FCAL Calibration Strategy

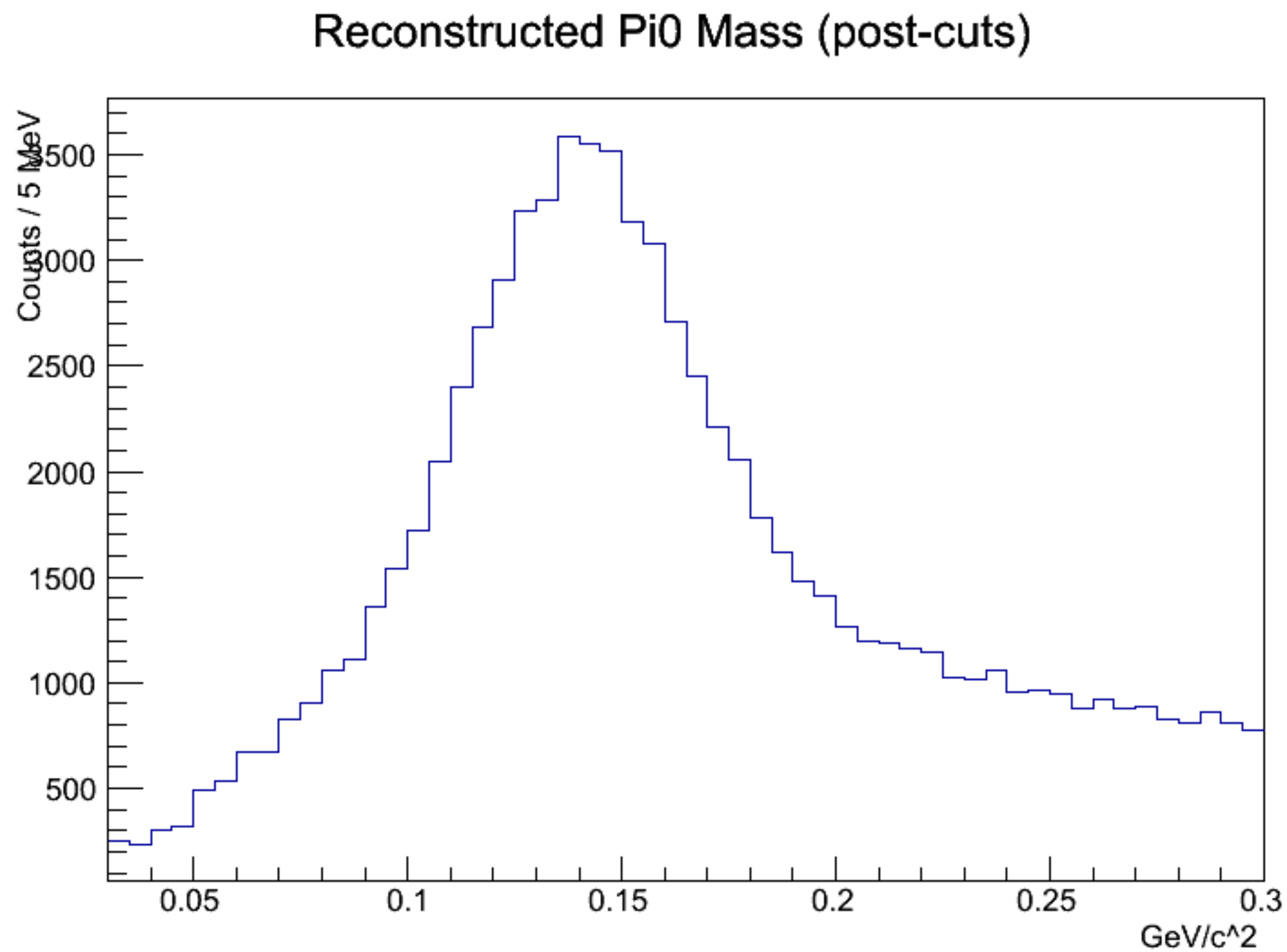
- Two leading order items to calibrate: time offsets and gain factors for each channel
- Global alignment: ignore for now
- Time offsets are HV dependent; HV will change with gain balancing
  - two-cluster resolution already good $\lesssim$ 5 ns
- Key focus: gain calibration (followed by subsequent hardware gain balancing)

