ProtoDUNE calibration database validation

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ProtoDUNE Sim/Reco Meeting
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Introduction

- ProtoDUNE dQ/dx calibration database:
  - https://wiki.dunescience.org/wiki/DQ/dx_Calibration_Database
- Configuration to use dQ/dx calibration correction from database:
  - Module that calls database:
    - *./dunetpc/dune/Protodune/singlephase/dEdxcalibration/CalibrationdEdXPDSP_module.cc*
  - *Fcl file that calls the above module:*
    - */dunetpc/fcl/protodune/reco/protoDUNE_ reco.fcl*
    - make sure that the "pandoracali", "pandoracalipid","pandoracaliSCE" and "pandoracalipidSCE" are included in "reco".
  - Run the reconstruction with calibration using database configuration, for example:

```
services.XYZCalibService.YZCorrDBTag: "v2.0"
services.XYZCalibService.XCorrDBTag: 'v2.0"
services.XYZCalibService.NormCorrDBTag: "v2.0"
```

Validation of Database Provider

- Add output stream in the module that calls database, for example:

```
std::cout<<"plane = "<<planeID.Plane<<" x = "<<vXYZ[j].X()<<" y = "<<vXYZ[j].Y()<<" z = "<<vXYZ[j].Z()<<" normcorrection = "<<normcorrection<<" xcorrection = "<<xcorrection<<" yzcorrection = "<<yzcorrection<<std::endl;
```

- Run reconstruction with calibration:
  - An example of fcl to run pandoracali, pandoracalipid, pandoracaliSCE, pandoracalipidSCE only is available at:
    - /dune/data/users/wwu/protodune/calibration/validation/protoDUNE_mc_sce_on_reco_with_calibration.fcl
- Check the output and compare that with what are stored in database:

plane = 0 x = -368.08 y = 465.801 z = 549.296 normcorrection = 1.59 xcorrection = 0 yzcorrection = 1.005

plane = 0 x = -368.121 y = 466.271 z = 549.167 normcorrection = 1.59 xcorrection = 0 yzcorrection = 1.005

plane = 2 x = 11.6197 y = 459.299 z = 25.3109 normcorrection = 0.9947 xcorrection = 1.01892 yzcorrection = 1.00531

plane = 2 x = 11.6444 y = 459.728 z = 25.3671 normcorrection = 0.9947 xcorrection = 1.01892 yzcorrection = 1.00531

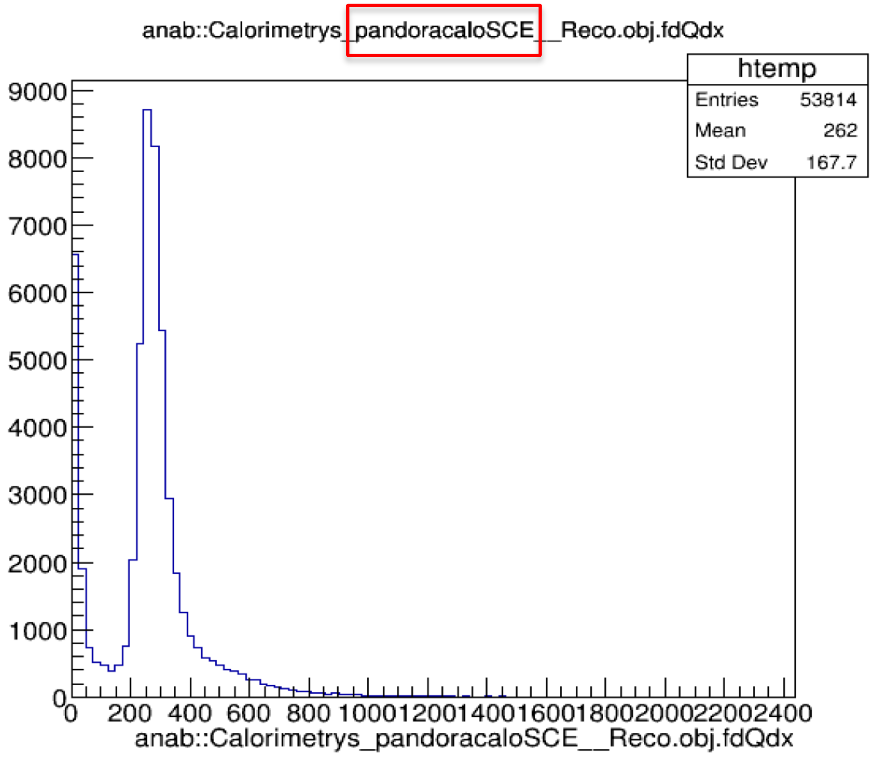
plane = 1 x = 11.6196 y = 459.297 z = 25.3107 normcorrection = 1.59 xcorrection = 1.0109 yzcorrection = 1.00545

