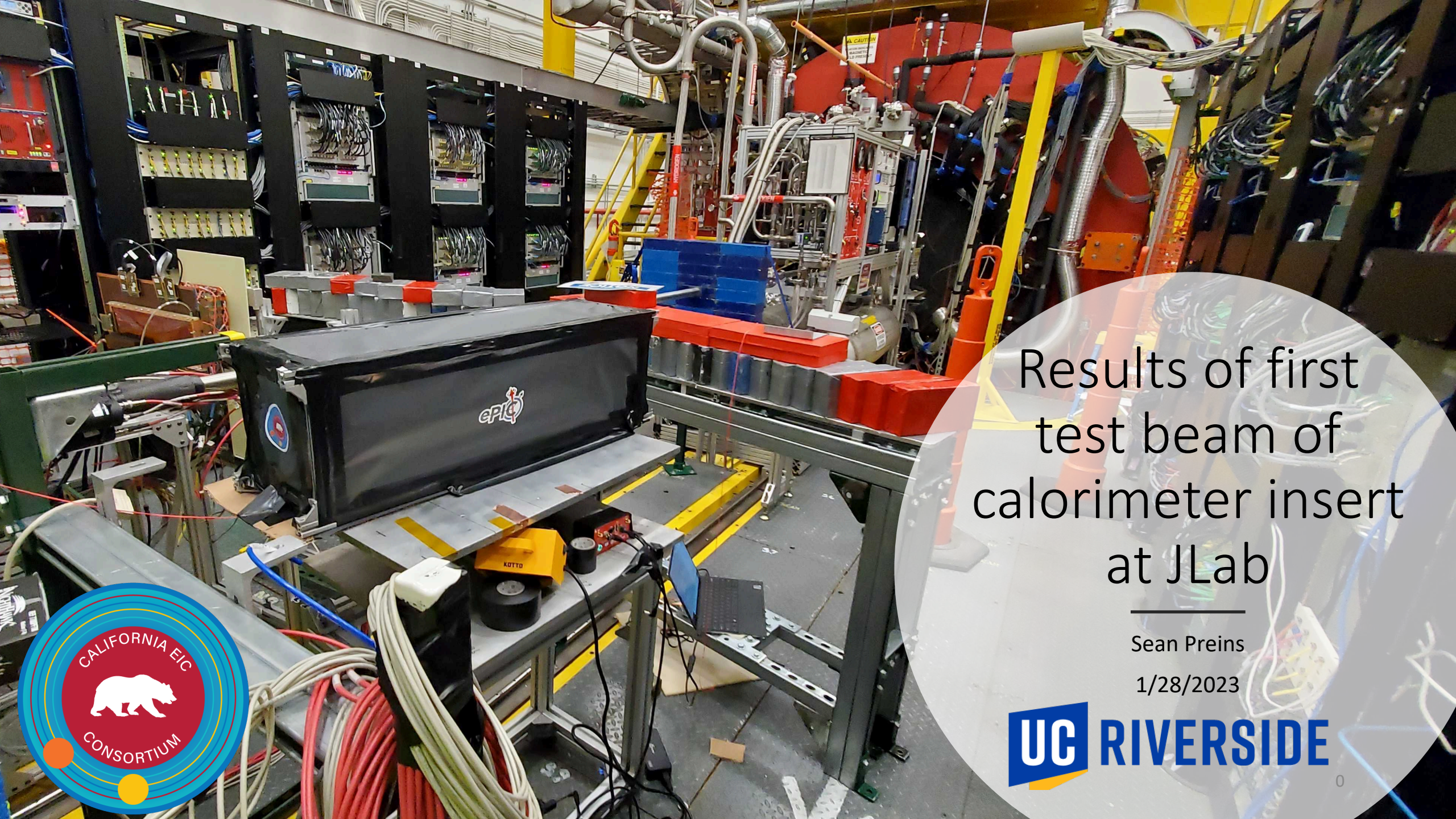


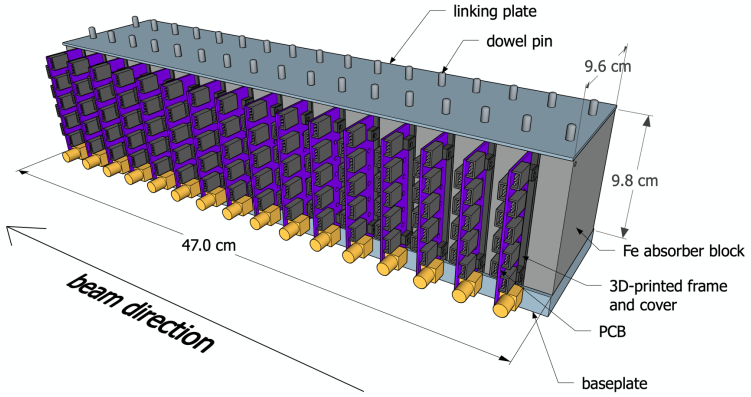
Results of first test beam of calorimeter insert at JLab

