blocked SSH
- ssh-agent process monitoring

The basics of setting up passwordless SSH are described in env:wiki:PasswordLessSSH

22.9.1 Debugging Blocked SSH

Daily transfers of large tarballs often fall foul of network blockages from institute network administrators. If SSH connections fail and pinging succeeds a possible cause is the blockage of port 22 from the web server by intermediate routers.

In order to check this try running an SSH daemon on another port and connect to that. For example, on the destination cms01.phys.ntu.edu.tw start sshd on port 1234 (may need to open the port on the firewall at destination):

```
[blyth@cms01 ~]$ sudo /usr/sbin/sshd -d -p 1234
Password:
main(5568) debug1: TOKEN IS afstokenpassing
...
```

This allows testing an ssh connection over a non-standard port:

```
[dayabay] /var/log > ssh -p 1234 -v -v -v cms01.phys.ntu.edu.tw
OpenSSH_4.3p2-6.cern-hpn, OpenSSL 0.9.7a Feb 19 2003
ssh(6369) debug1: Reading configuration data /home/blyth/.ssh/config
ssh(6369) debug1: Reading configuration data /etc/ssh/ssh_config
...
[blyth@cms01 ~]$
```

22.9.2 ssh-agent process monitoring

On nodes from which cron controlled daily backups to remote boxes are performed it is necessary to keep the *ssh-agent* process running. This requires manual steps to start and authenticate the agent following server reboots.

For example on *dayabay.ihep.ac.cn* the cron commandline for the *blyth* account:

```
21 14 * * * ( . $ENV_HOME/env.bash ; env- ; python- source ; ssh-- ; ssh--agent-monitor root ) > $CRO
```

This performs a daily check with function *ssh–agent-monitor root* using *pgrep* to look for the **ssh-agent** process. If not found a notification email is sent, such as:

```
From: me@dayabay.ihep.ac.cn
Date: 19 July 2013 14:21:02 GMT+08:00
Subject: === ssh--agent-check-user : Fri Jul 19 14:21:02 CST 2013

From: me@localhost
To: blyth@hep1.phys.ntu.edu.tw

=== ssh--agent-check-user : Fri Jul 19 14:21:02 CST 2013
=== ssh--agent-check-user : ssh-agent for user root NOT FOUND
```

The remedy is to use *ssh–agent-start* which prompts for the ssh key passphrase in order to authenticate the restarted agent, and allow the passwordless transfer of backup tarballs to proceed.

22.10 Offline DB Backup

- Backup System
- Issues
- Monitoring
- Crontab Auto Recovery
- Interactive Recovery
- Table Size Checks

22.10.1 Backup System

The backup system described here is in addition to the standard IHEP disk backup system.

MySQL DB servers at IHEP are backed up via mysqldump and rsync scripts that are invoked by cron jobs running on the nodes:

1. dybdb1.ihep.ac.cn
2. dybdb2.ihep.ac.cn (rsync to cms01.phys.ntu.edu.tw not currently operational)

22.10.2 Issues

Common issues over many years of operation:

- SSH agent not properly restarted and re-authenticated following server reboots
- out of disk space on target node
  - large mysql logfile resulting from daily auto-recovery on target node is implicated (TODO: move backups to larger disk)
- IHEP firewall configuration changes block SSH connection, preventing rsync

22.10.3 Monitoring

Very old functions remain in operation, sending daily status emails:

```
40 05 * * * ( . $ENV_HOME/env.bash ; db- ; db-backup-rsync-monitor ) > $CRONLOG_DIR/db-backup-rsync-m
```

22.10.4 Crontab Auto Recovery

User blyth@cms01 crontab:

```
08 09 * * * ( . $ENV_HOME/env.bash ; env- ; python- source ; db- ; db-backup-recover offline_db dybdb
```

A database named after the day is created, eg *offline_db_20130115* from the mysqldump and the prior days database is dropped.

22.10.5 Interactive Recovery

```
[blyth@cms01 var]$ db-backup-recover
=== db-backup-recover : name offline_db sqz /var/dbbackup/rsync/dybdb1.ihep.ac.cn/20130109/offline_db
27.46user 6.36system 7:49.51elapsed 7%CPU (0avgtext+0avgdata 0maxresident)k
0inputs+0outputs (0major+1383minor)pagefaults 0swaps
=== db-backup-recover : SUCCEEDED to create DB offline_db_20130109
=== db-backup-recover : dropping offline_db_20130108
[blyth@cms01 var]$
```

22.10.6 Table Size Checks

```
mysql> select table_name,round((data_length+index_length-data_free)/1024/1024,2) as MB from informati
+-----------------------+--------+
| table_name            | MB     |
+-----------------------+--------+
| DcsPmtHv              | 542.75 |
| CalibPmtFineGain      | 119.27 |
| DcsAdLidSensor        |  53.94 |
| DaqRawDataFileInfo    |  44.52 |
| DcsAdWpHv             |  44.04 |
| DaqRunConfig          |  27.37 |
| DaqRawDataFileInfoVld |  15.76 |
| GoodRunList           |   9.77 |
| CalibPmtHighGain      |   9.14 |
| CalibPmtSpec          |   7.92 |
| HardwareID            |   5.50 |
| DcsAdLidSensorVld     |   5.39 |
| DcsPmtHvVld           |   4.98 |
...
| DcsAdTempVld          |   4.84 |
| CoordinateReactorVld  |   0.00 |
| PhysAdVld             |   0.00 |
| CalibSrcEnergyVld     |   0.00 |
| LOCALSEQNO            |   0.00 |
+-----------------------+--------+
60 rows in set (0.65 sec)

mysql>
```

22.11 DBSVN : dybaux SVN pre-commit hook

DBSVN is a script used by the dybaux SVN pre-commit hook to perform basic validation of database updates. This section describes how to test changes to the dybgaudi:DybPython/python/DybPython/dbsvn.py script.

- Example of failure
- Fabricate pre-commit working copy
- Installing into the SVN server

22.11.1 Example of failure

Running *dbsvn.py* with no change yields error, as no update is not a valid update:

```
[blyth@belle7 ~]$ rm -rf tmp_offline_db ; svn co http://dayabay.ihep.ac.cn/svn/dybaux/catalog/tmp_of
[blyth@belle7 ~]$ dbsvn.py ~/tmp_offline_db -M
Traceback (most recent call last):
  File "/data1/env/local/dyb/NuWa-trunk/dybgaudi/InstallArea/scripts/dbsvn.py", line 4, in <module>
    main()
  File "/data1/env/local/dyb/NuWa-trunk/dybgaudi/InstallArea/python/DybPython/dbsvn.py", line 586, in
    dbiv()
  File "/data1/env/local/dyb/NuWa-trunk/dybgaudi/InstallArea/python/DybPython/dbsvn.py", line 478, in
    self.validate_update()
  File "/data1/env/local/dyb/NuWa-trunk/dybgaudi/InstallArea/python/DybPython/dbsvn.py", line 400, in
    assert 'LOCALSEQNO' in tabs, "No LOCALSEQNO in %s " % tabs
AssertionError: No LOCALSEQNO in []
[blyth@belle7 ~]$
```

22.11.2 Fabricate pre-commit working copy

Last five commits:

```
[blyth@belle7 ~]$ svn log --limit 5 ~/tmp_offline_db
------------------------------------------------------------------------
r5433 | zhanl | 2013-03-21 10:42:45 +0800 (Thu, 21 Mar 2013) | 1 line

fastforward updates following offline_db rloadcat of r5432 OVERRIDE
------------------------------------------------------------------------
r5432 | zhanl | 2013-03-21 10:41:00 +0800 (Thu, 21 Mar 2013) | 1 line

OVERRIDE fill blind flux
------------------------------------------------------------------------
r5431 | zhanl | 2013-03-21 10:37:57 +0800 (Thu, 21 Mar 2013) | 1 line

fastforward updates following offline_db rloadcat of r5429 and r5430 OVERRIDE
------------------------------------------------------------------------
r5430 | yuzy | 2013-03-19 09:28:48 +0800 (Tue, 19 Mar 2013) | 1 line

minor: Update offline_db ADScaled constants for MC with dybsvn:source:dybgaudi/trunk/Calibration/DBU
------------------------------------------------------------------------
r5429 | beizhenhu | 2013-03-18 22:47:44 +0800 (Mon, 18 Mar 2013) | 1 line

dybsvn:source:dybgaudi/trunk/Calibration/DBUpdate/UPDATES.txt@20069
------------------------------------------------------------------------
```

Back from HEAD to before the yuzy commit:

```
[blyth@belle7 tmp_offline_db]$ svn update -r 5429
U    EnergyRecon/EnergyReconVld.csv
U    EnergyRecon/EnergyRecon.csv
U    CalibPmtFineGain/CalibPmtFineGainVld.csv
U    Reactor/ReactorVld.csv
U    Reactor/Reactor.csv
U    LOCALSEQNO/LOCALSEQNO.csv
Updated to revision 5429.
[blyth@belle7 tmp_offline_db]$
```

Merge yuzy commit into working copy:

```
[blyth@belle7 tmp_offline_db]$ svn merge http://dayabay.ihep.ac.cn/svn/dybaux/catalog/tmp_offline_db(
--- Merging r5430 into '.':
U    EnergyRecon/EnergyReconVld.csv
U    EnergyRecon/EnergyRecon.csv
U    LOCALSEQNO/LOCALSEQNO.csv

[blyth@belle7 tmp_offline_db]$ svn st
M       EnergyRecon/EnergyReconVld.csv
M       EnergyRecon/EnergyRecon.csv
M       LOCALSEQNO/LOCALSEQNO.csv

[blyth@belle7 tmp_offline_db]$ dbsvn.py . -M     ## dbsvn approves the change
[blyth@belle7 tmp_offline_db]$ echo $?
0

[blyth@belle7 tmp_offline_db]$ dbsvn.py . -M -l debug
DEBUG:DybPython.dbsvn:starting with opts {'refcreds': '--username dayabay --password wrong', 'verbose
DEBUG:DybPython.dbsvn:DBIValidate 46 lines of diff
DEBUG:DybPython.dbsvn:DBIValidate {'LOCALSEQNO': '-+', 'EnergyRecon': '+', 'EnergyReconVld': '+'}
[blyth@belle7 tmp_offline_db]$
```

Make unethical manual edit:

```
[blyth@belle7 tmp_offline_db]$ vi EnergyRecon/EnergyReconVld.csv
[blyth@belle7 tmp_offline_db]$ tail -2  EnergyRecon/EnergyReconVld.csv
2108,"2013-03-12 22:41:31","2038-01-19 03:14:07",4,2,3,0,-1,"2013-03-12 22:41:31","2013-03-19 01:12:0
2109,"1970-01-01 00:00:00","2038-01-19 03:14:07",4,2,4,0,-1,"2013-03-12 22:41:31","2013-03-19 01:12:1
##                                                ^
##                                               SIMMASK
```

Now it squeals:

```
[blyth@belle7 tmp_offline_db]$ dbsvn.py . -M -l debug
DEBUG:DybPython.dbsvn:starting with opts {'refcreds': '--username dayabay --password wrong', 'verbose
DEBUG:DybPython.dbsvn:DBIValidate 46 lines of diff
DEBUG:DybPython.dbsvn:DBIValidate {'LOCALSEQNO': '-+', 'EnergyRecon': '+', 'EnergyReconVld': '+'}
Traceback (most recent call last):
  File "/data1/env/local/dyb/NuWa-trunk/dybgaudi/InstallArea/scripts/dbsvn.py", line 4, in <module>
    main()
  File "/data1/env/local/dyb/NuWa-trunk/dybgaudi/InstallArea/python/DybPython/dbsvn.py", line 586, in
    dbiv()
  File "/data1/env/local/dyb/NuWa-trunk/dybgaudi/InstallArea/python/DybPython/dbsvn.py", line 479, in
    self.validate_validity()
  File "/data1/env/local/dyb/NuWa-trunk/dybgaudi/InstallArea/python/DybPython/dbsvn.py", line 432, in
    self.validate_hunk(hunk)
  File "/data1/env/local/dyb/NuWa-trunk/dybgaudi/InstallArea/python/DybPython/dbsvn.py", line 451, in
```

```
    assert tbot < dt <= teot, ("time is out of range ", dt )
AssertionError: ('time is out of range ', datetime.datetime(1970, 1, 1, 0, 0))
[blyth@belle7 tmp_offline_db]$

[blyth@belle7 tmp_offline_db]$ which dbsvn.py            ## CAUTION NEED TO INSTALL DybPython after c
/data1/env/local/dyb/NuWa-trunk/dybgaudi/InstallArea/scripts/dbsvn.py
[blyth@belle7 tmp_offline_db]$
```

Make changes to dbsvn.py and dbvld.py and install:

```
[blyth@belle7 DybPython]$ pwd
/data1/env/local/dyb/NuWa-trunk/dybgaudi/DybPython/python/DybPython
[blyth@belle7 DybPython]$ ( cd ../../cmt ; make DybPython_python )
```

Now it passes:

```
[blyth@belle7 tmp_offline_db]$ dbsvn.py . -M -l debug
DEBUG:DybPython.dbsvn:starting with opts {'refcreds': '--username dayabay --password wrong', 'verbose
DEBUG:DybPython.dbsvn:DBIValidate 46 lines of diff
DEBUG:DybPython.dbsvn:DBIValidate {'LOCALSEQNO': '-+', 'EnergyRecon': '+', 'EnergyReconVld': '+'}
[blyth@belle7 tmp_offline_db]$ echo $?
0
```

Manual edit SIMMASK 2->1, and verify that it fails:

```
[blyth@belle7 tmp_offline_db]$ tail -1  EnergyRecon/EnergyReconVld.csv
2109,"1970-01-01 00:00:00","2038-01-19 03:14:07",4,1,4,0,-1,"2013-03-12 22:41:31","2013-03-19 01:12:1
```

22.11.3 Installing into the SVN server

Reference:

22.12 Bitten Debugging

Warning: **DO NOT** access the live *trac.db* always extract from backup tarball on another node

- Extract *trac.db* from backup tarball
- Examining bitten tables
  - table counts
  - bitten_build

22.12.1 Extract *trac.db* from backup tarball

Extract *dybsvn/db/trac.db* from the altbackup tarball on C:

```
[blyth@cms01 ~]$ tar zxf /data/var/scm/alt.backup/dayabay/tracs/dybsvn/2013/04/11/104702/dybsvn.tar.g
tar: dybsvn/db/trac.db: Wrote only 9216 of 10240 bytes
```

Arghh, its big, extract onto a disk with ~7GB of space:

```
[blyth@cms01 env]$ cd /data/env/tmp
[blyth@cms01 tmp]$ time tar zxf /data/var/scm/alt.backup/dayabay/tracs/dybsvn/2013/04/11/104702/dybsv

real    6m19.715s
user    1m11.404s
sys     1m4.570s

[blyth@cms01 tmp]$ du -hs dybsvn/db/trac.db
6.7G    dybsvn/db/trac.db
```

22.12.2 Examining bitten tables

```
[blyth@cms01 tmp]$ sqlite3 dybsvn/db/trac.db
SQLite version 3.1.2
Enter ".help" for instructions
sqlite> .tables
attachment          bitten_report       node_change         ticket
auth_cookie         bitten_report_item  permission          ticket_change
bitten_build        bitten_rule         report              ticket_custom
bitten_config       bitten_slave        revision            version
bitten_error        bitten_step         session             wiki
bitten_log          component           session_attribute
bitten_log_message  enum                system
bitten_platform     milestone           tags
sqlite>

sqlite> .tables bitten%
bitten_build        bitten_log          bitten_report       bitten_slave
bitten_config       bitten_log_message  bitten_report_item  bitten_step
bitten_error        bitten_platform     bitten_rule
sqlite>
```

table counts

```
sqlite> select count(*) from bitten_build ;
14433
sqlite> select count(*) from bitten_config ;
5
sqlite> select count(*) from bitten_error ;
8630
sqlite> select count(*) from bitten_log ;
336829
sqlite> select count(*) from bitten_log_message ;
46789033
sqlite> select count(*) from bitten_platform ;
16
sqlite> select count(*) from bitten_report ;
111263
sqlite> select count(*) from bitten_report_item ;
22410788
sqlite> select count(*) from bitten_rule ;
16
sqlite> select count(*) from bitten_slave ;
179125
sqlite> select count(*) from bitten_step ;
```

```
338484
sqlite>
```

bitten_build

Last 30 builds:

```
sqlite> .headers ON
sqlite> .mode column
sqlite> .width 10 15 10 15 5 25 15 15 5
sqlite>  select * from bitten_build order by id desc limit 30 ;
id          config           rev         rev_time         platf  slave                       started
----------  ---------------  ----------  ---------------  -----  --------------------------  ---------
20499       opt.dybinst      20242       1365636603       28                                 0
20498       opt.dybinst      20242       1365636603       34     pdyb-02                     136563787
20497       opt.dybinst      20242       1365636603       30                                 0
20496       opt.dybinst      20242       1365636603       33     farm4.dyb.local             136563801
20495       opt.dybinst      20242       1365636603       36     daya0004.rcf.bnl.gov        136563792
20494       dybinst          20242       1365636603       27                                 0
20493       dybinst          20242       1365636603       35     pdyb-03                     136563790
20492       dybinst          20242       1365636603       31                                 0
20491       dybinst          20242       1365636603       32     farm2.dyb.local             136563784
20490       dybinst          20242       1365636603       37     daya0001.rcf.bnl.gov        136563781
20489       dybinst          20242       1365636603       14                                 0
20488       dybinst          20242       1365636603       15     belle7.nuu.edu.tw           136563803
20487       opt.dybinst      20225       1365547583       28                                 0
20486       opt.dybinst      20225       1365547583       34     pdyb-02                     136554905
20485       opt.dybinst      20225       1365547583       30                                 0
20484       opt.dybinst      20225       1365547583       33     farm4.dyb.local             136554906
20483       opt.dybinst      20225       1365547583       36     daya0001.rcf.bnl.gov        136554904
20482       dybinst          20225       1365547583       27                                 0
20481       dybinst          20225       1365547583       35     pdyb-03                     136555265
20480       dybinst          20225       1365547583       31                                 0
20479       dybinst          20225       1365547583       32     farm2.dyb.local             136554897
20478       dybinst          20225       1365547583       37     daya0001.rcf.bnl.gov        136557788
20477       dybinst          20225       1365547583       14                                 0
20476       dybinst          20225       1365547583       15     belle7.nuu.edu.tw           136557796
20475       opt.dybinst      20216       1365525489       28                                 0
20474       opt.dybinst      20216       1365525489       34     pdyb-02                     136552689
20473       opt.dybinst      20216       1365525489       30                                 0
20472       opt.dybinst      20216       1365525489       33     farm4.dyb.local             136552696
20471       opt.dybinst      20216       1365525489       36     daya0004.rcf.bnl.gov        136552690
20470       dybinst          20216       1365525489       27                                 0
sqlite>
```

Last 40 on farm4.dyb.local:

```
sqlite> select id, rev, datetime(rev_time,'unixepoch') as rev_time,datetime(started,'unixepoch') as s
id          rev         rev_time             started              stopped              status
----------  ----------  -------------------  -------------------  -------------------  ----------
20496       20242       2013-04-10 23:30:03  2013-04-10 23:53:37  2013-04-11 02:08:16  F
20484       20225       2013-04-09 22:46:23  2013-04-09 23:11:00  2013-04-10 01:24:59  F
20472       20216       2013-04-09 16:38:09  2013-04-09 17:02:42  2013-04-09 19:20:01  F
20460       20193       2013-04-05 20:53:44  2013-04-05 21:17:39  2013-04-05 23:29:17  S
20448       20181       2013-04-04 15:48:18  2013-04-04 16:10:48  2013-04-04 18:23:48  S
20436       20180       2013-04-04 01:44:20  2013-04-04 02:07:46  2013-04-04 04:54:13  S
20424       20176       2013-04-03 20:01:07  2013-04-03 20:25:50  2013-04-03 22:41:50  S
```

```
20412       20164       2013-04-01 19:15:47   2013-04-01 20:56:05   2013-04-01 23:10:30   S
20400       20163       2013-04-01 18:16:26   2013-04-01 18:40:21   2013-04-01 20:55:25   S
20388       20160       2013-04-01 05:39:14   2013-04-01 06:01:11   2013-04-01 08:53:16   S
20376       20159       2013-04-01 02:26:11   2013-04-01 02:47:01   2013-04-01 05:05:27   S
20364       20156       2013-03-29 22:03:47   2013-03-29 22:44:18   2013-03-30 00:58:23   S
20352       20154       2013-03-29 20:05:25   2013-03-29 20:26:31   2013-03-29 22:43:38   S
20340       20147       2013-03-28 04:59:30   2013-03-28 05:23:23   2013-03-28 07:36:29   S
20328       20145       2013-03-27 18:07:13   2013-03-27 18:40:08   2013-03-27 20:56:27   S
20316       20143       2013-03-27 16:05:23   2013-03-27 16:25:27   2013-03-27 18:39:29   S
20304       20137       2013-03-27 03:19:32   2013-03-27 05:55:59   2013-03-27 06:54:00   S
20292       20137       2013-03-27 03:19:32   2013-03-27 03:39:46   2013-03-27 05:55:20   S
20280       20121       2013-03-25 04:37:48   2013-03-25 05:02:27   2013-03-25 07:18:09   S
20268       20093       2013-03-20 23:10:20   2013-03-20 23:31:29   2013-03-21 01:46:23   S
20256       20084       2013-03-20 16:15:42   2013-03-20 16:38:06   2013-03-20 18:50:20   S
20244       20072       2013-03-19 10:37:07   2013-03-19 11:25:05   2013-03-19 13:38:24   S
20232       20070       2013-03-19 01:25:52   2013-03-19 09:52:44   2013-03-19 11:24:26   S
20220       20069       2013-03-18 14:40:35   2013-03-18 15:01:02   2013-03-18 17:12:13   S
20208       20057       2013-03-18 07:26:02   2013-03-18 07:50:55   2013-03-18 09:59:59   S
20196       20054       2013-03-18 02:58:06   2013-03-18 06:43:01   2013-03-18 07:40:15   S
20184       20054       2013-03-18 02:58:06   2013-03-18 05:44:14   2013-03-18 06:42:18   S
20172       20054       2013-03-18 02:58:06   2013-03-18 03:29:00   2013-03-18 05:43:29   S
20160       19972       2013-03-11 20:03:17   2013-03-11 20:35:43   2013-03-11 22:48:47   S
20148       19951       2013-03-07 15:53:19   2013-03-07 16:23:57   2013-03-07 18:35:55   S
20136       19929       2013-03-05 18:57:20   2013-03-05 19:31:06   2013-03-05 21:41:52   S
20124       19906       2013-03-02 13:32:11   2013-03-02 14:02:51   2013-03-02 16:16:55   S
20112       19903       2013-03-01 21:54:31   2013-03-01 22:28:10   2013-03-02 00:41:01   S
20100       19901       2013-03-01 17:39:47   2013-03-01 18:13:08   2013-03-01 20:27:24   S
20088       19891       2013-03-01 07:21:58   2013-03-01 10:09:32   2013-03-01 11:06:08   S
20076       19891       2013-03-01 07:21:58   2013-03-01 07:53:24   2013-03-01 10:08:55   S
20064       19860       2013-02-27 06:56:28   2013-02-27 07:29:26   2013-02-27 10:12:27   S
20052       19856       2013-02-26 22:28:51   2013-02-26 22:59:59   2013-02-27 01:16:54   S
20040       19850       2013-02-26 17:37:31   2013-02-26 18:12:05   2013-02-26 20:59:12   S
20028       19835       2013-02-22 17:57:28   2013-02-22 18:29:28   2013-02-22 20:46:47   F
sqlite>
```

More digestable in terms of lag until build starts and duration minutes:

```
sqlite> .width 8 8 20 7 7 7
sqlite> select id, rev, datetime(rev_time,'unixepoch') as rev_time, ( started - rev_time )/60 as lagr
id        rev       rev_time              lagmin   durmin   status
--------  --------  --------------------  -------  -------  -------
20496     20242     2013-04-10 23:30:03   23       134      F
20484     20225     2013-04-09 22:46:23   24       133      F
20472     20216     2013-04-09 16:38:09   24       137      F
20460     20193     2013-04-05 20:53:44   23       131      S
20448     20181     2013-04-04 15:48:18   22       133      S
20436     20180     2013-04-04 01:44:20   23       166      S
20424     20176     2013-04-03 20:01:07   24       136      S
20412     20164     2013-04-01 19:15:47   100      134      S
20400     20163     2013-04-01 18:16:26   23       135      S
20388     20160     2013-04-01 05:39:14   21       172      S
20376     20159     2013-04-01 02:26:11   20       138      S
20364     20156     2013-03-29 22:03:47   40       134      S
20352     20154     2013-03-29 20:05:25   21       137      S
20340     20147     2013-03-28 04:59:30   23       133      S
20328     20145     2013-03-27 18:07:13   32       136      S
20316     20143     2013-03-27 16:05:23   20       134      S
20304     20137     2013-03-27 03:19:32   156      58       S
```

```
20292     20137     2013-03-27 03:19:32   20       135      S
20280     20121     2013-03-25 04:37:48   24       135      S
20268     20093     2013-03-20 23:10:20   21       134      S
20256     20084     2013-03-20 16:15:42   22       132      S
20244     20072     2013-03-19 10:37:07   47       133      S
20232     20070     2013-03-19 01:25:52   506      91       S
20220     20069     2013-03-18 14:40:35   20       131      S
20208     20057     2013-03-18 07:26:02   24       129      S
20196     20054     2013-03-18 02:58:06   224      57       S
20184     20054     2013-03-18 02:58:06   166      58       S
20172     20054     2013-03-18 02:58:06   30       134      S
20160     19972     2013-03-11 20:03:17   32       133      S
20148     19951     2013-03-07 15:53:19   30       131      S
20136     19929     2013-03-05 18:57:20   33       130      S
20124     19906     2013-03-02 13:32:11   30       134      S
20112     19903     2013-03-01 21:54:31   33       132      S
20100     19901     2013-03-01 17:39:47   33       134      S
20088     19891     2013-03-01 07:21:58   167      56       S
20076     19891     2013-03-01 07:21:58   31       135      S
20064     19860     2013-02-27 06:56:28   32       163      S
20052     19856     2013-02-26 22:28:51   31       136      S
20040     19850     2013-02-26 17:37:31   34       167      S
20028     19835     2013-02-22 17:57:28   32       137      F
sqlite>

sqlite> select id, rev, datetime(rev_time,'unixepoch') as rev_time, ( started - rev_time )/60 as lagm
id        rev       rev_time              lagmin   durmin   status   config           slave
--------  --------  --------------------  -------  -------  -------  ---------------  ---------------
20498     20242     2013-04-10 23:30:03   21       -227606  I        opt.dybinst      pdyb-02
20496     20242     2013-04-10 23:30:03   23       134      F        opt.dybinst      farm4.dyb.local
20495     20242     2013-04-10 23:30:03   22       99       F        opt.dybinst      daya0004.rcf.br
20486     20225     2013-04-09 22:46:23   24       223      F        opt.dybinst      pdyb-02
20484     20225     2013-04-09 22:46:23   24       133      F        opt.dybinst      farm4.dyb.local
20483     20225     2013-04-09 22:46:23   24       77       F        opt.dybinst      daya0001.rcf.br
20474     20216     2013-04-09 16:38:09   23       238      F        opt.dybinst      pdyb-02
20472     20216     2013-04-09 16:38:09   24       137      F        opt.dybinst      farm4.dyb.local
20471     20216     2013-04-09 16:38:09   23       103      F        opt.dybinst      daya0004.rcf.br
20462     20193     2013-04-05 20:53:44   24       206      S        opt.dybinst      pdyb-02
20460     20193     2013-04-05 20:53:44   23       131      S        opt.dybinst      farm4.dyb.local
20459     20193     2013-04-05 20:53:44   508      76       S        opt.dybinst      daya0001.rcf.br
20450     20181     2013-04-04 15:48:18   21       214      S        opt.dybinst      pdyb-02
20448     20181     2013-04-04 15:48:18   22       133      S        opt.dybinst      farm4.dyb.local
20447     20181     2013-04-04 15:48:18   21       72       S        opt.dybinst      daya0001.rcf.br
20438     20180     2013-04-04 01:44:20   23       243      S        opt.dybinst      pdyb-02
20436     20180     2013-04-04 01:44:20   23       166      S        opt.dybinst      farm4.dyb.local
20435     20180     2013-04-04 01:44:20   22       93       S        opt.dybinst      daya0001.rcf.br
20426     20176     2013-04-03 20:01:07   22       222      S        opt.dybinst      pdyb-02
20424     20176     2013-04-03 20:01:07   24       136      S        opt.dybinst      farm4.dyb.local
20423     20176     2013-04-03 20:01:07   24       79       S        opt.dybinst      daya0001.rcf.br
20414     20164     2013-04-01 19:15:47   171      216      S        opt.dybinst      pdyb-02
20412     20164     2013-04-01 19:15:47   100      134      S        opt.dybinst      farm4.dyb.local
20411     20164     2013-04-01 19:15:47   66       100      S        opt.dybinst      daya0004.rcf.br
20402     20163     2013-04-01 18:16:26   23       206      S        opt.dybinst      pdyb-02
20400     20163     2013-04-01 18:16:26   23       135      S        opt.dybinst      farm4.dyb.local
20399     20163     2013-04-01 18:16:26   24       100      S        opt.dybinst      daya0004.rcf.br
20390     20160     2013-04-01 05:39:14   24       259      S        opt.dybinst      pdyb-02
20388     20160     2013-04-01 05:39:14   21       172      S        opt.dybinst      farm4.dyb.local
20387     20160     2013-04-01 05:39:14   24       123      S        opt.dybinst      daya0004.rcf.br
```

```
20378     20159     2013-04-01 02:26:11   502      217      S        opt.dybinst      pdyb-02
20376     20159     2013-04-01 02:26:11   20       138      S        opt.dybinst      farm4.dyb.local
20375     20159     2013-04-01 02:26:11   24       101      S        opt.dybinst      daya0004.rcf.bn
20366     20156     2013-03-29 22:03:47   106      204      S        opt.dybinst      pdyb-02
20364     20156     2013-03-29 22:03:47   40       134      S        opt.dybinst      farm4.dyb.local
20363     20156     2013-03-29 22:03:47   22       99       S        opt.dybinst      daya0004.rcf.bn
20354     20154     2013-03-29 20:05:25   21       202      S        opt.dybinst      pdyb-02
20352     20154     2013-03-29 20:05:25   21       137      S        opt.dybinst      farm4.dyb.local
20351     20154     2013-03-29 20:05:25   22       103      S        opt.dybinst      daya0004.rcf.bn
20342     20147     2013-03-28 04:59:30   21       225      S        opt.dybinst      pdyb-02
```

22.13 MySQL DB Repair

22.13.1 MySQL Table Repair

Considerations for the repair of corrupt MySQL tables.

1. database backup mandatory before attempting repairs, as **data loss is a very real possibility**
2. large disk space is required for the dump files, **filling disks is known to be a cause of MySQL corruption**
   - estimate the disk space required for the dump, using queries shown below
   - check disk space available is comfortably adequate, remember the tarball and hotcopy directory will need to exist at the same time : so double the total obtained from the DB query
3. if the DB is actively being updated consider
   - need locking or other means to ensure consistent set of tables
   - must not lock for too long, or will kill writers : also backups are a large CPU load
4. doing backups is expensive and time consuming, with default settings of mysqldump the table will be locked for possibly an extended period
   - http://www.ducea.com/2006/10/26/dumping-large-mysql-innodb-tables/

Check table types and sizes

The *MB* sizes include indices which are not dumped, so dumpfiles might not be as big as feared (we shall see).

```
mysql> select table_name,table_type, engine, round((data_length+index_length-data_free)/1024/1024,2)
+-----------------------+------------+-----------+---------+
| table_name            | table_type | engine    | MB      |
+-----------------------+------------+-----------+---------+
| ChannelQuality        | BASE TABLE | MyISAM    |   47.31 |
| ChannelQualityVld     | BASE TABLE | MyISAM    |    0.53 |
| DaqRawDataFileInfo    | BASE TABLE | FEDERATED |   67.04 |
| DaqRawDataFileInfoVld | BASE TABLE | FEDERATED |   13.23 |
| DqChannel             | BASE TABLE | MyISAM    | 3570.58 |
| DqChannelStatus       | BASE TABLE | MyISAM    | 2338.56 |
| DqChannelStatusVld    | BASE TABLE | MyISAM    |   20.12 |
| DqChannelVld          | BASE TABLE | MyISAM    |   19.91 |
| LOCALSEQNO            | BASE TABLE | MyISAM    |    0.00 |
+-----------------------+------------+-----------+---------+
9 rows in set (0.09 sec)
```

```
mysql> select table_name,table_type, engine, round((data_length+index_length-data_free)/1024/1024,2)
+---------------------------+------------+--------+-------+
| table_name                | table_type | engine | MB    |
+---------------------------+------------+--------+-------+
| CableMap                  | BASE TABLE | MyISAM |  3.86 |
| CableMapVld               | BASE TABLE | MyISAM |  0.03 |
| CalibPmtFineGain          | BASE TABLE | MyISAM | 10.17 |
| CalibPmtFineGainVld       | BASE TABLE | MyISAM |  0.08 |
| CalibPmtHighGain          | BASE TABLE | MyISAM |  9.14 |
| CalibPmtHighGainPariah    | BASE TABLE | MyISAM | 49.42 |
| CalibPmtHighGainPariahVld | BASE TABLE | MyISAM |  0.38 |
| CalibPmtHighGainVld       | BASE TABLE | MyISAM |  0.08 |
| DcsAdWpHv                 | BASE TABLE | MyISAM | 35.81 |
| DcsAdWpHvVld              | BASE TABLE | MyISAM |  0.27 |
| Demo                      | BASE TABLE | MyISAM |  0.00 |
| DemoVld                   | BASE TABLE | MyISAM |  0.00 |
| DqChannelPacked           | BASE TABLE | MyISAM | 18.61 |
| DqChannelPackedVld        | BASE TABLE | MyISAM | 18.87 |
| HardwareID                | BASE TABLE | MyISAM |  5.50 |
| HardwareIDVld             | BASE TABLE | MyISAM |  0.02 |
| LOCALSEQNO                | BASE TABLE | MyISAM |  0.00 |
| McsPos                    | BASE TABLE | MyISAM |  0.00 |
| McsPosVld                 | BASE TABLE | MyISAM |  0.00 |
| PhysAd                    | BASE TABLE | MyISAM |  0.00 |
| PhysAdVld                 | BASE TABLE | MyISAM |  0.00 |
| SupernovaTrigger          | BASE TABLE | MyISAM |  0.00 |
| SupernovaTriggerVld       | BASE TABLE | MyISAM |  0.00 |
+---------------------------+------------+--------+-------+
23 rows in set (0.05 sec)

mysql> select count(*) from DqChannelPacked ;
+----------+
| count(*) |
+----------+
|   323000 |
+----------+
1 row in set (0.00 sec)
```

22.13.2 MySQL Backup/Recovery Tools

mysqldump is convenient as it works remotely, but for large DBs when you have access to the server *mysqlhotcopy* will be many orders of magnitude faster. As we are using mostly MyISAM tables the only way to create a consistent set of tables without locking the DB for a very long time will be *mysqlhotcopy*

mysqldump

- http://dev.mysql.com/doc/refman/5.0/en/mysqldump.html
- http://dev.mysql.com/doc/refman/5.0/en/mysqldump.html#option_mysqldump_single-transaction

The *–single-transaction* option is useful only with transactional tables such as InnoDB and BDB, not **MyISAM** tables. For **MyISAM** using *–lock-tables* seems neccessary for a consistent set, but that demands privileges I probably dont have for IHEP servers.

```
dbdumpload.py --tables "ChannelQuality ChannelQualityVld DqChannel DqChannelVld DqChannelStatus DqCha
time /data1/env/local/dyb/external/mysql/5.0.67/i686-slc5-gcc41-dbg/bin/mysqldump
```

```
    --no-defaults
    --skip-opt
    --extended-insert
    --quick
    --host=dybdb1.ihep.ac.cn --user=ligs --password=***
            tmp_ligs_offline_db ChannelQuality ChannelQualityVld DqChannel DqChannelVld DqChannelSta
```

Warning: Looks like this needs to be changed to lock

mysqlhotcopy

- *perldoc mysqlhotcopy* provides better documentation than http://dev.mysql.com/doc/refman/5.0/en/mysqlhotcopy.html
- **only works** for backing up MyISAM and ARCHIVE tables.
- really fast because it just locks tables and copies files

```
[blyth@belle7 DybPython]$ sudo ls -l  /var/lib/mysql/tmp_offline_db/
total 157200
-rw-rw---- 1 mysql mysql     8684 Aug 17  2012 CableMap.frm
-rw-rw---- 1 mysql mysql  2191045 Aug 17  2012 CableMap.MYD
-rw-rw---- 1 mysql mysql  1858560 Aug 18  2012 CableMap.MYI
-rw-rw---- 1 mysql mysql     8908 Aug 17  2012 CableMapVld.frm
-rw-rw---- 1 mysql mysql    25959 Aug 17  2012 CableMapVld.MYD
-rw-rw---- 1 mysql mysql     7168 Aug 18  2012 CableMapVld.MYI
...
```

- this means recovery is fiddly and limited wrt mysql version changes unlike mysqldump
- http://edoxy.net/Blog/40-Creating-and-restoring-MySQL-hotcopy-backups.html
- the path to the socket can be found in */etc/my.cnf*
- output directory needs to be empty and owned by root
- create a section *mysqlhotcopy* in `~/.my.cnf` to specify the

Usage

Create a *mysqlhotcopy* section in `~/.my.cnf` with localhost server coordinates and socket specified, the appropriate socket path can be found in `/etc/my.cnf`

```
[mysqlhotcopy]
socket    = /var/lib/mysql/mysql.sock
host      = localhost
user      = root
password  = ***
```

mysqlhotcopy.py

Try to test the repair on remote node

mysqlhotcopy operates at a very low level, so corruption will travel with the backup

A python wrapper script using the mysqlhotcopy command and the python tarfile module and MySQL-python extension to provide sanity checking, file management, remote node transfers.

- e:mysqlhotcopy/mysqlhotcopy details on script usage with many examples
- env:source:trunk/mysqlhotcopy sources for the script

22.13.3 Corruption incident *tmp_ligs_offline_db* : timeline and next steps

- Timeline Summary
- Next Steps

Timeline Summary

April 30 corruption occurs (assumed to be due to a killed KUP job) it goes unnoticed the DqChannelStatus table continuing to be written to

May 13 while performing a test compression run on DqChannelStatus corrupt SEQNO 323575 in DqChannelStatus is discovered dybsvn:ticket:1347#comment:20

May 14 begin development of env:source:trunk/mysqlhotcopy/mysqlhotcopy.py with *hotcopy/archive/extract/transfer* capabilities

May 15 formulate plan of action the first step of which is making a hotcopy backup

May 16 start working with Qiumei get to *mysqlhotcopy.py* operational on dybdb1.ihep.ac.cn, Miao notifies us that CQ filling is suspended

May 17-23 development via email (~18 email exchanges and ~20 env commits later, numerous issues every one of which required email exchange and related delays)

May 19 *2013-05-19 08:22:20* CQ filling resumes (contrary to expectations), but writes are Validity only due to the crashed payload table

May 20 1st attempt to perform hotcopy on dybdb1 meets error due to crashed table, originally thought that the hotcopy *flush* might have caused the crashed state, but the timing of the last validity insert *2013-05-19 22:26:55* is suggestive that the crash was due to this

May 21 Gaosong notes that cannot access the DqChannelStatus table at all, due to crashed status

May 23 finally a coldcopy (hotcopy fails due to crashed table) tarball transferred to NUU, and is extracted into DB and repaired

May 23-30 investigate approaches to getting recovered tables onto dybdb1 without long outtages. Using

May 24 Simon suggests name change from *tmp_ligs_offline_db* to reflect the critical nature of the DB. Gaosong agrees suggesting *channelquality_db* and using a clean cut approach to chop off inconsistent SEQNO

May 27 Uncover non-alignment of DqChannel and DqChannelStatus tables due to concurrent DBI writing using dybgaudi:Database/Scraper/python/Scraper/dq/cq_zip_check.py

May 29 Investigations of concurrent DBI writing using external locking conclude that the reward is not worth the effort dybgaudi:Database/DybDbi/tests/test_dbi_locking.sh

May 30 Tests of recovery at NUU using mysqldump took 70 min during which time the server was unresponsive. This is too long for comfort on primary server. Also tests of loading CSV dumps are uncomfortably long ~40 min for such large tables. Test approach of creating and populating tables on version matched server on belle1 then simply using mysqlhotcopy.py archiving and extraction functionality to transfer the pre-cooked tables. This

minimises load on the primary server, with the server continuing to function normally during 5 min of extracting the table tarball out to 9.2 G

May ~30 stood up MySQL server of version precisely matching that of dybdb1/2 e:/mysql/mysqlrpm due to concerns about limitations regards repairing tables created on different versions http://dev.mysql.com/doc/refman/5.0/en/repair-table.html

May 31 Instruct Qiumei how to recover repaired tables into a newly created DB on dybdb2 channelquality_db e:mysqlhotcopy/mysql_repair_table_live/#dybdb1-extraction-instructions-for-qiumei

Turns out to be not enough disk space on server to safely do the restoration.

June 4-6 Qiumei installs disk usage monitoring scripts on dybdb1 and dybdb2 e:db/valmon/ Delayed by a very old server with ancient sqlite forcing from source install of pysqlite e:sqlite/pysqlite/#static-amalgamation-install

June 5 Qiumei suceeds to install the repaired tables into a new DB *channelquality_db* on dybdb2

June 6 Validate DqChannel is the same up to the cutoff SEQNO between:

```
dybdb1.tmp_ligs_offline_db.DqChannel + Vld
dybdb2.channelquality_db.DqChannel + Vld
```

June 8 New disks installed on dybdb1 and dybdb2, thanks to Miao/Weidong for the speedy upgrade

June 11 Validated *dybdb2.channelquality_db.DqChannelStatus* by reimplementation of the CQ python judge method as a MySQL query (using nested case statements) applied to the ingredients table. Allowing all 62M judgements to be redone in 40 min. Comparing the results of this independent re-judge against the repaired DqChannelStatus yielded 1 discrepant bit out of 62M arising from a cut edge numerical precision difference. Thus confirming the validity of the repaired DqChannelStatus table.

- dybgaudi:Database/Scraper/python/Scraper/dq/CQJudge.py
- dybgaudi:Database/Scraper/python/Scraper/dq/CQValidate.py

June 13 Instruct Qiumei to setup partitioned channelquality_db backup system on dybdb2. Multi gigabyte DB are handled by dividing into partitions of 10k SEQNO drastically reducing backup load.

- oum:api/dbsrv/#installation-on-dybdb2

June 19 After fixing some ssh issues Qiumei succeeds to get interactive partitioned backups of *channelquality_db* from dybdb2 to NTU operational.

June 24 Following several interations(crontab errors,ssh environment) automated cron controlled partitioned backups are operational although ongoing careful monitoring of logs is needed until have gone through a complete state cycle (new partitions etc..)

June 26 Confirm that the *channelquality_db* can be precisely restored from the partitioned backup. Request that Miao/Gaosong proceed to re-fill the lost entries.

Next Steps

Once Miao/Gaosong confirms the refilling is updated.

1. Simon runs the compression script creating DqChannelPacked+Vld [running time was 26hrs up to SEQNO 323000, so estimate ~1 day to extend that to cover the KUP re-filling and make some validations.]

   The packed tables are a factor of 125 times smaller than the profligate DqChannelStatus, so mysqldump loading can be used to propagate the new table into *offline_db*

2. Liang load mysqldump into *offline_db.DqChannelPacked+Vld*
3. Brett tests service reading from *offline_db.DqChannelPacked*

4. Simon tests the scraper/compressor and works with Liang/Qiumei/Gaosong to get that running under cron control
    - dybgaudi:Database/Scraper/python/Scraper/dq/CQScraper.py

22.13.4 Lessons from MySQL corruption incident

Such rare events of DB corruption may recur no matter what we do. The improvements we implement in response to this should focus on preventive measures, mitigating the pain/disruption if it does recur and defining and documenting procedures for such incidents.

Preventive Avoidance

- avoid writing more that we need to, the DqChannelStatus tables use a ruinously profligate schema (by a factor of **125**) they are currently ~2350 MB (~14 months) they could be ~19 MB with no loss of information. As demonstrated by the size of DqChannelPacked.

  The probability of corruption probably scales with the time/volume of writes so it is no surprise that DQ tables are the first to see corruption.
- disk space monitoring at least daily with email notifications on all critical nodes especially *dybdb1.ihep.ac.cn* and *dybdb2.ihep.ac.cn*, reorganization/purchases to avoid tight disk space
- queue draining procedures for DB writing jobs

Large DB very different to small ones

Tools and procedures developed to handle DB of tens of megabytes mostly not applicable to multi GB databases. Required creation of new tools and optimised procedures.

Mitigating Pain/Disruption of corruption recovery

- automatic daily backups + remote tarball transfers + operation monitor for all critical databases,
  - *offline_db* has been for many years,
  - *channelquality_db* recently implemented partial backup, operational and validated but still under close scrutiny

  Replication is not a replacement for backups as "drop database" gets propagated along the chain within seconds.

  The servers are claimed to have disk level backups. However these do not lock the DB during the backup and without regular tests that backups are recoverable from I do not trust them. The backups of *offline_db* are recovered onto an NTU node daily.
- processes that perform critical tasks such as DB writing need logfile monitoring with email notifications when things go awry

TODO: Investigate DBI response to crashed payload OR validity table

Probably just need all unattended DB writing to check the written SEQNO is non-zero:

```
wseqno = wrt.Close()  # closing DybDbi writer returns SEQNO written OR zero on error
assert wseqno, wseqno
```

But checking DBI behavior when writing into a "crashed" payload table might suggest some DBI improvements beyond this usage change. Clearly the observered behavior of continuing to write into the validity table after the payload was corrupted is not appropriate.

A rapid job abort would have given a clean cut, and hopefully notified us of the problem sooner.

I have the crashed table in a tarball, so I can now reproduce DBI writing into a crashed table and observe the current error handling and see where improvements need to be made. Either in DBI/DybDBI or its usage/documentation.