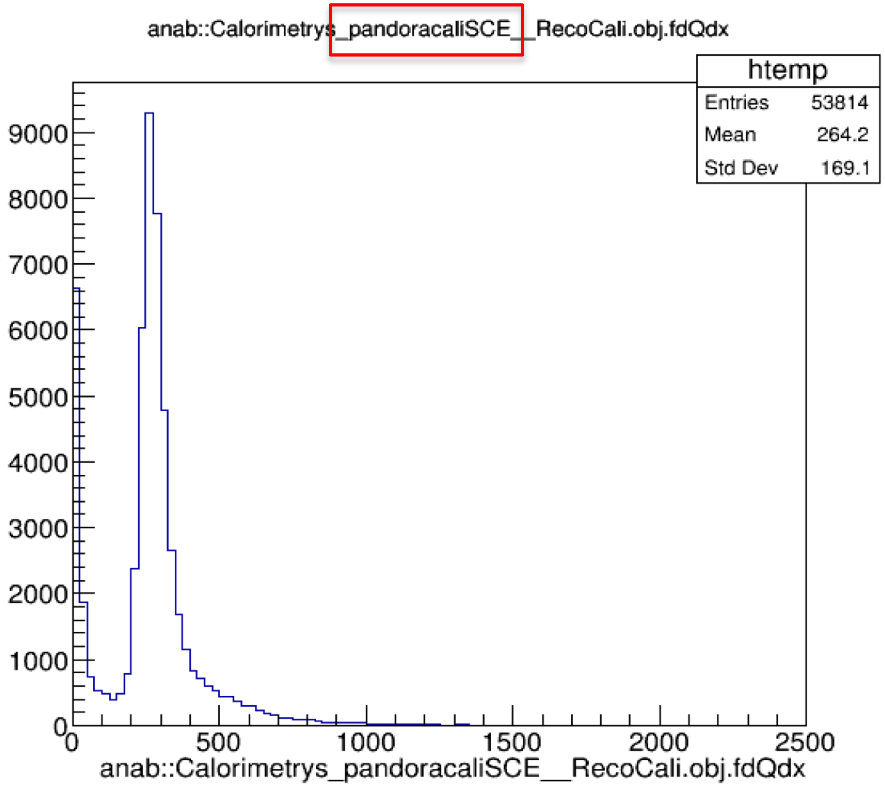
plane = 1 x = 11.6669 y = 460.119 z = 25.4183 normcorrection = 1.59 xcorrection = 1.0109 yzcorrection = 1.00545

Agree with values in database!

Validation of dQ/dx calibration using MC SCE ON sample

Check one event: pandoracaloSCE vs pandoracaliSCE





PandoracaliSCE uses the corrections from database.

Validation of dQ/dx calibration using MC SCE ON sample

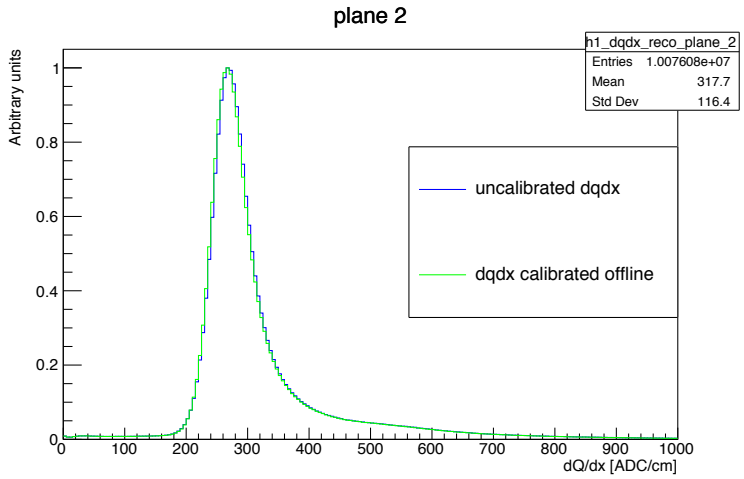
- Check the dQ/dx and dE/dx distribution:
  - We will compare the uncalibrated, offline-calibrated, and pandoracaliSCE-calibrated dQ/dx and dE/dx distribution.
  - For the offline-calibrated dQ/dx, the correction factors from the files that are used for generating database tables (here, v2.1).

