

ProtoDUNE-SP charge calibration scale

ProtoDUNE-SP sim/RECO

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Introduction

One topic today: calibration scale

- Similar talk given at July 8 meeting of this group
- No comments and no action taken then
- Now will act if there are no objections

Current calibration

Original pulser calibration is documented

- DUNE-doc-15523
- Based on Dec 2018 pulser dataset
- Injection capacitance assumed to be 183 fF

December 2019 update

- See my talk at Dec 11 meeting of this group (DRA)
- Fixed bug that was truncating area measurements
 - Shifted mean scale up by 0.4%. Mean gain is 23.5 e/ADC.
- Good agreement with May and Nov 2019 datasets
 - Still want to compare with July 2020 dataset
- This is the current calibration

Dataprep

- Calibration is applied early and most of dataprep is done at the calibrated scale: tail removal, CNR, ...
- Only output (now) is recob::Wire for wirecell at a different scale →

Connection to wirecell

Dataprep output for wirecell

- Wirecell wants recob::Wire output at approximate ADC scale
- Dataprep signals are scaled by a common factor before output
 - Originally 0.040 so units were 40 e instead of 1 ke
 - Wenqiang/Tingjun changed this to be closer to the mean gain
 - But that changes as we update the calibration
 - In principle this could change run to run although so far we have used the same calibration for all runs

Dataprep output for others

- Not yet available but easy to add
- With dataprep scale, user simply sums signals in a pulse to get the total collect charge in ke
 - For collection wires
- Dataprep has tools to deconvolute induction (and collection) signals
 - But not (yet) the 2D wirecell deconvolution

New calibration scale

There are a couple known issues with the current calibration

- The BNL CE group has a new and presumably better measurement of the injection capacitance
- Not all charge on wire is seen by the FE amplifier
 - Due to capacitive coupling to
 - Wires and traces in the same plane
 - Wires and traces in other planes

Injection capacitance

Cold CE group showed new charge injection parameters

- May 26 presentation at meeting on charge injection
 - https://indico.fnal.gov/event/43483/contributions/186922/attachments/128664/155790/Calibration_Pulse_V4_2.pdf
- Change in the charge injection capacitance:
 - $183 \rightarrow (187.8 \pm 1.4) \text{ fF}$
 - Using the nominal resistors for DAC setting 7, the step size changes:
 - $3.448 \rightarrow 3.539 \text{ fC}/(\text{DAC step})$
 - 2.6% increase in the calibrated charge

Charge sharing

Charge sharing between CE and wire planes is also important

- See my talk at the May 26 meeting:
 - https://indico.fnal.gov/event/43483/contributions/186928/attachments/128665/155791/adams_duneci_20200526_pdcplib.pdf
- Scale up calibrated charge to account for signal lost to wire planes
- From that talk:

View	C _{wire} [pF]	C _{amp} [nF]	Q _{lost} /Q	Q/Q _{cal}	Revised Q/Q _{cal}
u	200	3.31	5.7%	1.060	1.025
v	200	22.0	0.9%	1.009	1.004
x	150	3.31	4.3%	1.045	1.020

- But some (about half?) of the capacitance is to wires in the same plane and we don't want to double count that contribution when we integrate over multiple wires
 - My guesses at the corrections to use are shown in the box on the right

Dataprep modification

The following changes proposed for dataprep

- Start with current calibration.
- Immediately apply correction factor depending on wire plane type:
 - u: 1.052
 - v: 1.030
 - x: 1.047
- Run the bulk of dataprep at the new scale(s)
- Rescale for output to recob::Wire.
 - Need to choose a unit:
 - 1 ke: No scaling needed.
 - 40 e: Old scaling factor of 0.040. Approximately 1 ADC count.
 - 200 e: Traditional for recob::Wire (right?).
 - Some other value specified by wirecell group.