SOP for MySQL corruption

As soon as corruption is detected, presumbaly from failed KUP jobs

Continuing to write just makes a mess

Trying to allow writing to continue is pointless, as this just creates an inconsistent mess that will needs to removed anyhow

- stop writing to corrupted tables and other related tables until recovery is done and resumption is agreed by DB managers, sys admins, KUP job admins and table experts
  - could enforce readonly by appropiate *GRANT...* statements if controlling KUP jobs is problematic
- check the state of the automated backups by a remote node restoration and comparison with source tables that remain acccessible, transfered to remote node via mysqldump OR mysqlhotcopy
  - perform mysqldump or mysqlhotcopy (possibly with some SEQNO excluded) and transfer to a remote node in which the they are recovered from
- coordinate with table experts to decide on appropriate SEQNO cutoffs
- repairs could be attempted but as long as the backup system was operational there is no need to rely on that working

Comparing tables sizes of uncompressed and compressed tables

Table DqChannelStatus contains the same information as DqChannelPacked:

```
mysql> select concat(table_schema,".",table_name),table_type, engine, round((data_length+index_length
+-----------------------------------------+------------+--------+---------+
| concat(table_schema,".",table_name)      | table_type | engine | MB      |
+-----------------------------------------+------------+--------+---------+
| tmp_ligs_offline_db_0.DqChannelStatus    | BASE TABLE | MyISAM | 2265.14 |
| tmp_ligs_offline_db_0.DqChannelStatusVld | BASE TABLE | MyISAM |   20.24 |
| tmp_ligs_offline_db_1.DqChannelStatus    | BASE TABLE | MyISAM | 2349.86 |
| tmp_ligs_offline_db_1.DqChannelStatusVld | BASE TABLE | MyISAM |   20.24 |
| tmp_offline_db.DqChannelPacked           | BASE TABLE | MyISAM |   18.61 |
| tmp_offline_db.DqChannelPackedVld        | BASE TABLE | MyISAM |   18.87 |
+-----------------------------------------+------------+--------+---------+
6 rows in set (0.01 sec)

mysql> select max(SEQNO) from tmp_offline_db.DqChannelPacked ;
+------------+
| max(SEQNO) |
+------------+
|     323000 |
+------------+
```

```
1 row in set (0.04 sec)

mysql> select max(SEQNO) from tmp_ligs_offline_db_1.DqChannelStatus ;
+------------+
| max(SEQNO) |
+------------+
|     340817 |
+------------+
1 row in set (0.06 sec)

mysql> select 2349.86/18.61 ;
+---------------+
| 2349.86/18.61 |
+---------------+
|    126.268673 |
+---------------+
1 row in set (0.00 sec)
```

About the AOP

The AOP is sourced from reStructuredText in dybgaudi:Documentation/OfflineUserManual/tex/aop, and html and pdf versions are derived as part of the automated Offline User Manual build. For help with building see *Build Instructions for Sphinx based documentation*

CHAPTER

TWENTYTHREE

NUWA PYTHON API

Release 22909

Date May 16, 2014

See *Autodoc : pulling reStructuredText from docstrings* for a description of how this python API documentation was extracted from source docstrings.

23.1 DB

23.1.1 DybPython.db

$Id: db.py 22557 2014-02-20 07:08:30Z blyth $

DB operations performed via MySQLdb:

```
./db.py [options] <dbconf> <cmd>
```

Each invokation of this script talks to a single database only. A successful connection to "sectname" requires the config file (default `~/.my.cnf`) named section to provide the below keys, eg:

```
[offline_db]
host = dybdb1.ihep.ac.cn
user = dayabay
password = youknowit
database = offline_db

[tmp_username_offline_db]
...
```

For a wider view of how `db.py` is used see *DB Table Updating Workflow*

TODO

1. dry run option to report commands that would have been used without doing them
2. better logging and streamlined output

Required Arguments

dbconf the name of the section in ~/.my.cnf that specifies the host/database/user/password to use in making connection to the mysql server

cmd perform command on the database specified in the prior argument. NB some commands can only be performed locally, that is on the same node that the MySQL server is running on.

command summary

Command	Action	Note
dump	performs mysqldump, works remotely	special LOCALSEQNO handling
load	loads mysqldump, works remotely	very slow when done remotely, insert statement for every row
rdumpcat	dumps ascii catalog, works remotely	duplicates dumpcat output using low level _mysql uses LOCALSEQNO merging
rloadcat	loads ascii catalog, works remotely	mysqlimport implementation,
rcmpcat	compare ascii catalog with DB	readonly command
ls	lists tables in various sets	
cli	emit mysql client connection cmdline	Does not actually connect

former commands

Command	Action	Note
dumpcat	dumps ascii catalog, LOCAL ONLY	SELECT ... INTO OUTFILE
loadcat	loads ascii catalog, LOCAL ONLY	LOAD DATA LOCAL INFILE ... INTO TABLE

Former **loadcat** and **dumpcat** can be mimicked with `--local` option of **rdumpcat** and **rloadcat**. These are for expert usage only into self administered database servers.

using db.py in standalone manner (ie without NuWa)

This script is usuable with any recent python which has the mysql-python (1.2.2 or 1.2.3) package installed.

Check your python and mysql-python with:

```
which python
python -V
python -c "import MySQLdb as _ ; print _.__version__ "
```

Checkout `DybPython/python/DybPython` in order to access *db.py*, *dbcmd.py* and *dbconf.py*, for example with

```
cd
svn co http://dayabay.ihep.ac.cn/svn/dybsvn/dybgaudi/trunk/DybPython/python/DybPython
chmod u+x DybPython/db.py
```

Use as normal:

```
~/DybPython/db.py --help
~/DybPython/db.py offline_db count
```

checkout offline_db catalog from dybaux

Example, checkout OR update the catalog:

```
mkdir ~/dybaux
cd ~/dybaux
svn co http://dayabay.ihep.ac.cn/svn/dybaux/catalog
```

OR

```
cd ~/dybaux/catalog
svn up
```

rdumpcat `tmp_offline_db` into dybaux working copy:

```
db.py tmp_offline_db rdumpcat ~/dybaux/catalog/tmp_offline_db
```

Test usage of serialized ascii DB

Get into environment and directory of pkg dybgaudi:Database/DybDbi Modify the config to use ascii DB, for an example see dybgaudi:Database/DybDbi/tests/test_calibpmtspec.py

rloadcat testing, DB time machine

Warning: **forced_rloadcat** is for testing only, it skips checks and ploughs ahead with the load, also `--DROP` option drops and recreates tables

Fabricate a former state of the DB using **forced_rloadcat** and an earlier revision from dybaux, with:

```
## get to a clean revision of catalog (blowing away prior avoids conflicts when doing that)
rm -rf ~/dybaux/catalog/tmp_offline_db  ; svn up -r 4963 ~/dybaux/catalog/tmp_offline_db

## forcefully propagate that state into the tmp_offline_db
./db.py tmp_offline_db forced_rloadcat ~/dybaux/catalog/tmp_offline_db --DROP

## compare DB and catalog .. no updates should be found
./db.py tmp_offline_db rcmpcat ~/dybaux/catalog/tmp_offline_db

## wind up the revision
rm -rf ~/dybaux/catalog/tmp_offline_db  ; svn up -r 4964 ~/dybaux/catalog/tmp_offline_db

## compare DB and catalog again  ... updates expected, check timeline diffs
./db.py tmp_offline_db rcmpcat ~/dybaux/catalog/tmp_offline_db

## test rloadcat operation and check diffs afterwards
./db.py tmp_offline_db rloadcat ~/dybaux/catalog/tmp_offline_db
./db.py tmp_offline_db rcmpcat ~/dybaux/catalog/tmp_offline_db
```

23.1.2 DybPython.db.DB

class DybPython.db.**DB**(*sect=None*, *opts={}*, ***kwa*)

Bases: object

Initialize config dict corresponding to section of config file

Parameters **sect** – section in config file

allseqno
Provides a table name keyed dict containing lists of all SEQNO in each Vld table The tables included correspond to the read DBI tables (namely those in LOCALSEQNO)

check_(**args*, ***kwa*)
check connection to DB by issuing a SELECT of info functions such as DATABASE() and CURRENT_USER() command

check_allseqno()

check_seqno()
Compares the LASTUSEDSEQNO entries read into `self._seqno` with the `max(SEQNO)` results of selects on the DB payload and validity tables.

cli_(**args*, ***kwa*)
Emit to stdout the shell commandline for connecting to a mysql DB via the client, without actually doing so. The section names depends on content of `~/.my.cnf`

Usage:

```
eval $(db.py tmp_offline_db cli)
```

Bash function examples to define in `~/.bash_profile` using this command:

```
    idb(){ local cnf=$1 ; shift ; eval $(db.py $cnf cli) $* ; }
    offline_db(){              idb $FUNCNAME $* ; }
    tmp_offline_db(){          idb $FUNCNAME $* ; }
    tmp_etw_offline_db(){      idb $FUNCNAME $* ; }
    tmp_jpochoa_offline_db(){ idb $FUNCNAME $* ; }
    ihep_dcs(){                idb $FUNCNAME $* ; }

Invoke the shortcut with fast start extra argument for the client::

    ihep_dcs -A
```

Note a lower level *almost* equivalent command to this sub-command for standalone usage without *db.py* is provided by *my.py* which can probably run with the older system python alone. Install into your PATH with:

```
svn export http://dayabay.ihep.ac.cn/svn/dybsvn/dybgaudi/trunk/DybPython/scripts/my.py
```

count_(**args*, ***kwa*)
List table counts of all tables in database, usage example:

```
db.py offline_db count
```

offline_db is `~/.my.cnf` section name specifying host/database/user/password

desc(*tab*)
Header line with table definition in .csv files shift the pk definition to the end

describe(*tab*)

classmethod docs()
collect the docstrings on command methods identified by naming convention of ending with _ (and not starting with _)

dump_(**args*, ***kwa*)
Dumps tables from any accessible database into a mysqldump file. Usage:

```
db.py                          offline_db dump /tmp/offline_db.sql  ## without -t a default li
db.py -t CableMap,HardwareID offline_db dump /tmp/offline_db.sql
tail -25  /tmp/offline_db.sql                                       ## checking tail, look for
```

Use the `-t/--tselect` option with a comma delimited list of to select payload tables. Corresponding validity tables and the *LOCALSEQNO* table are included automatically.

The now default `-d/--decoupled` option means that the `LOCALSEQNO` table is dumped separately and only contains entries corresponding to the selected tables. The decoupled dump can be loaded into `tmp_offline_db` without any special options, as the table selection is reflected within the dump:

```
db.py tmp_offline_db load  /tmp/offline_db.sql
```

Partial dumping is implemented using:

```
mysqldump ... --where="TABLENAME IN ('*','CableMap','HardwareID')" LOCALSEQNO
```

fabseqno

Summarizes `db.allseqno`, by fabricating a dict keyed by table name contaoning the number of Vld SEQNO (from length of values in `db.allseqno`)

This dict can be compared with `db.seqno`, which is obtained from the LASTUSEDSEQNO entries in the `LOCALSEQNO` table:: Assuming kosher DBI handling of tables this fabricated dict `db.fabseqno` should match `db.seqno`, meaning that SEQNO start from 1 and have no gaps.

```
In [1]: from DybPython import DB

In [2]: db = DB("tmp_fake_offline_db")

In [3]: db.seqno   ## queries the LOCALSEQNO table in DB
Out[3]:
{'CableMap': 213,
 'CalibFeeSpec': 113,
 'CalibPmtSpec': 29,
 'FeeCableMap': 3,
 'HardwareID': 172}

In [4]: db.fabseqno    ## a summarization of db.allseqno
Out[4]:
{'CableMap': 213,
 'CalibFeeSpec': 111,
 'CalibPmtSpec': 8,
 'FeeCableMap': 3,
 'HardwareID': 172}

In [5]: db.miscreants   ## assertions avoided by miscreant status
Out[5]: ('CalibPmtSpec', 'CalibFeeSpec')
```

forced_rloadcat_(**args*, ***kwa*)
Forcible loading of a catalog ... FOR TESTING ONLY

get_allseqno()
Provides a table name keyed dict containing lists of all SEQNO in each Vld table The tables included correspond to the read DBI tables (namely those in LOCALSEQNO)

get_fabseqno()

Summarizes `db.allseqno`, by fabricating a dict keyed by table name contaoning the number of Vld SEQNO (from length of values in `db.allseqno`)

This dict can be compared with `db.seqno`, which is obtained from the LASTUSEDSEQNO entries in the `LOCALSEQNO` table:: Assuming kosher DBI handling of tables this fabricated dict `db.fabseqno` should match `db.seqno`, meaning that SEQNO start from 1 and have no gaps.

```
In [1]: from DybPython import DB

In [2]: db = DB("tmp_fake_offline_db")

In [3]: db.seqno   ## queries the LOCALSEQNO table in DB
Out[3]:
{'CableMap': 213,
 'CalibFeeSpec': 113,
 'CalibPmtSpec': 29,
 'FeeCableMap': 3,
 'HardwareID': 172}

In [4]: db.fabseqno    ## a summarization of db.allseqno
Out[4]:
{'CableMap': 213,
 'CalibFeeSpec': 111,
 'CalibPmtSpec': 8,
 'FeeCableMap': 3,
 'HardwareID': 172}

In [5]: db.miscreants   ## assertions avoided by miscreant status
Out[5]: ('CalibPmtSpec', 'CalibFeeSpec')
```

get_seqno()

SEQNO accessor, reading and checking is done on first access to `self.seqno` with

```
db = DB()
print db.seqno   ## checks DB
print db.seqno   ## uses cached
del db._seqno    ## force a re-read and check
print db.seqno
```

has_table(*tn*)

Parameters **tn** – table name

Return exists if table exists in the DB

load_(**args*, ***kwa*)

Loads tables from a mysqldump file into a target db, the target db is configured by the parameters in the for example *tmp_offline_db* section of the config file. For safety the name of the configured target database must begin with *tmp_*

Note: CAUTION IF THE TARGET DATABASE EXISTS ALREADY IT WILL BE DROPPED AND RECREATED BY THIS COMMAND

Usage example:

```
db.py tmp_offline_db load /tmp/offline_db.sql
```

loadcsv(*cat*, *tn*)

Parameters

- **cat** – AsciiCat instance
- **tn** – string payload table name or LOCALSEQNO

ls_(**args*, ***kwa*)
Usage:

```
./db.py tmp_offline_db ls
```

Annotation '-' indicates tables not in the table selection, typically only the below types of tables should appear with '-' annotation.

1.non-SOP tables such as scraped tables

2.temporary working tables not intended for offline_db

If a table appears with annotation '-' that is not one of the above cases then either `db.py` **tselect** needs to be updated to accomodate a new table (ask Liang to do this) OR you need to update your version of `db.py`. The first few lines of `db.py --help` lists the revision in use.

See dybsvn:ticket:1269 for issue with adding new table McsPos that this command would have helped to diagnose rapidly.

mysql(**args*, ***kwa*)

noop_(**args*, ***kwa*)
Do nothing command, allowing to just instanciate the DB object and provide it for interactive prodding, eg:

```
~/v/db/bin/ipython -- ~/DybPython/db.py tmp_offline_db noop

In [1]: db("show tables")     ## high level

In [2]: db.llconn.query("select * from CalibPmtSpecVld")    ## lowlevel _mysql
In [3]: r = db.conn.store_result()
```

This also demonstrates standalone `db.py` usage, assuming svn checkout:

```
svn co http://dayabay.ihep.ac.cn/svn/dybsvn/dybgaudi/trunk/DybPython/python/DybPython
```

optables
List of tables that commands such as **rdumpcat** perform operations on, outcome depends on:

1.table selection from the *-t/–tselect* option

2.decoupled option setting

3.DBCONF section name, where name **offline_db** is regarded as special

The default value of the table selection option constitutes the current standard set of DBI tables that should be reflected in the dybaux catalog.

When following the SOP in the now default "decoupled" mode the **offline_db** rdumpcat needs to abide by the table selection in force, whereas when dumping from **tmp_offline_db** onto a dybaux checkout need to dump all of the subset. Rather than the default table selection.

This special casing avoids the need for the `-t` selection when rdumpcating **tmp_offline_db**

outfile(*tab*)
Path of raw outfile as dumped by SELECT ... INTO OUTFILE

paytables
list of selected DBI payload tables

predump()
Checks performed before : **dump**, **dumpcat**, **rdumpcat**

rcmpcat_(**args*, ***kwa*)

Just dumps a comparison between target DB and ascii catalog, allowing the actions an **rloadcat** will do to be previewed.

Compares DBI vitals such as LASTUSEDSEQNO between a DBI database and a DBI ascii catalog, usage:

```
./db.py tmp_offline_db rcmpcat ~/dybaux/catalog/tmp_offline_db
```

rdumpcat_(**args*, ***kwa*)

Dumps DBI tables and merges LOCALSEQNO from `tmp_offline_db` into a pre-existing ascii catalog. Usage:

```
db.py -d   tmp_offline_db rdumpcat ~/dybaux/catalog/tmp_offline_db       ## -d/--decoupled i
db.py      tmp_offline_db rdumpcat ~/dybaux/catalog/tmp_offline_db

svn status ~/dybaux/catalog/tmp_offline_db                              ## see whats change
```

Features of the default `-d/--decoupled` option:

1. requires dumping into a pre-existing catalog
2. subset of tables present in the DB are dumped
3. partial LOCALSEQNO.csv is merged into the pre-existing catalog LOCALSEQNO.csv
4. performs safe writes, if the merge fails detritus files with names ending `.csv._safe` and `.csv._merged` will be left in the working copy

With alternate `-D/--nodecoupled` option must ensure that the table selection is appropriate to the content of the DB:

```
db.py -D -t CableMap,HardwareID   offline_db rdumpcat ~/offline_db
```

To obtain the dybaux SVN catalog:

```
mkdir ~/dybaux
cd ~/dybaux ;
svn co http://dayabay.ihep.ac.cn/svn/dybaux/catalog
```

The ascii catalog is structured

```
~/dybaux/catalog/tmp_offline_db
           tmp_offline_db.cat
           CalibFeeSpec/
               CalibFeeSpec.csv
               CalibFeeSpecVld.csv
           CalibPmtSpec/
               CalibPmtSpec.csv
               CalibPmtSpecVld.csv
           ...
           LOCALSEQNO/
               LOCALSEQNO.csv
```

The .csv files comprise a single header line with the table definition and remainder containing the row data.

ADVANCED USAGE OF ASCII CATALOGS IN CASCADES

The resulting catalog can be used in a DBI cascade by setting DBCONF to:

```
tmp_offline_db_ascii:offline_db
```

Assuming a section:

```
[tmp_offline_db_ascii]
host = localhost
user = whatever
password = whatever
db = tmp_offline_db#/path/to/catname/catname.cat
```

NB from dybsvn:r9869 /path/to/catname/catname.cat can also be a remote URL such as

```
http://dayabay:youknowit\@dayabay.ihep.ac.cn/svn/dybaux/trunk/db/cat/zhe/trial/trial.cat
http://dayabay:youknowit\@dayabay.ihep.ac.cn/svn/dybaux/!svn/bc/8000/trunk/db/cat/zhe/trial/
```

When stuffing basic authentication credentials into the URL it is necessary to backslash escape the "@" to avoid confusing DBI(TUrl) Note the use of "!svn/bc/NNNN" that requests apache mod_dav_svn to provide a specific revision of the catalog. rather than the default latest.

ADVANTAGES OF CATALOG FORMAT OVER MYSQLDUMP SERIALIZATIONS

- •effectively native DBI format that can be used in ascii cascades allowing previewing of future database after updates are made
- •very simple/easily parsable .csv that can be read by multiple tools
- •very simple diffs (DBI updates should be contiguous additional lines), unlike mysqldump, this means efficient storage in SVN
- •no-variants/options that change the format (unlike mysqldump)
- •no changes between versions of mysql
- •much faster to load than mysqldumps

IMPLEMENTATION NOTES

1. *mysql* does not support remote *SELECT ... INTO OUTFILE* even with *OUTFILE=/dev/stdout*
2. *mysqldump -Tpath/to/dumpdir* has the same limitation

To workaround these limitations a *csvdirect* approach is taken where low level mysql-python is used to perform a `select *` on selected tables and the strings obtained are written directly to the csv files of the catalog. Low-level mysql-python is used to avoid pointless conversion of strings from the underlying mysql C-api into python types and then back into strings.

read_desc(*tabfile*)
Read first line of csv file containing the description

read_seqno(*tab='LOCALSEQNO'*)
Read LASTUSEDSEQNO entries from table `LOCALSEQNO`

rloadcat_(**args*, ***kwa*)
Loads an ascii catalog into a possibly remote database. This is used by DB managers in the final step of the update SOP to propagate `dybaux` updates into `offline_db`.

Usage:

```
./db.py tmp_offline_db rloadcat ~/dybaux/catalog/tmp_offline_db
```

Steps taken by **rloadcat**:

1. compares tables and *SEQNO* present in the ascii catalog with those in the DB and reports diffences found. The comparison looks both at the `LOCALSEQNO` tables that DBI uses to hold the *LASTUSEDSEQNO* for each table and also by looking directly at all *SEQNO* present in the validity tables. The **rcmpcat** command does only these comparisons.
2. if updates are found the user is asked for consent to continue with updating

3. for the rows (*SEQNO*) that are added by the update the catalog validity tables `INSERTDATE` timestamps are *fastforwarded* inplace to the current UTC time

4. catalog tables are imported into the DB with the *mysqlimport* tool. For payload and validity tables the *mysqlimport* option `--ignore` is used meaning that only new rows (as determined by their primary keys) are imported, other rows are ignored. For the `LOCALSEQNO` table the option `--replace` is used in order to replace the `(TABLENAME,LASTUSEDSEQNO)` entry.

Returns dictionary keyed by payload table names with values containing lists of SEQNO values

Return type dict

You might be tempted to use **rloadcat** as a faster alternative to **load** however this is not advised due to the extra things that **rloadcat** does such as update comparisons and fastforwarding and potentially merging in (when the decouped option is used).

In comparison the **load** command blasts what comes before it, this can be done using **forced_rloadcat** with the `--DROP` option:

```
./db.py --DROP tmp_offline_db forced_rloadcat ~/dybaux/catalog/tmp_offline_db
```

After which you can check operation via an **rdumpcat** back onto the working copy, before doing any updates:

```
./db.py tmp_offline_db rdumpcat ~/dybaux/catalog/tmp_offline_db
svn st ~/dybaux/catalog/tmp_offline_db    ## should show no changes
```

Reading full catalog into memory is expensive.

1. can I omit the payload tables from the read ?

seqno
SEQNO accessor, reading and checking is done on first access to `self.seqno` with

```
db = DB()
print db.seqno   ## checks DB
print db.seqno   ## uses cached
del db._seqno    ## force a re-read and check
print db.seqno
```

showpaytables
list names of all DBI payload tables in DB as reported by SHOW TABLES LIKE '%Vld' with the 'Vld' chopped off

NB the result is cached so will become stale after deletions or creations unless *nocache=True* option is used

showtables
list names of all tables in DB as reported by SHOW TABLES, NB the result is cached so will become stale after deletions or creations unless *nocache=True* option is used

tab(*name*)

Parameters **name** – DBI payload table name

tabfile(*tab*, *catfold*)
path of table obtained from

tables
list of selected table names to operate on plus the mandatory LOCALSEQNO Poorly named should be `table_selection`

tmpdir
Create new temporary directory for each instance, writable by ugo

tmpfold
Path to temporary folder, named after the DBCONF section. The base directory can be controlled by tmpbase (-b) option

vdupe(*tab*)
Currently is overreporting as needs to be balkanized by context

vdupe_(**args*, ***kwa*)
Report the first Vlds which feature duplicated VERSIONDATEs:

```
mysql> SELECT SEQNO,VERSIONDATE,COUNT(VERSIONDATE) AS dupe  FROM DemoVld GROUP BY VERSIONDAT
+-------+---------------------+------+
| SEQNO | VERSIONDATE         | dupe |
+-------+---------------------+------+
|    71 | 2011-08-04 05:55:47 |    2 |
|    72 | 2011-08-04 05:56:47 |    3 |
+-------+---------------------+------+
2 rows in set (0.00 sec)

mysql> select * from DemoVld ;
+-------+---------------------+---------------------+----------+---------+---------+------+-
| SEQNO | TIMESTART           | TIMEEND             | SITEMASK | SIMMASK | SUBSITE | TASK |
+-------+---------------------+---------------------+----------+---------+---------+------+-
|    70 | 2011-08-04 05:54:47 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
|    71 | 2011-08-04 06:15:46 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
|    72 | 2011-08-04 07:02:51 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
|    73 | 2011-08-04 05:54:47 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
|    74 | 2011-08-04 06:15:46 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
|    75 | 2011-08-04 05:54:47 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
|    76 | 2011-08-04 06:15:46 | 2038-01-19 03:14:07 |      127 |       1 |       0 |    0 |
+-------+---------------------+---------------------+----------+---------+---------+------+-
7 rows in set (0.00 sec)
```

vsssta(*tab*)
Look at VERSIONDATE/TIMESTART/... within SSSTA groups

wipe_cache()
Wipe the cache forcing DB access to retrieve the info afresh This is needed when wish to check status after a DB load from the same process that performed the load.

23.2 DBAUX

23.2.1 DybPython.dbaux

$Id: dbaux.py 17856 2012-08-22 11:40:42Z blyth $

Performs actions based on working copy at various revision points.

action	notes
ls	lists commit times/messages
rcmpcat	compare ascii catalog with DB
rloadcat	load ascii catalog into DB

Usage examples:

```
./dbaux.py ls      4913
./dbaux.py ls      4913:4914
./dbaux.py ls      4913:4932
./dbaux.py ls      4913:4914   --author bv

./dbaux.py --workingcopy ~/mgr/tmp_offline_db --baseurl file:///tmp/repos/catalog ls 2:39
     #
     # using non default workingcopy path and baseurl
     #
     #      NB baseurl must be the base of the repository
     #    TODO: avoid duplication by extracting baseurl from the working copy, or at least assert on
     #

./dbaux.py    rcmpcat 4913
./dbaux.py    rcmpcat 4913:4932
./dbaux.py -r rcmpcat 4913

./dbaux.py         rloadcat 4913
./dbaux.py --reset rloadcat 4913   ## -r/--reset deletes SVN working copy before `svn up`
```

To select non-contiguous revisions use *-a/–author* to pick just that authors commits within the revision range. Test with *ls*.

While testing in "tmp_offline_db" return to starting point with:

```
./db.py offline_db dump ~/offline_db.sql
./db.py tmp_offline_db load ~/offline_db.sql
```

While performing test loads into *tmp_offline_db*, multiple ascii catalog revisions can be loaded into DB with a single command:

```
./dbaux.py -c -r rloadcat 4913:4932
       ## -c/--cachesvnlog   improves rerun speed while testing
       ## -r/--reset         starts from a clean revision each time,
                             ignoring fastforward changes done by **rloadcat**

./dbaux.py -c -r rloadcat 4913:4932
       ## a rerun will fail at the first revision and will do nothing
       ## as the DB is detected to be ahead of the catalog
```

However when performing the real definitive updates into *offline_db* it is preferable to do things a bit differently:

```
./dbaux.py -c -r --dbconf offline_db  rloadcat 4913:4932 --logpath dbaux-rloadcat-4913-4932.log

       ## -s/--sleep 3 seconds sleep between revisions, avoid fastforward insert times with the same
       ##  --dbconf offline_db      target ~/.my.cnf section
```

Checks after performing rloadcat(s)

Each **rloadcat** modifies the catalog inplace, changing the INSERTDATE times. However as are operating beneath the dybaux trunk it is not straightforward to commit these changes and record them as they are made. Instead propagate them from the database into the catalog by an **rdumpcat** following updates. This is also a further check of a sequence of **rloadcat**.

Dump the updated DB into the catalog with:

```
db.py offline_db rdumpcat ~/dybaux/catalog/tmp_offline_db
db.py tmp_offline_db rdumpcat ~/dybaux/catalog/tmp_offline_db    ## when testing
```

Then check the status of the catalog, only expected tables .csv should be changed:

```
svn st  ~/dybaux/catalog/tmp_offline_db

M       /home/blyth/dybaux/catalog/tmp_offline_db/CableMap/CableMapVld.csv
M       /home/blyth/dybaux/catalog/tmp_offline_db/HardwareID/HardwareIDVld.csv

           ## should only be INSERTDATE changes,
           ## the new times should be UTC now times spread out over the
           ## rloadcat operations

M       /home/blyth/dybaux/catalog/tmp_offline_db/tmp_offline_db.cat

           ##  minor annoyance : changed order of entries in .cat
           ##  ... to be fixed by standardizing order with sorted  TABLENAME
```

Following a sequence of definitive commits into *offline_db* do an OVERRIDE commit into dybaux mentioning the revision range and author in the commit message. For example:

```
svn ci -m "fastforward updates following offline_db rloadcat of bv r4913:r4932 OVERRIDE  " ~/dybaux/c
```

Logfile Checks

Using the `--logpath <path>` option writes a log that is nearly the same as the console output. Checks to make on the logfile:

Check all commits are covered:

```
grep commit dbaux-rloadcat-4913-4932.log
```

Look at the *SEQNO* being loaded, verify no gaps and that the starting *SEQNO* is where expected:

```
egrep "CableMap.*new SEQNO" dbaux-rloadcat-4913-4932.log
egrep "HardwareID.*new SEQNO" dbaux-rloadcat-4913-4932.log
```

Examine fastforward times:

```
grep fastforward dbaux-rloadcat-4913-4932.log
```

Manual Checks

Before loading a sequence of commits sample the ascii catalog at various revisions with eg:

```
svn up -r <revision> ~/dybaux/catalog/tmp_offline_db
cat ~/dybaux/catalog/tmp_offline_db/LOCALSQNO/LOCALSEQNO.csv
```

Verify that the `LASTUSEDSEQNO` value changes are as expected compared to:

```
mysql> select * from LOCALSEQNO ;
+--------------+---------------+
| TABLENAME    | LASTUSEDSEQNO |
+--------------+---------------+
| *            |             0 |
| CalibFeeSpec |           113 |
| CalibPmtSpec |            29 |
| FeeCableMap  |             3 |
| CableMap     |           440 |
| HardwareID   |           358 |
```

```
+--------------+---------------+
6 rows in set (0.00 sec)
```

Expectations are:

1. incremental only ... no going back in *SEQNO*
2. no *SEQNO* gaps

The tools perform many checks and comparisons, but manual checks are advisable also, eg:

```
mysql> select distinct(INSERTDATE) from CableMapVld  ;
mysql> select distinct(INSERTDATE) from HardwareIDVld
mysql> select distinct(SEQNO) from  CableMap ;
mysql> select distinct(SEQNO) from  CableMapVld ;
```

rloadcat checks in various situations

Starting with r4913 and r4914 already loaded, try some operations.

1. rloadcat r4913 again:

```
./dbaux.py rloadcat 4913
...
AssertionError: ('ERROR LASTUSEDSEQNO in target exceeds that in ascii cat HardwareID ', 42, 58)
   ## the DB is ahead of the catalog ... hence the error
```

2. rloadcat r4914 again:

```
./dbaux.py rloadcat 4913
..
WARNING:DybPython.db:no updates (new tables or new SEQNO) are detected
    ## DB and catalog are level pegging ... hence "no updates" warning
```

AVOIDED ISSUES

1. same process rcmpcat checking following an rloadcat fails as has outdated idea of DB content despite cache wiping on rloadcat. A subsequent rcmpcat in a new process succeeds. .. was avoided by creating a fresh DB instance after loads, forcing re-accessing to Database

23.2.2 DybPython.dbaux.Aux

class DybPython.dbaux.**Aux**(*args*)

Bases: object

fresh_db()

Pull up a new DB instance

info

parse/wrap output of *svn info –xml* ... caution rerun on each access

ls_()

Lists the revisions, author, time, commit message

rcmpcat_()

Loops over revisions:

1.*svn up -r* the working copy

2.runs **rcmpcat** comparing the ascii catalog with DB

rloadcat_()

Loops over revisions

1.*svn up -r* the working copy

2.runs **rcmpcat** to verify there are some updates to be loaded

3.invokes **rloadcat** loading ascii catalog into DB

4.runs **rcmpcat** agsin to verify load is complete

NB no confirmation is requested, thus before doing this perform an **rcmpcat** to verify expected updates

Rerunning an **rloadcat**

```
./dbaux.py rloadcat 4913   ## 1st time OK
./dbaux.py rloadcat 4913   ## 2nd time was giving conflicts ... now fails with unclean error
./dbaux.py --reset rloadcat 4913   ## blow away conflicts by deletion of working copy before
```

How to fix ?

1.When testing "svn revert" the changed validity tables throwing away the fastforward times ? via parsing "svn status"

stat

parse/wrap output of *svn status –xml ...* caution rerun on each access

svnup_(*rev*, *reset=False*, *force=False*)

Parameters

- **rev** – revision number to bring working copy directory to
- **reset** – remove the directory first, wiping away uncommitted changes/conflicts

Aug 22, 2012 moved to checkout and revert rather than priot just update as this was failing with `--reset` due to lack of the working copy directory, resulting in `svn up` skipping and subsequent assertions. The idea is to step thru pristine revisions, one by one:

```
svn co -r 5292 http://dayabay.ihep.ac.cn/svn/dybaux/catalog/tmp_offline_db ~/dybaux/catalog/
svn revert ~/dybaux/catalog/tmp_offline_db
```

23.3 DBConf

23.3.1 DybPython.dbconf

When invoked as a script determines if the configuration named in the single argument exists.

Usage example:

```
python path/to/dbconf.py configname  && echo configname exists || echo no configname
```

23.3.2 DBConf

class DybPython.dbconf.**DBConf**(*sect=None*, *path=None*, *user=None*, *pswd=None*, *url=None*, *host=None*, *db=None*, *fix=None*, *fixpass=None*, *restrict=None*, *verbose=False*, *secure=False*, *from_env=False*, *nodb=False*)

Bases: dict

Reads a section of the Database configuration file, storing key/value pairs into this dict. The default file *path* is `~/.my.cnf` which is formatted like:

```
[testdb]
host      = dybdb1.ihep.ac.cn
database  = testdb
user      = dayabay
password  = youknowoit
```

The standard python `ConfigParser` is used, which supports `%(name)s` style replacements in other values.

Usage example:

```
from DybPython import DBConf
dbc = DBConf(sect="client", path="~/.my.cnf" )
print dbc['host']

dbo = DBConf("offline_db")
assert dbo['host'] == "dybdb1.ihep.ac.cn"
```

Warning: As passwords are contained **DO NOT COMMIT** into any repository, and protect the file.

See also *Running* section of the Offline User Manual

Interpolates the DB connection parameter patterns gleaned from arguments, envvars or defaults (in that precedence order) into usable values using the context supplied by the *sect* section of the ini format config file at *path*

Optional keyword arguments:

Keyword	Description
sect	section in config file
path	colon delimited list of paths to config file
user	username
pswd	password
url	connection url
host	db host
db	db name
fix	triggers fixture loading into temporary spawned cascade and specifies paths to fixture files for each member of the cascade (semi-colon delimited)
fixpass	skip the DB cascade dropping/creation that is normally done as part of cascade spawning (used in DBWriter/tests)
restrict	constrain the names of DB that can connect to starting with a string, eg `tmp_` as a safeguard
nodb	used to connect without specifying the database this requires greater access privileges and is used to perform database dropping/creation

Correspondingly named envvars can also be used:

DBCONF

DBCONF_PATH

DBCONF_USER

DBCONF_PWSD

DBCONF_URL

DBCONF_HOST

DBCONF_DB

DBCONF_FIX

DBCONF_FIXPASS

DBCONF_RESTRICT

The DBCONF existance also triggers the DybPython.dbconf.DBConf.Export() in dybgaudi:Database/DatabaseInterface/src/DbiCascader.cxx

The DBCONF_PATH is a colon delimited list of paths that are user (~) and $envvar OR ${envvar} expanded, some of the paths may not exist. When there are repeated settings in more than one file the last one wins.

In secure mode a single protected config file is required, the security comes with a high price in convenience

classmethod Export(*sect=None*, ***extras*)
Exports the environment settings into environment of python process this is invoked by the C++ *DbiCascader* ctor

configure_cascade(*sect*, *path*)
Interpret the *sect* argument comprised of a either a single section name eg *offline_db* or a colon delimited list of section names eg *tmp_offline_db:offline_db* to provide easy cascade configuration. A single section is of course a special case of a cascade. The first(or only) section in zeroth slot is treated specially with its config parameters being propagated into *self*.

Caution any settings of *url*, *user*, *pswd*, *host*, *db* are overridden when the *sect* argument contains a colon.

export_(***extras*)
Exports the interpolated configuration into corresponding *DBI* envvars :

ENV_TSQL_USER ENV_TSQL_PSWD ENV_TSQL_URL ENV_TSQL_FIX (added to allow DBConf to survive thru the env-glass)

And *DatabaseSvc* envvars for access to non-DBI tables via DatabaseSvc :

DYB_DB_USER DYB_DB_PWSD DYB_DB_URL

classmethod from_env()
Construct DBConf objects from environment :

ENV_TSQL_URL ENV_TSQL_USER ENV_TSQL_PSWD ENV_TSQL_FIX

classmethod has_config(*name_=None*)
Returns if the named config is available in any of the available DBCONF files

For cascade configs (which comprise a colon delimited list of section names) all the config sections must be present.

As this module exposes this in its main, config sections can be tested on command line with:

```
./dbconf.py offline_db && echo y || echo n
./dbconf.py offline_dbx && echo y || echo n
./dbconf.py tmp_offline_db:offline_db && echo y || echo n
./dbconf.py tmp_offline_dbx:offline_db && echo y || echo n
```

mysqldb_parameters(*nodb=False*)
Using the *nodb=True* option skips database name parameter, this is useful when creating or dropping a database

classmethod prime_parser()
Prime parser with "today" to allow expansion of %(today)s in ~/.my.cnf allowing connection to a daily recovered database named after todays date

classmethod read_cfg(*path=None*)
Classmethod to read config file(s) as specified by *path* argument or DBCONF_PATH using ConfigParser

23.4 DBCas

23.4.1 DybPython.dbcas

Pythonic representation of a DBI cascade, see *A Cascade of Databases* , than implements spawning of the cascade. Creating a pristine cascade that can be populated via fixtures.

Advantages :

- allows testing to be perfomed in fully controlled/repeatable DB cascade
- prevents littering production DB with testing detritus

Note such manipulations are not possible with the C++ *DbiCascader DbiConnection* as these fail to be instanciated if the DB does not exist.

class DybPython.dbcas.**DBCas**(*cnf*, *append=True*)
Bases: list

Represents a cascade of databases (a list of DBCon instances) created from a DybPython.dbconf.DBConf instance

spawn()
Spawning a cascade creates the databases in the cascade with prefixed names and populates them with fixtures

class DybPython.dbcas.**DBCon**(*url*, *user*, *pswd*, ***kwa*)
Bases: dict

Dictionary holding parameters to connect to a DB and provides functionality to drop/create databases and run updates/queries against them.

process(*sql*)
Attempts to create prepared statement from sql then processes it

server
If the connection attempt fails, try again without specifying the DB name, see root:TMySQLServer

---

Todo

Find way to avoid/capture the error after failure to connect

---

spawn(*fixpass=False*)
Create new DB with prefixed name and spawn a DBCon to talk to it with

When *fixpass* is True the DB is neither created or dropped, but it is assumed to exist. This is used when doing DBI double dipping, used for example in dybgaudi:Database/DBWriter/tests

class DybPython.dbcas.**DD**
Bases: dict

Compares directories contained cascade mysqldumps after first replacing the times from todays dates avoiding inevitable validity insert time differences

Successful comparison Requires the *DbiTest* and *DybDbiTest* dumps to be created on the same UTC day.

get_prep()
Initially this just obscured the times in UTC todays date (which appears in the Vld table INSERTDATE column) to allow comparison between DbiTest and DybDbiTest runs done on the same UTC day

However, now that are extending usage of the MYSQLDUMP reference comparisons to dumps of DB-Writer created DB from different days, need to obscure todays date fully

prep
Initially this just obscured the times in UTC todays date (which appears in the Vld table INSERTDATE column) to allow comparison between DbiTest and DybDbiTest runs done on the same UTC day

However, now that are extending usage of the MYSQLDUMP reference comparisons to dumps of DB-Writer created DB from different days, need to obscure todays date fully

23.5 dbsvn - DBI SVN Gatekeeper

23.5.1 DybPython.dbsvn

Usage examples

```
./dbsvn.py --help
    ## full list of options and this help text

./dbsvn.py ~/catdir -M
    ## check catalog and skip commit message test

./dbsvn.py ~/catdir -m "test commit message  dybsvn:source:dybgaudi/trunk/CalibWritingPkg/DBUPDATE.tx
    ## check catalog and commit message
```

This script performs basic validations of SVN commits intended to lead to DB updates, it is used in two situations:

1. On the SVN server as part of the pre-commit hook that allows/denies the commit
2. On the client, to allow testing of an intended commit before actually attempting the commit as shown above

NB this script DOES NOT perform commits, it only verifies them

How this script fits into the workflow

```
cd ; svn co http://dayabay.ihep.ac.cn/svn/dybaux/catalog/tmp_offline_db
      ## check out catalog containing the subset of manually updated tables

cd ; svn co http://dayabay.phys.ntu.edu.tw/repos/newtest/catalog/tmp_offline_db/
      ## test catalog at NTU

./db.py offline_db rdumpcat ~/tmp_offline_db
      ## rdumpcat current offline_db on top of the SVN checkout and look for diffs

svn diff ~/tmp_offline_db
      ## COMPLAIN LOUDLY IF YOU SEE DIFFS HERE BEFORE YOU MAKE ANY UPDATES

./db.py tmp_joe_offline_db rdumpcat ~/tmp_offline_db       ## NB name switch
      ## write DBI catalog on top of working copy ~/tmp_offline_db

svn diff ~/tmp_offline_db
      ## see if changed files are as you expect
```

```
./dbsvn.py ~/tmp_offline_db
      ## use this script to check the "svn diff" to see if looks like a valid DBI update

./dbsvn.py ~/tmp_offline_db -m "Updating dybsvn:source:dybgaudi/trunk/CalibWritingPkg/DBUPDATE.txt@12
      ## fails as annotation link refers to dummy path, no such package and no change to that file at

./dbsvn.py ~/tmp_offline_db -m "Annotation link  dybsvn:source:dybgaudi/trunk/Database/DybDbiTest/tes
      ## check the "svn diff" and intended commit message, fails as no revision

./dbsvn.py ~/tmp_offline_db -m "Annotation link  dybsvn:source:dybgaudi/trunk/Database/DybDbiTest/tes
      ## fails as no change to that file at that revision

./dbsvn.py ~/tmp_offline_db -m "Annotation link  dybsvn:source:dybgaudi/trunk/Database/DybDbiTest/tes
      ## succeeds

svn ci ~/tmp/offline_db -m  "Updating dybsvn:source:dybgaudi/trunk/CalibWritingPkg/DBUPDATE.txt@12000
      ## attempt the actual commit
```

What is validated by `dbsvn.py`

1. The commit message, eg "Updating dybsvn:source:dybgaudi/trunk/CalibWritingPkg/DBUPDATE.txt@12000 "
   (a) must provide valid dybsvn reference which includes dybgaudi/trunk package path and revision number
2. Which files (which represent tables) are changed
   (a) author must have permission for these files/tables
   (b) change must effect DBI file/tablepairs (payload, validity)
3. What changes are made:
   (a) must be additions/subtractions only (allowing subtractions is for revertions)
   (b) note that LOCALSEQNO (a DBI bookkeeping table) is a special case

Rationale behind these validations

1. valid DBI updates
2. establish provenance and purpose
   (a) what purpose for the update
   (b) where it comes from (which revision of which code was used)
   (c) precise link to producing code and documentation

Commit denial

This script is invoked on the SVN server by the pre-commit hook (shown below) if any directories changed by the commit start with "catalog/". If this script exits normally with zero return code, the commit is allowed to proceed.

On the other hand, if this script returns a non-zero exit code, for example if an assert is tickled, then the commit is denied and stderr is returned to the failed committer.

OVERRIDE commits

Administrators (configured using -X option on the server) can use the string "OVERRIDE" in commit messages to short circuit validation. This is needed for non-standard operations, currently:

1. adding/removing tables

A commit like the below from inside catalog will fail, assuming that the **dayabay** svn identity is not on the admin list:

```
svn --username dayabay ci -m "can dayabay use newtest OVERRIDE "
```

Deployment of pre-commit hook on SVN server

Only SVN repository administrators need to understand this section.

The below commands are an example of creating a bash pre-commit wrapper. After changing the TARGET and apache user identity, the commands can be used to prepare the hook. Note that the pre-commit script is invoked by the server in a bare environment, so any customizations must be propagated in.

Checkout/Update DybPython on SVN server node:

```
cd
svn co http://dayabay.ihep.ac.cn/svn/dybsvn/dybgaudi/trunk/DybPython/python/DybPython
svn up ~/DybPython
```

As root, copy in python code used by the pre-commit hook:

```
cd /home/scm/svn/dybaux/hooks/
ls -l
rm *.pyc  # tidy up
cp ~/DybPython/{dbsvn,svndiff,dbvld}.py .
chown apache.apache {dbsvn,svndiff,dbvld}.py
```

Creating the hook:

```
export TARGET=/home/scm/svn/dybaux/hooks/pre-commit        ## dybaux hooks
DBSVN_XREF=/home/scm/svn/dybsvn python $HOME/DybPython/dbsvn.py HOOK  ## check the hook is customized
DBSVN_XREF=/home/scm/svn/dybsvn python $HOME/DybPython/dbsvn.py HOOK  | sudo bash -c "cat - > $TARGET
cat $TARGET
```

1. `DBSVN_XREF` points to the `dybsvn` SVN repository, which is used to validate cross referencing links from `dybaux` to `dybsvn`
2. user `apache` corresponds to the user which the SVN webserver process runs as
3. note that the `dbsvn.py` option `-c/--refcreds` is not used for `dybaux` as local access to `dybsvn` repository is used (with svnlook)

Hook Deployment on server remote from `dybsvn`

The test deployed hook at NTU gets cross-referencing to `dybsvn` via `svn log` etc whereas, the real `dybaux` hook accesses `dybsvn` locally on the server using `svnlook`. Due to this different options are needed in hook deployment, specicially as are using the default `DBSVN_XREF` of `http://dayabay.ihep.ac.cn/svn/dybsvn` need to enter `DBSVN_XREF_PASS`:

```
## on SVN server node
cd
svn co http://dayabay.ihep.ac.cn/svn/dybsvn/dybgaudi/trunk/DybPython/python/DybPython  ## into $HOME
svn up ~/DybPython
```

```
export TARGET=/var/scm/repos/newtest/hooks/pre-commit ; export APACHE_USER=nobody.nobody
sudo bash -c "cp $HOME/DybPython/{dbsvn,svndiff,dbvld}.py $(dirname $TARGET)/  && chown $APACHE_USER

DBSVN_XREF_PASS=youknowit python $HOME/DybPython/dbsvn.py HOOK  ## check the hook is customized as de
DBSVN_XREF_PASS=youknowit python $HOME/DybPython/dbsvn.py HOOK  | sudo bash -c "cat - > $TARGET && ch
cat $TARGET
```

Typical Problems with the Hook

Mainly for admins

If the precommit hook is mis-configured the likely result is that attempts to commit will hang. For example the `dbsvn.py` invokation in the hook script needs to have:

1. a valid admin user (SVN identity)
2. local filesystem repository path for the cross reference *-r* option

The default cross reference path is the dybsvn URL which might hang on the server as the user(root/nobody/...) that runs the SVN repository normally does not have user permissions to access sibling repository dybsvn. (have switched to non-interactive now)

A pre-commit hook testing harness is available in bash functions env:trunk/svn/svnprecommit.bash

Trac Config to limit large diff hangs

Only for admins

The large diffs representing DB updates that are stored in `dybaux` can cause Trac/apache to hang on attempting to browse them in Trac. To avoid this the default `max_diff_bytes` needs to be reduced, do this for `dybaux` with:

```
env-    ## env precursor
trac-
TRAC_INSTANCE=dybaux trac-edit
```

Modify down to `100000`:

```
[changeset]
max_diff_bytes = 100000       # 10000000
max_diff_files = 0
```

23.5.2 DBIValidate

class DybPython.dbsvn.**DBIValidate**(*diff*, *msg*, *author*, *opts*)

Bases: list

Basic validation of commit that represents an intended DB update

dump_diff()

Traverse the parsed diff hierarchy diff/delta/block/hunk to extract the validity diffs such as:

```
+30,"2010-09-22 12:26:59","2038-01-19 03:14:07",127,3,0,1,-1,"2010-09-22 12:26:59","2011-05-
```

deltas should have a single block for a valid update

validate_hunk(*hunk*)
Check the Vld table diff validity entries have valid times and conform to overlay versioning compliance.