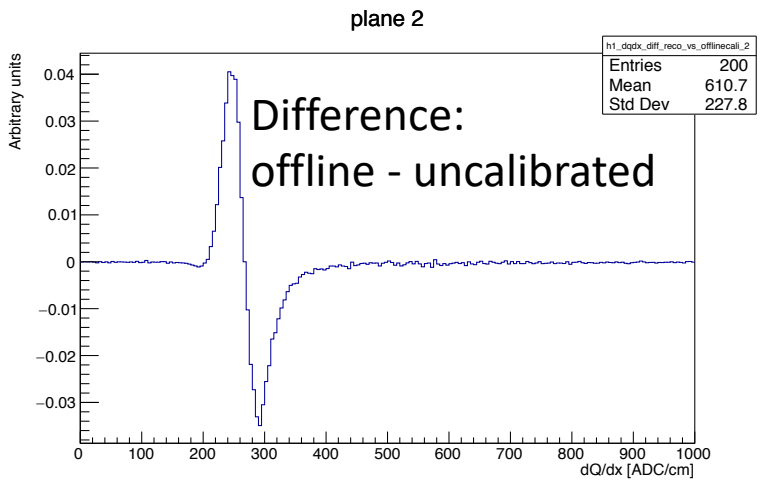
- Samples (~5000 events for each):
  - pandoracaloSCE:
    - /dune/data/users/wwu/protodune/calibration/dqdx/mc_sce_on/pandoracaloSCE/pandoracaloSCE_michelremoving_20191217.root
  - pandoracaliSCE:
    - /dune/data/users/wwu/protodune/calibration/dqdx/mc_sce_on/pandoracaliSCE/pandoracaliSCE_michelremoving_20191216.root

- The following slides show only plots from through-going muons with plane 2. Plane 0 and plane 1 have similar features.

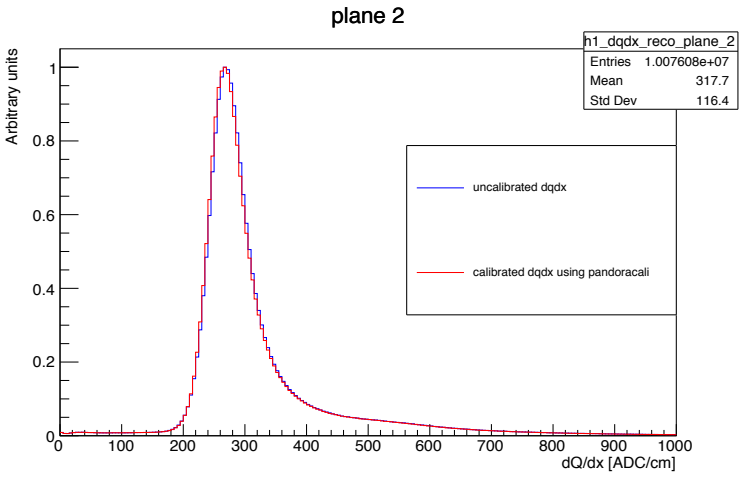
Validation of dQ/dx calibration using MC SCE ON sample

