Update on the electronics calibration factor

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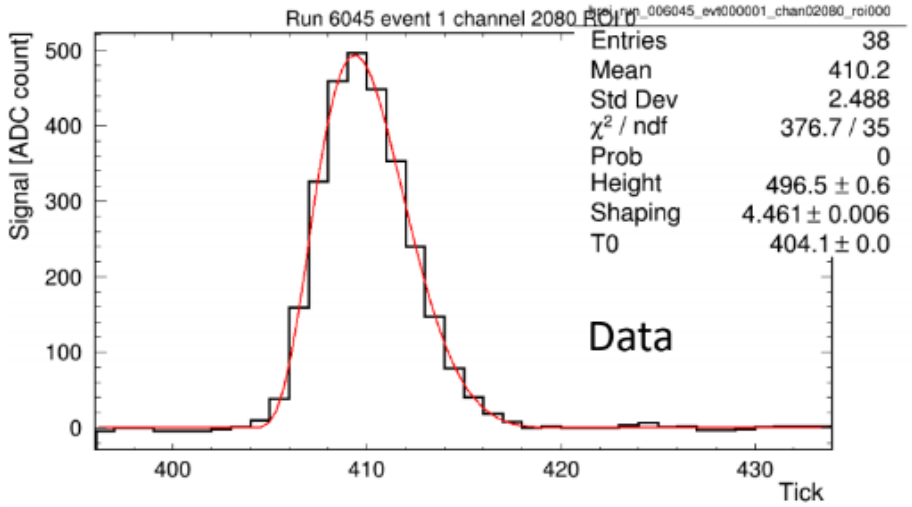
To document the essential changes in the reco chain

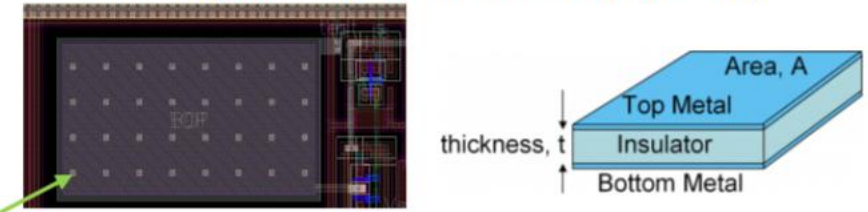
Charge injection capacitor

- Pulser calibration indicates an electronics gain of 23.4e/(ADC*tick) assuming 183 fF for the injection capacitor
- While it is 187.8fF in LN2, we think the number should be similar in LAr
- So we would like to update the electronics gain
  - $\frac{23.4\ \mathrm{e}}{\mathrm{ADC{*}tick}} \times \frac{187.8\ \mathrm{fF}}{183\ \mathrm{fF}} \approx 24.01\ \mathrm{e/(ADC{*}tick)}$



@D. Adam, pulser calibration

- **P2 FE ASIC**
  - RT: 186.8 +/- 1.6 fF
  - LN2: 187.8 +/- 1.4 fF
- Integrated injection capacitance
  - **MIM Capacitor (Metal-Insulator-Metal)**



@S. Gao, special meeting on charge injection calibration, https://indico.fnal.gov/event/43483/

Updates in the reco chain (I)

- DataPrep module for “denoised” waveform output

```
# Drop ROIs, scale back to ADC and zero bad/noisy channels for wirecell processing.
protodune_dataprep_tools_wirecell: [
 "digitReader",            # Read RawDigit
 "pdsp_sticky_codes_ped",     # Flag sticky codes
 "pd_adcPedestalFit",        # Find pedestal
 "adcSampleCalibration",      # Subtract pedestal and apply charge calibration
 "pdsp_adcMitigate",         # Mitigate sticky codes
 "pdsp_timingMitigate",       # Mitigate FEMB302 timing
 "adcCorrectUndershootKe",    # correct undershoot
 "pdsp_noiseRemovalKe"        # Remove high frequency noise and coherent noise
 "adcKeepAllSignalFinder",    # Keep all signal (no ROIs)
 "adcScaleKeToAdc",          # Scale samples to nominal ADC counts
 "pdsp_RemoveBadChannels"     # Set bad channels to 0 ADC
]
```

```
adcSampleCalibration calibrates ADC counts to ke.
adcScaleKeToAdc scales ke to ADC counts
# Scale samples from ke to ADC count.
tools.adcScaleKeToAdc: {
  tool_type: AdcSampleScaler
  LogLevel: 1
  ScaleFactor: 40.0 [(ADC count*tick)/ke]
  OutputUnit: "ADC count"
  InputUnit: "ke/tick"
}
```

*Nominal gain: 25 e/(ADC*tick)*

- To keep a consistent output in ADC, we suggest changing the output gain according to 24.01 e/(ADC*tick)

```
# Scale ke to ADC, protodune_dataprep_tools.fcl
tools.adcScaleKeToAdc.ScaleFactor: 41.649 # 24.01 e/ADC/ticks
```

Updates in the reco chain (II)

- WireCell configuration for simulation
- WireCell configuration for charge deconvolution
- We use a common electronics factor for both case, previously assuming 23.4 e/(ADC*tick)
- We suggest an update according to 24.01 e/(ADC*tick)

```
// dunetpc/dune/DUNEWireCell/pdsp/params.jsonnet
postgain: 1.166, // pulser calibration: 42.735 ADC*tick/1ke
                 // theoretical elec resp (14mV/fC): 36.6475 ADC*tick/1ke
shaping: 2.2 * wc.us,
```

Gain 23.4e/(ADC*tick)

https://indico.fnal.gov/event/43368/contributions/186122/attachments/128481/155468/electronics_response.pdf