Turns out not to be possible to check for overlay versioning compliance from a delta as in the case of updates with changed timestart the offset from the first timestart gets used, see #868

NB this has to run on SVN server without NuWa, and potentially with an ancient python, so hardcoded constants and conservative style are necessary

validate_update()
Current checks do not verify tail addition

validate_validity()
Checks on the validity contextrange of updates, to verify:

1. Presence of valid dates in all four DBI date slots
2. Overlay versioning compliance, namely appropriate correspondence between TIMESTART and VERSIONDATE

23.6 DBSRV

23.6.1 DybPython.dbsrv

dbsrv : MySQL Server Utilities

A more admin centric version of sibling *db.py* with advanced features, including:

- on server optimizations such as *select ... into outfile* taking advantage of the situation when the mysql client and server are on the same node.
- partitioned dump/load for dealing with very large tables and incremental backups
- implicit DB addressing without a *~/.my.cnf* section allowing handling of multiple databases all from the same server via comma delimited names or regular expressions
- despite coming from NuWa it does not need the NuWa environment, system python with MySQLdb is OK

TODO

1. checking the digests on the target and sending notification emails
2. test dumplocal when partitionsize is an exact factor of table size
3. warnings or asserts when using partitioned dumplocal with disparate table sizes

Usage

```
./dbsrv.py tmp_ligs_offline_db_0 databases
./dbsrv.py tmp_ligs_offline_db_0 tables
./dbsrv.py tmp_ligs_offline_db_0 dumplocal  --where "SEQNO < 100"
```

Similar to *db.py* the first argument can be a *~/.my.cnf* section name. Differently to *db.py* it can also simply be a database name which does not have a corresponding config section.

In this implicit case the other connection pararameters are obtained from the so called *home* section. Normally the *home* section is "loopback" indicating an on server connection. The *home* section must point to the *information_schema* database.

When the *–home* option is used databases on remote servers can be accessed without having config sections for them all.

Comparing DB via partitioned dump

Three table dumps skipping the crashed table in order to compare:

- *dybdb1_ligs.tmp_ligs_offline_db_dybdb1* original on dybdb1
- *dybdb2_ligs.channelquality_db_dybdb2* recovered on dybdb2
- *loopback.channelquality_db_belle7* recovered onto belle7 from hotcopy created on belle1

Invoked from cron for definiteness, and ability to leave running for a long time:

```
07 17 * * * ( $DYBPYTHON_DIR/dbsrv.py -t DqChannel,DqChannelVld,DqChannelStatusVld --home dybdb1_ligs
52 18 * * * ( $DYBPYTHON_DIR/dbsrv.py -t DqChannel,DqChannelVld,DqChannelStatusVld --home dybdb2_ligs
28 20 * * * ( $DYBPYTHON_DIR/dbsrv.py -t DqChannel,DqChannelVld,DqChannelStatusVld --home loopback ch
```

> **Warning:** *–partitioncfg* has now been split into *–partitionsize* and *–partitionrange*

Dump speed:

1. remote dumps from dybdb1/dybdb2 to belle7 take approx 165s for each chunk. Thus ~90min for all.
2. local dumps on belle7 take approx 20s for each chunk. Thus ~11min for all.

diffing the dumped partitions For the first two all but the partial chunk match.

Range of partition dirs to diff controlled by envvar:

```
[blyth@belle7 DybPython]$ RANGE=0,10 ./diff.py  /tmp/cq/tmp_ligs_offline_db_dybdb1/10000 /tmp/cq/char
[blyth@belle7 DybPython]$ RANGE=10,20 ./diff.py  /tmp/cq/tmp_ligs_offline_db_dybdb1/10000 /tmp/cq/cha
[blyth@belle7 DybPython]$ RANGE=20,30 ./diff.py  /tmp/cq/tmp_ligs_offline_db_dybdb1/10000 /tmp/cq/cha
[blyth@belle7 DybPython]$ RANGE=30,33 ./diff.py  /tmp/cq/tmp_ligs_offline_db_dybdb1/10000 /tmp/cq/cha

[blyth@belle7 DybPython]$ RANGE=0,10 ./diff.py  /tmp/cq/channelquality_db_belle7/10000 /tmp/cq/channe
[blyth@belle7 DybPython]$ RANGE=10,20 ./diff.py  /tmp/cq/channelquality_db_belle7/10000 /tmp/cq/chann
[blyth@belle7 DybPython]$ RANGE=20,30 ./diff.py  /tmp/cq/channelquality_db_belle7/10000 /tmp/cq/chann
[blyth@belle7 DybPython]$ RANGE=30,33 ./diff.py  /tmp/cq/channelquality_db_belle7/10000 /tmp/cq/chann
```

oops a difference, but its just different formatting of 0.0001 or 1e-04

```
[blyth@belle7 DybPython]$  RANGE=10,20 ./diff.py  /tmp/cq/channelquality_db_belle7/10000 /tmp/cq/char
2013-06-07 17:58:06,933 __main__ INFO     rng ['10', '11', '12', '13', '14', '15', '16', '17', '18',
2013-06-07 17:58:26,526 __main__ INFO     diff -r --brief /tmp/cq/channelquality_db_belle7/10000/10 /
2013-06-07 17:58:44,896 __main__ INFO     diff -r --brief /tmp/cq/channelquality_db_belle7/10000/11 /
2013-06-07 17:59:04,360 __main__ INFO     diff -r --brief /tmp/cq/channelquality_db_belle7/10000/12 /
2013-06-07 17:59:22,531 __main__ INFO     diff -r --brief /tmp/cq/channelquality_db_belle7/10000/13 /
2013-06-07 17:59:42,205 __main__ INFO     diff -r --brief /tmp/cq/channelquality_db_belle7/10000/14 /
2013-06-07 18:00:00,385 __main__ INFO     diff -r --brief /tmp/cq/channelquality_db_belle7/10000/15 /
2013-06-07 18:00:20,000 __main__ INFO     diff -r --brief /tmp/cq/channelquality_db_belle7/10000/16 /
2013-06-07 18:00:38,198 __main__ INFO     diff -r --brief /tmp/cq/channelquality_db_belle7/10000/17 /
2013-06-07 18:00:38,704 __main__ INFO     diff -r --brief /tmp/cq/channelquality_db_belle7/10000/18 /
```

```
Files /tmp/cq/channelquality_db_belle7/10000/18/DqChannel.csv and /tmp/cq/channelquality_db_dybdb2/10

2013-06-07 18:00:56,602 __main__ INFO     diff -r --brief /tmp/cq/channelquality_db_belle7/10000/19 /
[blyth@belle7 DybPython]$
[blyth@belle7 DybPython]$
[blyth@belle7 DybPython]$
[blyth@belle7 DybPython]$ diff /tmp/cq/channelquality_db_belle7/10000/18/DqChannel.csv  /tmp/cq/chann
1196930c1196930
< 186235,2,28473,7,67175938,0.0001,7.35714,3.39868,-1,-1
---
> 186235,2,28473,7,67175938,1e-04,7.35714,3.39868,-1,-1
...
```

Commands

summary Providea a summary of table counts and update times in all selected databases. The DB names are specified by comma delimited OR Regexp string arguments specifying the DB names.

```
./dbsrv.py               tmp_ligs_offline_db_\d summary

          # local home, requires "loopback" config section pointing to information_schema DB

./dbsrv.py --home dybdb1 tmp_\S* summary

          # remote home,  requires "dybdb1" config section pointing to information_schema DB
```

TODO:

Check handling of section names the same as DB names on different nodes, as the section config will trump the dbname ? BUT *home* config host matching should trip asserts ?

dumplocal The DB tables are dumped as *.csv* files and separate *.schema* files containing table creation SQL. Without a directory argument the dumps are writes beneath the *–backupfold* controllable directory, such as */var/dbbackup/dbsrv*

```
[blyth@belle7 DybPython]$ ./dbsrv.py  tmp_ligs_offline_db_0 dumplocal --where 'SEQNO <= 100'
2013-06-13 16:49:38,152 __main__ INFO     partition_dumplocal___ SEQNO <= 100 writing /var/dbbackup/c
2013-06-13 16:49:38,578 __main__ INFO     partition_dumplocal___ SEQNO <= 100 writing /var/dbbackup/c
...

[blyth@belle7 DybPython]$ ./dbsrv.py  tmp_ligs_offline_db_0 dumplocal /tmp/check/tmp_ligs_offline_db_
2013-06-13 16:50:49,003 __main__ WARNING  using basedir /tmp/check/tmp_ligs_offline_db_0 different fr
2013-06-13 16:50:49,031 __main__ INFO     partition_dumplocal___ SEQNO <= 100 writing /tmp/check/tmp_
2013-06-13 16:50:49,203 __main__ INFO     partition_dumplocal___ SEQNO <= 100 writing /tmp/check/tmp_
...
```

Warning: When there are databases of the same name on multiple nodes it is useful to include the names of the node in the section name

loadlocal When doing a load into a database to be created use *–DB_DROP_CREATE* option:

```
[blyth@belle7 DybPython]$ ./dbsrv.py tmp_ligs_offline_db_5 loadlocal ~/tmp_ligs_offline_db_0  -l debu
```

Typically when loading a database name change in needed, in this case the directory and new section name must be given:

```
[blyth@belle7 DybPython]$ ./dbsrv.py tmp_ligs_offline_db_50 loadlocal /var/dbbackup/dbsrv/belle7.nuu
DROP and reCREATE database tmp_ligs_offline_db_50 loosing all tables contained ? Enter "YES" to proce
2013-06-13 16:58:41,491 __main__ WARNING  using basedir /var/dbbackup/dbsrv/belle7.nuu.edu.tw/tmp_lig
2013-06-13 16:58:41,499 __main__ WARNING  creating table DqChannel from schema file /var/dbbackup/dbs
...
```

partitioned loadlocal NB when restoring need to do a name change, so it is neccesary to specify the source directory as an argument

```
[root@cms01 DybPython]# dbsrv channelquality_db_restored loadlocal /data/var/dbbackup/dbsrv/dybdb2.ih
                        ##  initial run, creating the DB  from 32 partitions took ~100 min

[root@cms01 DybPython]# dbsrv channelquality_db_restored loadlocal /data/var/dbbackup/dbsrv/dybdb2.ih
                        ##  quick re-run, notices nothing to do and completes in a few seconds

[blyth@cms01 ~]$ type dbsrv    # function to nab the NuWa python MySQLdb, as yum is being uncooperati
dbsrv is a function
dbsrv ()
{
   local python=/data/env/local/dyb/trunk/external/Python/2.7/i686-slc4-gcc34-dbg/bin/python;
   export PYTHONPATH=/data/env/local/dyb/trunk/NuWa-trunk/../external/mysql_python/1.2.3_mysql5.0.67_
   LD_LIBRARY_PATH=/data/env/local/dyb/trunk/NuWa-trunk/../external/mysql/5.0.67/i686-slc4-gcc34-dbg/
   LD_LIBRARY_PATH=/data/env/local/dyb/trunk/NuWa-trunk/../external/mysql_python/1.2.3_mysql5.0.67_py
   export LD_LIBRARY_PATH;
   $python -c "import MySQLdb";
   $python ~blyth/DybPython/dbsrv.py $*
}
```

Test run on cms01 chugging along at ~3 min per 10k partition, at 32 partitions estimate ~100 min to complete

```
[blyth@belle7 DybPython]$ ./dbsrv.py  channelquality_db_restored loadlocal  /var/dbbackup/dbsrv/dybdb
```

Partitioned Commands

The partitioning relies on these options:

–partition switches on partitioning, default False

–partitionkey default “SEQNO,0”, corresponding to the key name and its position in CSV dumps

–partitioncfg **NOW RPLACED WITH THE BELOW TWO OPTIONS** default “10000,0,33”, the three integers specify the number of keys in each chunk *10000* and the range of chunks *range(0,33)* ie 0 to 32

–partitionsize default “10000”, specify the number of keys in each chunk

–partitionrange default of None, meaning all partitions. If specified as eg “0,33” it restricts to a range of partition indices *range(0,33)*

–partitionlast‘ NOW DEPRECATED This the last partition is now auto determined, to allow daily cron running default None, when set to an integer string eg “32” this is used to identifiy the index of the last incomplete partition

For dump and load to refer to the same partition set, requires the same chunk size (and partition key although this is not checked).

partitioned loadlocal From cron:

```
DYBPYTHON_DIR=/data1/env/local/dyb/NuWa-trunk/dybgaudi/DybPython/python/DybPython
03 20 * * * ( $DYBPYTHON_DIR/dbsrv.py channelquality_db_0 loadlocal  /tmp/cq/channelquality_db --part
```

quick partitioning test For fast dump/load testing use small chunks and range of partitions:

```
./dbsrv.py tmp_ligs_offline_db_0 dumplocal /tmp/pp/tmp_ligs_offline_db_0 --partition --partitionsize
./dbsrv.py tmp_ligs_offline_db_5 loadlocal /tmp/pp/tmp_ligs_offline_db_0 --partition --partitionsize
```

Archiving and transfers to remote node

Controlled via options:

-a/–archive switch on archive creation

-x/–extract switch on archive extraction

–backupfold default /var/dbbackup/dbsrv, the location of backup dumps and tarballs

-T/–transfer switch on remote transfer of archives, must be used together with *-a/–archive* and the *dumplocal* command to be effective

–transfercfg configures the remote node and possible a directory prefix, that is prepended infront of the *backupfold*

For example the below command dumps partitions 0,1 and 2, creates archive tarballs and transfers them to the remote node configured:

```
./dbsrv.py -t DqChannel,DqChannelVld,DqChannelStatusVld --home loopback channelquality_db_belle7 dump
```

The local and remote tarball paths are the same, with no transfercfg prefix specified, namely:

```
/var/dbbackup/dbsrv/belle7.nuu.edu.tw/channelquality_db_belle7/10000_0.tar.gz
```

Transfer Optimization A small .dna sidecar to the tarballs is used for tarball content identification. When a rerun of the transfer is made, the sidecar DNA is first checked to see if the remote node already holds the tarball.

This means that only newly reached partitions are archived and transferred. The *last* incomplete partition will typically be transferred every time as it will have a different content causing the DNA mismatch to trigger a re-transfer.

Full archive/transfer cron test from belle7 to belle1 To prepare the remote node just need to create and set ownership of *backupfold* eg */var/dbbackup/dbsrv* and ensure keyed ssh access is working

```
DYBPYTHON_DIR=/data1/env/local/dyb/NuWa-trunk/dybgaudi/DybPython/python/DybPython
DBSRV_REMOTE_NODE=N1
35 18 * * * ( $DYBPYTHON_DIR/dbsrv.py -t DqChannel,DqChannelVld,DqChannelStatusVld --home loopback ch
```

Installation on dybdb2

Prepare target node The administrator of target node needs to prepare a folder for the archives:

```
[blyth@cms01 ~]$ sudo mkdir /data/var/dbbackup/dbsrv
[blyth@cms01 ~]$ sudo chown -R dayabayscp.dayabayscp /data/var/dbbackup/dbsrv
```

Setup mysql config at source The config file `~/.my.cnf` needs two sections "loopback" and "channelquality_db_dybdb2":

```
[loopback]
host      = 127.0.0.1
database  = information_schema
user      = root
password  = ***

[channelquality_db_dybdb2]
host      = 127.0.0.1
database  = channelquality_db
user      = root
password  = ***
```

SSH environment configuration The script runs *scp* commands internally that require:

- *ssh-agent* process to be running and authenticated
- public keys of source node to be appended to *.ssh/authorized_keys2* of target
- `SSH_AUTH_SOCK` to be defined.

When run from cron the envvar is typically not present. In order to define this the `~/.ssh-agent-info-$NODE_TAG` is parsed by the *sshenv()* from common.py.

This file is created by the **env** function *ssh–agent-start* which is used following reboots to start and authenticate the ssh agent process.

- http://belle7.nuu.edu.tw/e/base/ssh/

Get DybPython from dybsvn

```
cd
svn co http://dayabay.ihep.ac.cn/svn/dybsvn/dybgaudi/trunk/DybPython/python/DybPython
```

Despite coming from dybsvn the *dbsrv.py* script does not need the NuWa environment. Just the MySQLdb extension in the system python should be adequate.

Quick Interactive Test Configuring 5 small 100 SEQNO partitions allows the machinery to be quickly tested:

```
cd DybPython
./dbsrv.py channelquality_db_dybdb2 dumplocal --partition --partitionsize 100 --partitionrange 0,5 --
```

CRON commandline

```
## NB no DBSRV_REMOTE_NODE is needed, the default of S:/data is appropriate
DYBPYTHON_DIR=/root/DybPython
CRONLOG_DIR=/root/cronlog
NODE_TAG=D2
#
42 13 * * * ( $DYBPYTHON_DIR/dbsrv.py channelquality_db_dybdb2 dumplocal --partition --archive --tran
```

A do-nothing run, when there are no new partitions to dump/archive/transfer takes about 4 mins and uses little resources. When there are new completed partitions to archive and transfer, the default chunk size of 10000 SEQNO leads to tarballs of only 35M (maybe 70M when move for all 4 tables) resulting in rapid transfers.

Although new completed partitions might be reached perhaps every ~10 days with the 10k chunks, a daily transfer is still recommended in order to backup the last incomplete partition and also in order that issues with the transfer are rapidly identified and resolved.

Transfer Monitoring Implemented using *valmon.py* with *digestpath.py*. Valmon needs to run as a daily cronjob on the remote node. Configure with **dbsrvmon** section:

```
% ~/.env.cnf blyth@belle1.nuu.edu.tw
[dbsrvmon]
tn = channelquality_db
chdir = /var/dbbackup/dbsrv/belle7.nuu.edu.tw/channelquality_db_belle7/archive/10000
return = dict
dbpath = ~/.env/dbsrvmon.sqlite
cmd = digestpath.py
note = stores the dict returned by the command as a string in the DB without interpretation
valmon_version = 0.2
constraints = ( tarball_count >= 34, dna_mismatch == 0, age < 86400 , age < 1000, )
```

Tested on belle1:

```
[blyth@belle1 e]$ valmon.py -s dbsrvmon ls
2013-06-17 11:48:01,515 env.db.valmon INFO     /home/blyth/env/bin/valmon.py -s dbsrvmon ls
2013-06-17 11:48:01,520 env.db.valmon WARNING  no email section configures and no MAILTO envvar, NOTI
2013-06-17 11:48:01,521 env.db.valmon INFO     arg ls
('2013-06-13T19:46:01', 5.5278148651123047, "{'dna_match': 34, 'lookstamp': 1371123961.7826331, 'dna_
('2013-06-13T19:54:06', 5.8677470684051514, "{'dna_match': 34, 'lookstamp': 1371124446.7869501, 'dna_
```

Obtain the backup tarballs As of Dec 24 2013 there are 54 tarballs of 43M each, corresponding to 2322M total. scp them using the scponly account on cms01. Qiumei/Simon can provide the password:

```
dir=/data/var/dbbackup/dbsrv/dybdb2.ihep.ac.cn/channelquality_db_dybdb2/archive/
mkdir -p $dir && cd $dir
scp -r dayabayscp@cms01.phys.ntu.edu.tw:/data/var/dbbackup/dbsrv/dybdb2.ihep.ac.cn/channelquality_db_
```

Partioned dump usage

Full backups are impractical for 10G tables.

Partitioned dumping is attactive for backups of such large tables, as just new partitions need to be dumped on each invokation.

For scp transfers would need to create tarfiles for each partition with dna sidecars, and add a transfer subcommand with option controlled remote node. Clearly via dna checking would allow only new partitions to be transfereed.

System python API warning

Careful regarding PYTHONPATH, when mixing a NuWa PYTHONPATH with a system python get API Runtime-Warning:

```
[blyth@belle7 DybPython]$ /usr/bin/python dbsrv.py -t DqChannel,DqChannelVld,DqChannelStatusVld --hor
/data1/env/local/dyb/external/mysql_python/1.2.3_mysql5.0.67_python2.7/i686-slc5-gcc41-dbg/lib/python
  import _mysql
2013-06-06 18:03:08,963 __main__ INFO     schema dir /tmp/cq/channelquality_db_dybdb2/10/_ exists al
2013-06-06 18:03:08,963 __main__ INFO     /* 10-partition 1  /1  */ SEQNO >= 1 and SEQNO <= 10
```

```
2013-06-06 18:03:09,165 __main__ INFO     checking prior csv dump /tmp/cq/channelquality_db_dybdb2/10
[blyth@belle7 DybPython]$
```

Avoiding the NuWa PYTHONPATH means are entirely system and avoid the RuntimeWarning:

```
[blyth@belle7 DybPython]$ PYTHONPATH=  /usr/bin/python dbsrv.py -t DqChannel,DqChannelVld,DqChannelSt
2013-06-06 18:04:58,078 __main__ INFO     schema dir /tmp/cq/channelquality_db_dybdb2/10/_ exists al
2013-06-06 18:04:58,078 __main__ INFO     /* 10-partition 1  /1  */ SEQNO >= 1 and SEQNO <= 10
2013-06-06 18:04:58,282 __main__ INFO     checking prior csv dump /tmp/cq/channelquality_db_dybdb2/10
[blyth@belle7 DybPython]$
```

Import Notes

1. keep to a minimum of imports for portability to server situation, ie do not rely on NuWa environment
2. MySQLdb optionality is to allows non MySQL-python nodes to autodoc

23.6.2 DybPython.dbsrv.DB

class DybPython.dbsrv.**DB**(*sect*, *opts=None*, *home=None*)

Bases: object

Parameters

- **sect** – name of section in config file
- **opts** – options
- **home** – DB instance

Safety constraints on config to minimize accidents from config confusion.

Initially required non-loopback section names and database names to be the same

Loosening this to allow remote commands, by designating a "home" instance and requiring all other instances to match that one in everything but the database name

archive(*dir*, *force=False*)

Parameters **dir** – directory the contents of which should be archived

As a partition corresponds to a certain SEQNO range, it never changes so there is no need for a datestring in the path.

The configured backupfold needs to be created before using the archive *-a* option with:

```
[blyth@belle7 DybPython]$ sudo mkdir /var/dbbackup/dbsrv
[blyth@belle7 DybPython]$ sudo chown -R blyth.blyth /var/dbbackup/dbsrv/
```

archivepath(*dir*, *base=None*)

Parameters **dir** – directory to be archived or extracted into

Returns path to archive tarball, dir path relative to base

database_drop_create(*dbname*)

Parameters **dbname** – name of the database to be dropped and recreated

databases

List of database names obtained from information_schema.tables

datadir
Query DB server to find the datadir, eg /var/lib/mysql/ OR /data/mysql/

determine_basedir(**args*)

classmethod docs()
collect the docstrings on command methods identified by naming convention of ending with ___

dumplocal___(**args*, ***kwa*)

Parameters **outdir** – specifies output directory which must be writable by mysql user, it will be created if not existing

Rerunning this will do quick checks of the CSV files, looking at line counts and the first and last line and comparing with expections from DB queries. The quick checks are done via commands:

- *wc*
- *head -1*
- *tail -1*

This is not called in the partitioned case.

extract(*dir*, *base*)

Parameters

- **dir** – directory to be created by extraction
- **base** –

loadlocal___(**args*, ***kwa*)

Parameters **outdir** – specifies directory containing normal or partitioned dump of CSV files

loadlocal_dir(*dir*)

lsdatabases___(**args*, ***kwa*)
list databases

lstables___(**args*, ***kwa*)
list tables

partition_dumpcheck(*pdir*, *pwhere*, *is_last*, *keycount=False*)

Checks a partition dump returning flag to signal a dump or not.

Parameters

- **pdir** –
- **pwhere** –
- **is_last** –
- **keycount** – doing distinct keycount is quite slow, so can skip for pre-existing

Returns pdump, chk

partition_dumplocal___(**args*, ***kwa*)

partition_loadlocal___(**args*, ***kwa*)

1.look into putting the partitions back togther again, in partitioned load local

2.read file system tealeaves wrt the partitioning

3.factor off the checking

4.need to work out which partitions are new and just load those

ptables()

Returns list of tables with the key field

size
Size estimate of the DB in MB

summary___(**args*, ***kwa*)
Present summary of tables in rst table format:

TABLE_NAME	TABLE_ROWS	CREATE_TIME	CHECK_TIME
DqChannel	62126016	2013-05-30 18:52:51	2013-05-30 18:52:51
DqChannelStatus	62126016	2013-05-30 18:17:42	2013-05-30 18:17:42
DqChannelStatusVld	323573	2013-05-30 18:52:44	None
DqChannelVld	323573	2013-05-30 19:34:55	None
LOCALSEQNO	3	2013-05-30 19:35:02	None

tables
List of table names obtained from show tables

timestamped_dir(**args*)
Timestamping is needed for non-partitioned case

utables
List of tables to use in operations, when –tables option is used this can be a subset of all tables.

23.7 DybDbiPre

23.7.1 Tab

class DybDbiPre.**Tab**
Bases: list

DybDbiPre.Tab instances are created by the parsing of .spec files (dybgaudi:Database/DybDbi/spec). Instances contain a list of dicts corresponding to each payload row in the DBI table together with a metadata dictionary for class level information.

To test the parsing of a .spec file, use for example:

```
cat $DYBDBIROOT/spec/GSimPmtSpec.spec | python $DYBDBIPREROOT/python/DybDbiPre/__init__.py
```

The instances are available in the django context used to fill templates dybgaudi:Database/DybDbi/templates used in the generation of:

1.DbiTableRow subclasses allowing DBI to interact with the table

2.Documentation presenting the DBI tables in .tex and wiki formats

3.SQL scripts for table creation .sql

The meanings of the quantities in the .spec are ultimately determined by their usage in the templates, however some guideline definitions are listed below:

row level quantities

name column name as used in C++ getter and setter methods

dbtype MySQL column type name used in table description, such as *double* or *int(10) unsigned*

codetype type used in generated C++ code, eg *DayaBay::FeeChannelId*

legacy name of the column in database table

description short definition of the meaning of the column

code2db C++ converter function used to translate a value in code into a value stored in the DB, eg *.fullPackedData()*

memb name of the column data member in the C++ table row class, **WARNING, CURRENTLY NOT IN USE**

class/table level properties

meta a token that identifies the key, value pairs on the line as metadata rather than a table row

table name of the payload Database table, eg *CalibFeeSpec*

class name of the generated DbiTableRow class, follow convention of naming with a **G** prefix eg *GCalibFeeSpec*

CanL2Cache set to *kFALSE*, L2 caching is for debugging only

legacy name of prior table when migrations are performed, **WARNING, CURRENTLY NOT IN USE**, set to table name

rctx default read context represented by a comma delimited string, see dybgaudi:Database/DybDbi/src/DbiCtx.cxx

wctx default write context range represented by a comma delimited string, see dybgaudi:Database/DybDbi/src/DbiCtx.cxx

usage in templates

The class level and row level quantities are used in django templates with expressions of the form:

```
{{ t.meta.table }}

{% for r in t %}`{{ r.name }}` {{ r.dbtype }} default NULL COMMENT '{{ r.description }}',
```

__call__(*d*)
If fields in the `.spec` file include a "meta" key then the fieldname(ie key),value pairs are included into the meta dictionary

23.8 DybDbi

Making DBI easy to use from python:

23.8.1 DybDbi

DybDbi python package provides access to most Dbi functionality, with generation of classes based on .spec files and wrapping of the python classes for easier usage, enabling access to model objects via:

```
from DybDbi import GCalibPmtSpec
from DybDbi import *
```

Example of introspecting the specification:

```
sk = GCalibPmtSpec.SpecKeys().aslist()    # list of row names
sk
  ['PmtId',
   'Describ',
   'Status',
  ...

sl = GCalibPmtSpec.SpecList().aslod()    # list of row maps ... list-of-dict
sl
  [{'code2db': '',
    'codetype': 'int',
    'dbtype': 'int(11)',
    'description': '',
    'legacy': 'PMTID',
    'memb': 'm_pmtId',
    'name': 'PmtId'},
   ...

sm = GCalibPmtSpec.SpecMap().asdod()     # map of row maps, keyed by name    dict-of-dict
sm
      {'AfterPulseProb': {'code2db': '',
                          'codetype': 'double',
                          'dbtype': 'float',
                          'description': 'Probability of afterpulsing',
                          'legacy': 'PMTAFTERPULSE',
                          'memb': 'm_afterPulseProb',
                          'name': 'AfterPulseProb'},
    ...

sm['TimeOffset']['description']    # access any aspect of spec "matrix" directly by name
     'Relative transit time offset'


sk = cls.SpecKeys().aslist()
sm = cls.SpecMap().asdod()
for k in sk:
    print sm[k]
```

23.8.2 DybDbi.Wrap

Wrapping is the principal technique used by *DybDbi* to provide simple pythonic usage of the underlying *C++* classes (actually PyROOT proxies).

class DybDbi.**Wrap**(*kls*, *attfn={}*)

Bases: object

Control center for application of generic class manipulations based on the names of methods in contained kls. The manipulations do not require the classes to be imported into this scope.

Wrapping is applied to:

- all *genDbi* generated *DbiTableRow* subclasses and corresponding templated *DbiRpt* and *DbiWrt* (readers and writers)
- a selection of other Dbi classes that are useful interactively

define__repr__()
Assign default repr ... override later if desired

define_create()
Provide pythonic instance creation classmethod:

```
i = GTableName.Create( AttributeName=100. , ... )
```

define_csv()
Provide csv manipulations as classmethods on the Row classes

define_listlike()
Application of function RPT to DbiRpt<T> classes provides instances of that class with a list-like interface supporting access by index and slice, indices can be negative to provide access to the end.:

```
r[0]      first
r[-1]     last

r[0:9]    first 10
r[-3:]    last 3


r[0:2000:500]
r[-10:-1:2]    2-step thru the last 10

for x in r[2540:]:
    print x

for x in r[-10:]:
    print x
```

THOUGHTS : * no need for generator implementation for large result set as already all in memory anyhow

define_properties()
Define properties corresponding to Get* and Set* methods in the contained kls, providing attribute style access and setting

```
g = i.x
i.x = s
```

NB "getters" which take arguments GetWithArg(Int_t naughty) have to be skipped via:

```
cls.__skip__ = ("WithArg",)
```

define_update()
Provide dict like updating for DbiTableRow subclasses, eg:

```
from DybDbi import GCalibPmtSpec
r = GCalibPmtSpec.Rpt()
z = r[0]
print z.asdict
print z.keys
z.update( Status=10 )
```

get_attfn(*m*)
Returns function than when applied to an object returns (m,obj.Get<m>()) where m is the attribute name

make__repr__()
Provide a default *__repr__* function that presents the attribute names and values as a dict

23.8.3 DybDbi.CSV

class DybDbi.**CSV**(*path*, ***kwargs*)
Bases: list

Reader/writer for .csv files. The contents are stored as a list of dicts.

Parameters

- **delimiter** – csv field divider
- **prefix** – string start of comment lines to be ignored, default #Table
- **descmarker** – strings used to identify the field description line
- **synth** – when defined, add extra field with this name to hold the csv source line number
- **fields** – impose fieldnames externally, useful for handling broken csv which cannot be fixed immediately

Read usage example:

```
src = CSV("$DBWRITERROOT/share/DYB_MC_AD1.txt", delimiter="\t" )
src.read()
for d in src:
    print d

len(src)
src[0]
src[-1]
src.fieldnames
```

On reading an invalid CSV an exception, with error report, is raised:

```
src = CSV("$DBWRITERROOT/share/DYB_SAB_AD1.txt", delimiter="\t" )
src.read()
```

Handling of common csv incorrectnesses is made:

1.description line fixed up to conform to the delimiter

2.description line extraneous characters removed (other than fieldnames and delimiters)

3.removes comments

Write usage example, field names are obtained from the dict keys:

```
out = CSV("/tmp/demo.csv", delimiter="\t" )
for d in list_of_dict_datasource:
    out.append(d)
out.write()
```

fieldnames
If fieldnames keyword argument is supplied return that otherwise return the names of the keys in the first contained dict. In order to control the order of fields, the argument has to be specified.

write()

23.8.4 DybDbi.Source

class DybDbi.**Source**(*f*, *delimiter='t'*, *prefix='#Table'*, *descmarker='#[]'*, *synth='srcline'*, *fields=*[])
Bases: list

Behaves like a file and holds the original text of the CSV. Applies some fixes to make readable as CSV:

1. removes lines that begin with the `prefix` argument, default `#Table`
2. determines the description line by looking for all characters of the `descmarker` argument, default `#[]`
3. normalize the description line to conform to the delimiter

Normally used internally via CSV, but can be useful to debug broken .csv files interactively:

```
In [2]: import os

In [3]: from DybDbi import Source

In [4]: src=Source(open(os.path.expandvars("$DATASVCROOT/share/feeCableMap_MDC09a.txt")), de

In [5]: for _ in src:print _   ## have to interate to populate

In [7]: src
Out[7]:
Source stat:{'descline': 1, 'prefix': 0, 'total': 1585, 'payload': 1584}
 cols:['srcline', 'ChannelID', 'Description', 'ElecHardwareId', 'Description', 'SensorID', '

In [8]: src.descmarker
Out[8]: '#'

In [9]: src.descline( src[0] )   ## debugging the field extraction from the description line
Out[9]: ' ChannelID Description ElecHardwareId Description SensorID Description SensorHardwa
```

Note the severely invalid .csv (4 fields with the same name) workaround until the .csv can be fixed is to externally impose the fields:

```
fields = 'ChannelID Description0 ElecHardwareId Description1 SensorID Description2 SensorHardwar
src=Source(open(os.path.expandvars("$DATASVCROOT/share/feeCableMap_MDC09a.txt")), delimiter=" ",
```

Parameters

- **delimiter** – csv field divider
- **prefix** – string start of lines to be ignored
- **descmarker** – strings used to identify the field description line
- **synth** – when defined, add extra field with this name to hold the csv source line number
- **fields** – when defined overrides the content of the descline

clean(*line*)
shrink multiple spaces to a single space, and strip head and tail whitespace

descline(*line*)
Remove the descmarker characters from the description line,

is_descline(*line*)
Checks if line contains all of the description markers

next()
On iterating though this "synthetic" file fixes and additions are made to render the "physicist-csv" as real csv

23.8.5 DybDbi.Mapper

class DybDbi.**Mapper**(*cls*, *csv_fields*, ***kwargs*)
Bases: dict

Establish the mapping between sets of fields (such as csv fields) and dbi attributes, usage:

```
ckf = ['status', '_srcline', 'afterPulse', 'sigmaSpe', 'pmtID', 'efficiency', 'darkRate', '_hasb
mpr = Mapper( GCalibPmtSpec, ckf , afterPulse="AfterPulseProb", sigmaSpe="SigmaSpeHigh", prePuls
print mpr
```

If a mapping cannot be made, an exception is thrown that reports the partial mapping constructed.

The automapping performed is dumb by design, only case insensitively identical names are auto mapped. Other differences between csv field names and dbi attributes must be manually provided in the keyword arguments.

The string codetype from the spec is promoted into the corresponding python type, to enable conversion of the csv dict (comprised of all strings) into a dbi dict with appropriate types for the values.

automap()
Basic auto mapping, using case insensitive comparison and yielding case sensitive mapping from csv fields to dbi attributes

The index of the csv fieldname in the dbi attribute list is found with case insensitive string comparison

check_kv(*kvl*, *expect*, *name*)
Check the keys/values are in the expected list

convert_csv2dbi(*dcsv*)
Translate dict with csv fieldnames into dict with dbi attr names and appropiate types for insertion into the DBI Row cls instance

23.8.6 DybDbi.Ctx

class DybDbi.**Ctx**
Bases: ROOT.ObjectProxy

AsString
char* Ctx::AsString(int ctx)

FromIndex
int Ctx::FromIndex(int i)

FromString
int Ctx::FromString(char* str)

FullMask
int Ctx::FullMask()

Length
int Ctx::Length()

MaskFromString
int Ctx::MaskFromString(char* str)

MaxBits
int Ctx::MaxBits()

StringForIndex
char* Ctx::StringForIndex(int i)

StringFromMask
char* Ctx::StringFromMask(int mask)

23.8.7 DybDbi.DbiCtx

`DbiCtx` is a C++ class designed to facilitate DBI usage from python the `DbiRpt` and `DbiWrt` classes each contain an instance of `DbiCtx`

The `DbiCtx` instances have constituents corresponding to all possible arguments of all DBI reader and writer constructors:

1. readers `DbiResultPtr<T>`, see databaseinterface:DbiResultPtr.h
2. writers `DbiWriter<T>` see databaseinterface:DbiWriter.h

The precise constructor used is determined by the attribute settings made in the `DbiCtx` instance The attributes are divided into tables below according to recommended usage

When reading from DB

Attribute	type	notes
context	`DybDbi.Context`	composite setting
timestamp	`DybDbi.TimeStamp`	constituent of context
simflag		constituent of context
site		constituent of context
detectorid		constituent of context
subsite		
task		
dbno		
logcomment		
tablename		*Expert Usage Only* leave at default
aborttest		*Expert Usage Only*
findfulltimewindow		*Expert Usage Only*
sqlcontext		*sqlcontext* eg wideopen `1=1`
datasql		*datasql*

sqlcontext

Replaces the validity context with the provided SQL `where` clause applied to the Validity table, for example the wideopen `1=1` caution this can be very memory expensive.

datasql

Applies the provided SQL `where` clause to the payload table

Expert Usage Only

Familiarity with the DBI implementation is required.

Use when writing to the DB

Attribute	type	notes
contextrange	DybDbi.ContextRange	
timestart	DybDbi.TimeStamp	constituent of contextrange
timeend	DybDbi.TimeStamp	constituent of contextrange
sitemask		constituent of contextrange
simmask		constituent of contextrange
aggno		leave as default -1
task		
dbno		
logcomment		

Use with caution when reading from DB:

Attribute	notes
datasql	a payload where clause
tablename	genDbi default usually ok
versiondate	

Usage only advised for experts familiar with DbiWriter<T> and DbiResultPtr<T> ctors

Attribute	notes
seqno	
validityrec	
datafillopts	
dbname	

23.8.8 DybDbi.vld.versiondate

In *–transfix* mode copies all DBI tables from *tmp_offline_db* into *fix_offline_db* with *VERSIONDATE* changed to timestart floored scheme.

As yet no collision checks.

Try to back-predict versiondate for all validities in all Vld tables

Usage:

```
./versiondate.py --help
./versiondate.py
./versiondate.py CalibPmtHighGain
./versiondate.py --transfix
./versiondate.py --transfix             -l DEBUG
./versiondate.py --transfix HardwareID  -l DEBUG
./versiondate.py --transfix CableMap    -l DEBUG
./versiondate.py --transfix CalibPmtSpec -l DEBUG
```

To confirm no change when timestart flooring is off:

```
echo select \* from tmp_offline_db.HardwareIDVld | mysql -t > tmp_HardwareID.txt
echo select \* from fix_offline_db.HardwareIDVld | mysql -t > fix_HardwareID.txt
diff tmp_HardwareID.txt fix_HardwareID.txt
```

class DybDbi.vld.versiondate.**VFS**(*field*, *value*)
Bases: list

Convenience class to format all column names in validity table and allow easy swap out of single fields

DybDbi.vld.versiondate.**check_versiondate**(*args*)
For all DBI tables in source *tmp* DB invoke the *check_versiondate_tab*

DybDbi.vld.versiondate.**check_versiondate_tab**(*tab*)
Check if the versiondate of all validities matches that divined with QueryOverlayVersionDate, via SEQNO condition to allow backdating

Probably this is just confirming that overlay versioning was used

DybDbi.vld.versiondate.**setup**()

1.Establish coordinates of source *tmp* and target *fix* databases with safety asserts

2.drop and recreate the target DB *fix*

3.label DB instances with *dbno* for DBI usage

DybDbi.vld.versiondate.**transfix**(*args*)
Copies all DBI tables from *tmp* into *fix* changing the *VERSIONDATE* to conform to *TimeStartFlooredVersionDate* scheme.

Hmm currently the *VERSIONDATE* collision avoidance implemented in the DBI writer does not come into play here : **IT NEEDS TO BE SPOOFED HERE**

DybDbi.vld.versiondate.**transfix_tab**(*tmp*, *fix*, *tab*, *localseqno=False*)
SEQNO by SEQNO transfers table entries from `tmp` to `fix` databases effectively replaying table history as it grows in the `fix` DB. Allowing changes to the `VERSIONDATE` scheme to be tested.

Parameters

- **tmp** – source DybPython.DB instance
- **fix** – target DybPython.DB instance
- **tab** – payload table name

Actions:

1.create payload and validity tables using DBI, note there is no need to drop the tables first as started by dropping the fix DB

2.loops over validity entries of `tab` in tmp DB in *SEQNO asc* order

For each vld entry calls `qovd_transfix` prior to transferring the vld from the `tmp` to `fix` DB allowing the `VERSIONDATE` to be modified to use a different scheme.

The backdated qovd comparison with versiondate could be used to detect early entries that did not use overlay versioning:

```
qovd.GetSec() != versiondate.GetSec()
```

Note, formerly used application of an SQL condition to effect a timstart floor, inside:

```
qovd = qovd_transfix( kls, vrec, fix.dbno ).AsString("s")
```

But following C++ additions can now directly use `QueryOverlayVersionDate` and set the additional parameter `fTimeStartFlooredVersionDate`

23.8.9 DybDbi.vld.vlut

Compare validity lookup tables between different DB and option variations

Due to usage of `converter.tabular.TabularData` for presentation of the tables this must be run from the *docs* virtual python:

```
~/rst/bin/python vlut.py
~/v/docs/bin/python vlut.py
```

DEFICIENCIES

1. top level `index.rst` of tables requires manual editing
2. running single context, has habit of messing up all context indices. Workaround is rerunning the `--ctx ALL`

Production Run From Scratch

Clean start:

```
dybdbi
cd vld
./versiondate.py                ##  transfixion of tmp_offline_db creating fix_offline_db
rm -rf /tmp/blyth/dbiscan       ## clean start
time ~/rst/bin/python ./vlut.py
```

Full traverse takes:

```
real    103m41.969s
user    92m13.993s
sys     4m54.889s
```

Payload Digest Based Comparisons

Goal is to compare very different DB for content:

1. `tmp_offline_db` with CableMap,HardwareID duplications eliminated and written with the `G*Fix` classes
2. `tmp_copy_db` copy of `offline_db`

Features:

1. payload digests should allow comparison without SEQNO correspondence
2. TIMESTARTs should align

Issues:

1. insertdates(table update history) does not align forcing to manually
   (a) `opts['_insertdate_aligned'] = False`
   (b) common junctures might also be defined to allow more that just the last comparison

Presenting the LUTs with Sphinx

Debugging

Unexplained difference between *tmp_offline_db* without extra ordering (formerly though to be implicit `VERSIONDATE desc, SEQNO asc`) and *SEQNO asc*

> [blyth@belle7 aggno-1_simflag2_site1_subsite2_task0]$ diff ./tmp_offline_db/vlut.rst ./orderingSEQNOasc_tmp_offline_db/vlut.rst

Promising no diffs between tmp_offline_db with added "SEQNO asc" validity ordering and the fix_offline_db (for the fixed the SEQNO diddling makes no difference as all same ... at least in ctxs covered so far). This means that enforcing extra `SEQNO asc` validity ordering on an horrible degenerate mess of duplicated VERSIONDATEs in *tmp_offline_db* succeeds to give the same VLUT as the transfixed one ... with the careful timestart floored version date with no degeneracy.

This is understandable as the validity ordering becomes "VERSIONDATE desc, SEQNO asc" so the larger SEQNO of degenerate sets wins. That seems like it should be mostly correct ... are there any edge cases ?