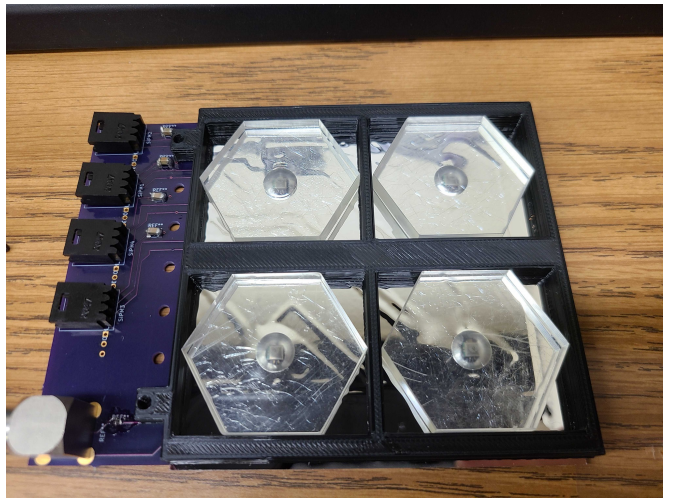
Sean Preins

1/28/2023

Operating Prototype Specs

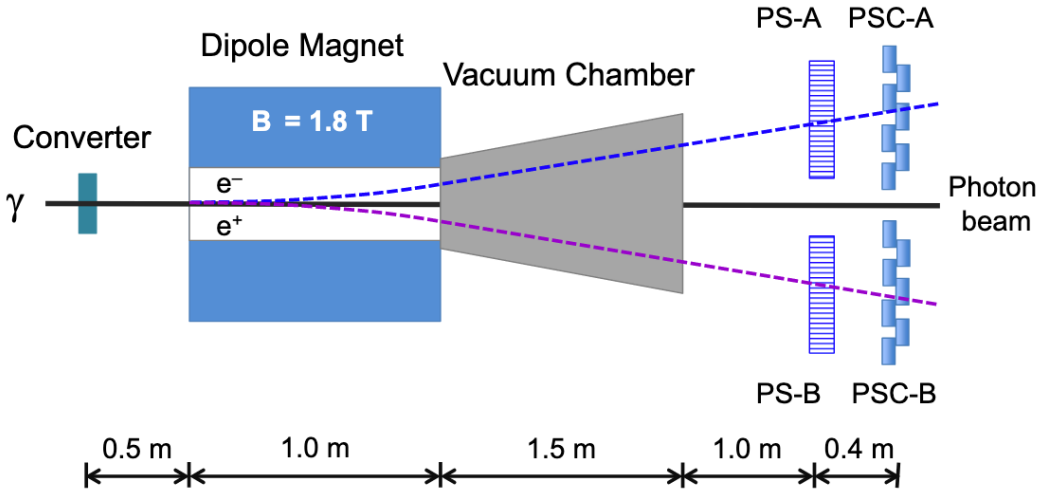
- Characterize components, work as proof of concept
- Consists of 10 layers, each subdivided into four scintillating tile cells (40 channels)
- Effectively 11.4 radiation lengths long
- Cross sectional area of 2x2 Moliere radii



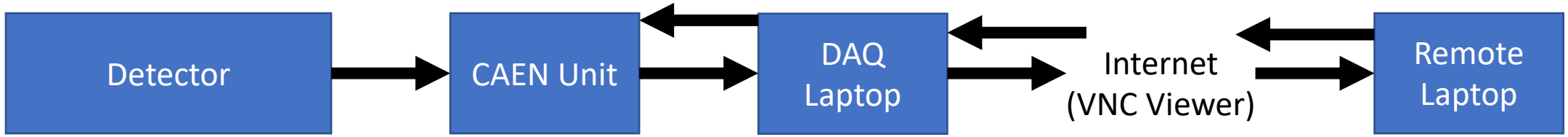


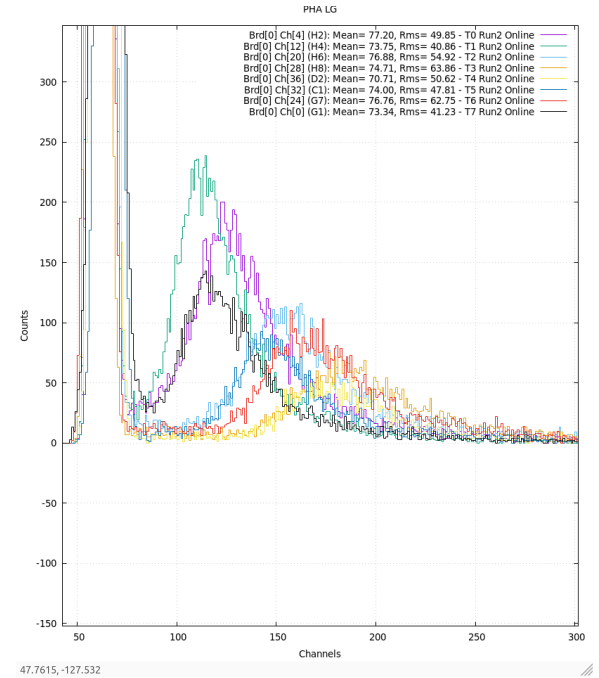
Hall D Beam Characteristics

- The prototype is situated in front of the Hall D pair spectrometer, off the beamline
- It receives ~4 GeV positrons at a variable luminosity (maximum of ~3 kHz)
- Coordinating with GlueX to synchronize data acquisition with a beam rate scan



DAQ Setup


Detector
CAEN Unit
DAQ Laptop
Internet (VNC Viewer)
Remote Laptop


PHA LG
Brd[0] Ch[4] (H2): Mean= 77.20, Rms= 49.85 - T0 Run2 Online
Brd[0] Ch[12] (H4): Mean= 73.75, Rms= 40.86 - T1 Run2 Online
Brd[0] Ch[20] (H6): Mean= 76.88, Rms= 54.92 - T2 Run2 Online
Brd[0] Ch[28] (H8): Mean= 74.71, Rms= 63.86 - T3 Run2 Online
Brd[0] Ch[36] (D2): Mean= 70.71, Rms= 50.62 - T4 Run2 Online
Brd[0] Ch[32] (C1): Mean= 74.00, Rms= 47.81 - T5 Run2 Online
Brd[0] Ch[24] (G7): Mean= 76.76, Rms= 62.75 - T6 Run2 Online
Brd[0] Ch[0] (G1): Mean= 73.34, Rms= 41.23 - T7 Run2 Online
Counts
Channels
300
250
200
150
100
50
0
-50
-100
-150
50
100
150
200
250
300
47.7615, -127.532