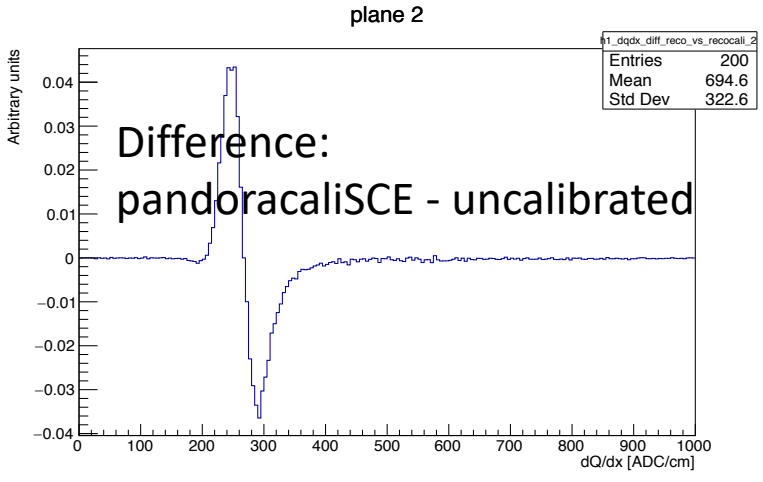
dQ/dx: uncalibrated vs offline





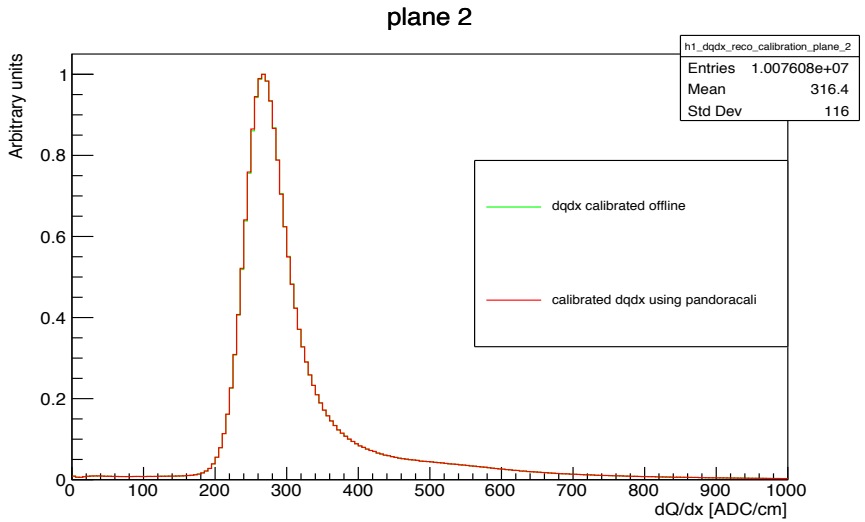
dQ/dx: uncalibrated vs pandoracaliSCE



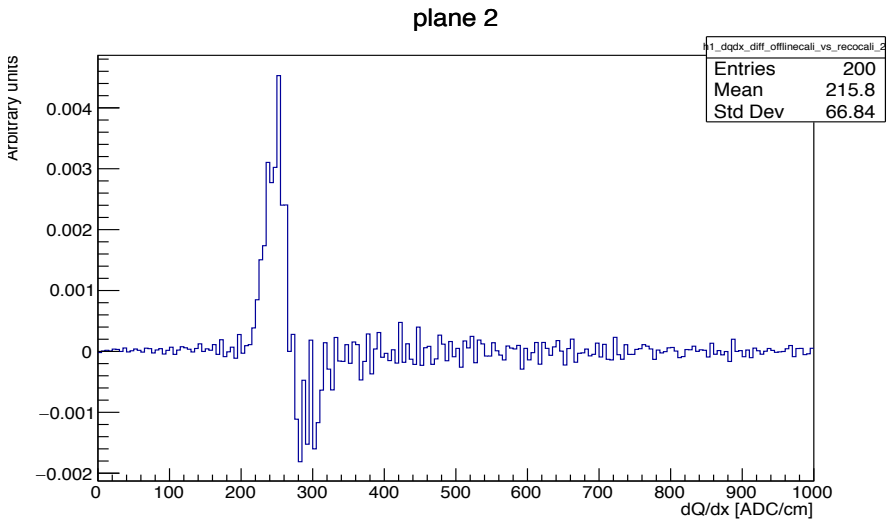


Validation of dQ/dx calibration using MC SCE ON sample

dQ/dx: offline vs pandoracaliSCE

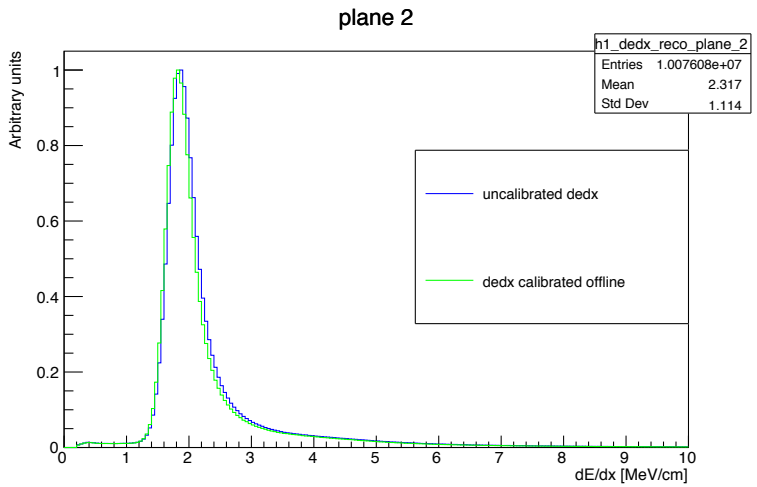


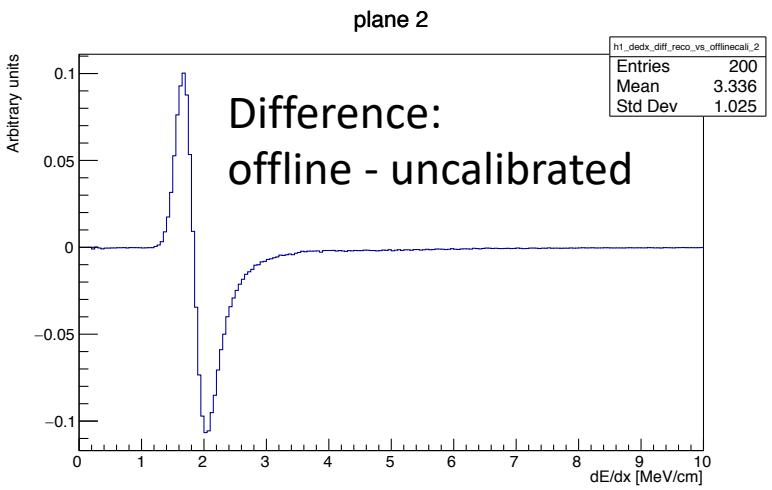
Difference:
pandoracaliSCE - uncalibrated