If this pans out to all ctxs then **the eagle has landed**

Nginx Hookup

Hook up to nginx:

```
nginx-
cd `nginx-htdocs`
sudo ln -s $SITEROOT/../users/$USER/dbiscan/sphinx/_build/dirhtml dbiscan
```

Add location with *nginx-edit*:

```
location /dbiscan {
     autoindex on ;
     autoindex_exact_size off ;
     autoindex_localtime on ;
}
```

After restart of nginx can peruse the tables:

- http://belle7.nuu.edu.tw/dbiscan/

Machinery Issues

1. rerun bug, not updating index have to manually: `rm /tmp/blyth/dbidigest/sphinx/CableMap/index.rst`

`DybDbi.vld.vlut.`**`traverse_vlut`**`(`*`vs`*`)`

> For all tables common to the databases traverse all contexts in common, writing the vlut rst files and making comparisons.
>
> Loads persisted scans created by `DybPython.vlut.Scan` and presents as LUTs (look up tables) in rst table format
>
> **Parameters** **vs** – *VlutSpec* instance

23.8.10 DybDbi.vld.vsmry

Usage:

```
time ~/rst/bin/python vsmry.py $SITEROOT/../users/$USER/dbiscan/sphinx/CableMap/smry.pc
```

Smry are dicts of stat dicts, keyed by the VLUT relative path, eg:

```
CableMap/aggno-1_simflag2_site4_subsite5_task0/tmp_offline_db_cf_fix_offline_db/vlutorderingSEQNOdesc
CableMap/aggno-1_simflag2_site4_subsite6_task0/tmp_offline_db_cf_fix_offline_db/vlut.rst {'ndif': 14}
CableMap/aggno-1_simflag2_site4_subsite6_task0/tmp_offline_db_cf_fix_offline_db/vlutorderingSEQNOasc
CableMap/aggno-1_simflag2_site4_subsite6_task0/tmp_offline_db_cf_fix_offline_db/vlutorderingSEQNOdesc
CableMap/aggno-1_simflag2_site4_subsite7_task0/tmp_offline_db_cf_fix_offline_db/vlut.rst {'ndif': 0}
CableMap/aggno-1_simflag2_site4_subsite7_task0/tmp_offline_db_cf_fix_offline_db/vlutorderingSEQNOasc
CableMap/aggno-1_simflag2_site4_subsite7_task0/tmp_offline_db_cf_fix_offline_db/vlutorderingSEQNOdesc
```

Down to handful of 3 pathological ctxs in 3 tables (Demo doesnt count) for whom the fix is not doing the biz:

```
    CRITICAL:__main__:checking smry beneath /tmp/blyth/dbiscan/sphinx levels ['ctx']

    CRITICAL:__main__:CableMap             aggno-1_simflag2_site32_subsite1_task0   tmp_offline_db_c
    CRITICAL:__main__: http://belle7.nuu.edu.tw/dbiscan/CableMap/aggno-1_simflag2_site32_subsite1_tas


    CRITICAL:__main__:CalibFeeSpec         aggno-1_simflag1_site32_subsite1_task0   tmp_offline_db_c
    CRITICAL:__main__: http://belle7.nuu.edu.tw/dbiscan/CalibFeeSpec/aggno-1_simflag1_site32_subsite1
                       http://belle7.nuu.edu.tw/dbiscan/CalibFeeSpec/aggno-1_simflag1_site32_subsite1

             ## this  CalibFeeSpec ctx is the only CalibFeeSpec ctx (suggesting junk?)

    CRITICAL:__main__:CalibPmtSpec         aggno-1_simflag1_site32_subsite2_task0   tmp_offline_db_c
    CRITICAL:__main__: http://belle7.nuu.edu.tw/dbiscan/CalibPmtSpec/aggno-1_simflag1_site32_subsite2
                       http://belle7.nuu.edu.tw/dbiscan/CalibPmtSpec/aggno-1_simflag1_site32_subsite2

             ## no order flip discrep within tmp_ and fix_ ... but there is between em ?

    CRITICAL:__main__:Demo                 aggno-1_simflag1_site127_subsite0_task0  tmp_offline_db_c
    CRITICAL:__main__: http://belle7.nuu.edu.tw/dbiscan/Demo/aggno-1_simflag1_site127_subsite0_task0/


select * from CableMapVld where SIMMASK=2 and SITEMASK=32 and TASK=0 ;
select * from CalibFeeSpecVld where SIMMASK=1 and SITEMASK=32 and TASK=0 ;
select * from CalibPmtSpecVld where SIMMASK=1 and SITEMASK=32 and TASK=0 ;
```

DEBUG/INFO/WARN/ERROR/FATAL

DybDbi.vld.vsmry.**ctx_count**(*dbconfs*)

To verify are seeing the appropriate number of distinct ctxs:

```
    mysql> select distinct(CONCAT(SITEMASK,":",SIMMASK,":",SUBSITE,":",TASK,":",AGGREGATENO)) from C
    +-----------------------------------------------------------------------+
    | (CONCAT(SITEMASK,":",SIMMASK,":",SUBSITE,":",TASK,":",AGGREGATENO)) |
    +-----------------------------------------------------------------------+
    | 32:1:1:0:-1                                                           |
    | 32:1:2:0:-1                                                           |
    | 127:1:0:0:-1                                                          |
    | 127:2:0:0:-1                                                          |
    | 1:2:1:0:-1                                                            |
    | 1:1:5:0:-1                                                            |
    | 1:1:6:0:-1                                                            |
```

```
| 1:1:1:0:-1                                                                |
| 1:1:2:0:-1                                                                |
+---------------------------------------------------------------------------+
9 rows in set (0.00 sec)
```

DybDbi.vld.vsmry.**dump_ctxsmry**()
Dump tables for each *cfdir* expressing summary dif info in cfdir/tn/name hierarchy:

tn	vlut.rst	vlutorderingSEQNOasc.rst	vlutorderingSEQN-Odesc.rst
CableMap	16/35	1/35	19/35
CalibFeeSpec	1/1	1/1	1/1
CalibPmtHigh-Gain	0/6	0/6	0/6
CalibPmtPedBias	0/1	0/1	0/1

DybDbi.vld.vsmry.**dump_difctx**(*cfdir='tmp_offline_db_cf_fix_offline_db'*, *name='vlut.rst'*)
For each *tn* within *cfdir/name* Dump tables listting *ctx* with differnces and their ranges of difference in INSERT-DATE,TIMESTART space

DybDbi.vld.vsmry.**grow_cf**(*tn*, *ctx*, *cfdir*, *name*, *stat*)

Parameters

- **tn** – table name
- **ctx** – context
- **cfdir** – comparison dir
- **name** – eg vlut.rst
- **stat** – statistics and range dict

Collect lists of all ctx and ctx with ndif > 0 into *cf* dict keyed into changed hierarchy *cfdir/tn/name*

DybDbi.vld.vsmry.**present_smry**()
Currently needs manual hookup to global index.rst

DybDbi.vld.vsmry.**squeeze_tab**(*dohd*, *cols*, *kn*)

Parameters

- **dohd** – dict of hashdicts
- **cols** – presentation ordering of keys in the hashdicts
- **kn** – name of the *dohd* key that becomes added column for gang up referencing

Suppress duplicate value entries in a table by ganging

Simple lookups:

23.8.11 DybDbi.IRunLookup

class DybDbi.**IRunLookup**(**args*, ***kwa*)
Bases: DybDbi.ilookup.ILookup

Specialization of DybDbi.ILookup, for looking for run numbers in GDaqRunInfo, usage:

```
iargs = (10,100,1000)
irl = IRunLookup( *iargs )
for ia in iargs:
    print ia, irl[ia]
```

23.8.12 DybDbi.ILookup

class DybDbi.**ILookup**(**args*, ***kwa*)
Bases: dict

Example of use:

```
il = ILookup( 10,100,1000, kls='GDaqRunInfo', ifield="runNo", iattr="RunNo" )
   #  corresponds to datasql WHERE clause :   runNo in (10,100,1000)
print il[10]
```

The positional arguments are used in datasql **IN** list, the query must result in the same number of entries as positional arguments. The `iattr` is needed as DybDbi attribute names are often different from fieldnames, this is used after the query with in memory lookup to arrange the results of the query by the argument values.

Effectively the positional arguments must behave like primary keys with each arg corresponding to one row.

23.8.13 DybDbi.AdLogicalPhysical

class DybDbi.**AdLogicalPhysical**(*timestamp=None*, *purgecache=False*, *DROP=False*)
Bases: dict

Provides access to logical/physical mappings from the DBI table *gendbi-gphysad*, with functionality to read the mappings at particular timestamps and write them with validity time range.

1. logical slots are expressed as tuples `(site,subsite)` such as `(Site.kSAB,DetectorId.kAD1)`
2. physical AD indices `1,2,...8` corresponding to `AD1,AD2,..,AD8`

Mappings are stored within this dict keyed by logical slot. Reverse `physical->logical` lookups are provide by the `__call__` method:

```
alp = AdLogicalPhysical()
site, subsite = alp(1)          ## find where AD1 is
```

An input `physadid` of **None** is used to express a vacated slot, and results in the writing of a payloadless DBI validity. Such **None** are not read back into this dict on reading, it being regarded as a write signal only.

For usage examples see dybgaudi:Database/DybDbi/tests/test_physad.py

Parameters

- **timestamp** – time at which to lookup mapping, defaults of None is promoted to now (UTC natually)
- **purgecache** – clear cache before reading, needed when reading updates from same process that wrote them
- **DROP** – drop the table and zero the LASTUSEDSEQNO (**only use during development**)

Read current mappings from `PhysAd` DB table, usage:

```
alp = AdLogicalPhysical()
print alp
blp = AdLogicalPhysical(timestamp=TimeStamp(2011,10,10,0,0,0))
print blp
```

Direct lookup:

```
phyadid = alp.get((site,subsite), None)
if physadid:
    print "(%(site)s,%(subsite)s) => %(physadid)s " % locals()
```

To update mappings in memory:

```
alp.update({(Site.kSAB,DetectorId.kAD1):1,(Site.kDayaBay,DetectorId.kAD2):2})
```

Vacating a formerly occupied slot is done using `None`:

```
alp.update({(Site.kSAB,DetectorId.kAD1):None,(Site.kDayaBay,DetectorId.kAD1):1})
```

To persist the update to the DB, within a particular timerange:

```
alp.write( timestart=TimeStamp.kNow() )
```

Read back by instanciating a new instance:

```
blp = AdLogicalPhysical( timestamp=... )
```

Reverse lookup from physical AD id `1,2,3..8` to logical slot:

```
sitesubsite = alp(1)          ## invokes the __call__ method for reverse lookup
if sitesubsite:
    site, subsite = sitesubsite
else:
    print "not found"
```

check_physical2logical()
Self consistency check Test that the call returns the expected slot, verifying that the physical2logic dict is in step

kls
alias of `GPhysAd`

classmethod lookup_logical2physical(*timestamp*, *sitesubsite*, *simflag=1*)

Parameters

- **timestamp** –
- **sitesubsite** –
- **simflag** –

Return physadid, vrec

Note that a payloadless DBI query result is interpreted to mean an empty logical slot resulting in the return of a `physadid` of **None**

Cannot use `kAnySubSite = -1` to avoid querying every slot as DBI non-aggregate reads always correspond to a single SEQNO

write(*timestart=None*, *timeend=None*)
Writes mappings expressed in this dict into DB

Parameters

- **timestart** –
- **timeend** –

Context basis classes from dybgaudi:DataModel/Context/Context

23.8.14 DybDbi.Context

The underlying C++ class is defined in context:Context.h.

class DybDbi.**Context**(*int site*, *int flag*, *const TimeStamp& time='TimeStamp()'*, *int det='kUnknown'*)
Bases: ROOT.ObjectProxy

Context::Context() Context::Context(const Context& other) Context::Context(int site, int flag, const TimeStamp& time = TimeStamp(), int det = kUnknown)

AsString
std::string Context::AsString(char* option = "")

GetDetId
int Context::GetDetId()

GetSimFlag
int Context::GetSimFlag()

GetSite
int Context::GetSite()

GetTimeStamp
TimeStamp& Context::GetTimeStamp()

IsA
TClass* Context::IsA()

IsValid
bool Context::IsValid()

SetDetId
void Context::SetDetId(int det)

SetSimFlag
void Context::SetSimFlag(int flag)

SetSite
void Context::SetSite(int site)

SetTimeStamp
void Context::SetTimeStamp(const TimeStamp& ts)

ShowMembers
void Context::ShowMembers(TMemberInspector&, char*)

detid
int Context::GetDetId()

simflag
int Context::GetSimFlag()

site
int Context::GetSite()

timestamp
TimeStamp& Context::GetTimeStamp()

23.8.15 DybDbi.ContextRange

The underlying C++ class is defined in context:ContextRange.h.

class DybDbi.**ContextRange**(*const int siteMask*, *const int simMask*, *const TimeStamp& tstart*, *const TimeStamp& tend*)

Bases: ROOT.ObjectProxy

ContextRange::ContextRange(const ContextRange&) ContextRange::ContextRange() ContextRange::ContextRange(const int siteMask, const int simMask, const TimeStamp& tstart, const TimeStamp& tend)

AsString
std::string ContextRange::AsString(char* option = "")

GetSimMask
int ContextRange::GetSimMask()

GetSiteMask
int ContextRange::GetSiteMask()

GetTimeEnd
TimeStamp ContextRange::GetTimeEnd()

GetTimeStart
TimeStamp ContextRange::GetTimeStart()

IsA
TClass* ContextRange::IsA()

IsCompatible
bool ContextRange::IsCompatible(const Context& cx) bool ContextRange::IsCompatible(Context* cx)

SetSimMask
void ContextRange::SetSimMask(const int simMask)

SetSiteMask
void ContextRange::SetSiteMask(const int siteMask)

SetTimeEnd
void ContextRange::SetTimeEnd(const TimeStamp& tend)

SetTimeStart
void ContextRange::SetTimeStart(const TimeStamp& tstart)

ShowMembers
void ContextRange::ShowMembers(TMemberInspector&, char*)

TrimTo
void ContextRange::TrimTo(const ContextRange& other)

simmask
int ContextRange::GetSimMask()

sitemask
int ContextRange::GetSiteMask()

timeend
TimeStamp ContextRange::GetTimeEnd()

timestart
TimeStamp ContextRange::GetTimeStart()

23.8.16 DybDbi.TimeStamp

Underlying C++ class is defined in context:TimeStamp.h

class DybDbi.**TimeStamp**(*unsigned int year*, *unsigned int month*, *unsigned int day*, *unsigned int hour*, *unsigned int min*, *unsigned int sec*, *unsigned int nsec=0*, *bool isUTC='true'*, *int secOffset=0*)

Bases: ROOT.ObjectProxy

Pythonic extensions to underlying DBI TimeStamp assume that **all TimeStamps are expressing UTC times** (this is the default)

```
In [2]: ts = TimeStamp.kNow()

In [3]: ts.UTCtoDatetime.ctime()
Out[3]: 'Thu May 26 13:10:20 2011'

In [4]: ts.UTCtoNaiveLocalDatetime.ctime()
Out[4]: 'Thu May 26 13:10:20 2011'

In [5]: ts.UTCtoDatetime
Out[5]: datetime.datetime(2011, 5, 26, 13, 10, 20, tzinfo=<DybDbi.TimeStampExt.UTC object at 0xb

In [6]: ts.UTCtoNaiveLocalDatetime                    ## useful for comparisons with naive dateti
Out[6]: datetime.datetime(2011, 5, 26, 13, 10, 20)
```

TimeStamp::TimeStamp() TimeStamp::TimeStamp(const TimeStamp& source) TimeStamp::TimeStamp(const timespec& ts) TimeStamp::TimeStamp(const time_t& t, const int nsec) TimeStamp::TimeStamp(unsigned int year, unsigned int month, unsigned int day, unsigned int hour, unsigned int min, unsigned int sec, unsigned int nsec = 0, bool isUTC = true, int secOffset = 0) TimeStamp::TimeStamp(unsigned int date, unsigned int time, unsigned int nsec, bool isUTC = true, int secOffset = 0) TimeStamp::TimeStamp(double seconds)

Add
: void TimeStamp::Add(const TimeStamp& offset) void TimeStamp::Add(double seconds)

AsString
: char* TimeStamp::AsString(char* option = "")

CloneAndSubtract
: TimeStamp TimeStamp::CloneAndSubtract(const TimeStamp& offset)

Copy
: void TimeStamp::Copy(TimeStamp& vldts)

DumpTMStruct
: static void TimeStamp::DumpTMStruct(const tm& tmstruct)

GetBOT
: static TimeStamp TimeStamp::GetBOT()

GetDate
: int TimeStamp::GetDate(bool inUTC = true, int secOffset = 0, unsigned int* year = 0, unsigned int* month = 0, unsigned int* day = 0)

GetEOT
: static TimeStamp TimeStamp::GetEOT()

GetNBOT
: static TimeStamp TimeStamp::GetNBOT()

GetNanoSec
: int TimeStamp::GetNanoSec()

GetSec
long TimeStamp::GetSec()

GetSeconds
double TimeStamp::GetSeconds()

GetTime
int TimeStamp::GetTime(bool inUTC = true, int secOffset = 0, unsigned int* hour = 0, unsigned int* min = 0, unsigned int* sec = 0)

GetTimeSpec
timespec TimeStamp::GetTimeSpec()

GetZoneOffset
static int TimeStamp::GetZoneOffset()

IsA
TClass* TimeStamp::IsA()

IsLeapYear
static bool TimeStamp::IsLeapYear(int year)

IsNull
bool TimeStamp::IsNull()

MktimeFromUTC
static long TimeStamp::MktimeFromUTC(tm* tmstruct)

Print
void TimeStamp::Print(char* option = "")

ShowMembers
void TimeStamp::ShowMembers(TMemberInspector&, char*)

Subtract
void TimeStamp::Subtract(const TimeStamp& offset) void TimeStamp::Subtract(double seconds)

UTCtoDatetime
From an **assumed** UTC TimeStamp return tz aware datetime

UTCtoNaiveLocalDatetime
From an **assumed** UTC TimeStamp return naive local datetime

```
ts = TimeStamp.kNow()
  'Thu, 26 May 2011 04:41:03 +0000 (GMT) +        0 nsec

ts.UTCtoDatetime.ctime()
  'Thu May 26 12:41:03 2011'

ts.UTCtoNaiveLocalDatetime.ctime()
  'Thu May 26 12:41:03 2011'
```

bot
static TimeStamp TimeStamp::GetBOT()

date
int TimeStamp::GetDate(bool inUTC = true, int secOffset = 0, unsigned int* year = 0, unsigned int* month = 0, unsigned int* day = 0)

eot
static TimeStamp TimeStamp::GetEOT()

classmethod kNow ()
TimeStamp object representing current UTC time

nanosec
int TimeStamp::GetNanoSec()

nbot
static TimeStamp TimeStamp::GetNBOT()

sec
long TimeStamp::GetSec()

seconds
double TimeStamp::GetSeconds()

time
int TimeStamp::GetTime(bool inUTC = true, int secOffset = 0, unsigned int* hour = 0, unsigned int* min = 0, unsigned int* sec = 0)

timespec
timespec TimeStamp::GetTimeSpec()

zoneoffset
static int TimeStamp::GetZoneOffset()

23.8.17 DybDbi.ServiceMode

The underlying C++ class is defined in context:ServiceMode.h.

class DybDbi.**ServiceMode**(*const Context& context*, *int task*)
Bases: ROOT.ObjectProxy

ServiceMode::ServiceMode(const ServiceMode&) ServiceMode::ServiceMode() ServiceMode::ServiceMode(const Context& context, int task)

IsA
TClass* ServiceMode::IsA()

ShowMembers
void ServiceMode::ShowMembers(TMemberInspector&, char*)

context
Context& ServiceMode::context()

task
int& ServiceMode::task()

Convention basis classes from :dybgaudi:DataModel/Conventions/Conventions

23.8.18 DybDbi.Site

The underlying enum is defined in conventions:Site.h.

class DybDbi.**Site**
Bases: ROOT.ObjectProxy

AsString
char* Site::AsString(int site)

FromString
int Site::FromString(char* str)

FullMask
int Site::FullMask()

MaskFromString
int Site::MaskFromString(char* str)

StringFromMask
char* Site::StringFromMask(int mask)

23.8.19 DybDbi.SimFlag

The underlying enum is defined in conventions:SimFlag.h.

class DybDbi.**SimFlag**
Bases: ROOT.ObjectProxy

AsString
char* SimFlag::AsString(int flag)

FromString
int SimFlag::FromString(char* str)

FullMask
int SimFlag::FullMask()

StringFromMask
char* SimFlag::StringFromMask(int mask)

23.8.20 DybDbi.DetectorId

class DybDbi.**DetectorId**
Bases: ROOT.ObjectProxy

AsString
char* DetectorId::AsString(int id)

FromString
int DetectorId::FromString(char* str)

FromString0
int DetectorId::FromString0(char* str)

isAD
bool DetectorId::isAD(int id)

isRPC
bool DetectorId::isRPC(int id)

isWaterShield
bool DetectorId::isWaterShield(int id)

23.8.21 DybDbi.Detector

DybDbi.**Detector**
alias of DayaBay::Detector

23.8.22 DybDbi.DetectorSensor

class DybDbi.**DetectorSensor**(*unsigned int sensor_id*, *int site*, *int det*)
Bases: DybDbi.DayaBay::DetectorSensor

DetectorSensor::DetectorSensor() DetectorSensor::DetectorSensor(unsigned int sensor_id, int site, int det) DetectorSensor::DetectorSensor(const DayaBay::DetectorSensor& sensor) DetectorSensor::DetectorSensor(int data)

23.8.23 DybDbi.FeeChannelId

class DybDbi.**FeeChannelId**(*int board*, *int connector*, *int site*, *int det*)
Bases: DybDbi.DayaBay::FeeChannelId

FeeChannelId::FeeChannelId() FeeChannelId::FeeChannelId(int board, int connector, int site, int det) FeeChannelId::FeeChannelId(const DayaBay::FeeChannelId& channel) FeeChannelId::FeeChannelId(int data)

23.8.24 DybDbi.FeeHardwareId

class DybDbi.**FeeHardwareId**(*int boardId*, *int connector*)
Bases: DybDbi.DayaBay::FeeHardwareId

FeeHardwareId::FeeHardwareId(const DayaBay::FeeHardwareId&) FeeHardwareId::FeeHardwareId() FeeHardwareId::FeeHardwareId(int boardId, int connector) FeeHardwareId::FeeHardwareId(int data)

23.8.25 DybDbi.PmtHardwareId

class DybDbi.**PmtHardwareId**(*unsigned int id*, *int hardware*)
Bases: DybDbi.DayaBay::PmtHardwareId

PmtHardwareId::PmtHardwareId(const DayaBay::PmtHardwareId&) PmtHardwareId::PmtHardwareId() PmtHardwareId::PmtHardwareId(unsigned int id, int hardware) PmtHardwareId::PmtHardwareId(int data)

Enums:

23.8.26 DybDbi.Dbi

class DybDbi.**Dbi**
Bases: ROOT.ObjectProxy

GetTimeGate
int Dbi::GetTimeGate(const string& tableName)

GetVldDescr
std::string Dbi::GetVldDescr(char* tableName, Bool_t isTemporary = false)

MakeDateTimeString
std::string Dbi::MakeDateTimeString(const TimeStamp& timeStamp)

MakeTimeStamp
TimeStamp Dbi::MakeTimeStamp(const string& sqlDateTime, bool* ok = 0)

NotGlobalSeqNo
bool Dbi::NotGlobalSeqNo(UInt_t seqNo)

SetTimeGate
void Dbi::SetTimeGate(const string& tableName, Int_t timeGate)

UsernameFromEnvironment
std::string Dbi::UsernameFromEnvironment()

timegate
int Dbi::GetTimeGate(const string& tableName)

vlddescr
std::string Dbi::GetVldDescr(char* tableName, Bool_t isTemporary = false)

Generated row classes:

23.8.27 DybDbi.GPhysAd

class DybDbi.**GPhysAd**(*const GPhysAd& from*)
Bases: DybDbi.DbiTableRow

This table can be read/written using DybDbi.AdLogicalPhysical

(adapted from Dan/Zhimin email 2011-01-17)

There are two ways to identify an AD in the experiment:

1.Location: SAB-AD1, ..., FAR-AD4

2.Physical ID: AD1, AD2, ..., AD8

Convention references

Convention	Reference
DCS	doc:3198
DAQ	doc:3442 page 6

The Offline convention can be found from:

- dybgaudi:DataModel/Conventions/Conventions/Site.h
- dybgaudi:DataModel/Conventions/Conventions/DetectorId.h

Here is a summary of the Location names/IDs that each system uses:

Site (Name and ID)

DCS	DAQ	Offline	DAQ_ID	Offline_ID
DBNS	DBN	DayaBay	0x10	0x01
LANS	LAN	LingAo	0x20	0x02
FARS	FAR	Far	0x30	0x04
MIDS	MID	Mid	.	0x08
.	.	Aberdeen	.	0x10
SAB	SAB	SAB	0x60	0x20
.	.	PMTBenchTest	.	0x40
LSH	.	.	.	.

Detector/MainSys (Name and ID)

DCS	DAQ	Offline	DAQ_ID	Offline_ID
AD1	AD1	AD1	0x01	0x01
AD2	AD2	AD2	0x02	0x02
AD3	AD3	AD3	0x03	0x03
AD4	AD4	AD4	0x04	0x04
IWP	WPI	IWS	0x05	0x05
OWP	WPO	OWS	0x06	0x06
RPC	RPC	RPC	0x07	0x07
Muon	.	.	.	.
GAS	.	.	.	.
PMT	.	.	.	.
FEE	.	.	.	.
SIS	.	.	.	.

GPhysAd::GPhysAd() GPhysAd::GPhysAd(const GPhysAd& from) GPhysAd::GPhysAd(int PhysAdId)

AssignTimeGate
static void GPhysAd::AssignTimeGate(Int_t seconds, char* alternateName = 0)

Cache
static DbiCache* GPhysAd::Cache(char* alternateName = 0)

CanL2Cache
bool GPhysAd::CanL2Cache()

Close
static void GPhysAd::Close(char* filepath = 0l)

Compare
bool GPhysAd::Compare(const GPhysAd& that)

classmethod Create (**args*, ***kwargs*)
Provide pythonic instance creation classmethod:

```
i = GTableName.Create( AttributeName=100. , ... )
```

CreateTableRow
DbiTableRow* GPhysAd::CreateTableRow()

CurrentTimeGate
static int GPhysAd::CurrentTimeGate(char* alternateName = 0)

DoubleValueForKey
double GPhysAd::DoubleValueForKey(char* key, double defval = -0x00000000000000001)

Fill
void GPhysAd::Fill(DbiResultSet& rs, DbiValidityRec* vrec)

FloatValueForKey
float GPhysAd::FloatValueForKey(char* key, float defval = -0x00000000000000001)

GetDatabaseLayout
std::string GPhysAd::GetDatabaseLayout()

GetDigest
std::string GPhysAd::GetDigest()

GetFields
std::string GPhysAd::GetFields()

GetPhysAdId
int GPhysAd::GetPhysAdId()

GetTableDescr
static std::string GPhysAd::GetTableDescr(char* alternateName = 0)

GetTableProxy
static DbiTableProxy& GPhysAd::GetTableProxy(char* alternateName = 0)

GetValues
std::string GPhysAd::GetValues()

IntValueForKey
int GPhysAd::IntValueForKey(char* key, int defval = -0x00000000000000001)

IsA
TClass* GPhysAd::IsA()

Rpt
static DbiRpt<GPhysAd>* GPhysAd::Rpt(char* ctx = GPhysAd::MetaRctx)

Save
void GPhysAd::Save()

SetPhysAdId
void GPhysAd::SetPhysAdId(int PhysAdId)

ShowMembers
void GPhysAd::ShowMembers(TMemberInspector&, char*)

SpecKeys
static TList* GPhysAd::SpecKeys()

SpecList
static TList* GPhysAd::SpecList()

SpecMap
static TMap* GPhysAd::SpecMap()

Store
void GPhysAd::Store(DbiOutRowStream& ors, DbiValidityRec* vrec)

Wrt
static DbiWrt<GPhysAd>* GPhysAd::Wrt(char* ctx = GPhysAd::MetaWctx)

aggregateno
int DbiTableRow::GetAggregateNo()

classmethod csv_check (*path*, ***kwargs*)
Check the validity of CSV file and correspondence with CSV fields and DBI attributes:

```
from DybDbi import GCalibPmtSpec
GCalibPmtSpec.csv_check( "$DBWRITERROOT/share/DYB_%s_AD1.txt" % "SAB", afterPulse="AfterPuls
```

Manual mapping is required if field names do not match DBI attribute names (primitive case insensitive auto mapping is applied to avoid the need for tedious full mapping).

classmethod csv_compare (*path*, ***kwargs*)
compare entries in CSV file with those found in DB

classmethod csv_export (*path*, ***kwargs*)
Export the result of a default context DBI query as a CSV file

Parameters

- **path** – path of output file
- **fieldnames** – optionally specifiy the field order with a list of fieldnames

Note: make the output more human readable with regular column widths

classmethod **csv_import** (*path*, ***kwargs*)

Import CSV file into Database Using default writer context for now

ContextRange::ContextRange(const int siteMask, const int simMask, const TimeStamp& tstart, const TimeStamp& tend)

ql> select * from CalibPmtSpecVld ; +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | SEQNO | TIMESTART | TIMEEND | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATENO | VERSIONDATE | INSERTDATE | +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | 26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 | 127 | 1 | 0 | 0 | -1 | 2011-01-22 08:15:17 | 2011-02-25 08:10:15 | | 18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 | 32 | 1 | 1 | 0 | -1 | 2010-06-21 15:50:24 | 2010-07-19 12:49:29 |

HMM... Better to make this a classmethod on the writer rather than the Row class... OR do not shrinkwrap .. just leave as example

databaselayout
std::string GPhysAd::GetDatabaseLayout()

digest
std::string GPhysAd::GetDigest()

extracondition
std::string DbiTableRow::GetExtraCondition()

fields
std::string GPhysAd::GetFields()

name
std::string GPhysAd::name()

physadid
int GPhysAd::GetPhysAdId()

tabledescr
static std::string GPhysAd::GetTableDescr(char* alternateName = 0)

tableproxy
static DbiTableProxy& GPhysAd::GetTableProxy(char* alternateName = 0)

values
std::string GPhysAd::GetValues()

23.8.28 DybDbi.GSimPmtSpec

class DybDbi.**GSimPmtSpec** (*DayaBay::DetectorSensor PmtId*, *string Describ*, *double Gain*, *double SigmaGain*, *double TimeOffset*, *double TimeSpread*, *double Efficiency*, *double PrePulseProb*, *double AfterPulseProb*, *double DarkRate*)

Bases: DybDbi.DbiTableRow

docstring

GSimPmtSpec::GSimPmtSpec() GSimPmtSpec::GSimPmtSpec(const GSimPmtSpec& from) GSimPmtSpec::GSimPmtSpec(DayaBay::DetectorSensor PmtId, string Describ, double Gain, double SigmaGain, double TimeOffset, double TimeSpread, double Efficiency, double PrePulseProb, double AfterPulseProb, double DarkRate)

AssignTimeGate
static void GSimPmtSpec::AssignTimeGate(Int_t seconds, char* alternateName = 0)

Cache
static DbiCache* GSimPmtSpec::Cache(char* alternateName = 0)

CanFixOrdering
bool GSimPmtSpec::CanFixOrdering()

CanL2Cache
bool GSimPmtSpec::CanL2Cache()

Close
static void GSimPmtSpec::Close(char* filepath = 0l)

Compare
bool GSimPmtSpec::Compare(const GSimPmtSpec& that)

classmethod Create (**args*, ***kwargs*)
Provide pythonic instance creation classmethod:

```
i = GTableName.Create( AttributeName=100. , ... )
```

CreateTableRow
DbiTableRow* GSimPmtSpec::CreateTableRow()

CurrentTimeGate
static int GSimPmtSpec::CurrentTimeGate(char* alternateName = 0)

DoubleValueForKey
double GSimPmtSpec::DoubleValueForKey(char* key, double defval = -0x00000000000000001)

Fill
void GSimPmtSpec::Fill(DbiResultSet& rs, DbiValidityRec* vrec)

FloatValueForKey
float GSimPmtSpec::FloatValueForKey(char* key, float defval = -0x00000000000000001)

GetAfterPulseProb
double GSimPmtSpec::GetAfterPulseProb()

GetDarkRate
double GSimPmtSpec::GetDarkRate()

GetDatabaseLayout
std::string GSimPmtSpec::GetDatabaseLayout()

GetDescrib
std::string GSimPmtSpec::GetDescrib()

GetDigest
std::string GSimPmtSpec::GetDigest()

GetEfficiency
double GSimPmtSpec::GetEfficiency()

GetFields
std::string GSimPmtSpec::GetFields()

GetGain
double GSimPmtSpec::GetGain()

GetPmtId
DayaBay::DetectorSensor GSimPmtSpec::GetPmtId()

GetPrePulseProb
double GSimPmtSpec::GetPrePulseProb()

GetSigmaGain
double GSimPmtSpec::GetSigmaGain()

GetTableDescr
static std::string GSimPmtSpec::GetTableDescr(char* alternateName = 0)

GetTableProxy
static DbiTableProxy& GSimPmtSpec::GetTableProxy(char* alternateName = 0)

GetTimeOffset
double GSimPmtSpec::GetTimeOffset()

GetTimeSpread
double GSimPmtSpec::GetTimeSpread()

GetValues
std::string GSimPmtSpec::GetValues()

IntValueForKey
int GSimPmtSpec::IntValueForKey(char* key, int defval = -0x0000000000000001)

IsA
TClass* GSimPmtSpec::IsA()

Rpt
static DbiRpt<GSimPmtSpec>* GSimPmtSpec::Rpt(char* ctx = GSimPmtSpec::MetaRctx)

Save
void GSimPmtSpec::Save()

SetAfterPulseProb
void GSimPmtSpec::SetAfterPulseProb(double AfterPulseProb)

SetDarkRate
void GSimPmtSpec::SetDarkRate(double DarkRate)

SetDescrib
void GSimPmtSpec::SetDescrib(string Describ)

SetEfficiency
void GSimPmtSpec::SetEfficiency(double Efficiency)

SetGain
void GSimPmtSpec::SetGain(double Gain)

SetPmtId
void GSimPmtSpec::SetPmtId(DayaBay::DetectorSensor PmtId)

SetPrePulseProb
void GSimPmtSpec::SetPrePulseProb(double PrePulseProb)

SetSigmaGain
void GSimPmtSpec::SetSigmaGain(double SigmaGain)

SetTimeOffset
void GSimPmtSpec::SetTimeOffset(double TimeOffset)

SetTimeSpread
void GSimPmtSpec::SetTimeSpread(double TimeSpread)

ShowMembers
void GSimPmtSpec::ShowMembers(TMemberInspector&, char*)

SpecKeys
static TList* GSimPmtSpec::SpecKeys()

SpecList
static TList* GSimPmtSpec::SpecList()

SpecMap
static TMap* GSimPmtSpec::SpecMap()

Store
void GSimPmtSpec::Store(DbiOutRowStream& ors, DbiValidityRec* vrec)

Wrt
static DbiWrt<GSimPmtSpec>* GSimPmtSpec::Wrt(char* ctx = GSimPmtSpec::MetaWctx)

afterpulseprob
double GSimPmtSpec::GetAfterPulseProb()

aggregateno
int DbiTableRow::GetAggregateNo()

classmethod csv_check(*path*, ***kwargs*)
Check the validity of CSV file and correspondence with CSV fields and DBI attributes:

```
from DybDbi import GCalibPmtSpec
GCalibPmtSpec.csv_check( "$DBWRITERROOT/share/DYB_%s_AD1.txt" % "SAB", afterPulse="AfterPuls
```

Manual mapping is required if field names do not match DBI attribute names (primitive case insensitive auto mapping is applied to avoid the need for tedious full mapping).

classmethod csv_compare(*path*, ***kwargs*)
compare entries in CSV file with those found in DB

classmethod csv_export(*path*, ***kwargs*)
Export the result of a default context DBI query as a CSV file

Parameters

- **path** – path of output file
- **fieldnames** – optionally specifiy the field order with a list of fieldnames

Note: make the output more human readable with regular column widths

classmethod csv_import(*path*, ***kwargs*)

Import CSV file into Database Using default writer context for now

ContextRange::ContextRange(const int siteMask, const int simMask, const TimeStamp& tstart, const TimeStamp& tend)

ql> select * from CalibPmtSpecVld ; +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | SEQNO | TIMESTART | TIMEEND

| SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATENO | VERSIONDATE | INSERTDATE | +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | 26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 | 127 | 1 | 0 | 0 | -1 | 2011-01-22 08:15:17 | 2011-02-25 08:10:15 | | 18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 | 32 | 1 | 1 | 0 | -1 | 2010-06-21 15:50:24 | 2010-07-19 12:49:29 |

HMM... Better to make this a classmethod on the writer rather than the Row class... OR do not shrinkwrap .. just leave as example

darkrate
double GSimPmtSpec::GetDarkRate()

databaselayout
std::string GSimPmtSpec::GetDatabaseLayout()

describ
std::string GSimPmtSpec::GetDescrib()

digest
std::string GSimPmtSpec::GetDigest()

efficiency
double GSimPmtSpec::GetEfficiency()

extracondition
std::string DbiTableRow::GetExtraCondition()

fields
std::string GSimPmtSpec::GetFields()

gain
double GSimPmtSpec::GetGain()

name
std::string GSimPmtSpec::name()

pmtid
DayaBay::DetectorSensor GSimPmtSpec::GetPmtId()

prepulseprob
double GSimPmtSpec::GetPrePulseProb()

sigmagain
double GSimPmtSpec::GetSigmaGain()

tabledescr
static std::string GSimPmtSpec::GetTableDescr(char* alternateName = 0)

tableproxy
static DbiTableProxy& GSimPmtSpec::GetTableProxy(char* alternateName = 0)

timeoffset
double GSimPmtSpec::GetTimeOffset()

timespread
double GSimPmtSpec::GetTimeSpread()

values
std::string GSimPmtSpec::GetValues()

23.8.29 DybDbi.GCalibPmtSpec

class DybDbi.**GCalibPmtSpec**(*int PmtId*, *string Describ*, *int Status*, *double SpeHigh*, *double SigmaSpeHigh*, *double SpeLow*, *double TimeOffset*, *double TimeSpread*, *double Efficiency*, *double PrePulseProb*, *double AfterPulseProb*, *double DarkRate*)

Bases: DybDbi.DbiTableRow

docstring

GCalibPmtSpec::GCalibPmtSpec() GCalibPmtSpec::GCalibPmtSpec(const GCalibPmtSpec& from) GCalibPmtSpec::GCalibPmtSpec(int PmtId, string Describ, int Status, double SpeHigh, double SigmaSpeHigh, double SpeLow, double TimeOffset, double TimeSpread, double Efficiency, double PrePulseProb, double AfterPulseProb, double DarkRate)

AssignTimeGate
static void GCalibPmtSpec::AssignTimeGate(Int_t seconds, char* alternateName = 0)

Cache
static DbiCache* GCalibPmtSpec::Cache(char* alternateName = 0)

CanL2Cache
bool GCalibPmtSpec::CanL2Cache()

Close
static void GCalibPmtSpec::Close(char* filepath = 0l)

Compare
bool GCalibPmtSpec::Compare(const GCalibPmtSpec& that)

classmethod Create(**args*, ***kwargs*)
Provide pythonic instance creation classmethod:

```
i = GTableName.Create( AttributeName=100. , ... )
```

CreateTableRow
DbiTableRow* GCalibPmtSpec::CreateTableRow()

CurrentTimeGate
static int GCalibPmtSpec::CurrentTimeGate(char* alternateName = 0)

DoubleValueForKey
double GCalibPmtSpec::DoubleValueForKey(char* key, double defval = -0x00000000000000001)

Fill
void GCalibPmtSpec::Fill(DbiResultSet& rs, DbiValidityRec* vrec)

FloatValueForKey
float GCalibPmtSpec::FloatValueForKey(char* key, float defval = -0x00000000000000001)

GetAfterPulseProb
double GCalibPmtSpec::GetAfterPulseProb()

GetDarkRate
double GCalibPmtSpec::GetDarkRate()

GetDatabaseLayout
std::string GCalibPmtSpec::GetDatabaseLayout()

GetDescrib
std::string GCalibPmtSpec::GetDescrib()

GetDigest
std::string GCalibPmtSpec::GetDigest()

GetEfficiency
double GCalibPmtSpec::GetEfficiency()

GetFields
std::string GCalibPmtSpec::GetFields()

GetPmtId
int GCalibPmtSpec::GetPmtId()

GetPrePulseProb
double GCalibPmtSpec::GetPrePulseProb()

GetSigmaSpeHigh
double GCalibPmtSpec::GetSigmaSpeHigh()

GetSpeHigh
double GCalibPmtSpec::GetSpeHigh()

GetSpeLow
double GCalibPmtSpec::GetSpeLow()

GetStatus
int GCalibPmtSpec::GetStatus()

GetTableDescr
static std::string GCalibPmtSpec::GetTableDescr(char* alternateName = 0)

GetTableProxy
static DbiTableProxy& GCalibPmtSpec::GetTableProxy(char* alternateName = 0)

GetTimeOffset
double GCalibPmtSpec::GetTimeOffset()

GetTimeSpread
double GCalibPmtSpec::GetTimeSpread()

GetValues
std::string GCalibPmtSpec::GetValues()

IntValueForKey
int GCalibPmtSpec::IntValueForKey(char* key, int defval = -0x0000000000000001)

IsA
TClass* GCalibPmtSpec::IsA()

Rpt
static DbiRpt<GCalibPmtSpec>* GCalibPmtSpec::Rpt(char* ctx = GCalibPmtSpec::MetaRctx)

Save
void GCalibPmtSpec::Save()

SetAfterPulseProb
void GCalibPmtSpec::SetAfterPulseProb(double AfterPulseProb)

SetDarkRate
void GCalibPmtSpec::SetDarkRate(double DarkRate)

SetDescrib
void GCalibPmtSpec::SetDescrib(string Describ)

SetEfficiency
void GCalibPmtSpec::SetEfficiency(double Efficiency)

SetPmtId
void GCalibPmtSpec::SetPmtId(int PmtId)

SetPrePulseProb
void GCalibPmtSpec::SetPrePulseProb(double PrePulseProb)

SetSigmaSpeHigh
void GCalibPmtSpec::SetSigmaSpeHigh(double SigmaSpeHigh)

SetSpeHigh
void GCalibPmtSpec::SetSpeHigh(double SpeHigh)

SetSpeLow
void GCalibPmtSpec::SetSpeLow(double SpeLow)

SetStatus
void GCalibPmtSpec::SetStatus(int Status)

SetTimeOffset
void GCalibPmtSpec::SetTimeOffset(double TimeOffset)

SetTimeSpread
void GCalibPmtSpec::SetTimeSpread(double TimeSpread)

ShowMembers
void GCalibPmtSpec::ShowMembers(TMemberInspector&, char*)

SpecKeys
static TList* GCalibPmtSpec::SpecKeys()

SpecList
static TList* GCalibPmtSpec::SpecList()

SpecMap
static TMap* GCalibPmtSpec::SpecMap()

Store
void GCalibPmtSpec::Store(DbiOutRowStream& ors, DbiValidityRec* vrec)

Wrt
static DbiWrt<GCalibPmtSpec>* GCalibPmtSpec::Wrt(char* ctx = GCalibPmtSpec::MetaWctx)

afterpulseprob
double GCalibPmtSpec::GetAfterPulseProb()

aggregateno
int DbiTableRow::GetAggregateNo()

classmethod csv_check (*path*, ***kwargs*)
Check the validity of CSV file and correspondence with CSV fields and DBI attributes:

```
from DybDbi import GCalibPmtSpec
GCalibPmtSpec.csv_check( "$DBWRITERROOT/share/DYB_%s_AD1.txt" % "SAB", afterPulse="AfterPuls
```

Manual mapping is required if field names do not match DBI attribute names (primitive case insensitive auto mapping is applied to avoid the need for tedious full mapping).

classmethod csv_compare (*path*, ***kwargs*)
compare entries in CSV file with those found in DB

classmethod csv_export (*path*, ***kwargs*)
Export the result of a default context DBI query as a CSV file

Parameters

- **path** – path of output file
- **fieldnames** – optionally specifiy the field order with a list of fieldnames

Note: make the output more human readable with regular column widths

classmethod **csv_import** (*path*, ***kwargs*)

Import CSV file into Database Using default writer context for now

ContextRange::ContextRange(const int siteMask, const int simMask, const TimeStamp& tstart, const TimeStamp& tend)

ql> select * from CalibPmtSpecVld ; +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | SEQNO | TIMESTART | TIMEEND | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATENO | VERSIONDATE | INSERTDATE | +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | 26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 | 127 | 1 | 0 | 0 | -1 | 2011-01-22 08:15:17 | 2011-02-25 08:10:15 | | 18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 | 32 | 1 | 1 | 0 | -1 | 2010-06-21 15:50:24 | 2010-07-19 12:49:29 |

HMM... Better to make this a classmethod on the writer rather than the Row class... OR do not shrinkwrap .. just leave as example

darkrate
double GCalibPmtSpec::GetDarkRate()

databaselayout
std::string GCalibPmtSpec::GetDatabaseLayout()

describ
std::string GCalibPmtSpec::GetDescrib()

digest
std::string GCalibPmtSpec::GetDigest()

efficiency
double GCalibPmtSpec::GetEfficiency()

extracondition
std::string DbiTableRow::GetExtraCondition()

fields
std::string GCalibPmtSpec::GetFields()

name
std::string GCalibPmtSpec::name()

pmtid
int GCalibPmtSpec::GetPmtId()

prepulseprob
double GCalibPmtSpec::GetPrePulseProb()

sigmaspehigh
double GCalibPmtSpec::GetSigmaSpeHigh()

spehigh
double GCalibPmtSpec::GetSpeHigh()

spelow
double GCalibPmtSpec::GetSpeLow()

status
int GCalibPmtSpec::GetStatus()

tabledescr
static std::string GCalibPmtSpec::GetTableDescr(char* alternateName = 0)

tableproxy
static DbiTableProxy& GCalibPmtSpec::GetTableProxy(char* alternateName = 0)

timeoffset
double GCalibPmtSpec::GetTimeOffset()

timespread
double GCalibPmtSpec::GetTimeSpread()

values
std::string GCalibPmtSpec::GetValues()

23.8.30 DybDbi.GCalibFeeSpec

class DybDbi.**GCalibFeeSpec**(*DayaBay::FeeChannelId ChannelId*, *int Status*, *double AdcPedestalHigh*, *double AdcPedestalHighSigma*, *double AdcPedestalLow*, *double AdcPedestalLowSigma*, *double AdcThresholdHigh*, *double AdcThresholdLow*)
Bases: DybDbi.DbiTableRow

docstring

GCalibFeeSpec::GCalibFeeSpec() GCalibFeeSpec::GCalibFeeSpec(const GCalibFeeSpec& from) GCalibFeeSpec::GCalibFeeSpec(DayaBay::FeeChannelId ChannelId, int Status, double AdcPedestalHigh, double AdcPedestalHighSigma, double AdcPedestalLow, double AdcPedestalLowSigma, double AdcThresholdHigh, double AdcThresholdLow)

AssignTimeGate
static void GCalibFeeSpec::AssignTimeGate(Int_t seconds, char* alternateName = 0)

Cache
static DbiCache* GCalibFeeSpec::Cache(char* alternateName = 0)

CanL2Cache
bool GCalibFeeSpec::CanL2Cache()

Close
static void GCalibFeeSpec::Close(char* filepath = 0l)

Compare
bool GCalibFeeSpec::Compare(const GCalibFeeSpec& that)

classmethod Create(**args*, ***kwargs*)
Provide pythonic instance creation classmethod:

```
i = GTableName.Create( AttributeName=100. , ... )
```