Data Acquisition Procedure

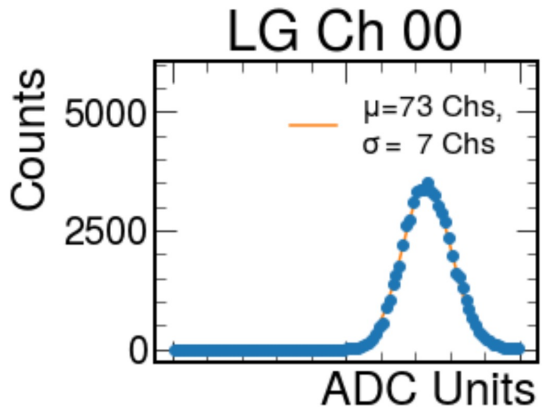
Decide on CAEN settings

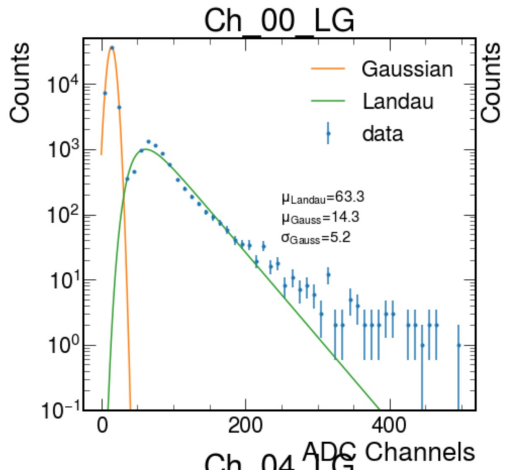
Record noise data from random triggers to determine the pedestal position and width for each channel

Apply pedestal cuts to all data going forward

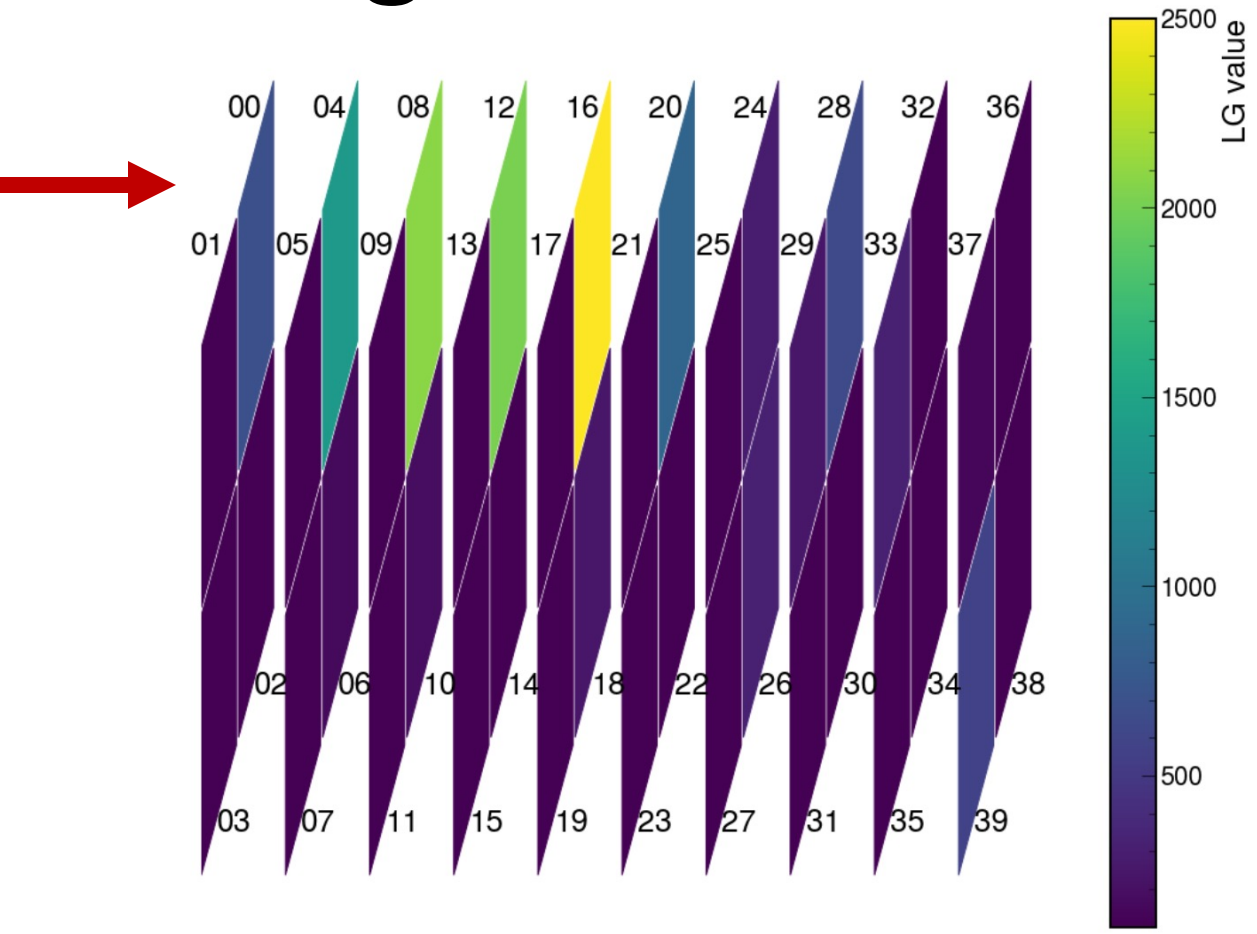
Record cosmic rays to determine how to convert between ADC Channels and MIPs