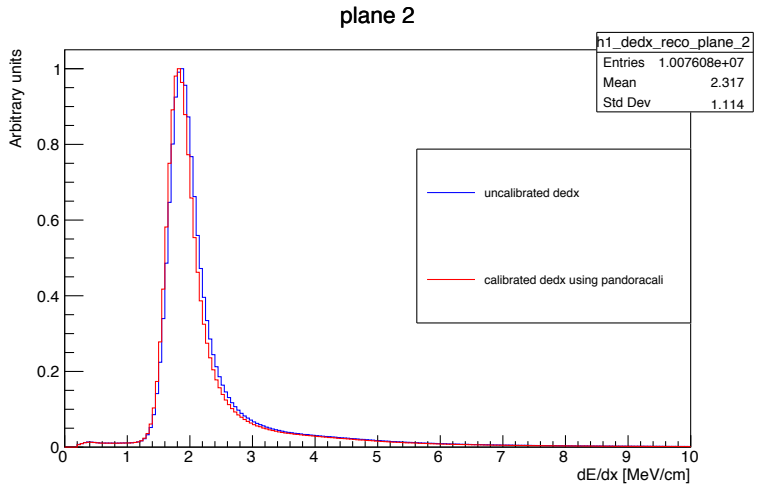
Validation of dQ/dx calibration using MC SCE ON sample

