UNIVERSITY OF CAMBRIDGE

DEEP UNDERGROUND NEUTRINO EXPERIMENT

Databases and ProtoDUNE

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Database Group Meeting

Introduction

- I’m going to focus on what we will need for ProtoDUNE-HD here

- Current ProtoDUNE-SP use cases
  - Will briefly cover things that we have for ProtoDUNE-SP
  - Detailed slides from Lino on calibration

- New use cases for ProtoDUNE-HD

Disclaimer: Tingjun is on holiday and I haven’t discussed this with him. No doubt there are things that I’ve forgotten or omitted

Calibrations

- Four calibrations use the calibration database

- These are required for converting dQ/dx to dE/dx
  - Electron lifetime
  - YZ position calibration
  - X calibration
  - Normalisation calibration

- Lino's slides give the details about these

More info: https://wiki.dunescience.org/wiki/ProtoDUNE-SP_Calibration_Database

Calibrations: electron lifetime

- Store four values in each row

```
<dunegpvm03:~> head -n 10 /dune/data/users/wwu/protodune/database/lifetime/v2.0/prm_elifetime_v2.0.csv
channel,tv,center,low,high
1,1537496339.000000,0.055601,0.055499,0.055672
1,1537552381.000000,0.063404,0.063269,0.063500
1,1537572985.000000,0.068539,0.068384,0.068648
1,1537646190.000000,0.081668,0.081443,0.081827
1,1537681642.000000,0.086869,0.086617,0.087047
1,1537724107.000000,0.096098,0.095790,0.096316
1,1537762844.000000,0.104053,0.103692,0.104308
1,1537794693.000000,0.116062,0.115613,0.116380
1,1537835458.000000,0.159732,0.159116,0.160167
```

- Gives the purity from each of the three monitors are a given timestamp
  - The table above has 3131 rows
- Lookup based on the time stamp

More info: https://wiki.dunescience.org/wiki/ProtoDUNE-SP_Calibration_Database

Calibrations: YZ

- Store seven values in each row

```
<dunegpvm03:~> head -n 10 /dune/data/users/wwu/protodune/database/dqdx_yz/v4.1/yzcorr_PDSPprod4_sceon_0.csv
channel,tv,y,dy,z,dz,corr,corr_err
1001,0,2.5,5,2.5,5,1,0.1
1002,0,7.5,5,2.5,5,0.958315,0.0958315
1003,0,12.5,5,2.5,5,1.00256,0.100256
1004,0,17.5,5,2.5,5,1.11104,0.111104
1005,0,22.5,5,2.5,5,1.0519,0.10519
1006,0,27.5,5,2.5,5,1.06699,0.106699
1007,0,32.5,5,2.5,5,1.0918,0.10918
1008,0,37.5,5,2.5,5,1.01703,0.101703
1009,0,42.5,5,2.5,5,0.94841,0.094841
```

- Each row is one 5cm x 5cm area in the YZ plane
  - 33360 rows in the table

- Separate constants for the three views
  - I think these are stored as three separate tables?

- Values on a per run basis for data
  - Single dummy timestamp for MC

Calibrations: X

- Store five values in each row

```
<dunegpvm03:~> head -n 10 /dune/data/users/wwu/protodune/database/dqdx_x/v4.1/xcorr_PDSPprod4_sceon_0.csv
channel,tv,x,dx,shape,shape_err
1,0,-357.5,5,1.00443,0.100443
2,0,-352.5,5,1.00029,0.100029
3,0,-347.5,5,0.998412,0.0998412
4,0,-342.5,5,0.997138,0.0997138
5,0,-337.5,5,0.995926,0.0995926
6,0,-332.5,5,0.999734,0.0999734
7,0,-327.5,5,0.997773,0.0997773
8,0,-322.5,5,0.998535,0.0998535
9,0,-317.5,5,0.999302,0.0999302
```

- Each row is one 5cm step along the x axis
  - 144 rows in the table

- Separate constants for the three views
  - I think these are stored as three separate tables?

- Values on a per run basis for data
  - Single dummy timestamp for MC

Calibrations: norm(alisation)

- Store three values in each row (although row index looks important)

```
<dunegpvm03:~> head -n 10 /dune/data/users/wwu/protodune/database/dqdx_norm/v3.0/norm_factor_r5841.csv
channel,tv,norm,norm_err
0,5841,0.9903,0.09903
1,5841,0.9834,0.09834
2,5841,0.9853,0.09853
```

- Each row is for a given readout plane and run number
  - Three rows per run - in this case run 5841

- Values on a per run basis for data
  - Single dummy timestamp for MC

High Voltage

- The high voltage stability matters at the event level
  - Need to know if there were problems on the event basis
    - Some HV blips recover very quickly, so they can only last a few events
    - Can just store the bad periods

```
[1537390160, 1537390188], [1537390256, 1537390265]
```

- The HV filter module runs as a filter on each event
  - https://github.com/DUNE/duneprototypes/blob/develop/duneprototypes/Protodune/singlephase/DataUtils/ProtoDUNEUnstableHVFilter_module.cc
  - Skips processing the event if the HV is unstable

High Voltage

- The high voltage stability matters at the event level
  - Need to know if there were problems on the event basis
    - Some HV blips recover very quickly, so they can only last a few events
    - Can just store the bad periods

- In ProtoDUNE-SP we just hard coded the bad periods in a .fcl
  - Clearly not maintainable for longer run periods etc

- Clear example of something to read from a conditions database
  - One table for bad periods, queried per event with time stamps
    - Start time of bad HV period
    - End time of bad HV period
  - One table with the HV setting for a given run, queried per “job”

ProtoDUNE-HD lasers

- ProtoDUNE-HD will have a laser system
  - There will be two lasers in fixed positions but with variable direction

- I don’t know exactly how these will be used yet
  - If we take whole laser runs, only need to access per run
  - If we have laser triggers in a mixed trigger run, need access per event?

- In either case, we need to store two angles and energy for each laser
  - Number of rows will depend on the actual use-case above

- Lasers will be used for calibrations
  - Will obtain the 4 aforementioned corrections using this method too
  - Could mean we have an extra four tables in the calibration database?
  - Again, this is something we need to think about in the DRA

ProtoDUNE-HD as module 0

- ProtoDUNE-HD is the real module 0 for the FD-HD
  - The APAs will actually form part of the FD
- It is a module 0 in more than just the components
  - Can we leverage it to get prepared for the FD?
- Good opportunity not just copy what was done for ProtoDUNE-SP
  - If FD will do things differently, can consider doing that
  - Interact with FD calibration group?

Summary

- A first attempt at listing the ProtoDUNE-HD use cases for the different databases

- Tingjun and I will need to discuss things more on our side
  - Write up some sort of document giving the expected use:
    - Number of values
    - Required time granularity
    - Processing stage