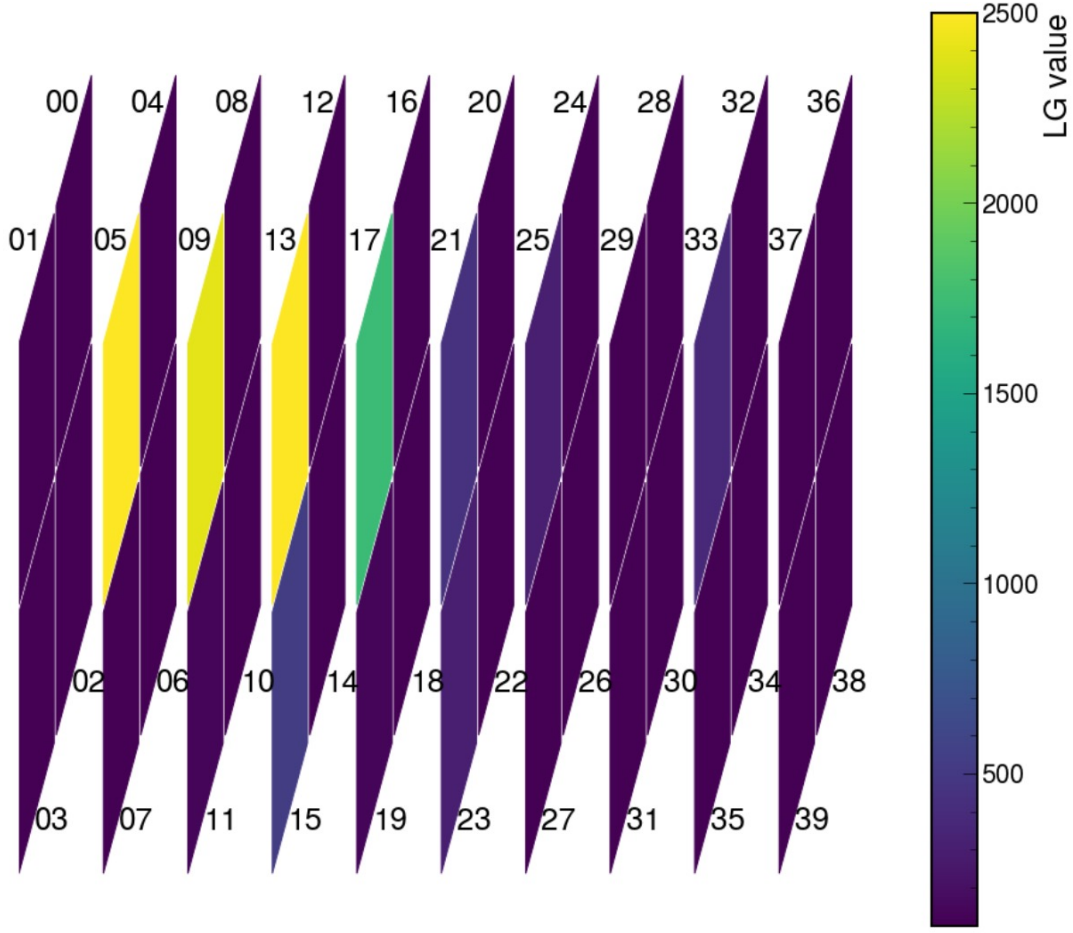
Record beam data, sum the total energy per event, and the layer-by-layer breakdown