CreateTableRow
DbiTableRow* GCalibFeeSpec::CreateTableRow()

CurrentTimeGate
static int GCalibFeeSpec::CurrentTimeGate(char* alternateName = 0)

DoubleValueForKey
double GCalibFeeSpec::DoubleValueForKey(char* key, double defval = -0x00000000000000001)

Fill
void GCalibFeeSpec::Fill(DbiResultSet& rs, DbiValidityRec* vrec)

FloatValueForKey
float GCalibFeeSpec::FloatValueForKey(char* key, float defval = -0x0000000000000001)

GetAdcPedestalHigh
double GCalibFeeSpec::GetAdcPedestalHigh()

GetAdcPedestalHighSigma
double GCalibFeeSpec::GetAdcPedestalHighSigma()

GetAdcPedestalLow
double GCalibFeeSpec::GetAdcPedestalLow()

GetAdcPedestalLowSigma
double GCalibFeeSpec::GetAdcPedestalLowSigma()

GetAdcThresholdHigh
double GCalibFeeSpec::GetAdcThresholdHigh()

GetAdcThresholdLow
double GCalibFeeSpec::GetAdcThresholdLow()

GetChannelId
DayaBay::FeeChannelId GCalibFeeSpec::GetChannelId()

GetDatabaseLayout
std::string GCalibFeeSpec::GetDatabaseLayout()

GetDigest
std::string GCalibFeeSpec::GetDigest()

GetFields
std::string GCalibFeeSpec::GetFields()

GetStatus
int GCalibFeeSpec::GetStatus()

GetTableDescr
static std::string GCalibFeeSpec::GetTableDescr(char* alternateName = 0)

GetTableProxy
static DbiTableProxy& GCalibFeeSpec::GetTableProxy(char* alternateName = 0)

GetValues
std::string GCalibFeeSpec::GetValues()

IntValueForKey
int GCalibFeeSpec::IntValueForKey(char* key, int defval = -0x0000000000000001)

IsA
TClass* GCalibFeeSpec::IsA()

Rpt
static DbiRpt<GCalibFeeSpec>* GCalibFeeSpec::Rpt(char* ctx = GCalibFeeSpec::MetaRctx)

Save
void GCalibFeeSpec::Save()

SetAdcPedestalHigh
void GCalibFeeSpec::SetAdcPedestalHigh(double AdcPedestalHigh)

SetAdcPedestalHighSigma
void GCalibFeeSpec::SetAdcPedestalHighSigma(double AdcPedestalHighSigma)

SetAdcPedestalLow
void GCalibFeeSpec::SetAdcPedestalLow(double AdcPedestalLow)

SetAdcPedestalLowSigma
void GCalibFeeSpec::SetAdcPedestalLowSigma(double AdcPedestalLowSigma)

SetAdcThresholdHigh
void GCalibFeeSpec::SetAdcThresholdHigh(double AdcThresholdHigh)

SetAdcThresholdLow
void GCalibFeeSpec::SetAdcThresholdLow(double AdcThresholdLow)

SetChannelId
void GCalibFeeSpec::SetChannelId(DayaBay::FeeChannelId ChannelId)

SetStatus
void GCalibFeeSpec::SetStatus(int Status)

ShowMembers
void GCalibFeeSpec::ShowMembers(TMemberInspector&, char*)

SpecKeys
static TList* GCalibFeeSpec::SpecKeys()

SpecList
static TList* GCalibFeeSpec::SpecList()

SpecMap
static TMap* GCalibFeeSpec::SpecMap()

Store
void GCalibFeeSpec::Store(DbiOutRowStream& ors, DbiValidityRec* vrec)

Wrt
static DbiWrt<GCalibFeeSpec>* GCalibFeeSpec::Wrt(char* ctx = GCalibFeeSpec::MetaWctx)

adcpedestalhigh
double GCalibFeeSpec::GetAdcPedestalHigh()

adcpedestalhighsigma
double GCalibFeeSpec::GetAdcPedestalHighSigma()

adcpedestallow
double GCalibFeeSpec::GetAdcPedestalLow()

adcpedestallowsigma
double GCalibFeeSpec::GetAdcPedestalLowSigma()

adcthresholdhigh
double GCalibFeeSpec::GetAdcThresholdHigh()

adcthresholdlow
double GCalibFeeSpec::GetAdcThresholdLow()

aggregateno
int DbiTableRow::GetAggregateNo()

channelid
DayaBay::FeeChannelId GCalibFeeSpec::GetChannelId()

classmethod csv_check (*path*, ***kwargs*)

Check the validity of CSV file and correspondence with CSV fields and DBI attributes:

```
from DybDbi import GCalibPmtSpec
GCalibPmtSpec.csv_check( "$DBWRITERROOT/share/DYB_%s_AD1.txt" % "SAB", afterPulse="AfterPuls
```

Manual mapping is required if field names do not match DBI attribute names (primitive case insensitive auto mapping is applied to avoid the need for tedious full mapping).

classmethod csv_compare (*path*, ***kwargs*)

compare entries in CSV file with those found in DB

classmethod csv_export (*path*, ***kwargs*)

Export the result of a default context DBI query as a CSV file

Parameters

- **path** – path of output file
- **fieldnames** – optionally specifiy the field order with a list of fieldnames

Note: make the output more human readable with regular column widths

classmethod csv_import (*path*, ***kwargs*)

Import CSV file into Database Using default writer context for now

ContextRange::ContextRange(const int siteMask, const int simMask, const TimeStamp& tstart, const TimeStamp& tend)

ql> select * from CalibPmtSpecVld ; +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | SEQNO | TIMESTART | TIMEEND | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATENO | VERSIONDATE | INSERTDATE | +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | 26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 | 127 | 1 | 0 | 0 | -1 | 2011-01-22 08:15:17 | 2011-02-25 08:10:15 | | 18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 | 32 | 1 | 1 | 0 | -1 | 2010-06-21 15:50:24 | 2010-07-19 12:49:29 |

HMM... Better to make this a classmethod on the writer rather than the Row class... OR do not shrinkwrap .. just leave as example

databaselayout

std::string GCalibFeeSpec::GetDatabaseLayout()

digest

std::string GCalibFeeSpec::GetDigest()

extracondition

std::string DbiTableRow::GetExtraCondition()

fields

std::string GCalibFeeSpec::GetFields()

name

std::string GCalibFeeSpec::name()

status

int GCalibFeeSpec::GetStatus()

tabledescr

static std::string GCalibFeeSpec::GetTableDescr(char* alternateName = 0)

tableproxy
static DbiTableProxy& GCalibFeeSpec::GetTableProxy(char* alternateName = 0)

values
std::string GCalibFeeSpec::GetValues()

23.8.31 DybDbi.GFeeCableMap

class DybDbi.**GFeeCableMap**(*DayaBay::FeeChannelId FeeChannelId*, *string FeeChannelDesc*, *DayaBay::FeeHardwareId FeeHardwareId*, *string ChanHrdwDesc*, *DayaBay::DetectorSensor SensorId*, *string SensorDesc*, *DayaBay::PmtHardwareId PmtHardwareId*, *string PmtHrdwDesc*)
Bases: DybDbi.DbiTableRow

Data members of instances of the generated class use specialized types, which are specified for each field by the codetype column.

codetype	API ref	defined	code2db
DayaBay::FeeChannelId	DybDbi.FeeChannelId	conventions:Electronics.h	.fullPackedData()
DayaBay::FeeHardwareId	DybDbi.FeeHardwareId	conventions:Hardware.h	.id()
DayaBay::DetectorSensor	DybDbi.DetectorSensor	conventions:Detectors.h	.fullPackedData()
DayaBay::PmtHardwareId	DybDbi.PmtHardwareId	conventions:Hardware.h	.id()

This usage is mirrored in the ctor/getters/setters of the generated class. As these cannot be directly stored into the DB, conversions are performed on writing and reading.

On writing to DB the code2db defined call is used to convert the specialized type into integers that can be persisted in the DB. On reading from the DB the one argument codetype ctors are used to convert the persisted integer back into the specialized types.

GFeeCableMap::GFeeCableMap() GFeeCableMap::GFeeCableMap(const GFeeCableMap& from) GFeeCableMap::GFeeCableMap(DayaBay::FeeChannelId FeeChannelId, string FeeChannelDesc, DayaBay::FeeHardwareId FeeHardwareId, string ChanHrdwDesc, DayaBay::DetectorSensor SensorId, string SensorDesc, DayaBay::PmtHardwareId PmtHardwareId, string PmtHrdwDesc)

AssignTimeGate
static void GFeeCableMap::AssignTimeGate(Int_t seconds, char* alternateName = 0)

Cache
static DbiCache* GFeeCableMap::Cache(char* alternateName = 0)

CanL2Cache
bool GFeeCableMap::CanL2Cache()

Close
static void GFeeCableMap::Close(char* filepath = 0l)

Compare
bool GFeeCableMap::Compare(const GFeeCableMap& that)

classmethod Create(**args*, ***kwargs*)
Provide pythonic instance creation classmethod:

```
i = GTableName.Create( AttributeName=100. , ... )
```

CreateTableRow
DbiTableRow* GFeeCableMap::CreateTableRow()

CurrentTimeGate
static int GFeeCableMap::CurrentTimeGate(char* alternateName = 0)

DoubleValueForKey
double GFeeCableMap::DoubleValueForKey(char* key, double defval = -0x00000000000000001)

Fill
void GFeeCableMap::Fill(DbiResultSet& rs, DbiValidityRec* vrec)

FloatValueForKey
float GFeeCableMap::FloatValueForKey(char* key, float defval = -0x00000000000000001)

GetChanHrdwDesc
std::string GFeeCableMap::GetChanHrdwDesc()

GetDatabaseLayout
std::string GFeeCableMap::GetDatabaseLayout()

GetDigest
std::string GFeeCableMap::GetDigest()

GetFeeChannelDesc
std::string GFeeCableMap::GetFeeChannelDesc()

GetFeeChannelId
DayaBay::FeeChannelId GFeeCableMap::GetFeeChannelId()

GetFeeHardwareId
DayaBay::FeeHardwareId GFeeCableMap::GetFeeHardwareId()

GetFields
std::string GFeeCableMap::GetFields()

GetPmtHardwareId
DayaBay::PmtHardwareId GFeeCableMap::GetPmtHardwareId()

GetPmtHrdwDesc
std::string GFeeCableMap::GetPmtHrdwDesc()

GetSensorDesc
std::string GFeeCableMap::GetSensorDesc()

GetSensorId
DayaBay::DetectorSensor GFeeCableMap::GetSensorId()

GetTableDescr
static std::string GFeeCableMap::GetTableDescr(char* alternateName = 0)

GetTableProxy
static DbiTableProxy& GFeeCableMap::GetTableProxy(char* alternateName = 0)

GetValues
std::string GFeeCableMap::GetValues()

IntValueForKey
int GFeeCableMap::IntValueForKey(char* key, int defval = -0x00000000000000001)

IsA
TClass* GFeeCableMap::IsA()

Rpt
static DbiRpt<GFeeCableMap>* GFeeCableMap::Rpt(char* ctx = GFeeCableMap::MetaRctx)

Save
void GFeeCableMap::Save()

SetChanHrdwDesc
void GFeeCableMap::SetChanHrdwDesc(string ChanHrdwDesc)

SetFeeChannelDesc
void GFeeCableMap::SetFeeChannelDesc(string FeeChannelDesc)

SetFeeChannelId
void GFeeCableMap::SetFeeChannelId(DayaBay::FeeChannelId FeeChannelId)

SetFeeHardwareId
void GFeeCableMap::SetFeeHardwareId(DayaBay::FeeHardwareId FeeHardwareId)

SetPmtHardwareId
void GFeeCableMap::SetPmtHardwareId(DayaBay::PmtHardwareId PmtHardwareId)

SetPmtHrdwDesc
void GFeeCableMap::SetPmtHrdwDesc(string PmtHrdwDesc)

SetSensorDesc
void GFeeCableMap::SetSensorDesc(string SensorDesc)

SetSensorId
void GFeeCableMap::SetSensorId(DayaBay::DetectorSensor SensorId)

ShowMembers
void GFeeCableMap::ShowMembers(TMemberInspector&, char*)

SpecKeys
static TList* GFeeCableMap::SpecKeys()

SpecList
static TList* GFeeCableMap::SpecList()

SpecMap
static TMap* GFeeCableMap::SpecMap()

Store
void GFeeCableMap::Store(DbiOutRowStream& ors, DbiValidityRec* vrec)

Wrt
static DbiWrt<GFeeCableMap>* GFeeCableMap::Wrt(char* ctx = GFeeCableMap::MetaWctx)

aggregateno
int DbiTableRow::GetAggregateNo()

chanhrdwdesc
std::string GFeeCableMap::GetChanHrdwDesc()

classmethod csv_check (*path*, ***kwargs*)
Check the validity of CSV file and correspondence with CSV fields and DBI attributes:

```
from DybDbi import GCalibPmtSpec
GCalibPmtSpec.csv_check( "$DBWRITERROOT/share/DYB_%s_AD1.txt" % "SAB", afterPulse="AfterPuls
```

Manual mapping is required if field names do not match DBI attribute names (primitive case insensitive auto mapping is applied to avoid the need for tedious full mapping).

classmethod **csv_compare** (*path*, ***kwargs*)
compare entries in CSV file with those found in DB

classmethod **csv_export** (*path*, ***kwargs*)
Export the result of a default context DBI query as a CSV file

Parameters

- **path** – path of output file
- **fieldnames** – optionally specifiy the field order with a list of fieldnames

Note: make the output more human readable with regular column widths

classmethod **csv_import** (*path*, ***kwargs*)

Import CSV file into Database Using default writer context for now

ContextRange::ContextRange(const int siteMask, const int simMask, const TimeStamp& tstart, const TimeStamp& tend)

ql> select * from CalibPmtSpecVld ; +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | SEQNO | TIMESTART | TIMEEND | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATENO | VERSIONDATE | INSERTDATE | +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | 26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 | 127 | 1 | 0 | 0 | -1 | 2011-01-22 08:15:17 | 2011-02-25 08:10:15 | | 18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 | 32 | 1 | 1 | 0 | -1 | 2010-06-21 15:50:24 | 2010-07-19 12:49:29 |

HMM... Better to make this a classmethod on the writer rather than the Row class... OR do not shrinkwrap .. just leave as example

databaselayout
std::string GFeeCableMap::GetDatabaseLayout()

digest
std::string GFeeCableMap::GetDigest()

extracondition
std::string DbiTableRow::GetExtraCondition()

feechanneldesc
std::string GFeeCableMap::GetFeeChannelDesc()

feechannelid
DayaBay::FeeChannelId GFeeCableMap::GetFeeChannelId()

feehardwareid
DayaBay::FeeHardwareId GFeeCableMap::GetFeeHardwareId()

fields
std::string GFeeCableMap::GetFields()

name
std::string GFeeCableMap::name()

pmthardwareid
DayaBay::PmtHardwareId GFeeCableMap::GetPmtHardwareId()

pmthrdwdesc
std::string GFeeCableMap::GetPmtHrdwDesc()

sensordesc
std::string GFeeCableMap::GetSensorDesc()

sensorid
DayaBay::DetectorSensor GFeeCableMap::GetSensorId()

tabledescr
static std::string GFeeCableMap::GetTableDescr(char* alternateName = 0)

tableproxy
static DbiTableProxy& GFeeCableMap::GetTableProxy(char* alternateName = 0)

values
std::string GFeeCableMap::GetValues()

23.8.32 DybDbi.GDaqRunInfo

class DybDbi.**GDaqRunInfo**(*int RunNo*, *int TriggerType*, *string RunType*, *int DetectorMask*, *string PartitionName*, *int SchemaVersion*, *int DataVersion*, *int BaseVersion*)
Bases: DybDbi.DbiTableRow

docstring

GDaqRunInfo::GDaqRunInfo() GDaqRunInfo::GDaqRunInfo(const GDaqRunInfo& from) GDaqRunInfo::GDaqRunInfo(int RunNo, int TriggerType, string RunType, int DetectorMask, string PartitionName, int SchemaVersion, int DataVersion, int BaseVersion)

AssignTimeGate
static void GDaqRunInfo::AssignTimeGate(Int_t seconds, char* alternateName = 0)

Cache
static DbiCache* GDaqRunInfo::Cache(char* alternateName = 0)

CanL2Cache
bool GDaqRunInfo::CanL2Cache()

Close
static void GDaqRunInfo::Close(char* filepath = 0l)

Compare
bool GDaqRunInfo::Compare(const GDaqRunInfo& that)

classmethod Create(**args*, ***kwargs*)
Provide pythonic instance creation classmethod:

```
i = GTableName.Create( AttributeName=100. , ... )
```

CreateTableRow
DbiTableRow* GDaqRunInfo::CreateTableRow()

CurrentTimeGate
static int GDaqRunInfo::CurrentTimeGate(char* alternateName = 0)

DoubleValueForKey
double GDaqRunInfo::DoubleValueForKey(char* key, double defval = -0x00000000000000001)

Fill
void GDaqRunInfo::Fill(DbiResultSet& rs, DbiValidityRec* vrec)

FloatValueForKey
float GDaqRunInfo::FloatValueForKey(char* key, float defval = -0x00000000000000001)

GetBaseVersion
int GDaqRunInfo::GetBaseVersion()

GetDataVersion
int GDaqRunInfo::GetDataVersion()

GetDatabaseLayout
std::string GDaqRunInfo::GetDatabaseLayout()

GetDetectorMask
int GDaqRunInfo::GetDetectorMask()

GetDigest
std::string GDaqRunInfo::GetDigest()

GetFields
std::string GDaqRunInfo::GetFields()

GetPartitionName
std::string GDaqRunInfo::GetPartitionName()

GetRunNo
int GDaqRunInfo::GetRunNo()

GetRunType
std::string GDaqRunInfo::GetRunType()

GetSchemaVersion
int GDaqRunInfo::GetSchemaVersion()

GetTableDescr
static std::string GDaqRunInfo::GetTableDescr(char* alternateName = 0)

GetTableProxy
static DbiTableProxy& GDaqRunInfo::GetTableProxy(char* alternateName = 0)

GetTriggerType
int GDaqRunInfo::GetTriggerType()

GetValues
std::string GDaqRunInfo::GetValues()

IntValueForKey
int GDaqRunInfo::IntValueForKey(char* key, int defval = -0x0000000000000001)

IsA
TClass* GDaqRunInfo::IsA()

Rpt
static DbiRpt<GDaqRunInfo>* GDaqRunInfo::Rpt(char* ctx = GDaqRunInfo::MetaRctx)

Save
void GDaqRunInfo::Save()

SetBaseVersion
void GDaqRunInfo::SetBaseVersion(int BaseVersion)

SetDataVersion
void GDaqRunInfo::SetDataVersion(int DataVersion)

SetDetectorMask
void GDaqRunInfo::SetDetectorMask(int DetectorMask)

SetPartitionName
void GDaqRunInfo::SetPartitionName(string PartitionName)

SetRunNo
void GDaqRunInfo::SetRunNo(int RunNo)

SetRunType
void GDaqRunInfo::SetRunType(string RunType)

SetSchemaVersion
void GDaqRunInfo::SetSchemaVersion(int SchemaVersion)

SetTriggerType
void GDaqRunInfo::SetTriggerType(int TriggerType)

ShowMembers
void GDaqRunInfo::ShowMembers(TMemberInspector&, char*)

SpecKeys
static TList* GDaqRunInfo::SpecKeys()

SpecList
static TList* GDaqRunInfo::SpecList()

SpecMap
static TMap* GDaqRunInfo::SpecMap()

Store
void GDaqRunInfo::Store(DbiOutRowStream& ors, DbiValidityRec* vrec)

Wrt
static DbiWrt<GDaqRunInfo>* GDaqRunInfo::Wrt(char* ctx = GDaqRunInfo::MetaWctx)

aggregateno
int DbiTableRow::GetAggregateNo()

baseversion
int GDaqRunInfo::GetBaseVersion()

classmethod csv_check (*path*, ***kwargs*)
Check the validity of CSV file and correspondence with CSV fields and DBI attributes:

```
from DybDbi import GCalibPmtSpec
GCalibPmtSpec.csv_check( "$DBWRITERROOT/share/DYB_%s_AD1.txt" % "SAB", afterPulse="AfterPuls
```

Manual mapping is required if field names do not match DBI attribute names (primitive case insensitive auto mapping is applied to avoid the need for tedious full mapping).

classmethod csv_compare (*path*, ***kwargs*)
compare entries in CSV file with those found in DB

classmethod csv_export (*path*, ***kwargs*)
Export the result of a default context DBI query as a CSV file

Parameters

- **path** – path of output file
- **fieldnames** – optionally specifiy the field order with a list of fieldnames

---

Note: make the output more human readable with regular column widths

---

classmethod csv_import (*path*, ***kwargs*)

Import CSV file into Database Using default writer context for now

ContextRange::ContextRange(const int siteMask, const int simMask, const TimeStamp& tstart, const TimeStamp& tend)

ql> select * from CalibPmtSpecVld ; +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | SEQNO | TIMESTART | TIMEEND | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATENO | VERSIONDATE | INSERTDATE | +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | 26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 | 127 | 1 | 0 | 0 | -1 | 2011-01-22 08:15:17 | 2011-02-25 08:10:15 | | 18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 | 32 | 1 | 1 | 0 | -1 | 2010-06-21 15:50:24 | 2010-07-19 12:49:29 |

HMM... Better to make this a classmethod on the writer rather than the Row class... OR do not shrinkwrap .. just leave as example

databaselayout
std::string GDaqRunInfo::GetDatabaseLayout()

dataversion
int GDaqRunInfo::GetDataVersion()

detectormask
int GDaqRunInfo::GetDetectorMask()

digest
std::string GDaqRunInfo::GetDigest()

extracondition
std::string DbiTableRow::GetExtraCondition()

fields
std::string GDaqRunInfo::GetFields()

name
std::string GDaqRunInfo::name()

partitionname
std::string GDaqRunInfo::GetPartitionName()

runno
int GDaqRunInfo::GetRunNo()

runtype
std::string GDaqRunInfo::GetRunType()

schemaversion
int GDaqRunInfo::GetSchemaVersion()

tabledescr
static std::string GDaqRunInfo::GetTableDescr(char* alternateName = 0)

tableproxy
static DbiTableProxy& GDaqRunInfo::GetTableProxy(char* alternateName = 0)

triggertype
int GDaqRunInfo::GetTriggerType()

values
std::string GDaqRunInfo::GetValues()

23.8.33 DybDbi.GDaqCalibRunInfo

class DybDbi.**GDaqCalibRunInfo**(*const GDaqCalibRunInfo& from*)
Bases: DybDbi.DbiTableRow

Calibration run information recorded in DAQ database from IS/ACU This information can also be accessed from raw data file recorded as

- dybgaudi:DaqFormat/FileReadoutFormat/FileTraits.h

References:

- doc:3442
- doc:3603

GDaqCalibRunInfo::GDaqCalibRunInfo() GDaqCalibRunInfo::GDaqCalibRunInfo(const GDaqCalibRunInfo& from)

AssignTimeGate
static void GDaqCalibRunInfo::AssignTimeGate(Int_t seconds, char* alternateName = 0)

Cache
static DbiCache* GDaqCalibRunInfo::Cache(char* alternateName = 0)

CanL2Cache
bool GDaqCalibRunInfo::CanL2Cache()

Close
static void GDaqCalibRunInfo::Close(char* filepath = 0l)

Compare
bool GDaqCalibRunInfo::Compare(const GDaqCalibRunInfo& that)

classmethod Create(**args*, ***kwargs*)
Provide pythonic instance creation classmethod:

```
i = GTableName.Create( AttributeName=100. , ... )
```

CreateTableRow
DbiTableRow* GDaqCalibRunInfo::CreateTableRow()

CurrentTimeGate
static int GDaqCalibRunInfo::CurrentTimeGate(char* alternateName = 0)

DoubleValueForKey
double GDaqCalibRunInfo::DoubleValueForKey(char* key, double defval = -0x00000000000000001)

Fill
void GDaqCalibRunInfo::Fill(DbiResultSet& rs, DbiValidityRec* vrec)

FloatValueForKey
float GDaqCalibRunInfo::FloatValueForKey(char* key, float defval = -0x00000000000000001)

GetAdNo
int GDaqCalibRunInfo::GetAdNo()

GetDatabaseLayout
std::string GDaqCalibRunInfo::GetDatabaseLayout()

GetDetectorId
int GDaqCalibRunInfo::GetDetectorId()

GetDigest
std::string GDaqCalibRunInfo::GetDigest()

GetDuration
int GDaqCalibRunInfo::GetDuration()

GetFields
std::string GDaqCalibRunInfo::GetFields()

GetHomeA
int GDaqCalibRunInfo::GetHomeA()

GetHomeB
int GDaqCalibRunInfo::GetHomeB()

GetHomeC
int GDaqCalibRunInfo::GetHomeC()

GetLedFreq
int GDaqCalibRunInfo::GetLedFreq()

GetLedNumber1
int GDaqCalibRunInfo::GetLedNumber1()

GetLedNumber2
int GDaqCalibRunInfo::GetLedNumber2()

GetLedPulseSep
int GDaqCalibRunInfo::GetLedPulseSep()

GetLedVoltage1
int GDaqCalibRunInfo::GetLedVoltage1()

GetLedVoltage2
int GDaqCalibRunInfo::GetLedVoltage2()

GetLtbMode
int GDaqCalibRunInfo::GetLtbMode()

GetRunNo
int GDaqCalibRunInfo::GetRunNo()

GetSourceIdA
int GDaqCalibRunInfo::GetSourceIdA()

GetSourceIdB
int GDaqCalibRunInfo::GetSourceIdB()

GetSourceIdC
int GDaqCalibRunInfo::GetSourceIdC()

GetTableDescr
static std::string GDaqCalibRunInfo::GetTableDescr(char* alternateName = 0)

GetTableProxy
static DbiTableProxy& GDaqCalibRunInfo::GetTableProxy(char* alternateName = 0)

GetValues
std::string GDaqCalibRunInfo::GetValues()

GetZPositionA
int GDaqCalibRunInfo::GetZPositionA()

GetZPositionB
int GDaqCalibRunInfo::GetZPositionB()

GetZPositionC
int GDaqCalibRunInfo::GetZPositionC()

IntValueForKey
int GDaqCalibRunInfo::IntValueForKey(char* key, int defval = -0x0000000000000001)

IsA
TClass* GDaqCalibRunInfo::IsA()

Rpt
static DbiRpt<GDaqCalibRunInfo>* GDaqCalibRunInfo::Rpt(char* ctx = GDaqCalibRunInfo::MetaRctx)

Save
void GDaqCalibRunInfo::Save()

SetAdNo
void GDaqCalibRunInfo::SetAdNo(int AdNo)

SetDetectorId
void GDaqCalibRunInfo::SetDetectorId(int DetectorId)

SetDuration
void GDaqCalibRunInfo::SetDuration(int Duration)

SetHomeA
void GDaqCalibRunInfo::SetHomeA(int HomeA)

SetHomeB
void GDaqCalibRunInfo::SetHomeB(int HomeB)

SetHomeC
void GDaqCalibRunInfo::SetHomeC(int HomeC)

SetLedFreq
void GDaqCalibRunInfo::SetLedFreq(int LedFreq)

SetLedNumber1
void GDaqCalibRunInfo::SetLedNumber1(int LedNumber1)

SetLedNumber2
void GDaqCalibRunInfo::SetLedNumber2(int LedNumber2)

SetLedPulseSep
void GDaqCalibRunInfo::SetLedPulseSep(int LedPulseSep)

SetLedVoltage1
void GDaqCalibRunInfo::SetLedVoltage1(int LedVoltage1)

SetLedVoltage2
void GDaqCalibRunInfo::SetLedVoltage2(int LedVoltage2)

SetLtbMode
void GDaqCalibRunInfo::SetLtbMode(int LtbMode)

SetRunNo
void GDaqCalibRunInfo::SetRunNo(int RunNo)

SetSourceIdA
void GDaqCalibRunInfo::SetSourceIdA(int SourceIdA)

SetSourceIdB
void GDaqCalibRunInfo::SetSourceIdB(int SourceIdB)

SetSourceIdC
void GDaqCalibRunInfo::SetSourceIdC(int SourceIdC)

SetZPositionA
void GDaqCalibRunInfo::SetZPositionA(int ZPositionA)

SetZPositionB
void GDaqCalibRunInfo::SetZPositionB(int ZPositionB)

SetZPositionC
void GDaqCalibRunInfo::SetZPositionC(int ZPositionC)

ShowMembers
void GDaqCalibRunInfo::ShowMembers(TMemberInspector&, char*)

SpecKeys
static TList* GDaqCalibRunInfo::SpecKeys()

SpecList
static TList* GDaqCalibRunInfo::SpecList()

SpecMap
static TMap* GDaqCalibRunInfo::SpecMap()

Store
void GDaqCalibRunInfo::Store(DbiOutRowStream& ors, DbiValidityRec* vrec)

Wrt
static DbiWrt<GDaqCalibRunInfo>* GDaqCalibRunInfo::Wrt(char* ctx = GDaqCalibRunInfo::MetaWctx)

adno
int GDaqCalibRunInfo::GetAdNo()

aggregateno
int DbiTableRow::GetAggregateNo()

classmethod csv_check (*path*, ***kwargs*)
Check the validity of CSV file and correspondence with CSV fields and DBI attributes:

```
from DybDbi import GCalibPmtSpec
GCalibPmtSpec.csv_check( "$DBWRITERROOT/share/DYB_%s_AD1.txt" % "SAB", afterPulse="AfterPuls
```

Manual mapping is required if field names do not match DBI attribute names (primitive case insensitive auto mapping is applied to avoid the need for tedious full mapping).

classmethod csv_compare (*path*, ***kwargs*)
compare entries in CSV file with those found in DB

classmethod csv_export (*path*, ***kwargs*)
Export the result of a default context DBI query as a CSV file

Parameters

- **path** – path of output file
- **fieldnames** – optionally specifiy the field order with a list of fieldnames

---

Note: make the output more human readable with regular column widths

---

classmethod csv_import (*path*, ***kwargs*)

Import CSV file into Database Using default writer context for now

ContextRange::ContextRange(const int siteMask, const int simMask, const TimeStamp& tstart, const TimeStamp& tend)

ql> select * from CalibPmtSpecVld ; +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | SEQNO | TIMESTART | TIMEEND | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATENO | VERSIONDATE | INSERTDATE | +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | 26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 | 127 | 1 | 0 | 0 | -1 | 2011-01-22 08:15:17 | 2011-02-25 08:10:15 | | 18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 | 32 | 1 | 1 | 0 | -1 | 2010-06-21 15:50:24 | 2010-07-19 12:49:29 |

HMM... Better to make this a classmethod on the writer rather than the Row class... OR do not shrinkwrap .. just leave as example

databaselayout
std::string GDaqCalibRunInfo::GetDatabaseLayout()

detectorid
int GDaqCalibRunInfo::GetDetectorId()

digest
std::string GDaqCalibRunInfo::GetDigest()

duration
int GDaqCalibRunInfo::GetDuration()

extracondition
std::string DbiTableRow::GetExtraCondition()

fields
std::string GDaqCalibRunInfo::GetFields()

homea
int GDaqCalibRunInfo::GetHomeA()

homeb
int GDaqCalibRunInfo::GetHomeB()

homec
int GDaqCalibRunInfo::GetHomeC()

ledfreq
int GDaqCalibRunInfo::GetLedFreq()

lednumber1
int GDaqCalibRunInfo::GetLedNumber1()

lednumber2
int GDaqCalibRunInfo::GetLedNumber2()

ledpulsesep
int GDaqCalibRunInfo::GetLedPulseSep()

ledvoltage1
int GDaqCalibRunInfo::GetLedVoltage1()

ledvoltage2
int GDaqCalibRunInfo::GetLedVoltage2()

ltbmode
int GDaqCalibRunInfo::GetLtbMode()

name
std::string GDaqCalibRunInfo::name()

runno
int GDaqCalibRunInfo::GetRunNo()

sourceida
int GDaqCalibRunInfo::GetSourceIdA()

sourceidb
int GDaqCalibRunInfo::GetSourceIdB()

sourceidc
int GDaqCalibRunInfo::GetSourceIdC()

tabledescr
static std::string GDaqCalibRunInfo::GetTableDescr(char* alternateName = 0)

tableproxy
static DbiTableProxy& GDaqCalibRunInfo::GetTableProxy(char* alternateName = 0)

values
std::string GDaqCalibRunInfo::GetValues()

zpositiona
int GDaqCalibRunInfo::GetZPositionA()

zpositionb
int GDaqCalibRunInfo::GetZPositionB()

zpositionc
int GDaqCalibRunInfo::GetZPositionC()

23.8.34 DybDbi.GDaqRawDataFileInfo

class DybDbi.**GDaqRawDataFileInfo**(*int RunNo*, *int FileNo*, *string FileName*, *string StreamType*, *string Stream*, *string FileState*, *int FileSize*, *string CheckSum*, *string TransferState*)

Bases: DybDbi.DbiTableRow

docstring

GDaqRawDataFileInfo::GDaqRawDataFileInfo() GDaqRawDataFileInfo::GDaqRawDataFileInfo(const GDaqRawDataFileInfo& from) GDaqRawDataFileInfo::GDaqRawDataFileInfo(int RunNo, int FileNo, string FileName, string StreamType, string Stream, string FileState, int FileSize, string CheckSum, string TransferState)

AssignTimeGate
static void GDaqRawDataFileInfo::AssignTimeGate(Int_t seconds, char* alternateName = 0)

Cache
static DbiCache* GDaqRawDataFileInfo::Cache(char* alternateName = 0)

CanL2Cache
bool GDaqRawDataFileInfo::CanL2Cache()

Close
static void GDaqRawDataFileInfo::Close(char* filepath = 0l)

Compare
bool GDaqRawDataFileInfo::Compare(const GDaqRawDataFileInfo& that)

classmethod Create(**args*, ***kwargs*)
Provide pythonic instance creation classmethod:

```
i = GTableName.Create( AttributeName=100. , ... )
```

CreateTableRow
DbiTableRow* GDaqRawDataFileInfo::CreateTableRow()

CurrentTimeGate
static int GDaqRawDataFileInfo::CurrentTimeGate(char* alternateName = 0)

DoubleValueForKey
double GDaqRawDataFileInfo::DoubleValueForKey(char* key, double defval = -0x0000000000000001)

Fill
void GDaqRawDataFileInfo::Fill(DbiResultSet& rs, DbiValidityRec* vrec)

FloatValueForKey
float GDaqRawDataFileInfo::FloatValueForKey(char* key, float defval = -0x0000000000000001)

GetCheckSum
std::string GDaqRawDataFileInfo::GetCheckSum()

GetDatabaseLayout
std::string GDaqRawDataFileInfo::GetDatabaseLayout()

GetDigest
std::string GDaqRawDataFileInfo::GetDigest()

GetFields
std::string GDaqRawDataFileInfo::GetFields()

GetFileName
std::string GDaqRawDataFileInfo::GetFileName()

GetFileNo
int GDaqRawDataFileInfo::GetFileNo()

GetFileSize
int GDaqRawDataFileInfo::GetFileSize()

GetFileState
std::string GDaqRawDataFileInfo::GetFileState()

GetRunNo
int GDaqRawDataFileInfo::GetRunNo()

GetStream
std::string GDaqRawDataFileInfo::GetStream()

GetStreamType
std::string GDaqRawDataFileInfo::GetStreamType()

GetTableDescr
static std::string GDaqRawDataFileInfo::GetTableDescr(char* alternateName = 0)

GetTableProxy
static DbiTableProxy& GDaqRawDataFileInfo::GetTableProxy(char* alternateName = 0)

GetTransferState
std::string GDaqRawDataFileInfo::GetTransferState()

GetValues
std::string GDaqRawDataFileInfo::GetValues()

IntValueForKey
int GDaqRawDataFileInfo::IntValueForKey(char* key, int defval = -0x00000000000000001)

IsA
TClass* GDaqRawDataFileInfo::IsA()

Rpt
static DbiRpt<GDaqRawDataFileInfo>* GDaqRawDataFileInfo::Rpt(char* ctx = GDaqRawDataFileInfo::MetaRctx)

Save
void GDaqRawDataFileInfo::Save()

SetCheckSum
void GDaqRawDataFileInfo::SetCheckSum(string CheckSum)

SetFileName
void GDaqRawDataFileInfo::SetFileName(string FileName)

SetFileNo
void GDaqRawDataFileInfo::SetFileNo(int FileNo)

SetFileSize
void GDaqRawDataFileInfo::SetFileSize(int FileSize)

SetFileState
void GDaqRawDataFileInfo::SetFileState(string FileState)

SetRunNo
void GDaqRawDataFileInfo::SetRunNo(int RunNo)

SetStream
void GDaqRawDataFileInfo::SetStream(string Stream)

SetStreamType
void GDaqRawDataFileInfo::SetStreamType(string StreamType)

SetTransferState
void GDaqRawDataFileInfo::SetTransferState(string TransferState)

ShowMembers
void GDaqRawDataFileInfo::ShowMembers(TMemberInspector&, char*)

SpecKeys
static TList* GDaqRawDataFileInfo::SpecKeys()

SpecList
static TList* GDaqRawDataFileInfo::SpecList()

SpecMap
static TMap* GDaqRawDataFileInfo::SpecMap()

Store
void GDaqRawDataFileInfo::Store(DbiOutRowStream& ors, DbiValidityRec* vrec)

Wrt
static DbiWrt<GDaqRawDataFileInfo>* GDaqRawDataFileInfo::Wrt(char* ctx = GDaqRawDataFileInfo::MetaWctx)

aggregateno
int DbiTableRow::GetAggregateNo()

checksum
std::string GDaqRawDataFileInfo::GetCheckSum()

classmethod csv_check (*path*, ***kwargs*)

Check the validity of CSV file and correspondence with CSV fields and DBI attributes:

```
from DybDbi import GCalibPmtSpec
GCalibPmtSpec.csv_check( "$DBWRITERROOT/share/DYB_%s_AD1.txt" % "SAB", afterPulse="AfterPuls
```

Manual mapping is required if field names do not match DBI attribute names (primitive case insensitive auto mapping is applied to avoid the need for tedious full mapping).

classmethod csv_compare (*path*, ***kwargs*)

compare entries in CSV file with those found in DB

classmethod csv_export (*path*, ***kwargs*)

Export the result of a default context DBI query as a CSV file

Parameters

- **path** – path of output file
- **fieldnames** – optionally specifiy the field order with a list of fieldnames

Note: make the output more human readable with regular column widths

classmethod csv_import (*path*, ***kwargs*)

Import CSV file into Database Using default writer context for now

ContextRange::ContextRange(const int siteMask, const int simMask, const TimeStamp& tstart, const TimeStamp& tend)

ql> select * from CalibPmtSpecVld ; +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | SEQNO | TIMESTART | TIMEEND | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATENO | VERSIONDATE | INSERTDATE | +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | 26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 | 127 | 1 | 0 | 0 | -1 | 2011-01-22 08:15:17 | 2011-02-25 08:10:15 | | 18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 | 32 | 1 | 1 | 0 | -1 | 2010-06-21 15:50:24 | 2010-07-19 12:49:29 |

HMM... Better to make this a classmethod on the writer rather than the Row class... OR do not shrinkwrap .. just leave as example

databaselayout

std::string GDaqRawDataFileInfo::GetDatabaseLayout()

digest

std::string GDaqRawDataFileInfo::GetDigest()

extracondition

std::string DbiTableRow::GetExtraCondition()

fields

std::string GDaqRawDataFileInfo::GetFields()

filename

std::string GDaqRawDataFileInfo::GetFileName()

fileno

int GDaqRawDataFileInfo::GetFileNo()

filesize

int GDaqRawDataFileInfo::GetFileSize()

filestate
std::string GDaqRawDataFileInfo::GetFileState()

name
std::string GDaqRawDataFileInfo::name()

runno
int GDaqRawDataFileInfo::GetRunNo()

stream
std::string GDaqRawDataFileInfo::GetStream()

streamtype
std::string GDaqRawDataFileInfo::GetStreamType()

tabledescr
static std::string GDaqRawDataFileInfo::GetTableDescr(char* alternateName = 0)

tableproxy
static DbiTableProxy& GDaqRawDataFileInfo::GetTableProxy(char* alternateName = 0)

transferstate
std::string GDaqRawDataFileInfo::GetTransferState()

values
std::string GDaqRawDataFileInfo::GetValues()

23.8.35 DybDbi.GDbiLogEntry

class DybDbi.**GDbiLogEntry**
Bases: genDbi.DbiLogEntry

GDbiLogEntry::GDbiLogEntry()

Cache
static DbiCache* GDbiLogEntry::Cache(char* alternateName = 0)

Close
static void GDbiLogEntry::Close(char* filepath = 0l)

classmethod Create(**args*, ***kwargs*)
Provide pythonic instance creation classmethod:

```
i = GTableName.Create( AttributeName=100. , ... )
```

CreateTableRow
DbiTableRow* GDbiLogEntry::CreateTableRow()

DoubleValueForKey
double GDbiLogEntry::DoubleValueForKey(char* key, double defval = -0x0000000000000001)

FloatValueForKey
float GDbiLogEntry::FloatValueForKey(char* key, float defval = -0x0000000000000001)

GetDigest
std::string GDbiLogEntry::GetDigest()

GetFields
std::string GDbiLogEntry::GetFields()

GetTableProxy
static DbiTableProxy& GDbiLogEntry::GetTableProxy(char* alternateName = 0)

GetValues
std::string GDbiLogEntry::GetValues()

IntValueForKey
int GDbiLogEntry::IntValueForKey(char* key, int defval = -0x00000000000000001)

IsA
TClass* GDbiLogEntry::IsA()

Rpt
static DbiRpt<GDbiLogEntry>* GDbiLogEntry::Rpt(char* ctx = GDbiLogEntry::MetaRctx)

Save
void GDbiLogEntry::Save()

ShowMembers
void GDbiLogEntry::ShowMembers(TMemberInspector&, char*)

Wrt
static DbiWrt<GDbiLogEntry>* GDbiLogEntry::Wrt(char* ctx = GDbiLogEntry::MetaWctx)

aggregateno
int DbiLogEntry::GetAggregateNo()

classmethod csv_check (*path*, ***kwargs*)
Check the validity of CSV file and correspondence with CSV fields and DBI attributes:

```
from DybDbi import GCalibPmtSpec
GCalibPmtSpec.csv_check( "$DBWRITERROOT/share/DYB_%s_AD1.txt" % "SAB", afterPulse="AfterPuls
```

Manual mapping is required if field names do not match DBI attribute names (primitive case insensitive auto mapping is applied to avoid the need for tedious full mapping).

classmethod csv_compare (*path*, ***kwargs*)
compare entries in CSV file with those found in DB

classmethod csv_export (*path*, ***kwargs*)
Export the result of a default context DBI query as a CSV file

Parameters

- **path** – path of output file
- **fieldnames** – optionally specifiy the field order with a list of fieldnames

Note: make the output more human readable with regular column widths

classmethod csv_import (*path*, ***kwargs*)

Import CSV file into Database Using default writer context for now

ContextRange::ContextRange(const int siteMask, const int simMask, const TimeStamp& tstart, const TimeStamp& tend)

ql> select * from CalibPmtSpecVld ; +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | SEQNO | TIMESTART | TIMEEND | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATENO | VERSIONDATE | INSERTDATE | +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | 26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 | 127 | 1 | 0 | 0 | -1 | 2011-01-22 08:15:17 | 2011-02-25 08:10:15 | | 18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 | 32 | 1 | 1 | 0 | -1 | 2010-06-21 15:50:24 | 2010-07-19 12:49:29 |

HMM... Better to make this a classmethod on the writer rather than the Row class... OR do not shrinkwrap .. just leave as example

databaselayout
std::string DbiLogEntry::GetDatabaseLayout()

digest
std::string GDbiLogEntry::GetDigest()

extracondition
std::string DbiTableRow::GetExtraCondition()

fields
std::string GDbiLogEntry::GetFields()

hostname
std::string& DbiLogEntry::GetHostName()

lognumseqno
int DbiLogEntry::GetLogNumSeqNo()

logseqnomax
int DbiLogEntry::GetLogSeqNoMax()

logseqnomin
int DbiLogEntry::GetLogSeqNoMin()

logtablename
std::string& DbiLogEntry::GetLogTableName()

name
std::string GDbiLogEntry::name()

processname
std::string& DbiLogEntry::GetProcessName()

reason
std::string& DbiLogEntry::GetReason()

servername
std::string& DbiLogEntry::GetServerName()

simmask
int DbiLogEntry::GetSimMask()

sitemask
int DbiLogEntry::GetSiteMask()

subsite
int DbiLogEntry::GetSubSite()

tableproxy
static DbiTableProxy& GDbiLogEntry::GetTableProxy(char* alternateName = 0)

task
int DbiLogEntry::GetTask()

updatetime
TimeStamp DbiLogEntry::GetUpdateTime()

username
std::string& DbiLogEntry::GetUserName()

values
std::string GDbiLogEntry::GetValues()

23.8.36 DybDbi.GDcsAdTemp

class DybDbi.**GDcsAdTemp**(*float Temp1*, *float Temp2*, *float Temp3*, *float Temp4*)
Bases: DybDbi.DbiTableRow

AD Temperature monitoring table:

```
mysql&gt; describe DcsAdTemp  ;
+-------------+---------+------+-----+---------+----------------+
| Field       | Type    | Null | Key | Default | Extra          |
+-------------+---------+------+-----+---------+----------------+
| SEQNO       | int(11) | NO   | PRI |         |                |
| ROW_COUNTER | int(11) | NO   | PRI | NULL    | auto_increment |
| Temp_PT1    | float   | YES  |     | NULL    |                |
| Temp_PT2    | float   | YES  |     | NULL    |                |
| Temp_PT3    | float   | YES  |     | NULL    |                |
| Temp_PT4    | float   | YES  |     | NULL    |                |
+-------------+---------+------+-----+---------+----------------+
6 rows in set (0.08 sec)
```

DBI read must explicitly give: Site, SubSite/DetectoId DBI write must explicitly give: SiteMask, SubSite

GDcsAdTemp::GDcsAdTemp() GDcsAdTemp::GDcsAdTemp(const GDcsAdTemp& from) GDcsAdTemp::GDcsAdTemp(float Temp1, float Temp2, float Temp3, float Temp4)

AssignTimeGate
static void GDcsAdTemp::AssignTimeGate(Int_t seconds, char* alternateName = 0)

Cache
static DbiCache* GDcsAdTemp::Cache(char* alternateName = 0)