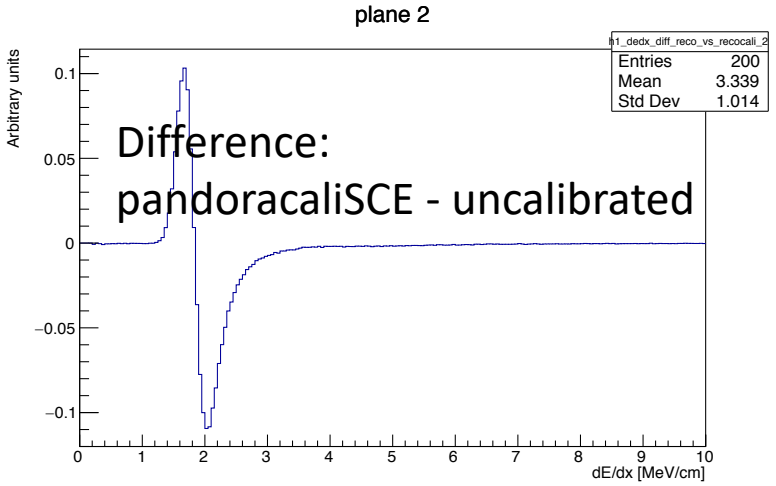
dE/dx: uncalibrated vs offline





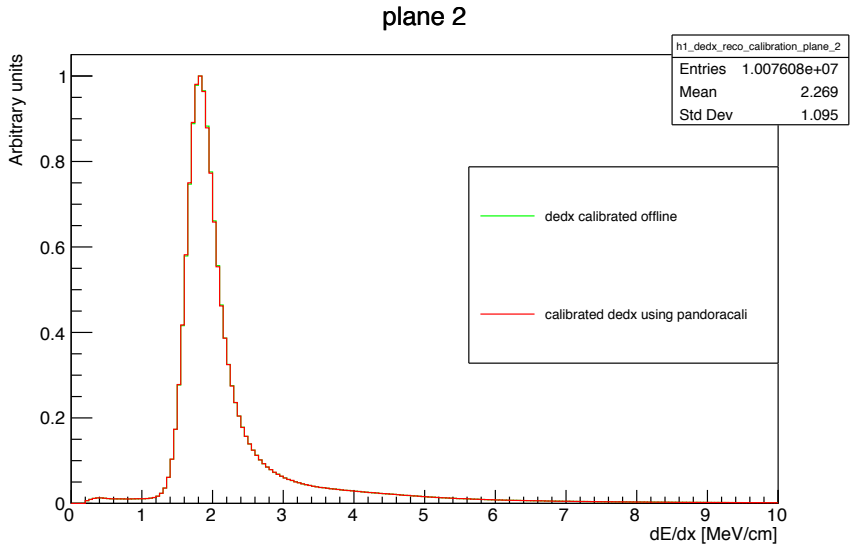
dE/dx: uncalibrated vs pandoracaliSCE



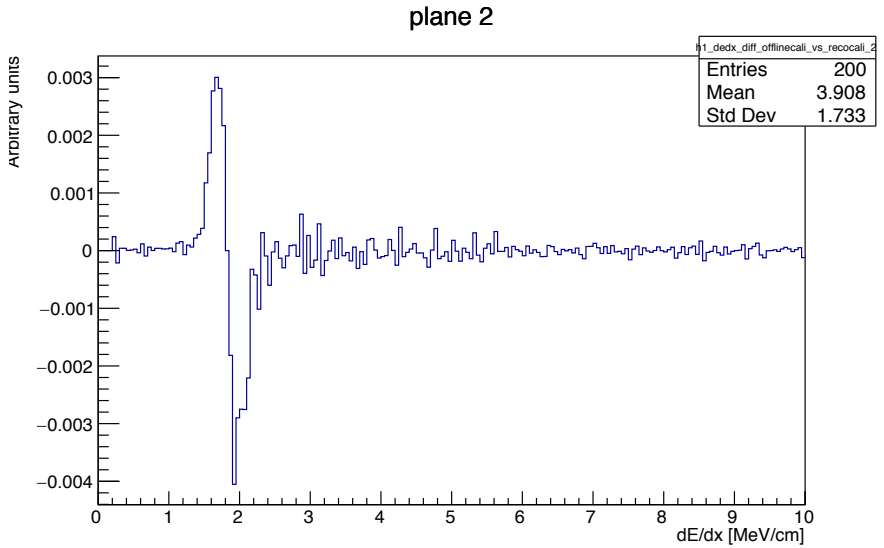


Validation of dQ/dx calibration using MC SCE ON sample

dE/dx: offline vs pandoracaliSCE



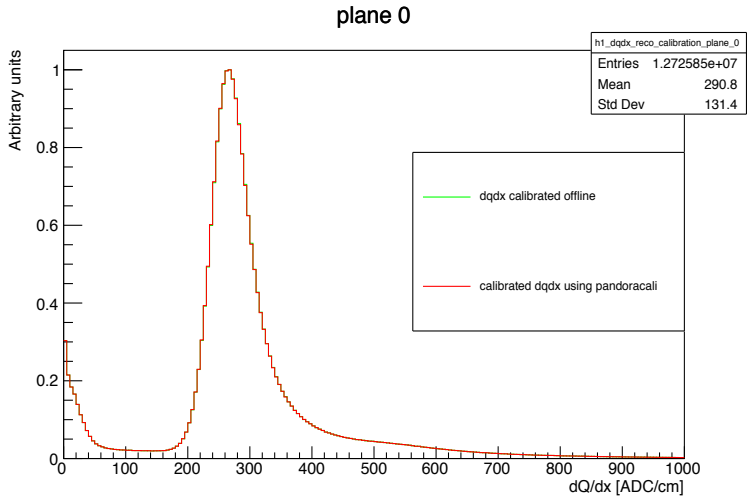
Difference:
pandoracaliSCE - uncalibrated