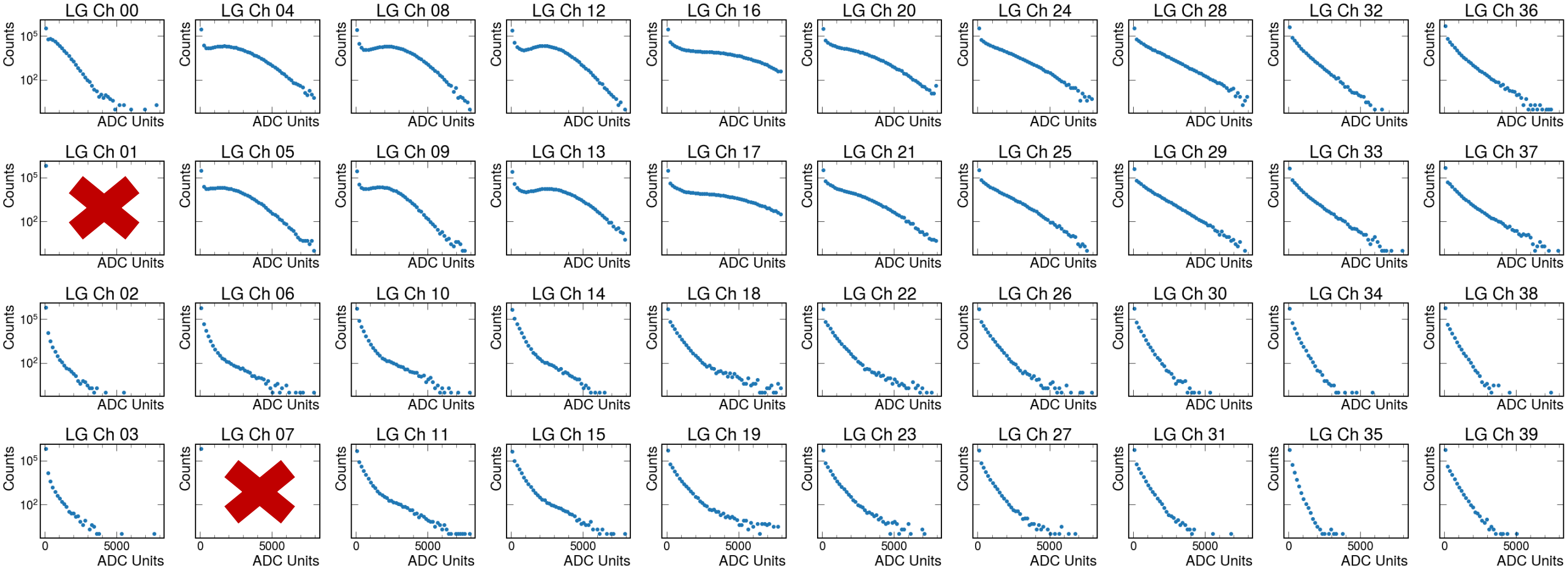
Single Events



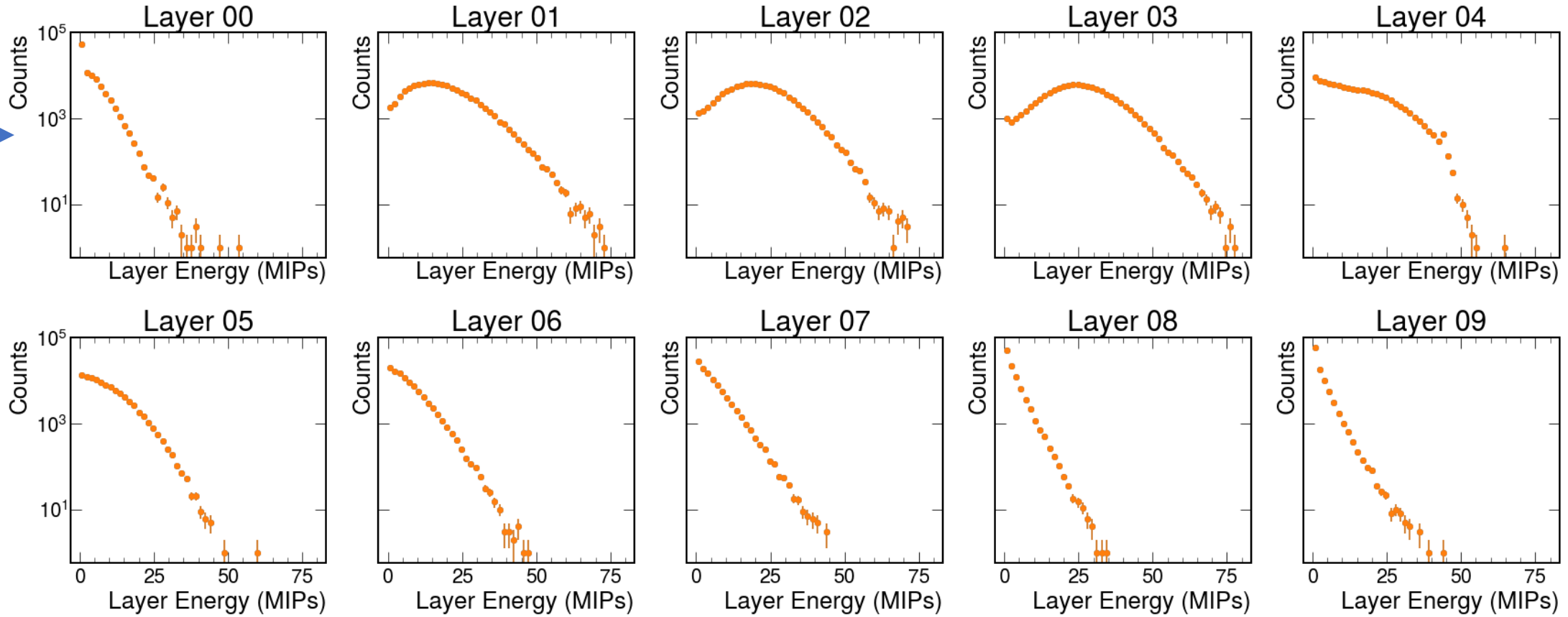


- We generally see only the top two rows show beam-like events
- Our detector was likely positioned slightly low relative to the beamline (can be adjusted)