CanL2Cache
bool GDcsAdTemp::CanL2Cache()

Close
static void GDcsAdTemp::Close(char* filepath = 0l)

Compare
bool GDcsAdTemp::Compare(const GDcsAdTemp& that)

classmethod Create(**args*, ***kwargs*)
Provide pythonic instance creation classmethod:

```
i = GTableName.Create( AttributeName=100. , ... )
```

CreateTableRow
DbiTableRow* GDcsAdTemp::CreateTableRow()

CurrentTimeGate
static int GDcsAdTemp::CurrentTimeGate(char* alternateName = 0)

DoubleValueForKey
double GDcsAdTemp::DoubleValueForKey(char* key, double defval = -0x0000000000000001)

Fill
void GDcsAdTemp::Fill(DbiResultSet& rs, DbiValidityRec* vrec)

FloatValueForKey
float GDcsAdTemp::FloatValueForKey(char* key, float defval = -0x00000000000000001)

GetDatabaseLayout
std::string GDcsAdTemp::GetDatabaseLayout()

GetDigest
std::string GDcsAdTemp::GetDigest()

GetFields
std::string GDcsAdTemp::GetFields()

GetTableDescr
static std::string GDcsAdTemp::GetTableDescr(char* alternateName = 0)

GetTableProxy
static DbiTableProxy& GDcsAdTemp::GetTableProxy(char* alternateName = 0)

GetTemp1
float GDcsAdTemp::GetTemp1()

GetTemp2
float GDcsAdTemp::GetTemp2()

GetTemp3
float GDcsAdTemp::GetTemp3()

GetTemp4
float GDcsAdTemp::GetTemp4()

GetValues
std::string GDcsAdTemp::GetValues()

IntValueForKey
int GDcsAdTemp::IntValueForKey(char* key, int defval = -0x00000000000000001)

IsA
TClass* GDcsAdTemp::IsA()

Rpt
static DbiRpt<GDcsAdTemp>* GDcsAdTemp::Rpt(char* ctx = GDcsAdTemp::MetaRctx)

Save
void GDcsAdTemp::Save()

SetTemp1
void GDcsAdTemp::SetTemp1(float Temp1)

SetTemp2
void GDcsAdTemp::SetTemp2(float Temp2)

SetTemp3
void GDcsAdTemp::SetTemp3(float Temp3)

SetTemp4
void GDcsAdTemp::SetTemp4(float Temp4)

ShowMembers
void GDcsAdTemp::ShowMembers(TMemberInspector&, char*)

SpecKeys
static TList* GDcsAdTemp::SpecKeys()

SpecList
static TList* GDcsAdTemp::SpecList()

SpecMap
static TMap* GDcsAdTemp::SpecMap()

Store
void GDcsAdTemp::Store(DbiOutRowStream& ors, DbiValidityRec* vrec)

Wrt
static DbiWrt<GDcsAdTemp>* GDcsAdTemp::Wrt(char* ctx = GDcsAdTemp::MetaWctx)

aggregateno
int DbiTableRow::GetAggregateNo()

classmethod csv_check (*path*, ***kwargs*)
Check the validity of CSV file and correspondence with CSV fields and DBI attributes:

```
from DybDbi import GCalibPmtSpec
GCalibPmtSpec.csv_check( "$DBWRITERROOT/share/DYB_%s_AD1.txt" % "SAB", afterPulse="AfterPuls
```

Manual mapping is required if field names do not match DBI attribute names (primitive case insensitive auto mapping is applied to avoid the need for tedious full mapping).

classmethod csv_compare (*path*, ***kwargs*)
compare entries in CSV file with those found in DB

classmethod csv_export (*path*, ***kwargs*)
Export the result of a default context DBI query as a CSV file

Parameters

- **path** – path of output file
- **fieldnames** – optionally specifiy the field order with a list of fieldnames

Note: make the output more human readable with regular column widths

classmethod csv_import (*path*, ***kwargs*)

Import CSV file into Database Using default writer context for now

ContextRange::ContextRange(const int siteMask, const int simMask, const TimeStamp& tstart, const TimeStamp& tend)

ql> select * from CalibPmtSpecVld ; +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | SEQNO | TIMESTART | TIMEEND | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATENO | VERSIONDATE | INSERTDATE | +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | 26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 | 127 | 1 | 0 | 0 | -1 | 2011-01-22 08:15:17 | 2011-02-25 08:10:15 | | 18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 | 32 | 1 | 1 | 0 | -1 | 2010-06-21 15:50:24 | 2010-07-19 12:49:29 |

HMM... Better to make this a classmethod on the writer rather than the Row class... OR do not shrinkwrap .. just leave as example

databaselayout
std::string GDcsAdTemp::GetDatabaseLayout()

digest
std::string GDcsAdTemp::GetDigest()

extracondition
std::string DbiTableRow::GetExtraCondition()

fields
std::string GDcsAdTemp::GetFields()

name
std::string GDcsAdTemp::name()

tabledescr
static std::string GDcsAdTemp::GetTableDescr(char* alternateName = 0)

tableproxy
static DbiTableProxy& GDcsAdTemp::GetTableProxy(char* alternateName = 0)

temp1
float GDcsAdTemp::GetTemp1()

temp2
float GDcsAdTemp::GetTemp2()

temp3
float GDcsAdTemp::GetTemp3()

temp4
float GDcsAdTemp::GetTemp4()

values
std::string GDcsAdTemp::GetValues()

23.8.37 DybDbi.GDcsPmtHv

class DybDbi.**GDcsPmtHv**(*int Ladder*, *int Column*, *int Ring*, *float Voltage*, *int Pw*)
Bases: DybDbi.DbiTableRow

PMT High Voltage monitoring table:

```
mysql&gt; describe DcsPmtHv  ;
+-------------+-------------+------+-----+---------+----------------+
| Field       | Type        | Null | Key | Default | Extra          |
+-------------+-------------+------+-----+---------+----------------+
| SEQNO       | int(11)     | NO   | PRI |         |                |
| ROW_COUNTER | int(11)     | NO   | PRI | NULL    | auto_increment |
| ladder      | tinyint(4)  | YES  |     | NULL    |                |
| col         | tinyint(4)  | YES  |     | NULL    |                |
| ring        | tinyint(4)  | YES  |     | NULL    |                |
| voltage     | decimal(6,2) | YES  |     | NULL    |                |
| pw          | tinyint(4)  | YES  |     | NULL    |                |
+-------------+-------------+------+-----+---------+----------------+
7 rows in set (0.07 sec)
```

GDcsPmtHv::GDcsPmtHv() GDcsPmtHv::GDcsPmtHv(const GDcsPmtHv& from) GDcsPmtHv::GDcsPmtHv(int Ladder, int Column, int Ring, float Voltage, int Pw)

AssignTimeGate
static void GDcsPmtHv::AssignTimeGate(Int_t seconds, char* alternateName = 0)

Cache
static DbiCache* GDcsPmtHv::Cache(char* alternateName = 0)

CanL2Cache
bool GDcsPmtHv::CanL2Cache()

Close
static void GDcsPmtHv::Close(char* filepath = 0l)

Compare
bool GDcsPmtHv::Compare(const GDcsPmtHv& that)

classmethod Create (**args*, ***kwargs*)
Provide pythonic instance creation classmethod:

```
i = GTableName.Create( AttributeName=100. , ... )
```

CreateTableRow
DbiTableRow* GDcsPmtHv::CreateTableRow()

CurrentTimeGate
static int GDcsPmtHv::CurrentTimeGate(char* alternateName = 0)

DoubleValueForKey
double GDcsPmtHv::DoubleValueForKey(char* key, double defval = -0x00000000000000001)

Fill
void GDcsPmtHv::Fill(DbiResultSet& rs, DbiValidityRec* vrec)

FloatValueForKey
float GDcsPmtHv::FloatValueForKey(char* key, float defval = -0x00000000000000001)

GetColumn
int GDcsPmtHv::GetColumn()

GetDatabaseLayout
std::string GDcsPmtHv::GetDatabaseLayout()

GetDigest
std::string GDcsPmtHv::GetDigest()

GetFields
std::string GDcsPmtHv::GetFields()

GetLadder
int GDcsPmtHv::GetLadder()

GetPw
int GDcsPmtHv::GetPw()

GetRing
int GDcsPmtHv::GetRing()

GetTableDescr
static std::string GDcsPmtHv::GetTableDescr(char* alternateName = 0)

GetTableProxy
static DbiTableProxy& GDcsPmtHv::GetTableProxy(char* alternateName = 0)

GetValues
std::string GDcsPmtHv::GetValues()

GetVoltage
float GDcsPmtHv::GetVoltage()

IntValueForKey
int GDcsPmtHv::IntValueForKey(char* key, int defval = -0x00000000000000001)

IsA
TClass* GDcsPmtHv::IsA()

Rpt
static DbiRpt<GDcsPmtHv>* GDcsPmtHv::Rpt(char* ctx = GDcsPmtHv::MetaRctx)

Save
void GDcsPmtHv::Save()

SetColumn
void GDcsPmtHv::SetColumn(int Column)

SetLadder
void GDcsPmtHv::SetLadder(int Ladder)

SetPw
void GDcsPmtHv::SetPw(int Pw)

SetRing
void GDcsPmtHv::SetRing(int Ring)

SetVoltage
void GDcsPmtHv::SetVoltage(float Voltage)

ShowMembers
void GDcsPmtHv::ShowMembers(TMemberInspector&, char*)

SpecKeys
static TList* GDcsPmtHv::SpecKeys()

SpecList
static TList* GDcsPmtHv::SpecList()

SpecMap
static TMap* GDcsPmtHv::SpecMap()

Store
void GDcsPmtHv::Store(DbiOutRowStream& ors, DbiValidityRec* vrec)

Wrt
static DbiWrt<GDcsPmtHv>* GDcsPmtHv::Wrt(char* ctx = GDcsPmtHv::MetaWctx)

aggregateno
int DbiTableRow::GetAggregateNo()

column
int GDcsPmtHv::GetColumn()

classmethod csv_check (*path*, ***kwargs*)
Check the validity of CSV file and correspondence with CSV fields and DBI attributes:

```
from DybDbi import GCalibPmtSpec
GCalibPmtSpec.csv_check( "$DBWRITERROOT/share/DYB_%s_AD1.txt" % "SAB", afterPulse="AfterPuls
```

Manual mapping is required if field names do not match DBI attribute names (primitive case insensitive auto mapping is applied to avoid the need for tedious full mapping).

classmethod csv_compare (*path*, ***kwargs*)
compare entries in CSV file with those found in DB

classmethod csv_export (*path*, ***kwargs*)
Export the result of a default context DBI query as a CSV file

Parameters

- **path** – path of output file
- **fieldnames** – optionally specifiy the field order with a list of fieldnames

Note: make the output more human readable with regular column widths

classmethod **csv_import** (*path*, ***kwargs*)

Import CSV file into Database Using default writer context for now

ContextRange::ContextRange(const int siteMask, const int simMask, const TimeStamp& tstart, const TimeStamp& tend)

ql> select * from CalibPmtSpecVld ; +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | SEQNO | TIMESTART | TIMEEND | SITEMASK | SIMMASK | SUBSITE | TASK | AGGREGATENO | VERSIONDATE | INSERTDATE | +——-+——————+——————+———-+———+———+——+————-+——————+——————+ | 26 | 2011-01-22 08:15:17 | 2020-12-30 16:00:00 | 127 | 1 | 0 | 0 | -1 | 2011-01-22 08:15:17 | 2011-02-25 08:10:15 | | 18 | 2010-06-21 07:49:24 | 2038-01-19 03:14:07 | 32 | 1 | 1 | 0 | -1 | 2010-06-21 15:50:24 | 2010-07-19 12:49:29 |

HMM... Better to make this a classmethod on the writer rather than the Row class... OR do not shrinkwrap .. just leave as example

databaselayout
std::string GDcsPmtHv::GetDatabaseLayout()

digest
std::string GDcsPmtHv::GetDigest()

extracondition
std::string DbiTableRow::GetExtraCondition()

fields
std::string GDcsPmtHv::GetFields()

ladder
int GDcsPmtHv::GetLadder()

name
std::string GDcsPmtHv::name()

pw
int GDcsPmtHv::GetPw()

ring
int GDcsPmtHv::GetRing()

tabledescr
static std::string GDcsPmtHv::GetTableDescr(char* alternateName = 0)

tableproxy
static DbiTableProxy& GDcsPmtHv::GetTableProxy(char* alternateName = 0)

values
std::string GDcsPmtHv::GetValues()

voltage
float GDcsPmtHv::GetVoltage()

23.9 DybPython

turns python/DybPython/ into a Python package

23.10 DybPython.Control

class DybPython.Control.**NuWa**

This is the main program to run NuWa offline jobs.

It provides a job with a minimal, standard setup. Non standard behavior can made using command line options or providing additional configuration in the form of python files or modules to load.

Usage:

```
nuwa.py --help
nuwa.py [options] [-m|--module "mod.ule --mod-arg ..."] \
        [config1.py config2.py ...] \
        [mod.ule1 mod.ule2 ...] \
        [[input1.root input2.root ...] or [input1.data ...]] \
```

Python modules can be specified with -m|–module options and may include any per-module arguments by enclosing them in shell quotes as in the above usage. Modules that do not take arguments may also be listed as non-option arguments. Modules may supply the following functions:

1. `configure(argv=[])` - if exists, executed at configuration time
2. `run(theApp)` - if exists, executed at run time with theApp set to the AppMgr.

Additionally, python job scripts may be specified.

Modules and scripts are loaded in the order they are specified on the command line.

Finally, input ROOT files may be specified. These will be read in the order they are specified and will be assigned to supplying streams not specificially specified in any input-stream map.

The listing of modules, job scripts and/or ROOT files may be interspersed but must follow all options.

In addition to the command line, arguments can be given in a text file with one line per argument. This file can then be given to nuwa.py on the command line prefaced with an '@' or a '+'.

Create a NuWa instance.

add_input_file(*fname*)
Add file name or list of file names to self.input_files, expanding if it is a .list file.

add_service_redirect(*alias*, *name*)
Make alias an alias for given service. Should be called during configuration only

cmdline(*argv*)
Parse command line

configure_args()
spin over all non-option arguments

configure_dbconf()
Existance of DBCONF envvar is used as a signal to switch between Static and DB services, so pull it out separate for clarity

configure_dbi()
For motivation for DbiSvc level configuration, see dybsvn:ticket:842

configure_dyb_services()
Configure common Dyb services

configure_framework()
Set up framework level defaults

configure_ipython()
If ipython not available or are already inside ipython, setup a dummy embedded ipython ipshell function, otherwise setup the real thing.

configure_mod(*modname*, *modargs=None*)
Configure this module, add to job

configure_optmods()
load and configure() "-m" modules here

configure_python_features()
Set up python features

configure_visualization()
Configure for "quanjing/panoramix" visualization

known_input_type(*fname*)
Return True if file name has a recognized extension.

run_post_user(*appMgr*)
Run time addition of Python Algs so they are in correct module-order

23.11 DybPython.dbicnf

An example using commandline parsing and pattern match against filenames, allowing smart DBI writer scripts to be created that minimize code duplication.

However make sure that arguments used are still captured into the repository either by creating one line scripts that invoke the flexible scripts. Or arranging for flexible scripts to read driver files.

class `DybPython.dbicnf.`**DbiCnf**(**args*, ***kwa*)
Bases: `dict`

DbiCnf is a dict holding parameters that are inputs to defining the DBI writer and ingredients like contextrange etc..

All outputs of this class such as `timestart`, `cr` etc.. are implemented as dynamically invoked properties, meaning that the only important state held is in this dict in the form of raw python types : str, int, datetime.

This dict is composed with class defaults, ctor arguments, commandline parsed results, path parameter regular expression parsed tokens, interactive updating.

Precedence in decreasing order:

1.commandline arguments

2.after ctor updates

3.ctor keyword arguments

4.basis defaults in `DbiCnf.defaults`

Usage in writer scripts:

```
from DybPython import DbiCnf
cnf = DbiCnf()
cnf()               ## performs the parse

from DybDbi import GCalibPmtSpec, CSV
wrt = cnf.writer( GCalibPmtSpec )

src = CSV( cnf.path )
for r in src:
    instance = GCalibPmtSpec.Create( **r )
    wrt.Write( instance )

if not cnf.dummy:
    assert wrt.close()
```

Debugging/checking usage in ipython:

```
from DybPython import DbiCnf
cnf = DbiCnf(key=val,key2=val2)
cnf['key3'] = 'val3'

cnf()    ## performs command line parse
cnf("All_AD1_Data.csv --task 20 --runtimestart 10 --dbconf tmp_offline_db:offline_db ")    ## tes
print cnf
cnf['runtimestart'] = 10
cnf.timestart
cnf['runtimestart'] = 1000
cnf.timestart                  ## will do timestart lookup for the changed run
```

The simplest and recommended usage is to define a standard *.csv* file naming convention. For example when using the default context pattern:

```
"^(?P<site>All|DayaBay|Far|LingAo|Mid|SAB)_(?P<subsite>AD1|AD2|AD3|AD4|All|IWS|OWS|RPC|Unknown)_
```

The tokens *site*, *subsite* and *simflag* are extracted from basenames such as the below by the pattern matching.

1.SAB_AD1_Data.csv

2.SAB_AD2_Data.csv

Parameters **kwa** – ctor keyword arguments override class defaults `DbiCnf.defaults` updating into *self*

cr

Convert the strings into enum value, and datetimes into TimeStamps in order to create the ContextRange instance

Returns context range instance

logging_(*args*)

Hmm need some work ...

parse_path(*path_*, *ptn*, *nomatch*)

Extract context metadata from the path using the regular expression string supplied.

Parameters

- **path** – path to .csv source file
- **ptn** – regular expression string that can contain tokens for any config parameters

Rtype dict dict of strings extracted from the path

simflag
Convert string simflag into enum integer

simmask
Convert string simflag into enum integer (note the simflag is interpreted as the mask)

site
Convert string site into enum integer

sitemask
Convert string site into enum integer if multi-site masks are needed will have to revisit this

subsite
Convert string subsite/DetectorId into enum integer

timeend

timestart

writer(*kls*)
Create a pre-configured DybDbi writer based on arguments and source csv filename parsing and creates the corresponding DB table if it does not exist.

Parameters kls – DybDbi class, eg GCalibPmtHighGain

class DybPython.dbicnf.**TimeAction**(*option_strings*, *dest*, *nargs=None*, *const=None*, *default=None*, *type=None*, *choices=None*, *required=False*, *help=None*, *metavar=None*)
Bases: argparse.Action

Converts string date representations into datetimes

23.12 DbiDataSvc

23.12.1 DbiDataSvc

23.13 NonDbi

23.13.1 NonDbi

SQLAlchemy Ecosystem

Requirements, the currently non-standard SQLAlchemy external, install with:

```
./dybinst trunk external SQLAlchemy
```

After installation many examples are available at:

```
external/build/LCG/SQLAlchemy-0.6.7/examples/
```

Reading from DB dybgaudi:Database/NonDbi/tests/read.py:

```
from NonDbi import session_, Movie, Director
session = session_("tmp_offline_db", echo=False)
for m in session.query(Movie).all():
    print m
```

Writing to DB dybgaudi:Database/NonDbi/tests/write.py:

```
from NonDbi import session_, Movie, Director
session = session_("tmp_offline_db", echo=False)
m1 = Movie("Star Trek", 2009)
m1.director = Director("JJ Abrams")
d2 = Director("George Lucas")
d2.movies = [Movie("Star Wars", 1977), Movie("THX 1138", 1971)]
try:
    session.add(m1)
    session.add(d2)
    session.commit()
except:
    session.rollback()
```

Deficiencies

Problems with multiple sessions, may need rearrangement

- http://www.sqlalchemy.org/docs/orm/session.html#session-frequently-asked-questions

Accessing Non Dbi tables with SQLAlchemy

The `kls_` method on the SQLAlchemy `session` returns an SQLAlchemy class mapped to the specified table. Usage:

```
from NonDbi import session_
s = session_("fake_dcs")
kls = s.kls_("DBNS_SAB_TEMP")
n = s.query(kls).count()
```

Accessing DBI pairs with SQLAlchemy

The `dbikls_` method on the SQLAlchemy `session` has been shoe-horned in using some esoteric python. It returns an SQLAlchemy class mapped to the join of payload and validity tables. Usage:

```
from NonDbi import session_
session = session_("tmp_offline_db")
YReactor = session.dbikls_("Reactor")

# Use dynamic class in standard SQLAlchemy ORM manner
n = session.query(YReactor).count()
a = session.query(YReactor).filter(YReactor.SEQNO==1).one()
print vars(a)        ## instances of the class have all payload and validity attributes
```

Esotericness includes : closures, dynamic addition of instance methods and dynamic class generation. The advantage of this approach is that there are no static ".spec" or declarative table definitions, everything is dynamically created from the Database schema. This dynamism is also a disadvantage as the static files can be useful places for adding functionality.

Reference for SQLAlchemy querying

- http://www.sqlalchemy.org/docs/orm/tutorial.html#querying

How to add a class/table

1. follow patten of examples in `movie.py` and `director.py`
2. import the declarative classes into `__init__` of **NonDbi**
3. write tests to check functionality

References

Declarative SQLAlchemy

- http://www.sqlalchemy.org/docs/orm/tutorial.html#creating-table-class-and-mapper-all-at-once-declaratively

Hierarchy using self referential one-to-many:

- http://www.sqlalchemy.org/docs/orm/relationships.html#adjacency-list-relationships

For a self-contained script to quickstart model prototyping see :

- http://www.blog.pythonlibrary.org/2010/02/03/another-step-by-step-sqlalchemy-tutorial-part-2-of-2/

SQLite tips

SQLite is useful for quick tests without need to connect to a remote DB, the DB lives inside a file or even in memory:

```
sqlite3 tutorial.db
SQLite version 3.3.6
Enter ".help" for instructions
sqlite> .tables
addresses  users
sqlite> .help
.databases             List names and files of attached databases
.dump ?TABLE? ...      Dump the database in an SQL text format
.echo ON|OFF           Turn command echo on or off
.exit                  Exit this program
...

sqlite> .schema addresses
CREATE TABLE addresses (
   id INTEGER NOT NULL,
   email_address VARCHAR NOT NULL,
   user_id INTEGER,
   PRIMARY KEY (id),
   FOREIGN KEY(user_id) REFERENCES users (id)
);
```

Implementation Notes

Try adopting SA split model layout promulgated at

- http://docs.pylonsproject.org/projects/pyramid_cookbook/dev/sqla.html
- http://blogs.symora.com/nmishra/2010/02/28/configure-pylons-with-sqlalchemy-and-separate-files-for-models/

With motivation:

1. keep model classes in separate files

class NonDbi.**MetaDB**(*dbconf=None*)

Bases: object

Create **one** *MetaDB* instance per database connection , usage:

```
off_ = MetaDB("tmp_offline_db")
off  = off_()                          ## call to pull up a session

daq_ = MetaDB("tmp_daqdb")
daq = daq_()

YCableMap = off_.dbikls_("CableMap")      ## NB now on the MetaDB instance rather than the sessio
print off.query(YCableMap).count()

YSTF = daq_.kls_("SFO_TZ_FILE")
print daq.query(YSTF).count()
```

No need to diddle with the session kls this way, although could if decide to get sugary.

The initial *session_* approach has difficulties when dealing with multiple DB/sessions, multiple `Session.configure` causes warnings

The contortions were caused by:

1.sharing metadata with declarative base ?

2.having a single vehicle on which to plant API (the session)

Try again unencumbered by declarative base compatitbility and the meta module

session()

Binding is deferred until the last moment

NonDbi.**cfg_**(*sect*, *path='~/.my.cnf'*)

Provide a dict of config paramertes in section *sect*

NonDbi.**dj_init_**(*dbconf='tmp_offline_db'*, *djapp='NonDbi.dj.dataset'*)

Check Django compatibility by trying to use it to talk to the SQLAlchemy generated model

NonDbi.**engine_**(*dbconf='tmp_offline_db'*, *echo=False*)

Creates SQLAlchemy engine for *dbconf*, usage:

```
from NonDbi import engine_
engine = engine_("tmp_offline_db")
print engine.table_names()
```

NonDbi.**session_**(*dbconf='tmp_offline_db'*, *echo=False*, *drop_all=False*, *drop_some=[]*, *create=False*)

Creates SQLAlchemy connection to DB and drops and/or creates all tables from the active declarative models Returns `session` through which DB can be queries or updates

Parameters

- **dbconf** – section in `~/.my.cnf` with DB connection parameters
- **echo** – emit the SQL commands being performed
- **drop_all** – drop all active NonDbi tables **CAUTION: ALL TABLES**
- **drop_some** – drop tables corresponding to listed mapped classes
- **create** – create all tables if not existing

SQLAlchemy innards are managed in the `meta` module

23.14 Scraper

In addition to this API reference documentation, see the introductory documentation at *Scraping source databases into offline_db*

- Scraper
- Table specific scraper module examples
  - Scraper.pmthv
    - Scraper.pmthv.PmtHv
    - Scraper.pmthv.PmtHvSource
    - Scraper.pmthv.PmtHvScraper
    - Scraper.pmthv.PmtHvFaker
  - Scraper.adtemp
    - Scraper.adtemp.AdTemp
    - Scraper.adtemo.AdTempSource
    - Scraper.adtemp.AdTempScraper
    - Scraper.adtemp.AdTempFaker
- Scrapers in development
  - Scraper.adlidsensor
    - Scraper.adlidsensor.AdLidSensor
- Scraper.dcs : source DB naming conventions
- Scraper.base : directly used/subclassed
  - Scraper.base.main()
  - Scraper.base.Regime
  - Scraper.base.DCS
  - Scraper.base.Scraper
  - Scraper.base.Target
  - Scraper.base.Faker
- Other classes used internally
  - Scraper.base.sourcevector.SourceVector
  - Scraper.base.aparser.AParser : argparser/configparser amalgam
  - Scraper.base.parser.Parser :
  - Scraper.base.sa.SA : details of SQLAlchemy connection

23.14.1 Scraper

Generic Scraping Introduction at *Scraping source databases into offline_db*

23.14.2 Table specific scraper module examples

Scraper.pmthv

PMT HV scraping specialization

Scraper.pmthv.PmtHv

class Scraper.pmthv.**PmtHv**(**args*, ***kwa*)

Bases: Scraper.base.regime.Regime

Regime frontend class with simple prescribed interface, takes the cfg argument into this dict and no args in call. This allows the frontend to be entirely generic.

Scraper.pmthv.PmtHvSource

class Scraper.pmthv.**PmtHvSource**(*srcdb*)
Bases: list

Parameters **srcdb** – source DB instance of Scraper.base.DCS

List of source SA classes that map tables/joins in srcdb Accommodates a table naming irregularity HVPw rather than HV_Pw

Scraper.pmthv.PmtHvScraper

class Scraper.pmthv.**PmtHvScraper**(*srcs*, *target*, *cfg*)
Bases: Scraper.base.scraper.Scraper

Parameters

- **srcs** – list of source SA classes
- **target** – *Target* instance that encapsulates the DybDbi class
- **cfg** – instance of relevant *Regime* subclass (which isa dict holding config)

Config options:

Parameters

- **maxiter** – maximum iterations or 0 for no limit
- **interval** – timedelta cursor step size
- **maxage** – timedelta maximum age, beyond which even an unchanged row gets written
- **sleep** – timedelta sleep between scrape update sampling

changed(*sv*)

Parameters **sv** – source vector instance Scraper.base.sourcevector.SourceVector

Decide if sufficient change to propagate based on differences between the first and last elements of *SourceVector* instance argument

propagate(*sv*)

Parameters **sv** – source vector instance Scraper.base.sourcevector.SourceVector

Yield write ready DybDbi target dicts to base class, note that a single source vector instance is yielding multiple target dicts. The keys of the target dict must match the specified attributes of the DybDbi target class.

Here the output is based entirely on the last element of the source vector. A smarter implementation might average the first and last to smooth variations. The python yield command makes it possible to iterate over a what is returned by a function/method.

seed(*sc*)
Used for seeding target DB when testing into empty tables

Parameters **sc** – source class, potentially different seeds will be needed for each source that feeds into a single target

Scraper.pmthv.PmtHvFaker

class Scraper.pmthv.**PmtHvFaker**(*srcs*, *cfg*)
Bases: Scraper.base.faker.Faker

Creates fake instances and inserts them into sourcedb

fake(*inst*, *id*, *dt*)
Invoked from base class call method, set attributes of source instance to form a fake

Parameters

- **inst** – source instance
- **id** – id to assign to the instance instance

Scraper.adtemp

AD Temperature scraping specialization

Scraper.adtemp.AdTemp

class Scraper.adtemp.**AdTemp**(**args*, ***kwa*)
Bases: Scraper.base.regime.Regime

Regime frontend class with simple prescribed interface, takes the cfg argument into this dict and no args in call ... allowing the frontend to be entirely generic

Scraper.adtemo.AdTempSource

class Scraper.adtemp.**AdTempSource**(*srcdb*)
Bases: list

A list of SQLAlchemy dynamic classes

Coordinates of source table/joins

Scraper.adtemp.AdTempScraper

class Scraper.adtemp.**AdTempScraper**(*srcs*, *target*, *cfg*)
Bases: Scraper.base.scraper.Scraper

Specialization of generic scraper for AD temperature tables

Parameters

- **srcs** – list of source SA classes
- **target** – *Target* instance that encapsulates the DybDbi class
- **cfg** – instance of relevant *Regime* subclass (which isa dict holding config)

Config options:

Parameters

- **maxiter** – maximum iterations or 0 for no limit
- **interval** – timedelta cursor step size

- **maxage** – timedelta maximum age, beyond which even an unchanged row gets written
- **sleep** – timedelta sleep between scrape update sampling

changed(*sv*)
returns changed decision to base class

Caution DB/SQLAlchemy is providing decimal.Decimal values... unify types to float before comparison to avoid surprises

propagate(*sv*)
yields one or more target dicts ready for writing to target DB

Scraper.adtemp.AdTempFaker

class Scraper.adtemp.**AdTempFaker**(*srcs*, *cfg*)
Bases: Scraper.base.faker.Faker

fake(*inst*, *id*, *dt*)
Invoked from base class, sets source instance attributes to form a fake

Parameters

- **inst** – source instance
- **id** – suggested id to use
- **dt** – suggested date_time to use

Note the settings can not easily be done in the framework as the `inst` can represent a join of multiple tables, requiring specialized action.

23.14.3 Scrapers in development

Scraper.adlidsensor

AD lid sensors scraping specialization

Discussion from Wei:

1. we were discussing scrapping the average, its standard deviation, the minimum and the maximum within each hour.
2. It seems average once per hour is sufficient. (Note: reactor flux will be available sparser than 1/hour).

reference	
doc:6673	discussion
doc:6996	for the current status given by David W.
doc:6983	summarizes the lid sensor data so far.

Scraper.adlidsensor.AdLidSensor

class Scraper.adlidsensor.**AdLidSensor**(**args*, ***kwa*)
Bases: Scraper.base.regime.Regime

Regime frontend class with simple prescribed interface, takes the cfg argument into this dict and no args in call ... allowing the frontend to be entirely generic

23.14.4 `Scraper.dcs` : source DB naming conventions

Encapsulation of naming conventions for tables and fields used in DCS database

23.14.5 `Scraper.base` : directly used/subclassed

Functions/classes subclassed or used directly by specific table scrapers

`Scraper.base.main()`

Scraper.base.**main**()

Scraper/Faker frontend

Parses the config into the cfg dict and imports, instanciates and calls the regime class identified by the cfg. This pattern minimises code duplication and retains flexibility.

1. bulk behaviour controlled via single argument pointing to section of config file *$SCRAPER_CFG* which defines all the default settings of options
2. config includes which classes to import into the main and invoke... so need simple common interface for frontends in all regimes : pmthv/adtemp

Note that the default *section* and its settings are listed together with the option names to change these defaults by:

```
scr.py --help
scr.py -s adtemp_testscrape --help    ## show defaults for this section
scr.py -s adtemp_faker --help
```

Typical Usage:

```
scr.py -s adtemp_scraper
scr.py -s pmthv_scraper

scr.py -s adtemp_faker
scr.py -s pmthv_faker
```

During testing/development options can be added to change the behavior

The primary argument points to the section of `.scraper.cfg` which configures the details of the scrape:

```
[adtemp_scraper]

regime = Scraper.adtemp:AdTemp
kls = GDcsAdTemp
mode = scraper

source = fake_dcs
target = offline_db_dummy

interval = 10s
sleep = 3s
maxage = 10m

threshold = 1.0
maxiter = 100

dbi_loglevel = INFO
```

Scraper.base.Regime

class Scraper.base.**Regime**(**args*, ***kwa*)
Bases: dict

The regime class ctor takes the cfg as its sole argument, which being a dict takes the cfg into itself.

initialize()
Preparations done prior to calling the regime class, including:

setsignals()
signal handling following the approach of supervisord

Scraper.base.DCS

Specialization of SA providing SQLAlchemy access to source DCS DB

class Scraper.base.**DCS**(*dbconf*)
Bases: Scraper.base.sa.SA

SQLAlchemy connection to database, performing table reflection and mappings from tables

Specializations:

1.standard query ordering, assuming a *date_time* attribute in tables

qafter(*kls*, *cut*)
date_time ordered query for instances at or beyond the time cut:

```
t0  t1  t2  t3  (t4  t5  t6  t7  t8  t9 ... )
```

Parameters

- **kls** – source SQLAlchemy mapped class
- **cut** – local time cutoff datetime

qbefore(*kls*, *cut*)
date_time ordered query for instances before the cut

subbase(*dtn*)
subclass to use, that can be dependent on table coordinate

Scraper.base.Scraper

class Scraper.base.**Scraper**(*srcs*, *target*, *cfg*)
Bases: Scraper.base.propagator.Propagator

Base class holding common scrape features, such as the scrape logic which assumes:

1.source instances correspond to fixed time measurement *snapshots*

2.target instances represent source measurements over time ranges

3.2 source instances are required to form one target instance, the target validity is derived from the datetimes of two source instances

Initialisation in *Propagator* superclass

Parameters

- **srcs** – list of source SA classes

- **target** – *Target* instance that encapsulates the DybDbi class
- **cfg** – instance of relevant *Regime* subclass (which isa dict holding config)

Config options:

Parameters

- **maxiter** – maximum iterations or 0 for no limit
- **interval** – timedelta cursor step size
- **maxage** – timedelta maximum age, beyond which even an unchanged row gets written
- **sleep** – timedelta sleep between scrape update sampling

changed(*sv*)
Override in subclasses to return if a significant change in source instances is observed. This together with age checks is used to decide is the propagate method is called.

Parameters **sv** – source vector containing two source instances to interrogate for changes

propagate(*sv*)
Override this method in subclasses to yield one or more write ready target dicts derived from the *sv[-1]* source instance or *sv[-1].aggd* aggregate dict

Parameters **sv** – source vector containing two source instances to propagate to one target write

tunesleep(*i*)
Every *self.tunesleepmod* iterations check lags behind sources and adjust sleep time accordingly. Allowing to turn up the beat in order to catchup.

Tune heuristic uses an effective heartbeat, which is is the time between entries of interest to the scrapee, ie time between source updates scaled by offset+1

Only makes sense to tune after a write, as it is only then that **tcursor** gets moved ahead. When are close to current the sleep time can correspond to the timecursor **interval** when behind sleep to allow swift catchup

POSSIBLE ISSUES

1.if ebeatlag never gets to 0, the sleep time will sink to the minimum

(a)minimum was formerly 0.1, adjusted to max(0.5,ebeatsec/10.) out of concern for excessive querying

(b)adjusting to ebeatsec would be too conservative : would prevent catchup

Scraper.base.Target

class Scraper.base.**Target**(**args*, ***kwa*)
Bases: dict

Encapsulate DybDbi dealings here to avoid cluttering Scraper

Relevant config parameters

Parameters **timefloor** – None or a datetime or string such as '2010-09-18 22:57:32' used to limit the expense of validity query

instance(***kwa*)
Might fail with TypeError if kwa cannot be coerced, eg from aggregate queries returning None when zero samples

If the attribute names are not expected for the target kls they are skipped. This will be the case for the system attributes *_date_time_min _date_time_max*

lastvld(*source*)
Last validity record in target database for context corresponding to *source* class. Query expense is restricted by the *timefloor*. If *timefloor* is None a sequence of progressively more expensive queries are performed to get the target last validty.

Parameters

- **source** – source context instance either an **xtn** of MockSource instance with subsite and sitemask attributes
- **timefloor** – time after which to look for validity entries in target database or None

Note this is called only at scraper initialization, in order for the scraper to find its time cursor.

require_manual(*msg*)
Require manual operation (ie running scr.py from commandline) preventing usage of rare operations/options under supervisor control

seed(*srcs*, *scraper*, *dummy=False*)

This is invoked at scraper instanciation when the conditions are met:

1.`seed_target_tables` is configured True

Seed entries are written to the target table. The seed validity range is configured with the options: *seed_timestart seed_timeend* and formerly the payload entry was specified by the *def seed()* method implemented in the scraper class.

Attempts to perform seeding under supervisor raises an exception, to enforce this restriction.

When testing seeding start from scratch with eg:

```
mysql> drop table DcsAdTemp, DcsAdTempVld ;
mysql> update LOCALSEQNO set LASTUSEDSEQNO=0 where TABLENAME='DcsAdTemp' ;
```

Changes from Oct 2012,

1.allow use against an existing table

2.remove table creation functionality is removed

3.move to payloadless seeds (removing need for dummy payload instances)

Motivated by the need to add new sources that contribute to an existing target which has already collected data eg for adding ADs to the DcsAdWpHv scraper.

writer(*sv*, *localstart=None*, *localend=None*)
Prepare DybDbi writer for target class, with contextrange/subsite appropriate for the source instance

Use of non-default localstart and localend type is typically only used for aggregate_group_by quering where the instance datetimes such as *sv[0].date_time* do not correspond to the contextrange of the aggregate dict.

Parameters

- **sv** – source vector instance that contains instances of an SA mapped class
- **localstart** – default of *None* corresponds to *sv[0].date_time*
- **localend** – default of *None* corresponds to *sv[-1].date_time*

Scraper.base.Faker

class Scraper.base.**Faker**(*srcs*, *cfg*)
Bases: list

create fake source instances and insert them

23.14.6 Other classes used internally

Scraper.base.sourcevector.SourceVector

class Scraper.base.sourcevector.**SourceVector**(*scraper*, *source*)
Bases: list

This is a simply a holder for source instances and the timecursor, the action is driven by the *Scraper* instance, which invokes the SourceVector.__call__ method to perform the sampling, ie querying for new instances at times beyond the tcursor

As each instance is collected the prior last instance is discarded until sufficient deviation (in age or value) between the first and last is seen. Deviation results in this *SourceVector* being collapsed to start again from the last sample. This also is driven from the *Scraper* by setting the *tcursor* property.

Manages:

1. 0,1 or 2 source class instances
2. timecursor
3. lastresult enum from last _sample

Actions:

1. checks to see if conditions are met to propagate collected source instances into target, in __call__ method

   Parameters

   - **scraper** – parent scraper
   - **source** – SA mapped class

iinst(*i*)

Parameters **i** – instance index into source vector

Rtype source returns instance or None

lag()

Returns timedelta instance representing scraper lag or None if no last entry beyind the tcursor

Query source to find datetime of last entry and return the time difference last - tcursor indicating how far behind the scraper is. This will normally be positive indicating that the scraper is behind.

It would be inefficient to do this on every iteration

lastentry()

Query source to find last entry with *date_time* greater than the timecursor When the tcursor is approaching the cached last entry time, need to query otherwise just use cached

Returns SA instance or None

lastresult_
progress string representing *lastresult* enum integer

set_tcursor(*tc*)
Assigning to this *sv.tcursor* not only changes the cursor but also collapses the SourceVector ready to collect new sampled source instances.

smry()
Example:

```
SV 4   (43, 46) 2011-01-10 10:02:00 full       unchanged  (10:34:28 10:34:34)
# calls   ids        tcursor        status     lastresult       times
```

Shows the status of source vector including the `id` and `date_time` of source entries `sv[0]` and `sv[-1]`

calls iteration count

ids `id` of source entries

tcursor timecursor, stepping through time. Changes only at each propagation

status fullness of source vector: `empty/partial/full` (**full** means 2 entries)

lastresult possibilities: "noupdate","notfull","overage","changed","unchanged","init","lastfirst"

times `date_time` of source entries, changes as each sample is made

status
enum status integer

status_
status string representing *status* enum integer

tcursor
Assigning to this *sv.tcursor* not only changes the cursor but also collapses the SourceVector ready to collect new sampled source instances.

Scraper.base.aparser.AParser : argparser/configparser amalgam

class Scraper.base.aparser.**AParser**(**args*, ***kwargs*)
Bases: argparse.ArgumentParser

Primes an argparser with defaults read from a section of an ConfigParser style config file and sets up logging

Operates via 2-stage parsing

Usage:

```
parser = AParser(defpath="~/.scraper.cfg",defsect="default")
parser.add_argument( '-m','--maxiter', help="maximum iterations, or 0 for no limit")
parser.set_defaults( maxiter=0 )
args = parser()
print args
```

Draws upon:

- http://blog.vwelch.com/2011/04/combining-configparser-and-argparse.html
- http://www.doughellmann.com/PyMOTW/argparse/

Scraper.base.parser.Parser :

class Scraper.base.parser.**Parser**(**args*, ***kwargs*)
Bases: Scraper.base.aparser.AParser

To see all the available options and defaults for a particular config sections:

```
scr.py --help
scr.py -s adtemp_scraper --help
scr.py -s pmthv_scraper --help
```

Performs two stage parsing, with the first stage driven by `-s/--sect` option to specify the section name within a configuration file. The path at which a config file is read from can be controlled by `SCRAPER_CFG`, with default value:

```
echo $SCRAPER_CFG      ## path of default config file
    -->  $SITEROOT/dybgaudi/Database/Scraper/python/Scraper/.scraper.cfg
    -->  $SCRAPERROOT/python/Scraper/.scraper.cfg
```

Note that the first stage of parsing occurs in the `AParser.__init__` which:

1.provides config section name and path

2.primes the base `AParser` dict with defaults read from that section

The 2nd stage parse typically does nothing, as it is preferable to keep config at defaults read from file. This commandline control is mainly for testing/debugging.

Note the configparser/argparser mismatch in boolean handling:

1.argparse typically has "store_true/store_false" actions for convenient/brief commandline control

2.configparser and config file understandability requires True/False strings

Have sided with configparser as the commandline interface beyond the *-s* is mainly for developer usage. However some options, such as *–dryrun* which make little sense in config files, buck this tendency.

classmethod **config**(*defsect='adtemp_scraper'*, *defpath=None*, *noargs=False*)
Conveniuece classmethod for config access

Scraper.base.sa.SA : details of SQLAlchemy connection

class Scraper.base.sa.**SA**(*dbconf*)
Bases: object

Manages SQLAlchemy DB connections, orchestrates reflection on tables, dynamic class creation and mapping from tables to classes. These are all done lazily, when a class is requested via *.kls(xtn)*

kls(*xtn*)
Return mapped dynamic class from a xtn instance

reflect(*tn*)
Reflect on the table, recording it in the meta

table(*tn*)
Return the sqlalchemy.schema.Table representation of a table, reflect upon the table if not already done

23.15 DybTest

23.15.1 dybtest

23.15.2 dybtest.histref

This provides the connector between the the Run machinery in run.py and histo comparisons in cfroot.py

Simply adding a `histref` argument

```
Run("nuwa.py ...." , histref="path/to/myhistname.root" )
```

with value that points to a .root file containing the histograms, switches on the comparison of histograms with reference.

Created histograms become the "blessed" reference when the above is invoked and the reference path does not exist : `path/to/histref_myhistname.root`

Thus to bless the current hists simply delete the reference and rerun.

NB splitting up the time consuming steps and the histo creators is perfectly acceptable, as is use of python scripts or root .C histo creators (although using python modules with nuwa.py is recommended), eg:

```
def test_time_consuming_creation():
    Run("nuwa.py ..... ")

def test_quick_nuwa_ana():
    Run("nuwa.py ..."  , histref="histos1.root" )
def test_quick_py_ana():
    Run("python blah.py", histref="histos2.root" )
def test_quick_root_ana():
    Run("root -b -q maker.C ", histref="histos3.root" )
```

23.15.3 dybtest.cfroot

Usage examples:

```
cfr = CfRoot(['ex1.root','ex2.root','ex3.root'], ['TH1F','TH2F'] )
rcr = cfr()       ## compare all correspondings hists between the files
if rcr == 0:print "consistent"
print cfr
```

Compare the last hist between the files, by accessing a list of keys:

```
cfh = CfHist(cfr[-1])
rch = cfh()
if rch == 0:print "consistent"
print cfh
```

class dybtest.cfroot.**CfHist**(*keys*)

Facilitate comparisons between multiple histograms specified by lists of keys. Consistency is assessed by roots KolmogorovTest with fixed cut of *0.9*. To change that:

```
from dybtest.cfroot import CfHist
CfHist.kolmogorov_cut = 0.95
```

class dybtest.cfroot.**CfRoot**(*paths*, *cls*)
Facilitate comparisons between multiple root files by holding KeyList's into each of them, allowing list access to corresponding objects from all the files

Usage examples:

```
cf = CfRoot(['ex1.root','ex2.root','ex3.root'], ['TH1F','TH2F'] )
rc = cf()
print cf

for i in len(cf):
    cfi = cf[i]
```

class dybtest.cfroot.**KeyList**(*path*, *cls*)
Recursive walk the TDirectory structure inside a single TFile providing list access to all keys that hold instances of classes within the cls list or all classes if cls is an empty list

Usage examples:

```
kl = KeyList( "path/to/histos.root" , ['TH1F', 'TH2F'] )
list(kl)
print len(kl)
for k in kl:
    print k
print kl[0], kl[-1]
```

dybtest.cfroot.**TKey_GetCoords**(*self*)

provides filename, directory within the file and key name:: ['ex2.root', 'red/aa/bb/cc', 'h2', 'TH1F']

dybtest.cfroot.**TKey_GetIdentity**(*self*)
skip the file name

23.15.4 dybtest.capture

for gbl.cout/gbl.stringstream to be available/usable from python observe that must kickstart ROOT for example with "from ROOT import TObject" prior to "from GaudiPython import gbl"

When GaudiPython comes first get:

```
AttributeError: class _global_cpp has no attribute 'cout'
```

class dybtest.capture.**Capture**(*arg=''*)
Bases: object

Allows capturing of logging output in a generic way, allowing tests to be made on the logging output. This can be a shortcut way of testing as functionality can be tested without exposing underlying classes to python.