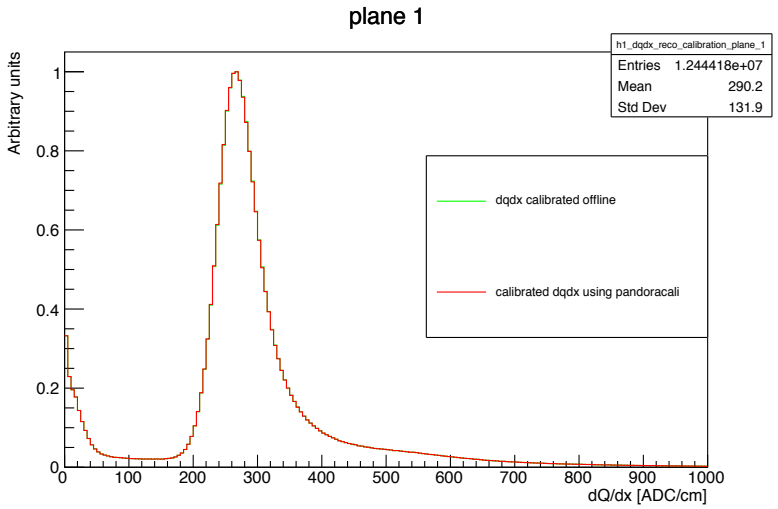


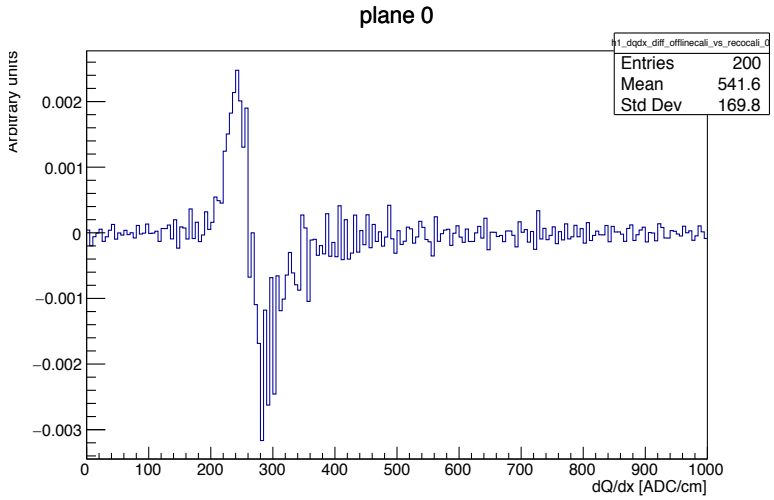
Summary

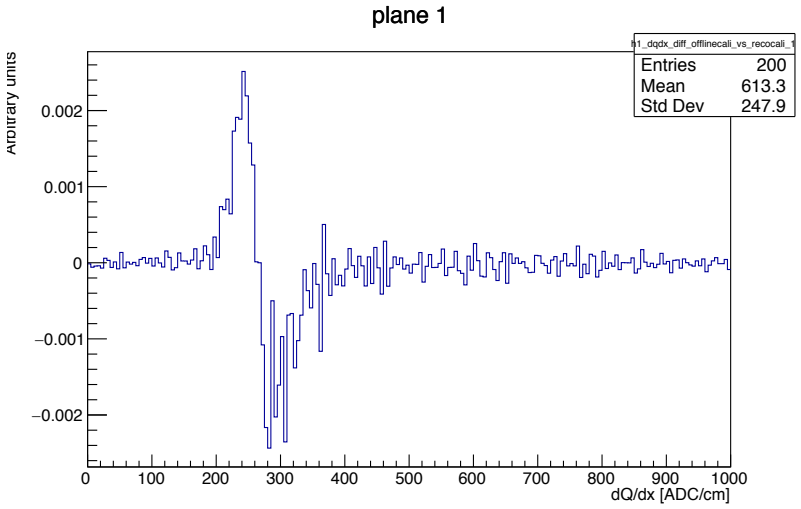
- The above validations show that ProtoDUNE dQ/dx calibration database can be accessed through the database providers successfully.

Backup

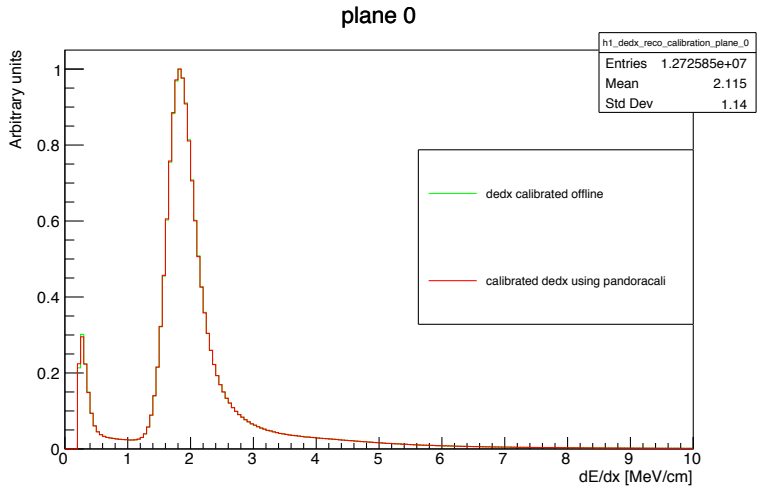

plane 0
h1_dqdx_reco_calibration_plane_0
Entries 1.272585e+07
Mean 290.8
Std Dev 131.4
dqdx calibrated offline
calibrated dqdx using pandoracali
Arbitrary units
dQ/dx [ADC/cm]