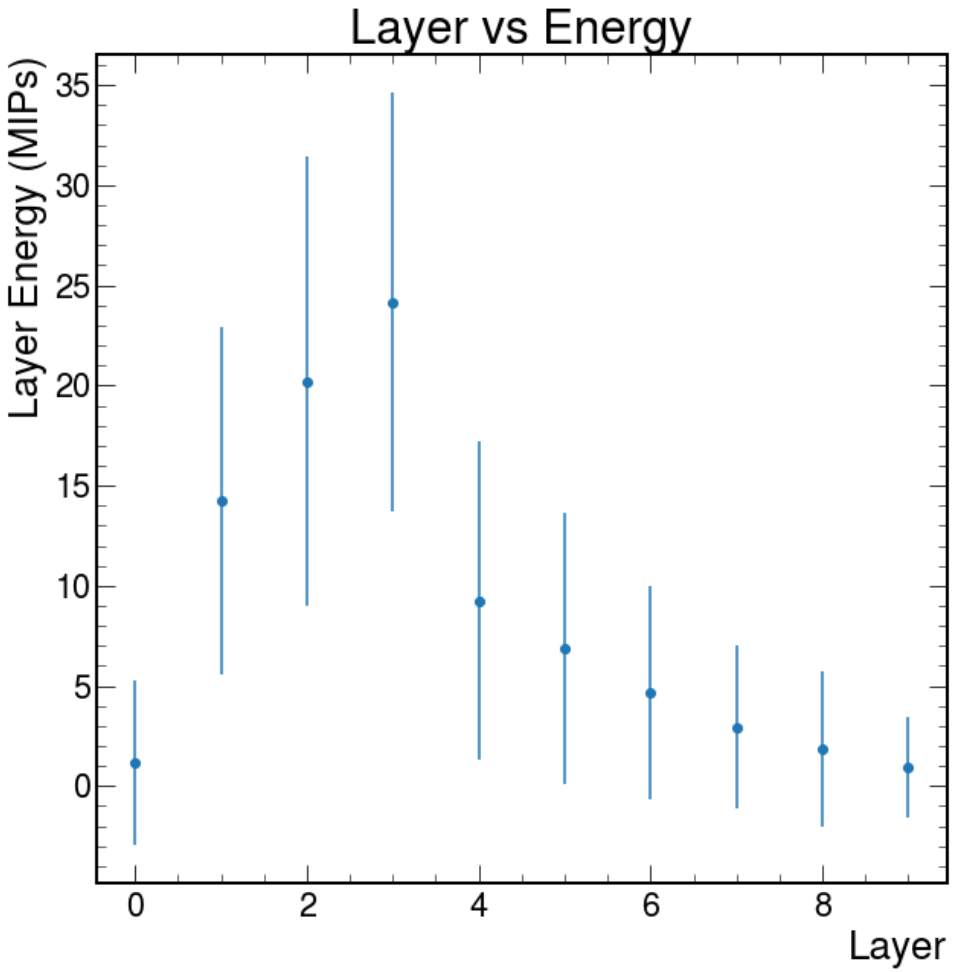
Channel Energy



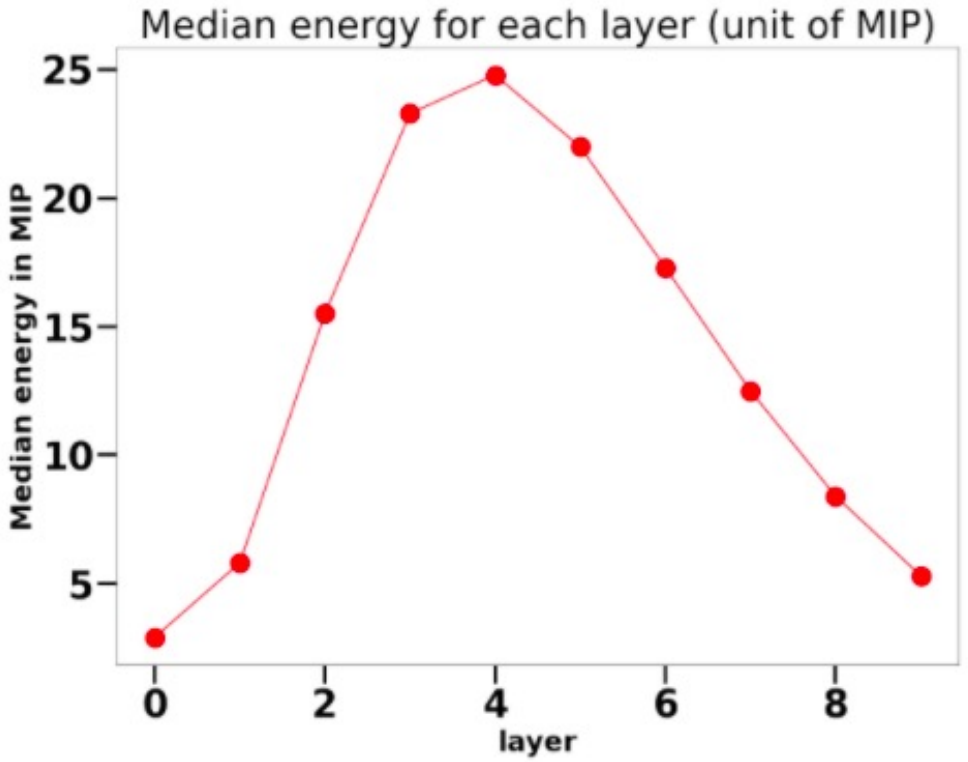
Layer Energy



Test Beam



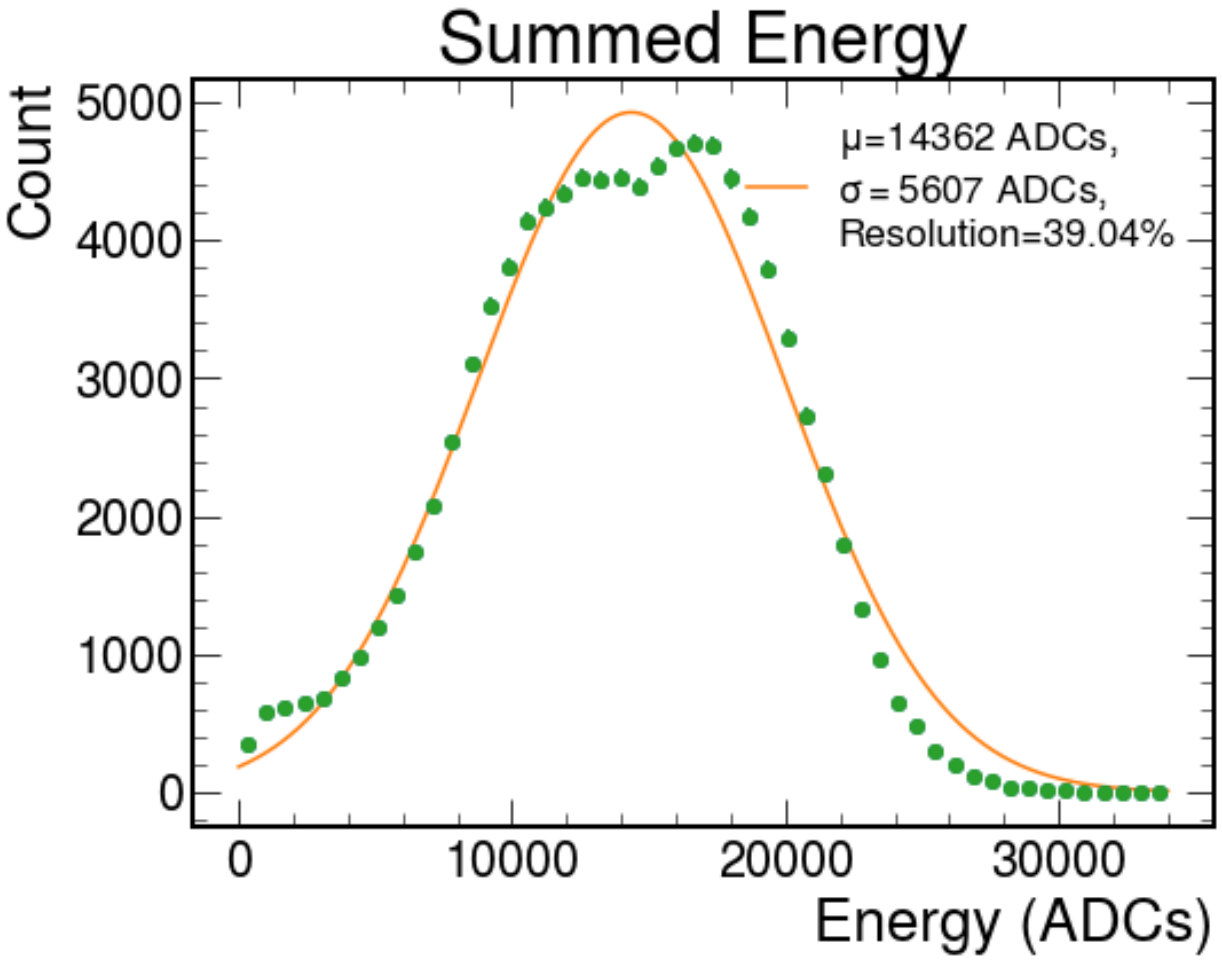
Simulation



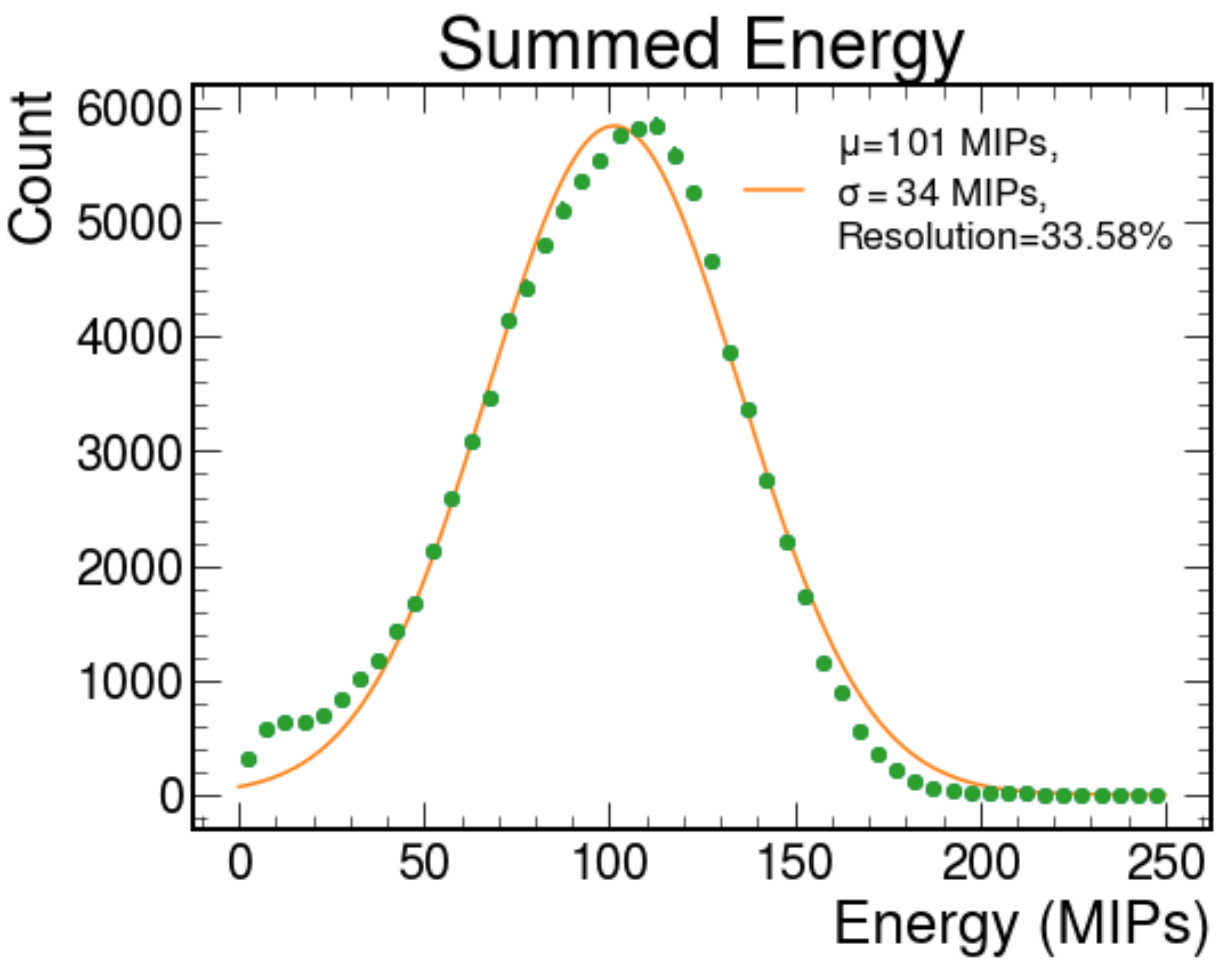
- The energy profile trend is promising, and will likely be improved
- The first four layers and last six use different cell shapes, which may explain the discontinuity