Usage example:

```
from dybtest import Capture

def test_dbimaketimestamp():
    c = Capture("capture Dbi.MakeTimeStamp ... " )
    t = Dbi.MakeTimeStamp("")
    t = Dbi.MakeTimeStamp("")
    c()
    assert str(c).find("Bad date string") > -1
```

Redirect cout into contained stringstream

CHAPTER

TWENTYFOUR

DOCUMENTATION

Documenting the documentation.

24.1 About This Documentation

Latex sources are translated into reStructuredText [1] using converter [2], which is used by the Sphinx [3] documentation generator. The html render includes an integrated search function that is OpenSearch [4] enabled, allowing you to search from your browsers search field in supported browsers.

Note: Use the **Show Source** link in the sidebar of every html page to get familiar with reStructuredText and Sphinx

24.1.1 Build Instructions for Sphinx based documentation

Who needs to build the Sphinx docs ?

The Sphinx based documentation is built automatically by the dybinst slave, thus latex source editors need not build the Sphinx docs themselves. Committed latex sources should be automatically converted at the next slave build. However usage of latex commands/environments unknown to the converter will break the build.

People using the *Autodoc : pulling reStructuredText from docstrings* feature or those wishing to make significant additions to the documentation will benefit from being able to build the documentation themselves in order to achieve the desired presentation of their docstrings.

Once only virtualenv setup

1. Get into nuwa environment and check that `virtualenv` is in your path:

   ```
   which virtualenv            ## should be the NuWa one
   ```

2. Create virtual python environment, *spawned* from nuwa python eg:

   ```
   mkdir -p ~/v
   virtualenv ~/v/docs
   ```

For background info on `virtualenv` see http://www.virtualenv.org/en/latest/

[1] http://docutils.sourceforge.net/rst.html
[2] https://github.com/scb-/converter
[3] http://sphinx.pocoo.org
[4] http://www.opensearch.org

Installation of Sphinx and converter into virtual python

The virtualenv comes with **pip** and **easy_install** as standard, install sphinx and converter:

```
. ~/v/docs/bin/activate      # activate the docs virtualenv
pip install sphinx
pip install -e git+git://github.com/scb-/converter.git#egg=converter
pip install -e git+git@github.com:scb-/converter.git#egg=converter    ## if you have the key
```

Several sphinx pre-requisites will be installed by pip : *Pygments*, *Jinja2* and *docutils*

Additional dependencies

Note: dependency removed

These additional dependencies on numpy and matplotlib has been removed in order to simplify the setup of a documentation building system.

Additional dependencies are required for some sphinx extensions *Sandbox Testing reST/Sphinx*:

```
pip install -E ~/v/docs -e git+git://github.com/scb-/numpy.git#egg=numpy     ## my fork of numpy
pip -v install -e svn+https://matplotlib.svn.sourceforge.net/svnroot/matplotlib/trunk/matplotlib/#egg
```

Todo

test return to numpy original, now that my changes are integrated

---

Sphinx Quickstart/Configuration

The results of the *sphinx-quickstart* are stored in the *conf.py* and *Makefile* in the dybgaudi:Documentation/OfflineUserManual/tex directory. These have been customized, and thus the quickstart procedure should **not** be repeated.

Building docs

Steps to build the docs:

1. Enter nuwa environment and activate the *docs* virtualpython:

   ```
   . ~/v/docs/bin/activate
   which python    ## should be ~/v/docs/bin/python
   ```

2. Enter the *tex* directory:

   ```
   cd NuWa-trunk/dybgaudi/Documentation/OfflineUserManual/tex
   ```

3. Convert *tex* sources into *rst* and then derive *html*, *tex* and *pdf*:

   ```
   make
   ```

4. Get out of the virtual python:

   ```
   deactivate
   ```

5. Check the resulting documentation, at http://daya0001.rcf.bnl.gov/oum/

Partial Builds

While editing documentation it is useful to perform quick partial builds in order to quickly preview changes to parts of the document. Do so using non-default *make* targets such as *api* and *sop*.

Possible Problems

If on building you find the Latex error:

```
(/opt/local/share/texmf-dist/tex/latex/base/inputenc.sty
! LaTeX Error: File `utf8x.def' not found.
```

You can use a machine with a newer latex/tetex distribution, or kludge your Sphinx:

```
perl -pi -e 's,utf8x,utf8,'  ~/v/docs/lib/python2.7/site-packages/sphinx/ext/pngmath.py
```

24.1.2 Sphinx Customizations/Primer

The general usage of Sphinx and reStructuredText are well documented:

- *Sphinx*
- *rst-primer*
- quick primer an_example_pypi_project

This document covers customizations made for the `Offline User Manual` and the features these customizations provide. Use the **Show Source** links in the html sidebar of every page to see more usage examples.

External Links

Commands are defined in dybgaudi:Documentation/OfflineUserManual/tex/main.tex to facilitate referencing external links from latex sources. Corresponding sphinx extlinks are configured in dybgaudi:Documentation/OfflineUserManual/tex/conf.py to allow similar usage from reStructuredText sources:

```
extlinks = {
    'dybsvn':('http://dayabay.ihep.ac.cn/tracs/dybsvn/intertrac/%s', 'dybsvn:'),
    'source':('http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/%s', 'source:'),
  'dybgaudi':('http://dayabay.ihep.ac.cn/tracs/dybsvn/browser/dybgaudi/trunk/%s', 'dybgaudi:'),
    'dybaux':('http://dayabay.ihep.ac.cn/tracs/dybaux/intertrac/%s', 'dybaux:'),
      'wiki':('https://wiki.bnl.gov/dayabay/index.php?title=%s','wiki:'),
       'doc':('http://dayabay.ihep.ac.cn/cgi-bin/DocDB/ShowDocument?docid=%s','doc:'),
     'docdb':('http://dayabay.ihep.ac.cn/cgi-bin/DocDB/ShowDocument?docid=%s','doc:'),
}
```

latex source	reStructuredText source	render
\dybsvn{ticket:666}	`:dybsvn:`ticket:666``	dybsvn:ticket:666
\dybaux{source:catalog}	`:dybaux:`source:catalog``	dybaux:source:catalog
\doc{999}	`:doc:`999``	doc:999
\wiki{Database}	`:wiki:`Database``	wiki:Database

An inline example of the reStructuredText source to create such links, using *dybsvn* and *docdb roles*:

```
Beastly :dybsvn:`ticket:666` and lucky :docdb:`888`
```

Futher details at `sphinx.ext.extlinks`.

Intersphinx

A facility for simple linking to **objects** (in a very general sense) from other Sphinx documented projects is implemented in the extension module `sphinx.ext.intersphinx` This for example allows inline linking to a python class `zipfile.ZipFile` and a matplotlib module `matplotlib.pyplot` without specifying the precise target URL.

Spelling out the source (also use the):

reST source	render
:py:mod:`sphinx.ext.intersphinx`	sphinx.ext.intersphinx
:mod:`sphinx.ext.intersphinx`	sphinx.ext.intersphinx
:py:class:`zipfile.ZipFile`	zipfile.ZipFile
:py:mod:`matplotlib.pyplot`	matplotlib.pyplot
:meth:`matplotlib.pyplot.acorr`	matplotlib.pyplot.acorr()
:mod:`numpy`	numpy
:class:`numpy.ndarray`	numpy.ndarray
:rst:dir:`math`	math
:rst:role:`math`	math
:rst:directive:`math`	**FAILS**

Note that the `:py:` is not strictly needed as **py** is the default domain.

This is configured in `conf.py` with:

```
intersphinx_cache_limit = 10     # days to keep the cached inventories
intersphinx_mapping = {
        'sphinx': ('http://sphinx.pocoo.org',  None),
        'python':('http://docs.python.org/2.7',None),
    'matplotlib':('http://matplotlib.sourceforge.net', None),
         'numpy':('http://docs.scipy.org/doc/numpy',None),
}
```

Object Inventories

A simple script to dump the content of intersphinx inventories is at **docs/inventory.py**. Use it to find reference targets, for example:

```
./docs/inventory.py sphinx | grep reStructured
   rst-primer = (u'Sphinx', u'1.0.6', u'./docs/inv/sphinx/objects.inv/rest.html#rst-primer', u'reStru

./docs/inventory.py sphinx std:label
std:label
   basic-domain-markup = (u'Sphinx', u'1.0.6', u'./docs/inv/sphinx/objects.inv/domains.html#basic-dor
   build-config = (u'Sphinx', u'1.0.6', u'./docs/inv/sphinx/objects.inv/config.html#build-config', u'
   builders = (u'Sphinx', u'1.0.6', u'./docs/inv/sphinx/objects.inv/builders.html#builders', u'Availa
   builtin-themes = (u'Sphinx', u'1.0.6', u'./docs/inv/sphinx/objects.inv/theming.html#builtin-themes
   ...

./docs/inventory.py self std:label     ## "self" refers to the Offline User Manual inventory
std:label
    api-main = (u'Offline User Manual', u'0.1', u'./_build/dirhtml/objects.inv/api/main/#api-main', u
    ch:framework = (u'Offline User Manual', u'0.1', u'./_build/dirhtml/objects.inv/framework/main/#ch
    ch:source = (u'Offline User Manual', u'0.1', u'./_build/dirhtml/objects.inv/sourcecode/main/#ch-s
     ...
```

Shows that can refer to the primer as shown in the below table, labels begging `std:` are refered to with the `ref` role others use the dedicated role for the object type.

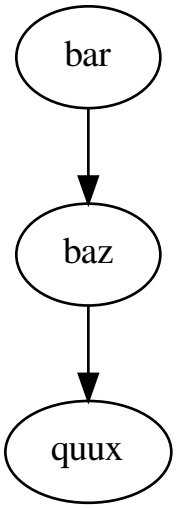
reST source	render	note
`:ref:`rst-primer``	*rst-primer*	no need to specify sphinx
`:ref:`invocation``	*invocation*	label from resolving inventory
`:ref:`<sphinx:invocation>``	*<sphinx:invocation>*	specify inventory **FAILS**
`:ref:`from sphinx<sphinx:invocation>``	*from sphinx*	my label, defines src proj

Graphviz Figures

Sphinx graphviz extension provides `graphviz`, `graph` and `digraph` , allowing source like:

```
.. digraph:: foo

   "bar" -> "baz" -> "quux";
```

To generates a figure:



For details see `sphinx.ext.graphviz`, for an intro take your pick from google:graphviz dot tutorial eg wikipedia:Dot_language

24.1.3 Autodoc : pulling reStructuredText from docstrings

Sphinx has an `sphinx.ext.autodoc` feature that allows reStructuredText to be extracted out of docstrings in your python code. reStructuredText was designed for usage in docstrings, featuring a very light weight markup that is very readable in its source form.

See pages beneath *NuWa Python API* and use **Show Source** or view sources at dyb-gaudi:Documentation/OfflineUserManual/tex/api to see how the autodoc directives are used

- `automodule`
- `autoclass`

And examine the docstrings at for example:

- dybgaudi:DybPython/python/DybPython/db.py

How to AutoDocifying a module

Create a *.rst* named after your module in the hierarchy beneath dybgaudi:Documentation/OfflineUserManual/tex/api. Entire modules can be autodoc-ified with a couple of lines (pay attention to the `__all__` setting for the python modules):

```
.. automodule:: <python-dotted-path>
   :members:
```

But the resulting docs are liable to include too much. Creating useful docs requires draconian editing to only include what is instructive, beyond that the source code should be consulted.

Creating Useful AutoDocumentation

Creating useful API docs requires full control of what is included (which classes/functions/methods) and how they are grouped/ordered/presented/headered/indexed. Autodoc *.rst* files need to be source files rather than generated files in order to provide this control.

tips for docstring preparation

A gotcha when improving the docstrings is to forget to `cmt <pkg>_python` after changing them, as Sphinx is reading them from `sys.path` not the sources.

docstring debugging

1. relative indentation is significant to reST, thus use consistent indentation for your docstrings. An example of docstring cleanup is dybsvn:r10222
2. error reporting seems to get incorrect line nos in docstrings, use non-existing roles eg `:red:`dummy`` to instrument the docstrings

general reST debugging

1. leave a blank line before literal blocks
2. for the colon pointing to a literal block to be visible abutt the the double colon against the last word of the prior para
3. inline literals cannot start or end with a space

24.1.4 Doxygen : automated documentation of C++ API

Doxygen Integration with Breathe

A possible future enhancement is to integrate doxygen documentation of *C++* code into the Offline User Manual.

The breathe project provides an extension to reStructuredText and Sphinx that enables reading and rendering of Doxygen xml output.

It is usable at whatever granularity is desired (similar to Sphinx autodoc) enabling the problem of boring and unreadable auto-generated API docs to be avoided, albeit with some effort from the documenters.

See also:

Doxygen Publishing

24.1.5 Publishing Documentation on Separate Webserver

Configure Target

Snippet from `~/.dybinstrc`:

```
sphinx_vpy=$HOME/rst
sphinx_pub=C:/tmp/oum
```

The `sphinx_vpy` configures the location of the virtual python in which Sphinx and dependencies are installed. The presence of `sphinx_pub` causes the generated html to be **rsynced** to the target node directory specified.

The example `sphinx_pub` assumes a `C` host alias in the `~/.ssh/config`:

```
host C
    user blyth
    hostname target.node.domain
    protocol 2
```

Test Dybinst build

Disable until passwordless SSH operational

Prevent the slave hanging by commenting out the `sphinx_pub=...` until passwordless SSH is operational

Test interactively with:

```
./dybinst trunk docs sphinx
```

If that pauses for password entry then passwordless SSH is not configured and/or an ssh-agent is not running. See env:wiki:PasswordLessSSH

Warning: ssh-agent must be manually restarted after rebooting the slave node to avoid slave hangs

Doxygen Publishing

In a similar manner the `dox` documentation derived by `doxygen` can be published to another node with

```
doxyman_pub=C:/tmp/dox
```

To debug doxygen building, test interactively with:

```
./dybinst trunk docs doxyman
```

Implemented with dybsvn:r11922, issues with `doxygen` docs discussed in dybsvn:ticket:655

24.1.6 Sandbox Testing reST/Sphinx

Examine the source with the **Show Source** links in the html sidebar to see the reST markup used to create this.

Matplotlib extensions

Note: matplotlib dependency removal

In order to simplify documentation building, the dependency on matplotlib has been removed requiring all live ipython blocks to be converted to dead code blocks

live ipython session with ipython directive

See *ipython_directive*

live ipython

The commands are actually performed when the documentation is built, ensuring uptodate ... but risking errors in the documentation

```
In [136]: x = 2

In [137]: x**3
```

The session remembers its scope values `x` and numbers its `In Out`

```
In [4]: x
```

dead ipython

See *ipython-highlighting*

```
In [69]: lines = plot([1,2,3])

In [70]: setp(lines)
  alpha: float
  animated: [True | False]
  antialiased or aa: [True | False]
  ...snip
```

inline plots

See *pyplots*

Before removal of matplotlib dependency plots could be included inline with:

```
.. plot::
   :include-source:

   import matplotlib.pyplot as plt
   import numpy as np
   x = np.random.randn(1000)
   plt.hist( x, 20)
   plt.grid()
   plt.title(r'Normal: $\mu=%.2f, \sigma=%.2f$'%(x.mean(), x.std()))
   plt.show()
```

Syntax Highlighting

Pygments emits `Lexer name not known` for `C++` or `Python` or `C` , instead use `cpp`, `python`, or `c`

```
public:
    static const CLID& classID() {
        return DayaBay::CLID_GenHeader;
    }

    GenHeaderCnv(ISvcLocator* svc);
    virtual ~GenHeaderCnv();
```

```
def __init__(self):
    pass
```

```
int main(int argc, char argv[])
```

math

Latex math markup used by the `math` directive.

math equation

$$V(t) = VoltageScale \cdot \frac{(e^{-t/t_0} - e^{-t/t_1})}{(t_1 - t_0)} \qquad t_0 = 3.6ns \qquad t_1 = 5.4ns \tag{24.1}$$

equation (**??**) is propagated from label

math eqnarray

$$y = ax^2 + bx + c \tag{24.2}$$

$$f(x) = x^2 + 2xy + y^2 \tag{24.3}$$

labels are not ferreted out of the math (**??**) ... just passed to latex to create a png presumably

raw html css usage via reST custom roles

Section contains invisble content that create custom roles **r**, **v** and **g** that are used to style cells of the below tables.

table styled with custom role

Table 24.1: Frozen Delights!

Treat	Quantity	Description
Albatross	2.99	On a stick!
Crunchy Frog	1.49	If we took the bones out, it wouldn't be crunchy, now would it?
Gannet Ripple	1.99	On a stick!

The role results in the html:

```
<tr>
    <td><span class="custom">Gannet Ripple</span></td>
    <td>1.99</td>
    <td>On a stick!</td>
</tr>
```

longtable

Name & Synonyms	Type	Track	Vertex	Stats	Description
timet	double	X	X	X	Time of the vertex/track start
x global_x	double	X	X	X	Global X position of the vertex/track start/step
yglobal_y	d	X	X	X	Global Y position of the vertex/track start/step
zglobal_z	double	X	X	X	Global Z position of the vertex/track start/step
EnergyLostSinceLastVertex	double		X		Energy difference sine the last created SimVertex
AngleFromLastVertex	double		X		Change in direction since the last created SimVertex (degrees)

figures

A code block can be placed in the legend of a figure.

The `ref` role is used to refer to the fig by its label *f:test_simtrack_accessors*

tabledoc

Generate the below list of tabledoc directives with somthing like

```
echo show tables | mysql dcs | perl -p -e 's,(\S*),.. tabledoc:: dcs $1, ' -
```

24.1.7 Dayabay Sphinx Extensions

Sphinx extensions allow arbitary *rst* generating python to be performed on building the documentation. Allowing documentation or other output to be dynamically generated.

Table Doc Directive

Invoking the **tabledoc** directive (from *OfflineUserManual.sphinxext.tabledoc*) with *dbconf* (section name in `~/.my.cnf`) and *tablename* arguments:

```
.. tabledoc:: offline_db LOCALSEQNO
```

Performs a live DB description lookup and converts the *MySQL-python* output into an *rst* table.

This is configured in the Sphinx *conf.py* with:

.

Figure 24.1: **f:test_simtrack_accessors**
SimTrack Accessors. A list of accessible data from the SimTrack object.

```
class SimTrack {
    ...
    /// Geant4 track ID
    int trackId() const;

    /// PDG code of this track
    int particle() const;

    /// PDG code of the immediate parent to this track
    int parentParticle() const;

    /// Reference to the parent or ancestor of this track.
    const DayaBay::SimTrackReference& ancestorTrack() const;

    /// Reference to the parent or ancestor of this track.
    const DayaBay::SimVertexReference& ancestorVertex() const;

    /// Pointer to the ancestor primary kinematics particle
    const HepMC::GenParticle* primaryParticle() const;

    /// Pointers to the vertices along this track. Not owned.
    const vertex_list& vertices() const;

    /// Get number of unrecordeds for given pdg type
    unsigned int unrecordedDescendants(int pdg) const;
    ...
}
```

```
extensions += [ 'OfflineUserManual.sphinxext.tabledoc' ]
```

Further details in *extensions*

DBI Validity Record

Invoke directive with:

```
.. dbivld:: tmp_offline_db Demo 1,10
```

Yielding a table:

DBI Context Query

Invoke directive with:

```
.. dbictx:: tmp_offline_db Demo
   :site: 127
   :simflag: 1
   :task: 0
   :subsite: 0
```

Yielding table:

DBI Validity Lookup Table

Invoke directive with:

```
.. dbivlut:: tmp_offline_db Demo
```

24.2 Todolist

Collection of todo notes sprinkled across the documentation provided by `todolist`

Todo

Find way to avoid/capture the error after failure to connect

(The *original entry* is located in /data4/slave_install/dybinstall/NuWa-trunk/dybgaudi/InstallArea/python/DybPython/dbcas.py:docstring of DybPython.dbcas.DBCon.server, line 3.)

Todo

test return to numpy original, now that my changes are integrated

---

(The *original entry* is located in /data4/slave_install/dybinstall/NuWa-trunk/dybgaudi/Documentation/OfflineUserManual/tex/docs/build line 60.)

Todo

Provide a way for non-administrators to do this style of debugging, perhaps with an extra DBI log file ?

(The *original entry* is located in /data4/slave_install/dybinstall/NuWa-trunk/dybgaudi/Documentation/OfflineUserManual/tex/sop/dbdeb
line 134.)

Todo

plant internal reference targets to genDbi documentation

(The *original entry* is located in /data4/slave_install/dybinstall/NuWa-trunk/dybgaudi/Documentation/OfflineUserManual/tex/sop/dbspe
line 133.)

Todo

enforce usage of overlay date in pre-commmit hook

(The *original entry* is located in /data4/slave_install/dybinstall/NuWa-trunk/dybgaudi/Documentation/OfflineUserManual/tex/sop/dbwrit
line 138.)

Todo

try changing implementation of enums to make them usable from python

(The *original entry* is located in /data4/slave_install/dybinstall/NuWa-trunk/dybgaudi/Documentation/OfflineUserManual/tex/sop/dbwrit
line 300.)

24.3 References

CHAPTER

TWENTYFIVE

UNRECOGNIZED LATEX COMMANDS

None

CHAPTER

TWENTYSIX

INDICES AND TABLES

- *genindex*
- *modindex*
- *search*

[g4dyb] Reference target needed for g4dyb

d

DbiDataSvc, 479
DbiMonitor.tests.test_dcs, 352
DbiMonitor.tests.test_offline, 354
DybDbi, 412
DybDbi.vld.versiondate, 418
DybDbi.vld.vlut, 420
DybDbi.vld.vsmry, 422
DybDbiPre, 410
DybPython, 476
DybPython.Control, 476
DybPython.db, 379
DybPython.dbaux, 389
DybPython.dbcas, 396
DybPython.dbconf, 393
DybPython.dbicnf, 477
DybPython.dbsrv, 401
DybPython.dbsvn, 397
dybtest, 494
dybtest.capture, 495
dybtest.cfroot, 494
dybtest.histref, 494

n

NonDbi, 479

s

Scraper, 483
Scraper.adlidsensor, 486
Scraper.adtemp, 485
Scraper.dcs, 487
Scraper.pmthv, 483

Symbols

__call__() (DybDbiPre.Tab method), 411

A

adcpedestalhigh (DybDbi.GCalibFeeSpec attribute), 447
adcpedestalhighsigma (DybDbi.GCalibFeeSpec attribute), 447
adcpedestallow (DybDbi.GCalibFeeSpec attribute), 447
adcpedestallowsigma (DybDbi.GCalibFeeSpec attribute), 447
adcthresholdhigh (DybDbi.GCalibFeeSpec attribute), 447
adcthresholdlow (DybDbi.GCalibFeeSpec attribute), 447
Add (DybDbi.TimeStamp attribute), 428
add_input_file() (DybPython.Control.NuWa method), 476
add_service_redirect() (DybPython.Control.NuWa method), 476
AdLidSensor (class in Scraper.adlidsensor), 486
AdLogicalPhysical (class in DybDbi), 424
adno (DybDbi.GDaqCalibRunInfo attribute), 460
AdTemp (class in Scraper.adtemp), 485
AdTempFaker (class in Scraper.adtemp), 486
AdTempScraper (class in Scraper.adtemp), 485
AdTempSource (class in Scraper.adtemp), 485
afterpulseprob (DybDbi.GCalibPmtSpec attribute), 443
afterpulseprob (DybDbi.GSimPmtSpec attribute), 439
aggregateno (DybDbi.GCalibFeeSpec attribute), 447
aggregateno (DybDbi.GCalibPmtSpec attribute), 443
aggregateno (DybDbi.GDaqCalibRunInfo attribute), 460
aggregateno (DybDbi.GDaqRawDataFileInfo attribute), 464
aggregateno (DybDbi.GDaqRunInfo attribute), 455
aggregateno (DybDbi.GDbiLogEntry attribute), 467
aggregateno (DybDbi.GDcsAdTemp attribute), 471
aggregateno (DybDbi.GDcsPmtHv attribute), 474
aggregateno (DybDbi.GFeeCableMap attribute), 451
aggregateno (DybDbi.GPhysAd attribute), 435
aggregateno (DybDbi.GSimPmtSpec attribute), 439
allseqno (DybPython.db.DB attribute), 382
AParser (class in Scraper.base.aparser), 492
archive() (DybPython.dbsrv.DB method), 408
archivepath() (DybPython.dbsrv.DB method), 408
AssignTimeGate (DybDbi.GCalibFeeSpec attribute), 445
AssignTimeGate (DybDbi.GCalibPmtSpec attribute), 441
AssignTimeGate (DybDbi.GDaqCalibRunInfo attribute), 457
AssignTimeGate (DybDbi.GDaqRawDataFileInfo attribute), 462
AssignTimeGate (DybDbi.GDaqRunInfo attribute), 453
AssignTimeGate (DybDbi.GDcsAdTemp attribute), 469
AssignTimeGate (DybDbi.GDcsPmtHv attribute), 472
AssignTimeGate (DybDbi.GFeeCableMap attribute), 449
AssignTimeGate (DybDbi.GPhysAd attribute), 434
AssignTimeGate (DybDbi.GSimPmtSpec attribute), 437
AsString (DybDbi.Context attribute), 426
AsString (DybDbi.ContextRange attribute), 427
AsString (DybDbi.Ctx attribute), 416
AsString (DybDbi.DetectorId attribute), 431
AsString (DybDbi.SimFlag attribute), 431
AsString (DybDbi.Site attribute), 430
AsString (DybDbi.TimeStamp attribute), 428
automap() (DybDbi.Mapper method), 416
Aux (class in DybPython.dbaux), 392

B

baseversion (DybDbi.GDaqRunInfo attribute), 455
bot (DybDbi.TimeStamp attribute), 429
BUILD_REVISION, 192

C

Cache (DybDbi.GCalibFeeSpec attribute), 445
Cache (DybDbi.GCalibPmtSpec attribute), 441
Cache (DybDbi.GDaqCalibRunInfo attribute), 457
Cache (DybDbi.GDaqRawDataFileInfo attribute), 462
Cache (DybDbi.GDaqRunInfo attribute), 453
Cache (DybDbi.GDbiLogEntry attribute), 466
Cache (DybDbi.GDcsAdTemp attribute), 469
Cache (DybDbi.GDcsPmtHv attribute), 472
Cache (DybDbi.GFeeCableMap attribute), 449
Cache (DybDbi.GPhysAd attribute), 434
Cache (DybDbi.GSimPmtSpec attribute), 437
CanFixOrdering (DybDbi.GSimPmtSpec attribute), 437
CanL2Cache (DybDbi.GCalibFeeSpec attribute), 445
CanL2Cache (DybDbi.GCalibPmtSpec attribute), 441

CanL2Cache (DybDbi.GDaqCalibRunInfo attribute), 457
CanL2Cache (DybDbi.GDaqRawDataFileInfo attribute), 462
CanL2Cache (DybDbi.GDaqRunInfo attribute), 453
CanL2Cache (DybDbi.GDcsAdTemp attribute), 469
CanL2Cache (DybDbi.GDcsPmtHv attribute), 472
CanL2Cache (DybDbi.GFeeCableMap attribute), 449
CanL2Cache (DybDbi.GPhysAd attribute), 434
CanL2Cache (DybDbi.GSimPmtSpec attribute), 437
Capture (class in dybtest.capture), 495
cfg_() (in module NonDbi), 482
CfHist (class in dybtest.cfroot), 494
CfRoot (class in dybtest.cfroot), 494
changed() (Scraper.adtemp.AdTempScraper method), 486
changed() (Scraper.base.Scraper method), 489
changed() (Scraper.pmthv.PmtHvScraper method), 484
chanhrdwdesc (DybDbi.GFeeCableMap attribute), 451
channelid (DybDbi.GCalibFeeSpec attribute), 447
check_() (DybPython.db.DB method), 382
check_allseqno() (DybPython.db.DB method), 382
check_kv() (DybDbi.Mapper method), 416
check_physical2logical() (DybDbi.AdLogicalPhysical method), 425
check_seqno() (DybPython.db.DB method), 382
check_versiondate() (in module DybDbi.vld.versiondate), 419
check_versiondate_tab() (in module DybDbi.vld.versiondate), 419
checksum (DybDbi.GDaqRawDataFileInfo attribute), 464
clean() (DybDbi.Source method), 415
cli_() (DybPython.db.DB method), 382
CloneAndSubtract (DybDbi.TimeStamp attribute), 428
Close (DybDbi.GCalibFeeSpec attribute), 445
Close (DybDbi.GCalibPmtSpec attribute), 441
Close (DybDbi.GDaqCalibRunInfo attribute), 457
Close (DybDbi.GDaqRawDataFileInfo attribute), 462
Close (DybDbi.GDaqRunInfo attribute), 453
Close (DybDbi.GDbiLogEntry attribute), 466
Close (DybDbi.GDcsAdTemp attribute), 469
Close (DybDbi.GDcsPmtHv attribute), 473
Close (DybDbi.GFeeCableMap attribute), 449
Close (DybDbi.GPhysAd attribute), 434
Close (DybDbi.GSimPmtSpec attribute), 437
cmdline() (DybPython.Control.NuWa method), 476
column (DybDbi.GDcsPmtHv attribute), 474
Compare (DybDbi.GCalibFeeSpec attribute), 445
Compare (DybDbi.GCalibPmtSpec attribute), 441
Compare (DybDbi.GDaqCalibRunInfo attribute), 457
Compare (DybDbi.GDaqRawDataFileInfo attribute), 462
Compare (DybDbi.GDaqRunInfo attribute), 453
Compare (DybDbi.GDcsAdTemp attribute), 469
Compare (DybDbi.GDcsPmtHv attribute), 473
Compare (DybDbi.GFeeCableMap attribute), 449
Compare (DybDbi.GPhysAd attribute), 434
Compare (DybDbi.GSimPmtSpec attribute), 437
config() (Scraper.base.parser.Parser class method), 493
configure_args() (DybPython.Control.NuWa method), 476
configure_cascade() (DybPython.dbconf.DBConf method), 395
configure_dbconf() (DybPython.Control.NuWa method), 476
configure_dbi() (DybPython.Control.NuWa method), 476
configure_dyb_services() (DybPython.Control.NuWa method), 476
configure_framework() (DybPython.Control.NuWa method), 477
configure_ipython() (DybPython.Control.NuWa method), 477
configure_mod() (DybPython.Control.NuWa method), 477
configure_optmods() (DybPython.Control.NuWa method), 477
configure_python_features() (DybPython.Control.NuWa method), 477
configure_visualization() (DybPython.Control.NuWa method), 477
Context (class in DybDbi), 426
context (DybDbi.ServiceMode attribute), 430
ContextRange (class in DybDbi), 427
convert_csv2dbi() (DybDbi.Mapper method), 416
Copy (DybDbi.TimeStamp attribute), 428
count_() (DybPython.db.DB method), 382
cr (DybPython.dbicnf.DbiCnf attribute), 478
Create() (DybDbi.GCalibFeeSpec class method), 445
Create() (DybDbi.GCalibPmtSpec class method), 441
Create() (DybDbi.GDaqCalibRunInfo class method), 457
Create() (DybDbi.GDaqRawDataFileInfo class method), 462
Create() (DybDbi.GDaqRunInfo class method), 453
Create() (DybDbi.GDbiLogEntry class method), 466
Create() (DybDbi.GDcsAdTemp class method), 469
Create() (DybDbi.GDcsPmtHv class method), 473
Create() (DybDbi.GFeeCableMap class method), 449
Create() (DybDbi.GPhysAd class method), 434
Create() (DybDbi.GSimPmtSpec class method), 437
CreateTableRow (DybDbi.GCalibFeeSpec attribute), 445
CreateTableRow (DybDbi.GCalibPmtSpec attribute), 441
CreateTableRow (DybDbi.GDaqCalibRunInfo attribute), 457
CreateTableRow (DybDbi.GDaqRawDataFileInfo attribute), 463
CreateTableRow (DybDbi.GDaqRunInfo attribute), 453
CreateTableRow (DybDbi.GDbiLogEntry attribute), 466
CreateTableRow (DybDbi.GDcsAdTemp attribute), 469
CreateTableRow (DybDbi.GDcsPmtHv attribute), 473
CreateTableRow (DybDbi.GFeeCableMap attribute), 449

CreateTableRow (DybDbi.GPhysAd attribute), 434
CreateTableRow (DybDbi.GSimPmtSpec attribute), 437
CSV (class in DybDbi), 414
csv_check() (DybDbi.GCalibFeeSpec class method), 447
csv_check() (DybDbi.GCalibPmtSpec class method), 443
csv_check() (DybDbi.GDaqCalibRunInfo class method), 460
csv_check() (DybDbi.GDaqRawDataFileInfo class method), 464
csv_check() (DybDbi.GDaqRunInfo class method), 455
csv_check() (DybDbi.GDbiLogEntry class method), 467
csv_check() (DybDbi.GDcsAdTemp class method), 471
csv_check() (DybDbi.GDcsPmtHv class method), 474
csv_check() (DybDbi.GFeeCableMap class method), 451
csv_check() (DybDbi.GPhysAd class method), 435
csv_check() (DybDbi.GSimPmtSpec class method), 439
csv_compare() (DybDbi.GCalibFeeSpec class method), 448
csv_compare() (DybDbi.GCalibPmtSpec class method), 443
csv_compare() (DybDbi.GDaqCalibRunInfo class method), 460
csv_compare() (DybDbi.GDaqRawDataFileInfo class method), 465
csv_compare() (DybDbi.GDaqRunInfo class method), 455
csv_compare() (DybDbi.GDbiLogEntry class method), 467
csv_compare() (DybDbi.GDcsAdTemp class method), 471
csv_compare() (DybDbi.GDcsPmtHv class method), 474
csv_compare() (DybDbi.GFeeCableMap class method), 451
csv_compare() (DybDbi.GPhysAd class method), 435
csv_compare() (DybDbi.GSimPmtSpec class method), 439
csv_export() (DybDbi.GCalibFeeSpec class method), 448
csv_export() (DybDbi.GCalibPmtSpec class method), 443
csv_export() (DybDbi.GDaqCalibRunInfo class method), 460
csv_export() (DybDbi.GDaqRawDataFileInfo class method), 465
csv_export() (DybDbi.GDaqRunInfo class method), 455
csv_export() (DybDbi.GDbiLogEntry class method), 467
csv_export() (DybDbi.GDcsAdTemp class method), 471
csv_export() (DybDbi.GDcsPmtHv class method), 474
csv_export() (DybDbi.GFeeCableMap class method), 452
csv_export() (DybDbi.GPhysAd class method), 435
csv_export() (DybDbi.GSimPmtSpec class method), 439
csv_import() (DybDbi.GCalibFeeSpec class method), 448
csv_import() (DybDbi.GCalibPmtSpec class method), 444
csv_import() (DybDbi.GDaqCalibRunInfo class method), 460
csv_import() (DybDbi.GDaqRawDataFileInfo class method), 465
csv_import() (DybDbi.GDaqRunInfo class method), 455
csv_import() (DybDbi.GDbiLogEntry class method), 467
csv_import() (DybDbi.GDcsAdTemp class method), 471
csv_import() (DybDbi.GDcsPmtHv class method), 475
csv_import() (DybDbi.GFeeCableMap class method), 452
csv_import() (DybDbi.GPhysAd class method), 436
csv_import() (DybDbi.GSimPmtSpec class method), 439
Ctx (class in DybDbi), 416
ctx_count() (in module DybDbi.vld.vsmry), 422
CurrentTimeGate (DybDbi.GCalibFeeSpec attribute), 445
CurrentTimeGate (DybDbi.GCalibPmtSpec attribute), 441
CurrentTimeGate (DybDbi.GDaqCalibRunInfo attribute), 457
CurrentTimeGate (DybDbi.GDaqRawDataFileInfo attribute), 463
CurrentTimeGate (DybDbi.GDaqRunInfo attribute), 453
CurrentTimeGate (DybDbi.GDcsAdTemp attribute), 469
CurrentTimeGate (DybDbi.GDcsPmtHv attribute), 473
CurrentTimeGate (DybDbi.GFeeCableMap attribute), 450
CurrentTimeGate (DybDbi.GPhysAd attribute), 434
CurrentTimeGate (DybDbi.GSimPmtSpec attribute), 437

D

darkrate (DybDbi.GCalibPmtSpec attribute), 444
darkrate (DybDbi.GSimPmtSpec attribute), 440
database_drop_create() (DybPython.dbsrv.DB method), 408
databaselayout (DybDbi.GCalibFeeSpec attribute), 448
databaselayout (DybDbi.GCalibPmtSpec attribute), 444
databaselayout (DybDbi.GDaqCalibRunInfo attribute), 461
databaselayout (DybDbi.GDaqRawDataFileInfo attribute), 465
databaselayout (DybDbi.GDaqRunInfo attribute), 456
databaselayout (DybDbi.GDbiLogEntry attribute), 468
databaselayout (DybDbi.GDcsAdTemp attribute), 471
databaselayout (DybDbi.GDcsPmtHv attribute), 475
databaselayout (DybDbi.GFeeCableMap attribute), 452
databaselayout (DybDbi.GPhysAd attribute), 436
databaselayout (DybDbi.GSimPmtSpec attribute), 440
databases (DybPython.dbsrv.DB attribute), 408
datadir (DybPython.dbsrv.DB attribute), 408
dataversion (DybDbi.GDaqRunInfo attribute), 456
date (DybDbi.TimeStamp attribute), 429
DB (class in DybPython.db), 381
DB (class in DybPython.dbsrv), 408

DBCas (class in DybPython.dbcas), 396
DBCon (class in DybPython.dbcas), 396
DBCONF, 208, 212, 229, 246, 395
DBConf (class in DybPython.dbconf), 393
DBCONF_PATH, 395, 396
Dbi (class in DybDbi), 432
DbiCnf (class in DybPython.dbicnf), 477
DbiDataSvc (module), 479
DbiMonitor.tests.test_dcs (module), 352
DbiMonitor.tests.test_offline (module), 354
DBIValidate (class in DybPython.dbsvn), 400
DCS (class in Scraper.base), 488
DD (class in DybPython.dbcas), 396
define__repr__() (DybDbi.Wrap method), 413
define_create() (DybDbi.Wrap method), 413
define_csv() (DybDbi.Wrap method), 413
define_listlike() (DybDbi.Wrap method), 413
define_properties() (DybDbi.Wrap method), 413
define_update() (DybDbi.Wrap method), 413
desc() (DybPython.db.DB method), 382
descline() (DybDbi.Source method), 415
describ (DybDbi.GCalibPmtSpec attribute), 444
describ (DybDbi.GSimPmtSpec attribute), 440
describe() (DybPython.db.DB method), 382
Detector (in module DybDbi), 431
DetectorId (class in DybDbi), 431
detectorid (DybDbi.GDaqCalibRunInfo attribute), 461
detectormask (DybDbi.GDaqRunInfo attribute), 456
DetectorSensor (class in DybDbi), 432
determine_basedir() (DybPython.dbsrv.DB method), 409
detid (DybDbi.Context attribute), 426
digest (DybDbi.GCalibFeeSpec attribute), 448
digest (DybDbi.GCalibPmtSpec attribute), 444
digest (DybDbi.GDaqCalibRunInfo attribute), 461
digest (DybDbi.GDaqRawDataFileInfo attribute), 465
digest (DybDbi.GDaqRunInfo attribute), 456
digest (DybDbi.GDbiLogEntry attribute), 468
digest (DybDbi.GDcsAdTemp attribute), 471
digest (DybDbi.GDcsPmtHv attribute), 475
digest (DybDbi.GFeeCableMap attribute), 452
digest (DybDbi.GPhysAd attribute), 436
digest (DybDbi.GSimPmtSpec attribute), 440
dj_init_() (in module NonDbi), 482
docs() (DybPython.db.DB class method), 382
docs() (DybPython.dbsrv.DB class method), 409
DoubleValueForKey (DybDbi.GCalibFeeSpec attribute), 445
DoubleValueForKey (DybDbi.GCalibPmtSpec attribute), 441
DoubleValueForKey (DybDbi.GDaqCalibRunInfo attribute), 457
DoubleValueForKey (DybDbi.GDaqRawDataFileInfo attribute), 463
DoubleValueForKey (DybDbi.GDaqRunInfo attribute), 453
DoubleValueForKey (DybDbi.GDbiLogEntry attribute), 466
DoubleValueForKey (DybDbi.GDcsAdTemp attribute), 469
DoubleValueForKey (DybDbi.GDcsPmtHv attribute), 473
DoubleValueForKey (DybDbi.GFeeCableMap attribute), 450
DoubleValueForKey (DybDbi.GPhysAd attribute), 434
DoubleValueForKey (DybDbi.GSimPmtSpec attribute), 437
dump_() (DybPython.db.DB method), 382
dump_ctxsmry() (in module DybDbi.vld.vsmry), 423
dump_difctx() (in module DybDbi.vld.vsmry), 423
dump_diff() (DybPython.dbsvn.DBIValidate method), 400
dumplocal___() (DybPython.dbsrv.DB method), 409
DumpTMStruct (DybDbi.TimeStamp attribute), 428
duration (DybDbi.GDaqCalibRunInfo attribute), 461
DYB_DB_PWSD, 395
DYB_DB_URL, 395
DYB_DB_USER, 395
DybDbi (module), 412
DybDbi.vld.versiondate (module), 418
DybDbi.vld.vlut (module), 420
DybDbi.vld.vsmry (module), 422
DybDbiPre (module), 410
DybPython (module), 476
DybPython.Control (module), 476
DybPython.db (module), 379
DybPython.dbaux (module), 389
DybPython.dbcas (module), 396
DybPython.dbconf (module), 393
DybPython.dbicnf (module), 477
DybPython.dbsrv (module), 401
DybPython.dbsvn (module), 397
dybtest (module), 494
dybtest.capture (module), 495
dybtest.cfroot (module), 494
dybtest.histref (module), 494

E

efficiency (DybDbi.GCalibPmtSpec attribute), 444
efficiency (DybDbi.GSimPmtSpec attribute), 440
engine_() (in module NonDbi), 482
ENV_TSQL_FIX, 395
ENV_TSQL_PSWD, 395
ENV_TSQL_URL, 395
ENV_TSQL_USER, 395
environment variable
    BUILD_REVISION, 192
    DBCONF, 208, 212, 229, 246, 394, 395

DBCONF_DB, 395
DBCONF_FIX, 395
DBCONF_FIXPASS, 395
DBCONF_HOST, 394
DBCONF_PATH, 394–396
DBCONF_PWSD, 394
DBCONF_RESTRICT, 395
DBCONF_URL, 394
DBCONF_USER, 394
DYB_DB_PWSD, 395
DYB_DB_URL, 395
DYB_DB_USER, 395
ENV_TSQL_FIX, 395
ENV_TSQL_PSWD, 395
ENV_TSQL_URL, 395
ENV_TSQL_USER, 395
LOCAL_NODE, 359
MAILTO, 353
NODE_TAG, 357
SCM_FOLD, 359
SCRAPER_CFG, 294, 301, 493
SSH_AUTH_SOCK, 406
eot (DybDbi.TimeStamp attribute), 429
Export() (DybPython.dbconf.DBConf class method), 395
export_() (DybPython.dbconf.DBConf method), 395
extracondition (DybDbi.GCalibFeeSpec attribute), 448
extracondition (DybDbi.GCalibPmtSpec attribute), 444
extracondition (DybDbi.GDaqCalibRunInfo attribute), 461
extracondition (DybDbi.GDaqRawDataFileInfo attribute), 465
extracondition (DybDbi.GDaqRunInfo attribute), 456
extracondition (DybDbi.GDbiLogEntry attribute), 468
extracondition (DybDbi.GDcsAdTemp attribute), 471
extracondition (DybDbi.GDcsPmtHv attribute), 475
extracondition (DybDbi.GFeeCableMap attribute), 452
extracondition (DybDbi.GPhysAd attribute), 436
extracondition (DybDbi.GSimPmtSpec attribute), 440
extract() (DybPython.dbsrv.DB method), 409

F

fabseqno (DybPython.db.DB attribute), 383
fake() (Scraper.adtemp.AdTempFaker method), 486
fake() (Scraper.pmthv.PmtHvFaker method), 485
Faker (class in Scraper.base), 491
feechanneldesc (DybDbi.GFeeCableMap attribute), 452
FeeChannelId (class in DybDbi), 432
feechannelid (DybDbi.GFeeCableMap attribute), 452
FeeHardwareId (class in DybDbi), 432
feehardwareid (DybDbi.GFeeCableMap attribute), 452
fieldnames (DybDbi.CSV attribute), 414
fields (DybDbi.GCalibFeeSpec attribute), 448
fields (DybDbi.GCalibPmtSpec attribute), 444
fields (DybDbi.GDaqCalibRunInfo attribute), 461
fields (DybDbi.GDaqRawDataFileInfo attribute), 465
fields (DybDbi.GDaqRunInfo attribute), 456
fields (DybDbi.GDbiLogEntry attribute), 468
fields (DybDbi.GDcsAdTemp attribute), 472
fields (DybDbi.GDcsPmtHv attribute), 475
fields (DybDbi.GFeeCableMap attribute), 452
fields (DybDbi.GPhysAd attribute), 436
fields (DybDbi.GSimPmtSpec attribute), 440
filename (DybDbi.GDaqRawDataFileInfo attribute), 465
fileno (DybDbi.GDaqRawDataFileInfo attribute), 465
filesize (DybDbi.GDaqRawDataFileInfo attribute), 465
filestate (DybDbi.GDaqRawDataFileInfo attribute), 465
Fill (DybDbi.GCalibFeeSpec attribute), 445
Fill (DybDbi.GCalibPmtSpec attribute), 441
Fill (DybDbi.GDaqCalibRunInfo attribute), 457
Fill (DybDbi.GDaqRawDataFileInfo attribute), 463
Fill (DybDbi.GDaqRunInfo attribute), 453
Fill (DybDbi.GDcsAdTemp attribute), 469
Fill (DybDbi.GDcsPmtHv attribute), 473
Fill (DybDbi.GFeeCableMap attribute), 450
Fill (DybDbi.GPhysAd attribute), 434
Fill (DybDbi.GSimPmtSpec attribute), 437
FloatValueForKey (DybDbi.GCalibFeeSpec attribute), 446
FloatValueForKey (DybDbi.GCalibPmtSpec attribute), 441
FloatValueForKey (DybDbi.GDaqCalibRunInfo attribute), 457
FloatValueForKey (DybDbi.GDaqRawDataFileInfo attribute), 463
FloatValueForKey (DybDbi.GDaqRunInfo attribute), 453
FloatValueForKey (DybDbi.GDbiLogEntry attribute), 466
FloatValueForKey (DybDbi.GDcsAdTemp attribute), 469
FloatValueForKey (DybDbi.GDcsPmtHv attribute), 473
FloatValueForKey (DybDbi.GFeeCableMap attribute), 450
FloatValueForKey (DybDbi.GPhysAd attribute), 434
FloatValueForKey (DybDbi.GSimPmtSpec attribute), 437
forced_rloadcat_() (DybPython.db.DB method), 383
fresh_db() (DybPython.dbaux.Aux method), 392
from_env() (DybPython.dbconf.DBConf class method), 395
FromIndex (DybDbi.Ctx attribute), 416
FromString (DybDbi.Ctx attribute), 416
FromString (DybDbi.DetectorId attribute), 431
FromString (DybDbi.SimFlag attribute), 431
FromString (DybDbi.Site attribute), 430
FromString0 (DybDbi.DetectorId attribute), 431
FullMask (DybDbi.Ctx attribute), 416
FullMask (DybDbi.SimFlag attribute), 431
FullMask (DybDbi.Site attribute), 431