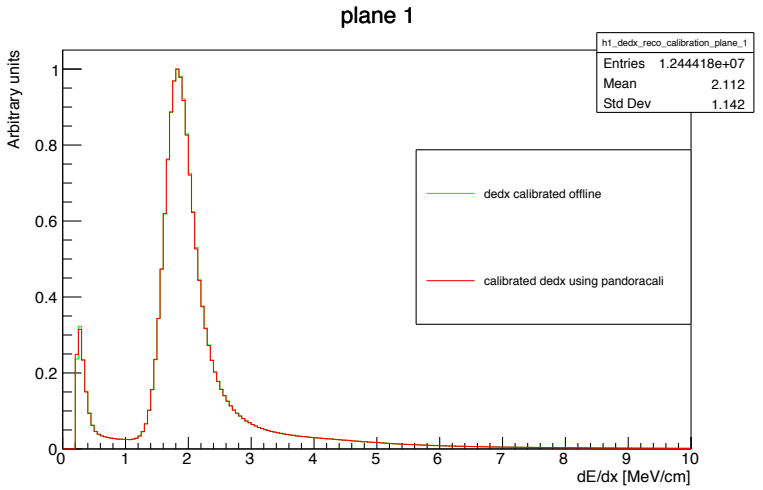

plane 1
h1_dqdx_reco_calibration_plane_1
Entries 1.244418e+07
Mean 290.2
Std Dev 131.9
dqdx calibrated offline
calibrated dqdx using pandoracali
Arbitrary units
dQ/dx [ADC/cm]

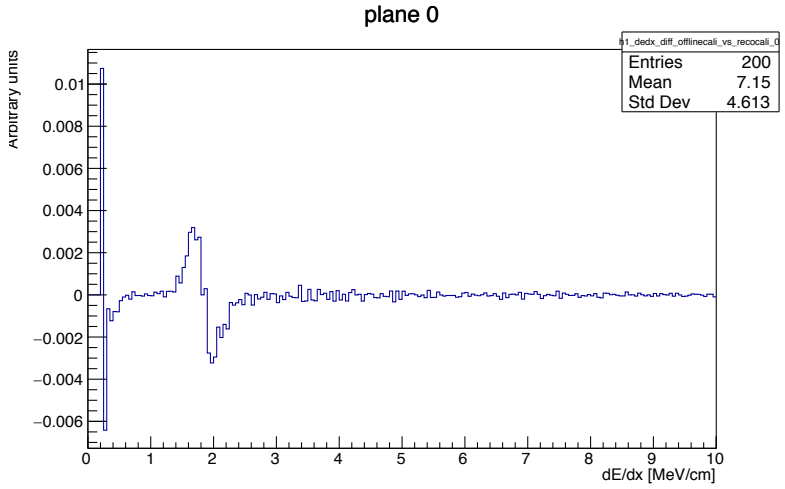

plane 0
h1_dqdx_diff_offlinecali_vs_recocali_0
Entries 200
Mean 541.6
Std Dev 169.8
Arbitrary units
dQ/dx [ADC/cm]

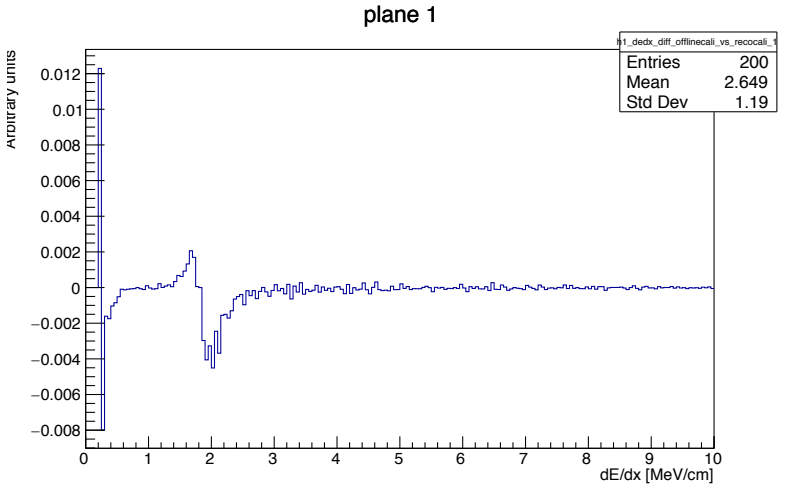

plane 1
h1_dqdx_diff_offlinecali_vs_recocali_1
Entries 200
Mean 613.3
Std Dev 247.9
Arbitrary units
dQ/dx [ADC/cm]

Backup


plane 0
h1_dedx_reco_calibration_plane_0
Entries 1.272585e+07
Mean 2.115
Std Dev 1.14
dedx calibrated offline
calibrated dedx using pandoracali
Arbitrary units
dE/dx [MeV/cm]


plane 1
h1_dedx_reco_calibration_plane_1
Entries 1.244418e+07
Mean 2.112
Std Dev 1.142
dedx calibrated offline
calibrated dedx using pandoracali
Arbitrary units
dE/dx [MeV/cm]


plane 0
Entries 200
Mean 7.15
Std Dev 4.613
Arbitrary units
dE/dx [MeV/cm]


plane 1
Entries 200
Mean 2.649
Std Dev 1.19
Arbitrary units
dE/dx [MeV/cm]