Total Energy

Uncalibrated



Calibrated



Calibrating each channel improves the energy resolution a significant amount, but there is room for improvement...

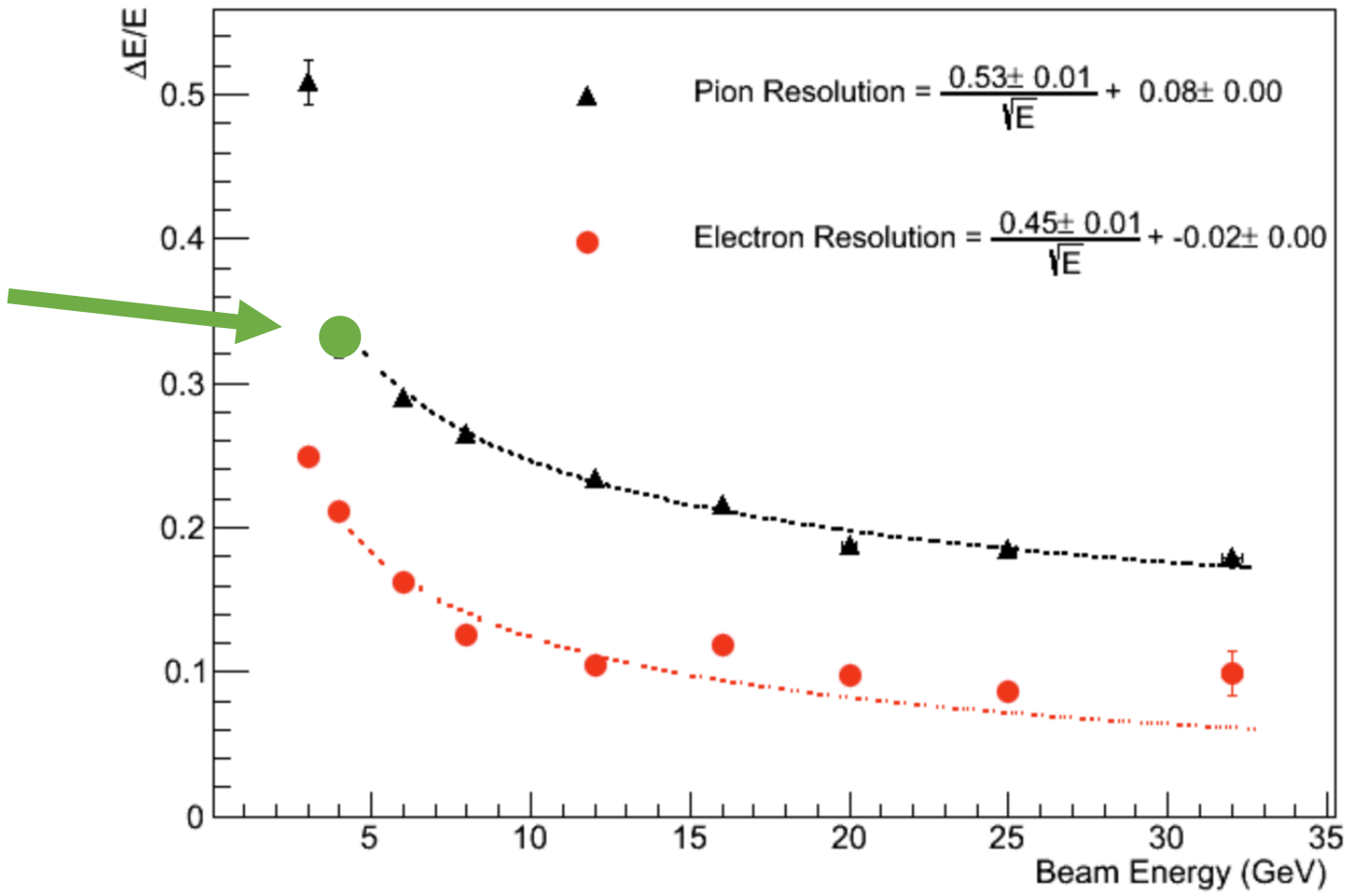
- Relatively poor electron resolution when compared with a recent UCLA Pb/Sc calorimeter test beam
- Several possible reasons, several fixes!