G

gain (DybDbi.GSimPmtSpec attribute), 440
GCalibFeeSpec (class in DybDbi), 445
GCalibPmtSpec (class in DybDbi), 441
GDaqCalibRunInfo (class in DybDbi), 457
GDaqRawDataFileInfo (class in DybDbi), 462
GDaqRunInfo (class in DybDbi), 453
GDbiLogEntry (class in DybDbi), 466
GDcsAdTemp (class in DybDbi), 469
GDcsPmtHv (class in DybDbi), 472
get_allseqno() (DybPython.db.DB method), 383
get_attfn() (DybDbi.Wrap method), 413
get_fabseqno() (DybPython.db.DB method), 383
get_prep() (DybPython.dbcas.DD method), 396
get_seqno() (DybPython.db.DB method), 384
GetAdcPedestalHigh (DybDbi.GCalibFeeSpec attribute), 446
GetAdcPedestalHighSigma (DybDbi.GCalibFeeSpec attribute), 446
GetAdcPedestalLow (DybDbi.GCalibFeeSpec attribute), 446
GetAdcPedestalLowSigma (DybDbi.GCalibFeeSpec attribute), 446
GetAdcThresholdHigh (DybDbi.GCalibFeeSpec attribute), 446
GetAdcThresholdLow (DybDbi.GCalibFeeSpec attribute), 446
GetAdNo (DybDbi.GDaqCalibRunInfo attribute), 457
GetAfterPulseProb (DybDbi.GCalibPmtSpec attribute), 441
GetAfterPulseProb (DybDbi.GSimPmtSpec attribute), 437
GetBaseVersion (DybDbi.GDaqRunInfo attribute), 453
GetBOT (DybDbi.TimeStamp attribute), 428
GetChanHrdwDesc (DybDbi.GFeeCableMap attribute), 450
GetChannelId (DybDbi.GCalibFeeSpec attribute), 446
GetCheckSum (DybDbi.GDaqRawDataFileInfo attribute), 463
GetColumn (DybDbi.GDcsPmtHv attribute), 473
GetDarkRate (DybDbi.GCalibPmtSpec attribute), 441
GetDarkRate (DybDbi.GSimPmtSpec attribute), 437
GetDatabaseLayout (DybDbi.GCalibFeeSpec attribute), 446
GetDatabaseLayout (DybDbi.GCalibPmtSpec attribute), 441
GetDatabaseLayout (DybDbi.GDaqCalibRunInfo attribute), 457
GetDatabaseLayout (DybDbi.GDaqRawDataFileInfo attribute), 463
GetDatabaseLayout (DybDbi.GDaqRunInfo attribute), 454
GetDatabaseLayout (DybDbi.GDcsAdTemp attribute), 470
GetDatabaseLayout (DybDbi.GDcsPmtHv attribute), 473
GetDatabaseLayout (DybDbi.GFeeCableMap attribute), 450
GetDatabaseLayout (DybDbi.GPhysAd attribute), 434
GetDatabaseLayout (DybDbi.GSimPmtSpec attribute), 437
GetDataVersion (DybDbi.GDaqRunInfo attribute), 454
GetDate (DybDbi.TimeStamp attribute), 428
GetDescrib (DybDbi.GCalibPmtSpec attribute), 441
GetDescrib (DybDbi.GSimPmtSpec attribute), 437
GetDetectorId (DybDbi.GDaqCalibRunInfo attribute), 457
GetDetectorMask (DybDbi.GDaqRunInfo attribute), 454
GetDetId (DybDbi.Context attribute), 426
GetDigest (DybDbi.GCalibFeeSpec attribute), 446
GetDigest (DybDbi.GCalibPmtSpec attribute), 441
GetDigest (DybDbi.GDaqCalibRunInfo attribute), 457
GetDigest (DybDbi.GDaqRawDataFileInfo attribute), 463
GetDigest (DybDbi.GDaqRunInfo attribute), 454
GetDigest (DybDbi.GDbiLogEntry attribute), 466
GetDigest (DybDbi.GDcsAdTemp attribute), 470
GetDigest (DybDbi.GDcsPmtHv attribute), 473
GetDigest (DybDbi.GFeeCableMap attribute), 450
GetDigest (DybDbi.GPhysAd attribute), 434
GetDigest (DybDbi.GSimPmtSpec attribute), 437
GetDuration (DybDbi.GDaqCalibRunInfo attribute), 458
GetEfficiency (DybDbi.GCalibPmtSpec attribute), 441
GetEfficiency (DybDbi.GSimPmtSpec attribute), 437
GetEOT (DybDbi.TimeStamp attribute), 428
GetFeeChannelDesc (DybDbi.GFeeCableMap attribute), 450
GetFeeChannelId (DybDbi.GFeeCableMap attribute), 450
GetFeeHardwareId (DybDbi.GFeeCableMap attribute), 450
GetFields (DybDbi.GCalibFeeSpec attribute), 446
GetFields (DybDbi.GCalibPmtSpec attribute), 442
GetFields (DybDbi.GDaqCalibRunInfo attribute), 458
GetFields (DybDbi.GDaqRawDataFileInfo attribute), 463
GetFields (DybDbi.GDaqRunInfo attribute), 454
GetFields (DybDbi.GDbiLogEntry attribute), 466
GetFields (DybDbi.GDcsAdTemp attribute), 470
GetFields (DybDbi.GDcsPmtHv attribute), 473
GetFields (DybDbi.GFeeCableMap attribute), 450
GetFields (DybDbi.GPhysAd attribute), 434
GetFields (DybDbi.GSimPmtSpec attribute), 437
GetFileName (DybDbi.GDaqRawDataFileInfo attribute), 463
GetFileNo (DybDbi.GDaqRawDataFileInfo attribute), 463
GetFileSize (DybDbi.GDaqRawDataFileInfo attribute), 463

GetFileState (DybDbi.GDaqRawDataFileInfo attribute), 463
GetGain (DybDbi.GSimPmtSpec attribute), 437
GetHomeA (DybDbi.GDaqCalibRunInfo attribute), 458
GetHomeB (DybDbi.GDaqCalibRunInfo attribute), 458
GetHomeC (DybDbi.GDaqCalibRunInfo attribute), 458
GetLadder (DybDbi.GDcsPmtHv attribute), 473
GetLedFreq (DybDbi.GDaqCalibRunInfo attribute), 458
GetLedNumber1 (DybDbi.GDaqCalibRunInfo attribute), 458
GetLedNumber2 (DybDbi.GDaqCalibRunInfo attribute), 458
GetLedPulseSep (DybDbi.GDaqCalibRunInfo attribute), 458
GetLedVoltage1 (DybDbi.GDaqCalibRunInfo attribute), 458
GetLedVoltage2 (DybDbi.GDaqCalibRunInfo attribute), 458
GetLtbMode (DybDbi.GDaqCalibRunInfo attribute), 458
GetNanoSec (DybDbi.TimeStamp attribute), 428
GetNBOT (DybDbi.TimeStamp attribute), 428
GetPartitionName (DybDbi.GDaqRunInfo attribute), 454
GetPhysAdId (DybDbi.GPhysAd attribute), 434
GetPmtHardwareId (DybDbi.GFeeCableMap attribute), 450
GetPmtHrdwDesc (DybDbi.GFeeCableMap attribute), 450
GetPmtId (DybDbi.GCalibPmtSpec attribute), 442
GetPmtId (DybDbi.GSimPmtSpec attribute), 438
GetPrePulseProb (DybDbi.GCalibPmtSpec attribute), 442
GetPrePulseProb (DybDbi.GSimPmtSpec attribute), 438
GetPw (DybDbi.GDcsPmtHv attribute), 473
GetRing (DybDbi.GDcsPmtHv attribute), 473
GetRunNo (DybDbi.GDaqCalibRunInfo attribute), 458
GetRunNo (DybDbi.GDaqRawDataFileInfo attribute), 463
GetRunNo (DybDbi.GDaqRunInfo attribute), 454
GetRunType (DybDbi.GDaqRunInfo attribute), 454
GetSchemaVersion (DybDbi.GDaqRunInfo attribute), 454
GetSec (DybDbi.TimeStamp attribute), 429
GetSeconds (DybDbi.TimeStamp attribute), 429
GetSensorDesc (DybDbi.GFeeCableMap attribute), 450
GetSensorId (DybDbi.GFeeCableMap attribute), 450
GetSigmaGain (DybDbi.GSimPmtSpec attribute), 438
GetSigmaSpeHigh (DybDbi.GCalibPmtSpec attribute), 442
GetSimFlag (DybDbi.Context attribute), 426
GetSimMask (DybDbi.ContextRange attribute), 427
GetSite (DybDbi.Context attribute), 426
GetSiteMask (DybDbi.ContextRange attribute), 427
GetSourceIdA (DybDbi.GDaqCalibRunInfo attribute), 458
GetSourceIdB (DybDbi.GDaqCalibRunInfo attribute), 458
GetSourceIdC (DybDbi.GDaqCalibRunInfo attribute), 458
GetSpeHigh (DybDbi.GCalibPmtSpec attribute), 442
GetSpeLow (DybDbi.GCalibPmtSpec attribute), 442
GetStatus (DybDbi.GCalibFeeSpec attribute), 446
GetStatus (DybDbi.GCalibPmtSpec attribute), 442
GetStream (DybDbi.GDaqRawDataFileInfo attribute), 463
GetStreamType (DybDbi.GDaqRawDataFileInfo attribute), 463
GetTableDescr (DybDbi.GCalibFeeSpec attribute), 446
GetTableDescr (DybDbi.GCalibPmtSpec attribute), 442
GetTableDescr (DybDbi.GDaqCalibRunInfo attribute), 458
GetTableDescr (DybDbi.GDaqRawDataFileInfo attribute), 463
GetTableDescr (DybDbi.GDaqRunInfo attribute), 454
GetTableDescr (DybDbi.GDcsAdTemp attribute), 470
GetTableDescr (DybDbi.GDcsPmtHv attribute), 473
GetTableDescr (DybDbi.GFeeCableMap attribute), 450
GetTableDescr (DybDbi.GPhysAd attribute), 435
GetTableDescr (DybDbi.GSimPmtSpec attribute), 438
GetTableProxy (DybDbi.GCalibFeeSpec attribute), 446
GetTableProxy (DybDbi.GCalibPmtSpec attribute), 442
GetTableProxy (DybDbi.GDaqCalibRunInfo attribute), 458
GetTableProxy (DybDbi.GDaqRawDataFileInfo attribute), 463
GetTableProxy (DybDbi.GDaqRunInfo attribute), 454
GetTableProxy (DybDbi.GDbiLogEntry attribute), 466
GetTableProxy (DybDbi.GDcsAdTemp attribute), 470
GetTableProxy (DybDbi.GDcsPmtHv attribute), 473
GetTableProxy (DybDbi.GFeeCableMap attribute), 450
GetTableProxy (DybDbi.GPhysAd attribute), 435
GetTableProxy (DybDbi.GSimPmtSpec attribute), 438
GetTemp1 (DybDbi.GDcsAdTemp attribute), 470
GetTemp2 (DybDbi.GDcsAdTemp attribute), 470
GetTemp3 (DybDbi.GDcsAdTemp attribute), 470
GetTemp4 (DybDbi.GDcsAdTemp attribute), 470
GetTime (DybDbi.TimeStamp attribute), 429
GetTimeEnd (DybDbi.ContextRange attribute), 427
GetTimeGate (DybDbi.Dbi attribute), 432
GetTimeOffset (DybDbi.GCalibPmtSpec attribute), 442
GetTimeOffset (DybDbi.GSimPmtSpec attribute), 438
GetTimeSpec (DybDbi.TimeStamp attribute), 429
GetTimeSpread (DybDbi.GCalibPmtSpec attribute), 442
GetTimeSpread (DybDbi.GSimPmtSpec attribute), 438
GetTimeStamp (DybDbi.Context attribute), 426
GetTimeStart (DybDbi.ContextRange attribute), 427
GetTransferState (DybDbi.GDaqRawDataFileInfo attribute), 463
GetTriggerType (DybDbi.GDaqRunInfo attribute), 454

GetValues (DybDbi.GCalibFeeSpec attribute), 446
GetValues (DybDbi.GCalibPmtSpec attribute), 442
GetValues (DybDbi.GDaqCalibRunInfo attribute), 458
GetValues (DybDbi.GDaqRawDataFileInfo attribute), 463
GetValues (DybDbi.GDaqRunInfo attribute), 454
GetValues (DybDbi.GDbiLogEntry attribute), 466
GetValues (DybDbi.GDcsAdTemp attribute), 470
GetValues (DybDbi.GDcsPmtHv attribute), 473
GetValues (DybDbi.GFeeCableMap attribute), 450
GetValues (DybDbi.GPhysAd attribute), 435
GetValues (DybDbi.GSimPmtSpec attribute), 438
GetVldDescr (DybDbi.Dbi attribute), 432
GetVoltage (DybDbi.GDcsPmtHv attribute), 473
GetZoneOffset (DybDbi.TimeStamp attribute), 429
GetZPositionA (DybDbi.GDaqCalibRunInfo attribute), 458
GetZPositionB (DybDbi.GDaqCalibRunInfo attribute), 458
GetZPositionC (DybDbi.GDaqCalibRunInfo attribute), 458
GFeeCableMap (class in DybDbi), 449
GPhysAd (class in DybDbi), 433
grow_cf() (in module DybDbi.vld.vsmry), 423
GSimPmtSpec (class in DybDbi), 436

H

has_config() (DybPython.dbconf.DBConf class method), 395
has_table() (DybPython.db.DB method), 384
homea (DybDbi.GDaqCalibRunInfo attribute), 461
homeb (DybDbi.GDaqCalibRunInfo attribute), 461
homec (DybDbi.GDaqCalibRunInfo attribute), 461
hostname (DybDbi.GDbiLogEntry attribute), 468

I

iinst() (Scraper.base.sourcevector.SourceVector method), 491
ILookup (class in DybDbi), 424
info (DybPython.dbaux.Aux attribute), 392
initialize() (Scraper.base.Regime method), 488
instance() (Scraper.base.Target method), 489
IntValueForKey (DybDbi.GCalibFeeSpec attribute), 446
IntValueForKey (DybDbi.GCalibPmtSpec attribute), 442
IntValueForKey (DybDbi.GDaqCalibRunInfo attribute), 459
IntValueForKey (DybDbi.GDaqRawDataFileInfo attribute), 463
IntValueForKey (DybDbi.GDaqRunInfo attribute), 454
IntValueForKey (DybDbi.GDbiLogEntry attribute), 467
IntValueForKey (DybDbi.GDcsAdTemp attribute), 470
IntValueForKey (DybDbi.GDcsPmtHv attribute), 473
IntValueForKey (DybDbi.GFeeCableMap attribute), 450
IntValueForKey (DybDbi.GPhysAd attribute), 435
IntValueForKey (DybDbi.GSimPmtSpec attribute), 438
IRunLookup (class in DybDbi), 423
is_descline() (DybDbi.Source method), 415
IsA (DybDbi.Context attribute), 426
IsA (DybDbi.ContextRange attribute), 427
IsA (DybDbi.GCalibFeeSpec attribute), 446
IsA (DybDbi.GCalibPmtSpec attribute), 442
IsA (DybDbi.GDaqCalibRunInfo attribute), 459
IsA (DybDbi.GDaqRawDataFileInfo attribute), 464
IsA (DybDbi.GDaqRunInfo attribute), 454
IsA (DybDbi.GDbiLogEntry attribute), 467
IsA (DybDbi.GDcsAdTemp attribute), 470
IsA (DybDbi.GDcsPmtHv attribute), 473
IsA (DybDbi.GFeeCableMap attribute), 450
IsA (DybDbi.GPhysAd attribute), 435
IsA (DybDbi.GSimPmtSpec attribute), 438
IsA (DybDbi.ServiceMode attribute), 430
IsA (DybDbi.TimeStamp attribute), 429
isAD (DybDbi.DetectorId attribute), 431
IsCompatible (DybDbi.ContextRange attribute), 427
IsLeapYear (DybDbi.TimeStamp attribute), 429
IsNull (DybDbi.TimeStamp attribute), 429
isRPC (DybDbi.DetectorId attribute), 431
IsValid (DybDbi.Context attribute), 426
isWaterShield (DybDbi.DetectorId attribute), 431

K

KeyList (class in dybtest.cfroot), 495
kls (DybDbi.AdLogicalPhysical attribute), 425
kls() (Scraper.base.sa.SA method), 493
kNow() (DybDbi.TimeStamp class method), 429
known_input_type() (DybPython.Control.NuWa method), 477

L

ladder (DybDbi.GDcsPmtHv attribute), 475
lag() (Scraper.base.sourcevector.SourceVector method), 491
lastentry() (Scraper.base.sourcevector.SourceVector method), 491
lastresult_ (Scraper.base.sourcevector.SourceVector attribute), 491
lastvld() (Scraper.base.Target method), 490
ledfreq (DybDbi.GDaqCalibRunInfo attribute), 461
lednumber1 (DybDbi.GDaqCalibRunInfo attribute), 461
lednumber2 (DybDbi.GDaqCalibRunInfo attribute), 461
ledpulsesep (DybDbi.GDaqCalibRunInfo attribute), 461
ledvoltage1 (DybDbi.GDaqCalibRunInfo attribute), 461
ledvoltage2 (DybDbi.GDaqCalibRunInfo attribute), 461
Length (DybDbi.Ctx attribute), 416
load_() (DybPython.db.DB method), 384
loadcsv() (DybPython.db.DB method), 384
loadlocal___() (DybPython.dbsrv.DB method), 409
loadlocal_dir() (DybPython.dbsrv.DB method), 409

LOCAL_NODE, 359
logging_() (DybPython.dbicnf.DbiCnf method), 478
lognumseqno (DybDbi.GDbiLogEntry attribute), 468
logseqnomax (DybDbi.GDbiLogEntry attribute), 468
logseqnomin (DybDbi.GDbiLogEntry attribute), 468
logtablename (DybDbi.GDbiLogEntry attribute), 468
lookup_logical2physical() (DybDbi.AdLogicalPhysical class method), 425
ls_() (DybPython.db.DB method), 385
ls_() (DybPython.dbaux.Aux method), 392
lsdatabases___() (DybPython.dbsrv.DB method), 409
lstables___() (DybPython.dbsrv.DB method), 409
ltbmode (DybDbi.GDaqCalibRunInfo attribute), 461

M

MAILTO, 353
main() (in module Scraper.base), 487
make__repr__() (DybDbi.Wrap method), 414
MakeDateTimeString (DybDbi.Dbi attribute), 432
MakeTimeStamp (DybDbi.Dbi attribute), 432
Mapper (class in DybDbi), 416
MaskFromString (DybDbi.Ctx attribute), 416
MaskFromString (DybDbi.Site attribute), 431
MaxBits (DybDbi.Ctx attribute), 416
MetaDB (class in NonDbi), 481
MktimeFromUTC (DybDbi.TimeStamp attribute), 429
mysql() (DybPython.db.DB method), 385
mysqldb_parameters() (DybPython.dbconf.DBConf method), 395

N

name (DybDbi.GCalibFeeSpec attribute), 448
name (DybDbi.GCalibPmtSpec attribute), 444
name (DybDbi.GDaqCalibRunInfo attribute), 461
name (DybDbi.GDaqRawDataFileInfo attribute), 466
name (DybDbi.GDaqRunInfo attribute), 456
name (DybDbi.GDbiLogEntry attribute), 468
name (DybDbi.GDcsAdTemp attribute), 472
name (DybDbi.GDcsPmtHv attribute), 475
name (DybDbi.GFeeCableMap attribute), 452
name (DybDbi.GPhysAd attribute), 436
name (DybDbi.GSimPmtSpec attribute), 440
nanosec (DybDbi.TimeStamp attribute), 430
nbot (DybDbi.TimeStamp attribute), 430
next() (DybDbi.Source method), 415
NODE_TAG, 357
NonDbi (module), 479
noop_() (DybPython.db.DB method), 385
NotGlobalSeqNo (DybDbi.Dbi attribute), 432
NuWa (class in DybPython.Control), 476

O

optables (DybPython.db.DB attribute), 385
outfile() (DybPython.db.DB method), 385

P

parse_path() (DybPython.dbicnf.DbiCnf method), 478
Parser (class in Scraper.base.parser), 493
partition_dumpcheck() (DybPython.dbsrv.DB method), 409
partition_dumplocal___() (DybPython.dbsrv.DB method), 409
partition_loadlocal___() (DybPython.dbsrv.DB method), 409
partitionname (DybDbi.GDaqRunInfo attribute), 456
paytables (DybPython.db.DB attribute), 385
physadid (DybDbi.GPhysAd attribute), 436
PmtHardwareId (class in DybDbi), 432
pmthardwareid (DybDbi.GFeeCableMap attribute), 452
pmthrdwdesc (DybDbi.GFeeCableMap attribute), 452
PmtHv (class in Scraper.pmthv), 483
PmtHvFaker (class in Scraper.pmthv), 485
PmtHvScraper (class in Scraper.pmthv), 484
PmtHvSource (class in Scraper.pmthv), 484
pmtid (DybDbi.GCalibPmtSpec attribute), 444
pmtid (DybDbi.GSimPmtSpec attribute), 440
predump() (DybPython.db.DB method), 385
prep (DybPython.dbcas.DD attribute), 397
prepulseprob (DybDbi.GCalibPmtSpec attribute), 444
prepulseprob (DybDbi.GSimPmtSpec attribute), 440
present_smry() (in module DybDbi.vld.vsmry), 423
prime_parser() (DybPython.dbconf.DBConf class method), 395
Print (DybDbi.TimeStamp attribute), 429
process() (DybPython.dbcas.DBCon method), 396
processname (DybDbi.GDbiLogEntry attribute), 468
propagate() (Scraper.adtemp.AdTempScraper method), 486
propagate() (Scraper.base.Scraper method), 489
propagate() (Scraper.pmthv.PmtHvScraper method), 484
ptables() (DybPython.dbsrv.DB method), 410
pw (DybDbi.GDcsPmtHv attribute), 475

Q

qafter() (Scraper.base.DCS method), 488
qbefore() (Scraper.base.DCS method), 488

R

rcmpcat_() (DybPython.db.DB method), 385
rcmpcat_() (DybPython.dbaux.Aux method), 392
rdumpcat_() (DybPython.db.DB method), 386
read_cfg() (DybPython.dbconf.DBConf class method), 395
read_desc() (DybPython.db.DB method), 387
read_seqno() (DybPython.db.DB method), 387
reason (DybDbi.GDbiLogEntry attribute), 468
reflect() (Scraper.base.sa.SA method), 493
Regime (class in Scraper.base), 488

require_manual() (Scraper.base.Target method), 490
ring (DybDbi.GDcsPmtHv attribute), 475
rloadcat_() (DybPython.db.DB method), 387
rloadcat_() (DybPython.dbaux.Aux method), 393
Rpt (DybDbi.GCalibFeeSpec attribute), 446
Rpt (DybDbi.GCalibPmtSpec attribute), 442
Rpt (DybDbi.GDaqCalibRunInfo attribute), 459
Rpt (DybDbi.GDaqRawDataFileInfo attribute), 464
Rpt (DybDbi.GDaqRunInfo attribute), 454
Rpt (DybDbi.GDbiLogEntry attribute), 467
Rpt (DybDbi.GDcsAdTemp attribute), 470
Rpt (DybDbi.GDcsPmtHv attribute), 474
Rpt (DybDbi.GFeeCableMap attribute), 450
Rpt (DybDbi.GPhysAd attribute), 435
Rpt (DybDbi.GSimPmtSpec attribute), 438
run_post_user() (DybPython.Control.NuWa method), 477
runno (DybDbi.GDaqCalibRunInfo attribute), 462
runno (DybDbi.GDaqRawDataFileInfo attribute), 466
runno (DybDbi.GDaqRunInfo attribute), 456
runtype (DybDbi.GDaqRunInfo attribute), 456

S

SA (class in Scraper.base.sa), 493
Save (DybDbi.GCalibFeeSpec attribute), 446
Save (DybDbi.GCalibPmtSpec attribute), 442
Save (DybDbi.GDaqCalibRunInfo attribute), 459
Save (DybDbi.GDaqRawDataFileInfo attribute), 464
Save (DybDbi.GDaqRunInfo attribute), 454
Save (DybDbi.GDbiLogEntry attribute), 467
Save (DybDbi.GDcsAdTemp attribute), 470
Save (DybDbi.GDcsPmtHv attribute), 474
Save (DybDbi.GFeeCableMap attribute), 451
Save (DybDbi.GPhysAd attribute), 435
Save (DybDbi.GSimPmtSpec attribute), 438
schemaversion (DybDbi.GDaqRunInfo attribute), 456
SCM_FOLD, 359
Scraper (class in Scraper.base), 488
Scraper (module), 483
Scraper.adlidsensor (module), 486
Scraper.adtemp (module), 485
Scraper.dcs (module), 487
Scraper.pmthv (module), 483
SCRAPER_CFG, 294, 301, 493
sec (DybDbi.TimeStamp attribute), 430
seconds (DybDbi.TimeStamp attribute), 430
seed() (Scraper.base.Target method), 490
seed() (Scraper.pmthv.PmtHvScraper method), 484
sensordesc (DybDbi.GFeeCableMap attribute), 452
sensorid (DybDbi.GFeeCableMap attribute), 453
seqno (DybPython.db.DB attribute), 388
server (DybPython.dbcas.DBCon attribute), 396
servername (DybDbi.GDbiLogEntry attribute), 468
ServiceMode (class in DybDbi), 430
session() (NonDbi.MetaDB method), 482
session_() (in module NonDbi), 482
set_tcursor() (Scraper.base.sourcevector.SourceVector method), 492
SetAdcPedestalHigh (DybDbi.GCalibFeeSpec attribute), 446
SetAdcPedestalHighSigma (DybDbi.GCalibFeeSpec attribute), 446
SetAdcPedestalLow (DybDbi.GCalibFeeSpec attribute), 447
SetAdcPedestalLowSigma (DybDbi.GCalibFeeSpec attribute), 447
SetAdcThresholdHigh (DybDbi.GCalibFeeSpec attribute), 447
SetAdcThresholdLow (DybDbi.GCalibFeeSpec attribute), 447
SetAdNo (DybDbi.GDaqCalibRunInfo attribute), 459
SetAfterPulseProb (DybDbi.GCalibPmtSpec attribute), 442
SetAfterPulseProb (DybDbi.GSimPmtSpec attribute), 438
SetBaseVersion (DybDbi.GDaqRunInfo attribute), 454
SetChanHrdwDesc (DybDbi.GFeeCableMap attribute), 451
SetChannelId (DybDbi.GCalibFeeSpec attribute), 447
SetCheckSum (DybDbi.GDaqRawDataFileInfo attribute), 464
SetColumn (DybDbi.GDcsPmtHv attribute), 474
SetDarkRate (DybDbi.GCalibPmtSpec attribute), 442
SetDarkRate (DybDbi.GSimPmtSpec attribute), 438
SetDataVersion (DybDbi.GDaqRunInfo attribute), 454
SetDescrib (DybDbi.GCalibPmtSpec attribute), 442
SetDescrib (DybDbi.GSimPmtSpec attribute), 438
SetDetectorId (DybDbi.GDaqCalibRunInfo attribute), 459
SetDetectorMask (DybDbi.GDaqRunInfo attribute), 454
SetDetId (DybDbi.Context attribute), 426
SetDuration (DybDbi.GDaqCalibRunInfo attribute), 459
SetEfficiency (DybDbi.GCalibPmtSpec attribute), 442
SetEfficiency (DybDbi.GSimPmtSpec attribute), 438
SetFeeChannelDesc (DybDbi.GFeeCableMap attribute), 451
SetFeeChannelId (DybDbi.GFeeCableMap attribute), 451
SetFeeHardwareId (DybDbi.GFeeCableMap attribute), 451
SetFileName (DybDbi.GDaqRawDataFileInfo attribute), 464
SetFileNo (DybDbi.GDaqRawDataFileInfo attribute), 464
SetFileSize (DybDbi.GDaqRawDataFileInfo attribute), 464
SetFileState (DybDbi.GDaqRawDataFileInfo attribute), 464
SetGain (DybDbi.GSimPmtSpec attribute), 438

SetHomeA (DybDbi.GDaqCalibRunInfo attribute), 459
SetHomeB (DybDbi.GDaqCalibRunInfo attribute), 459
SetHomeC (DybDbi.GDaqCalibRunInfo attribute), 459
SetLadder (DybDbi.GDcsPmtHv attribute), 474
SetLedFreq (DybDbi.GDaqCalibRunInfo attribute), 459
SetLedNumber1 (DybDbi.GDaqCalibRunInfo attribute), 459
SetLedNumber2 (DybDbi.GDaqCalibRunInfo attribute), 459
SetLedPulseSep (DybDbi.GDaqCalibRunInfo attribute), 459
SetLedVoltage1 (DybDbi.GDaqCalibRunInfo attribute), 459
SetLedVoltage2 (DybDbi.GDaqCalibRunInfo attribute), 459
SetLtbMode (DybDbi.GDaqCalibRunInfo attribute), 459
SetPartitionName (DybDbi.GDaqRunInfo attribute), 454
SetPhysAdId (DybDbi.GPhysAd attribute), 435
SetPmtHardwareId (DybDbi.GFeeCableMap attribute), 451
SetPmtHrdwDesc (DybDbi.GFeeCableMap attribute), 451
SetPmtId (DybDbi.GCalibPmtSpec attribute), 442
SetPmtId (DybDbi.GSimPmtSpec attribute), 438
SetPrePulseProb (DybDbi.GCalibPmtSpec attribute), 443
SetPrePulseProb (DybDbi.GSimPmtSpec attribute), 438
SetPw (DybDbi.GDcsPmtHv attribute), 474
SetRing (DybDbi.GDcsPmtHv attribute), 474
SetRunNo (DybDbi.GDaqCalibRunInfo attribute), 459
SetRunNo (DybDbi.GDaqRawDataFileInfo attribute), 464
SetRunNo (DybDbi.GDaqRunInfo attribute), 455
SetRunType (DybDbi.GDaqRunInfo attribute), 455
SetSchemaVersion (DybDbi.GDaqRunInfo attribute), 455
SetSensorDesc (DybDbi.GFeeCableMap attribute), 451
SetSensorId (DybDbi.GFeeCableMap attribute), 451
SetSigmaGain (DybDbi.GSimPmtSpec attribute), 438
SetSigmaSpeHigh (DybDbi.GCalibPmtSpec attribute), 443
setsignals() (Scraper.base.Regime method), 488
SetSimFlag (DybDbi.Context attribute), 426
SetSimMask (DybDbi.ContextRange attribute), 427
SetSite (DybDbi.Context attribute), 426
SetSiteMask (DybDbi.ContextRange attribute), 427
SetSourceIdA (DybDbi.GDaqCalibRunInfo attribute), 459
SetSourceIdB (DybDbi.GDaqCalibRunInfo attribute), 459
SetSourceIdC (DybDbi.GDaqCalibRunInfo attribute), 459
SetSpeHigh (DybDbi.GCalibPmtSpec attribute), 443
SetSpeLow (DybDbi.GCalibPmtSpec attribute), 443
SetStatus (DybDbi.GCalibFeeSpec attribute), 447
SetStatus (DybDbi.GCalibPmtSpec attribute), 443
SetStream (DybDbi.GDaqRawDataFileInfo attribute), 464
SetStreamType (DybDbi.GDaqRawDataFileInfo attribute), 464
SetTemp1 (DybDbi.GDcsAdTemp attribute), 470
SetTemp2 (DybDbi.GDcsAdTemp attribute), 470
SetTemp3 (DybDbi.GDcsAdTemp attribute), 470
SetTemp4 (DybDbi.GDcsAdTemp attribute), 470
SetTimeEnd (DybDbi.ContextRange attribute), 427
SetTimeGate (DybDbi.Dbi attribute), 432
SetTimeOffset (DybDbi.GCalibPmtSpec attribute), 443
SetTimeOffset (DybDbi.GSimPmtSpec attribute), 438
SetTimeSpread (DybDbi.GCalibPmtSpec attribute), 443
SetTimeSpread (DybDbi.GSimPmtSpec attribute), 439
SetTimeStamp (DybDbi.Context attribute), 426
SetTimeStart (DybDbi.ContextRange attribute), 427
SetTransferState (DybDbi.GDaqRawDataFileInfo attribute), 464
SetTriggerType (DybDbi.GDaqRunInfo attribute), 455
setup() (in module DybDbi.vld.versiondate), 419
SetVoltage (DybDbi.GDcsPmtHv attribute), 474
SetZPositionA (DybDbi.GDaqCalibRunInfo attribute), 460
SetZPositionB (DybDbi.GDaqCalibRunInfo attribute), 460
SetZPositionC (DybDbi.GDaqCalibRunInfo attribute), 460
ShowMembers (DybDbi.Context attribute), 426
ShowMembers (DybDbi.ContextRange attribute), 427
ShowMembers (DybDbi.GCalibFeeSpec attribute), 447
ShowMembers (DybDbi.GCalibPmtSpec attribute), 443
ShowMembers (DybDbi.GDaqCalibRunInfo attribute), 460
ShowMembers (DybDbi.GDaqRawDataFileInfo attribute), 464
ShowMembers (DybDbi.GDaqRunInfo attribute), 455
ShowMembers (DybDbi.GDbiLogEntry attribute), 467
ShowMembers (DybDbi.GDcsAdTemp attribute), 470
ShowMembers (DybDbi.GDcsPmtHv attribute), 474
ShowMembers (DybDbi.GFeeCableMap attribute), 451
ShowMembers (DybDbi.GPhysAd attribute), 435
ShowMembers (DybDbi.GSimPmtSpec attribute), 439
ShowMembers (DybDbi.ServiceMode attribute), 430
ShowMembers (DybDbi.TimeStamp attribute), 429
showpaytables (DybPython.db.DB attribute), 388
showtables (DybPython.db.DB attribute), 388
sigmagain (DybDbi.GSimPmtSpec attribute), 440
sigmaspehigh (DybDbi.GCalibPmtSpec attribute), 444
SimFlag (class in DybDbi), 431
simflag (DybDbi.Context attribute), 426
simflag (DybPython.dbicnf.DbiCnf attribute), 479
simmask (DybDbi.ContextRange attribute), 427
simmask (DybDbi.GDbiLogEntry attribute), 468

simmask (DybPython.dbicnf.DbiCnf attribute), 479
Site (class in DybDbi), 430
site (DybDbi.Context attribute), 426
site (DybPython.dbicnf.DbiCnf attribute), 479
sitemask (DybDbi.ContextRange attribute), 427
sitemask (DybDbi.GDbiLogEntry attribute), 468
sitemask (DybPython.dbicnf.DbiCnf attribute), 479
size (DybPython.dbsrv.DB attribute), 410
smry() (Scraper.base.sourcevector.SourceVector method), 492
Source (class in DybDbi), 415
sourceida (DybDbi.GDaqCalibRunInfo attribute), 462
sourceidb (DybDbi.GDaqCalibRunInfo attribute), 462
sourceidc (DybDbi.GDaqCalibRunInfo attribute), 462
SourceVector (class in Scraper.base.sourcevector), 491
spawn() (DybPython.dbcas.DBCas method), 396
spawn() (DybPython.dbcas.DBCon method), 396
SpecKeys (DybDbi.GCalibFeeSpec attribute), 447
SpecKeys (DybDbi.GCalibPmtSpec attribute), 443
SpecKeys (DybDbi.GDaqCalibRunInfo attribute), 460
SpecKeys (DybDbi.GDaqRawDataFileInfo attribute), 464
SpecKeys (DybDbi.GDaqRunInfo attribute), 455
SpecKeys (DybDbi.GDcsAdTemp attribute), 470
SpecKeys (DybDbi.GDcsPmtHv attribute), 474
SpecKeys (DybDbi.GFeeCableMap attribute), 451
SpecKeys (DybDbi.GPhysAd attribute), 435
SpecKeys (DybDbi.GSimPmtSpec attribute), 439
SpecList (DybDbi.GCalibFeeSpec attribute), 447
SpecList (DybDbi.GCalibPmtSpec attribute), 443
SpecList (DybDbi.GDaqCalibRunInfo attribute), 460
SpecList (DybDbi.GDaqRawDataFileInfo attribute), 464
SpecList (DybDbi.GDaqRunInfo attribute), 455
SpecList (DybDbi.GDcsAdTemp attribute), 470
SpecList (DybDbi.GDcsPmtHv attribute), 474
SpecList (DybDbi.GFeeCableMap attribute), 451
SpecList (DybDbi.GPhysAd attribute), 435
SpecList (DybDbi.GSimPmtSpec attribute), 439
SpecMap (DybDbi.GCalibFeeSpec attribute), 447
SpecMap (DybDbi.GCalibPmtSpec attribute), 443
SpecMap (DybDbi.GDaqCalibRunInfo attribute), 460
SpecMap (DybDbi.GDaqRawDataFileInfo attribute), 464
SpecMap (DybDbi.GDaqRunInfo attribute), 455
SpecMap (DybDbi.GDcsAdTemp attribute), 471
SpecMap (DybDbi.GDcsPmtHv attribute), 474
SpecMap (DybDbi.GFeeCableMap attribute), 451
SpecMap (DybDbi.GPhysAd attribute), 435
SpecMap (DybDbi.GSimPmtSpec attribute), 439
spehigh (DybDbi.GCalibPmtSpec attribute), 444
spelow (DybDbi.GCalibPmtSpec attribute), 444
squeeze_tab() (in module DybDbi.vld.vsmry), 423
SSH_AUTH_SOCK, 406
stat (DybPython.dbaux.Aux attribute), 393
status (DybDbi.GCalibFeeSpec attribute), 448
status (DybDbi.GCalibPmtSpec attribute), 444
status (Scraper.base.sourcevector.SourceVector attribute), 492
status_ (Scraper.base.sourcevector.SourceVector attribute), 492
Store (DybDbi.GCalibFeeSpec attribute), 447
Store (DybDbi.GCalibPmtSpec attribute), 443
Store (DybDbi.GDaqCalibRunInfo attribute), 460
Store (DybDbi.GDaqRawDataFileInfo attribute), 464
Store (DybDbi.GDaqRunInfo attribute), 455
Store (DybDbi.GDcsAdTemp attribute), 471
Store (DybDbi.GDcsPmtHv attribute), 474
Store (DybDbi.GFeeCableMap attribute), 451
Store (DybDbi.GPhysAd attribute), 435
Store (DybDbi.GSimPmtSpec attribute), 439
stream (DybDbi.GDaqRawDataFileInfo attribute), 466
streamtype (DybDbi.GDaqRawDataFileInfo attribute), 466
StringForIndex (DybDbi.Ctx attribute), 417
StringFromMask (DybDbi.Ctx attribute), 417
StringFromMask (DybDbi.SimFlag attribute), 431
StringFromMask (DybDbi.Site attribute), 431
subbase() (Scraper.base.DCS method), 488
subsite (DybDbi.GDbiLogEntry attribute), 468
subsite (DybPython.dbicnf.DbiCnf attribute), 479
Subtract (DybDbi.TimeStamp attribute), 429
summary___() (DybPython.dbsrv.DB method), 410
svnup_() (DybPython.dbaux.Aux method), 393

T

Tab (class in DybDbiPre), 410
tab() (DybPython.db.DB method), 388
tabfile() (DybPython.db.DB method), 388
table() (Scraper.base.sa.SA method), 493
tabledescr (DybDbi.GCalibFeeSpec attribute), 448
tabledescr (DybDbi.GCalibPmtSpec attribute), 445
tabledescr (DybDbi.GDaqCalibRunInfo attribute), 462
tabledescr (DybDbi.GDaqRawDataFileInfo attribute), 466
tabledescr (DybDbi.GDaqRunInfo attribute), 456
tabledescr (DybDbi.GDcsAdTemp attribute), 472
tabledescr (DybDbi.GDcsPmtHv attribute), 475
tabledescr (DybDbi.GFeeCableMap attribute), 453
tabledescr (DybDbi.GPhysAd attribute), 436
tabledescr (DybDbi.GSimPmtSpec attribute), 440
tableproxy (DybDbi.GCalibFeeSpec attribute), 448
tableproxy (DybDbi.GCalibPmtSpec attribute), 445
tableproxy (DybDbi.GDaqCalibRunInfo attribute), 462
tableproxy (DybDbi.GDaqRawDataFileInfo attribute), 466
tableproxy (DybDbi.GDaqRunInfo attribute), 456
tableproxy (DybDbi.GDbiLogEntry attribute), 468
tableproxy (DybDbi.GDcsAdTemp attribute), 472
tableproxy (DybDbi.GDcsPmtHv attribute), 475

tableproxy (DybDbi.GFeeCableMap attribute), 453
tableproxy (DybDbi.GPhysAd attribute), 436
tableproxy (DybDbi.GSimPmtSpec attribute), 440
tables (DybPython.db.DB attribute), 388
tables (DybPython.dbsrv.DB attribute), 410
Target (class in Scraper.base), 489
task (DybDbi.GDbiLogEntry attribute), 468
task (DybDbi.ServiceMode attribute), 430
tcursor (Scraper.base.sourcevector.SourceVector attribute), 492
temp1 (DybDbi.GDcsAdTemp attribute), 472
temp2 (DybDbi.GDcsAdTemp attribute), 472
temp3 (DybDbi.GDcsAdTemp attribute), 472
temp4 (DybDbi.GDcsAdTemp attribute), 472
time (DybDbi.TimeStamp attribute), 430
TimeAction (class in DybPython.dbicnf), 479
timeend (DybDbi.ContextRange attribute), 427
timeend (DybPython.dbicnf.DbiCnf attribute), 479
timegate (DybDbi.Dbi attribute), 433
timeoffset (DybDbi.GCalibPmtSpec attribute), 445
timeoffset (DybDbi.GSimPmtSpec attribute), 440
timespec (DybDbi.TimeStamp attribute), 430
timespread (DybDbi.GCalibPmtSpec attribute), 445
timespread (DybDbi.GSimPmtSpec attribute), 440
TimeStamp (class in DybDbi), 428
timestamp (DybDbi.Context attribute), 426
timestamped_dir() (DybPython.dbsrv.DB method), 410
timestart (DybDbi.ContextRange attribute), 427
timestart (DybPython.dbicnf.DbiCnf attribute), 479
TKey_GetCoords() (in module dybtest.cfroot), 495
TKey_GetIdentity() (in module dybtest.cfroot), 495
tmpdir (DybPython.db.DB attribute), 388
tmpfold (DybPython.db.DB attribute), 389
transferstate (DybDbi.GDaqRawDataFileInfo attribute), 466
transfix() (in module DybDbi.vld.versiondate), 419
transfix_tab() (in module DybDbi.vld.versiondate), 419
traverse_vlut() (in module DybDbi.vld.vlut), 421
triggertype (DybDbi.GDaqRunInfo attribute), 456
TrimTo (DybDbi.ContextRange attribute), 427
tunesleep() (Scraper.base.Scraper method), 489

U

updatetime (DybDbi.GDbiLogEntry attribute), 468
username (DybDbi.GDbiLogEntry attribute), 468
UsernameFromEnvironment (DybDbi.Dbi attribute), 433
utables (DybPython.dbsrv.DB attribute), 410
UTCtoDatetime (DybDbi.TimeStamp attribute), 429
UTCtoNaiveLocalDatetime (DybDbi.TimeStamp attribute), 429

V

validate_hunk() (DybPython.dbsvn.DBIValidate method), 400
validate_update() (DybPython.dbsvn.DBIValidate method), 401
validate_validity() (DybPython.dbsvn.DBIValidate method), 401
values (DybDbi.GCalibFeeSpec attribute), 449
values (DybDbi.GCalibPmtSpec attribute), 445
values (DybDbi.GDaqCalibRunInfo attribute), 462
values (DybDbi.GDaqRawDataFileInfo attribute), 466
values (DybDbi.GDaqRunInfo attribute), 456
values (DybDbi.GDbiLogEntry attribute), 468
values (DybDbi.GDcsAdTemp attribute), 472
values (DybDbi.GDcsPmtHv attribute), 475
values (DybDbi.GFeeCableMap attribute), 453
values (DybDbi.GPhysAd attribute), 436
values (DybDbi.GSimPmtSpec attribute), 440
vdupe() (DybPython.db.DB method), 389
vdupe_() (DybPython.db.DB method), 389
VFS (class in DybDbi.vld.versiondate), 418
vlddescr (DybDbi.Dbi attribute), 433
voltage (DybDbi.GDcsPmtHv attribute), 475
vsssta() (DybPython.db.DB method), 389

W

wipe_cache() (DybPython.db.DB method), 389
Wrap (class in DybDbi), 412
write() (DybDbi.AdLogicalPhysical method), 425
write() (DybDbi.CSV method), 414
writer() (DybPython.dbicnf.DbiCnf method), 479
writer() (Scraper.base.Target method), 490
Wrt (DybDbi.GCalibFeeSpec attribute), 447
Wrt (DybDbi.GCalibPmtSpec attribute), 443
Wrt (DybDbi.GDaqCalibRunInfo attribute), 460
Wrt (DybDbi.GDaqRawDataFileInfo attribute), 464
Wrt (DybDbi.GDaqRunInfo attribute), 455
Wrt (DybDbi.GDbiLogEntry attribute), 467
Wrt (DybDbi.GDcsAdTemp attribute), 471
Wrt (DybDbi.GDcsPmtHv attribute), 474
Wrt (DybDbi.GFeeCableMap attribute), 451
Wrt (DybDbi.GPhysAd attribute), 435
Wrt (DybDbi.GSimPmtSpec attribute), 439

Z

zoneoffset (DybDbi.TimeStamp attribute), 430
zpositiona (DybDbi.GDaqCalibRunInfo attribute), 462
zpositionb (DybDbi.GDaqCalibRunInfo attribute), 462
zpositionc (DybDbi.GDaqCalibRunInfo attribute), 462