➢ Hexagonal cells have a large amount of dead space between them

➢ Many events may not be horizontally contained

➢ Scintillating tiles may not be optically ideal

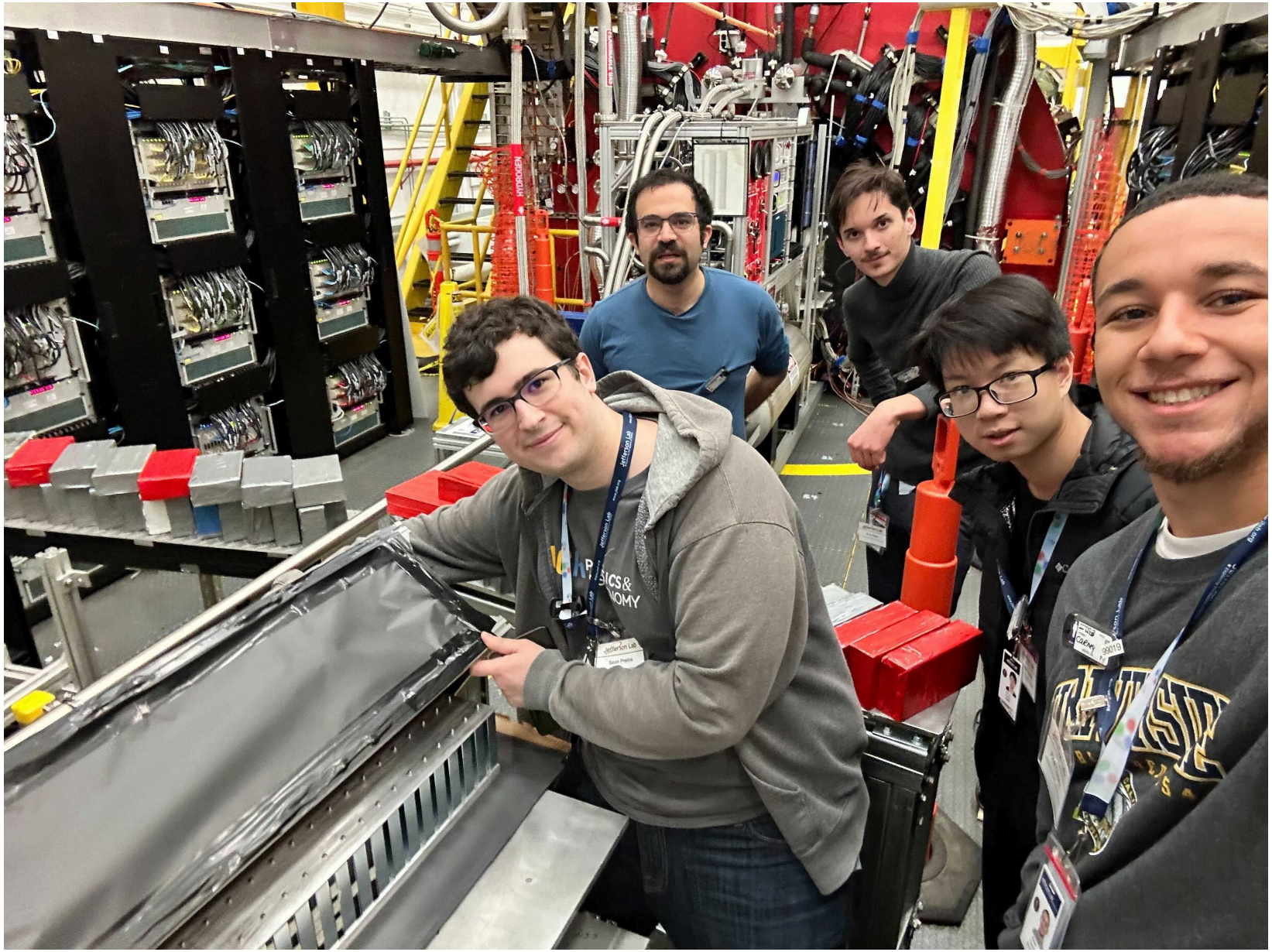
➢ MIP values may need recalibration in its current configuration



To Do

- Collect enough cosmic ray data during beam-off time to generate more accurate MIP values for each channel
- Continue to refine the CAEN settings to find the most appropriate gain and threshold settings for both beam and cosmic ray data
- Upgrade the prototype (add trigger layer, fix dead cells, add layers, increase granularity...)
- Continue to improve and characterize detector components (create more robust cables, investigate light yield from different cell shapes, etc.)
- Prepare for new test beams! Hall B, Fermilab, Brookhaven


NOTICE


Jefferson Lab