Parallel Strategies

- Minimize width of π^0 using technique implemented in RadPhi (Jon)
  - latches onto statistical fluctuations in background
- Use the fact that E/p = 1 for electrons
  - code written by Matt, but having trouble finding electrons (again) in the two-track skim — bug or skim criteria?
- Use the LED monitoring system under the assumption that the response should be smooth (Adesh and Manuel)
  - preliminary result obtained: need to feed back into reconstruction and use π^0 width (or E/p) as a metric

π^0 Skim
(2-track skim; run > 1770)

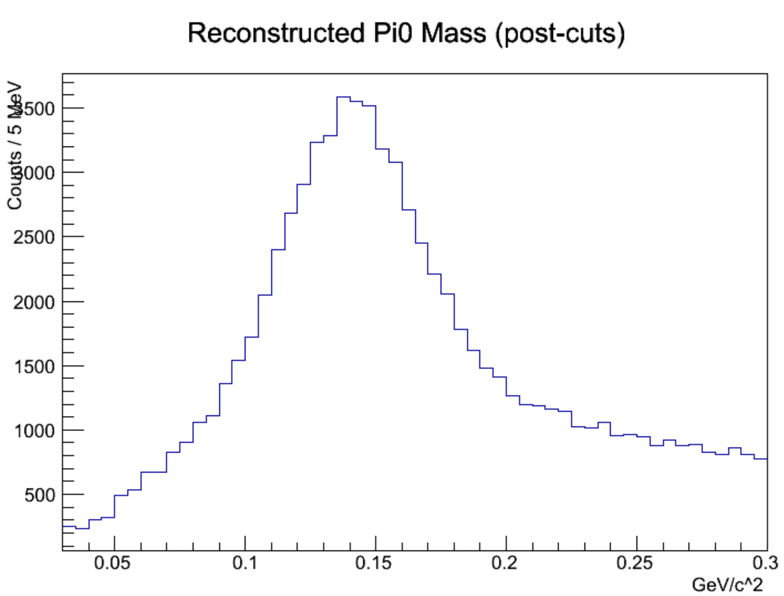
Before Gain Calibrations



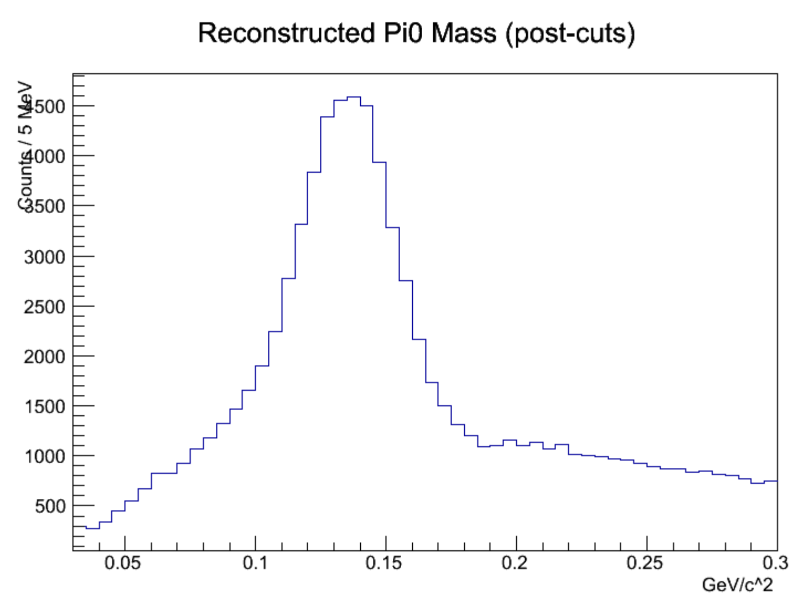
Iterative Adjustment of Gain Factors

Region of minimization: 100 MeV - 190 MeV

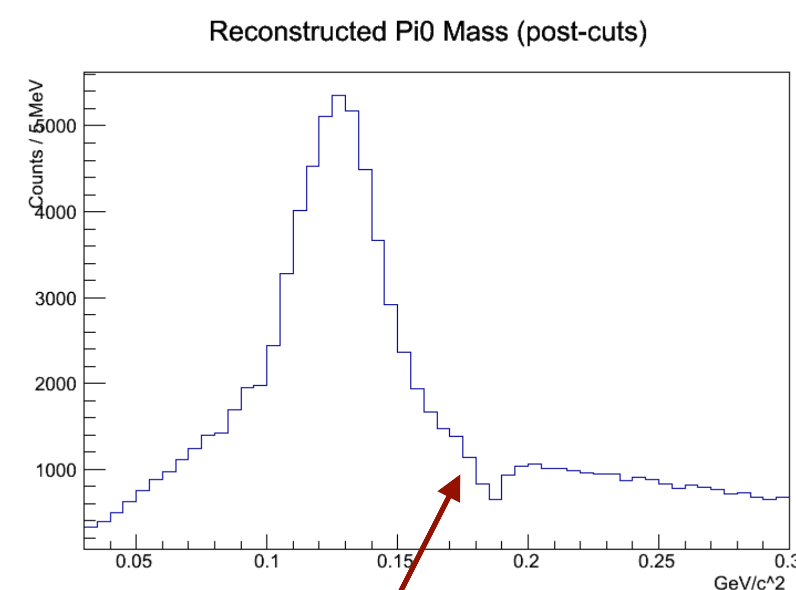
No Gain Balancing



After First Iteration



After Convergence

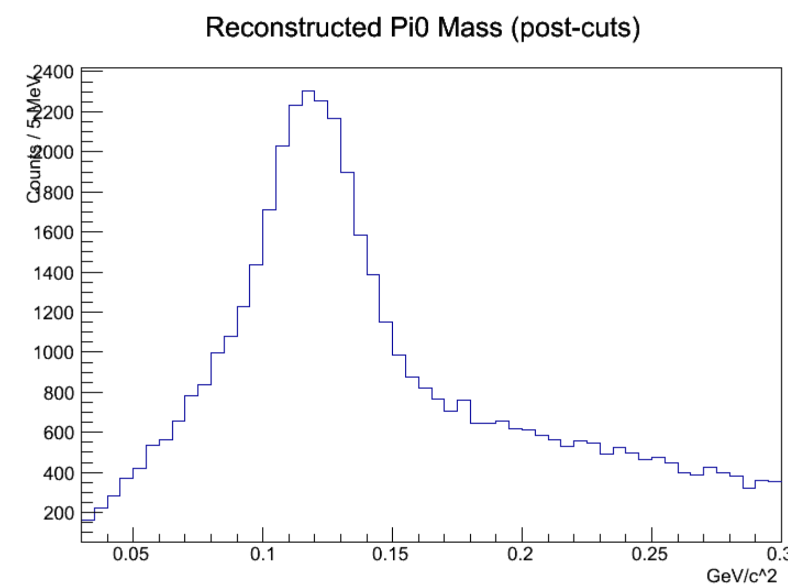


minimizing width of background near the upper edge of the region

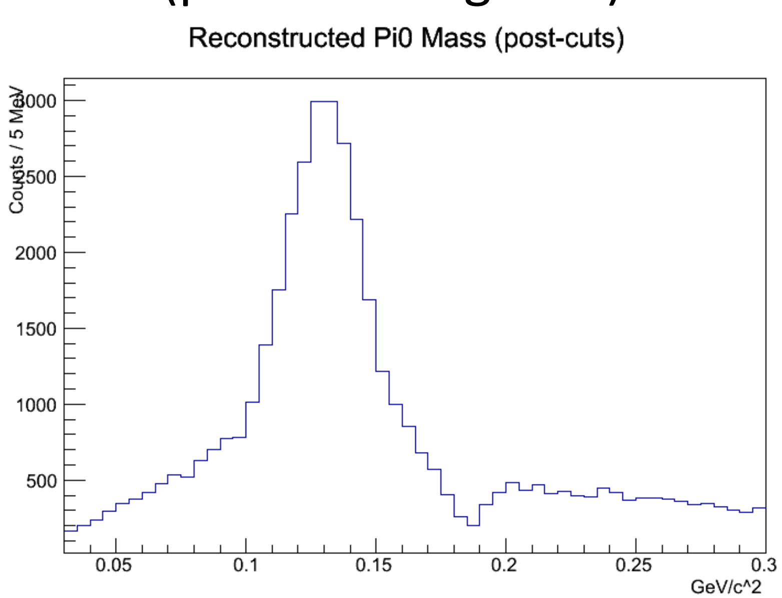
Divide Sample in Half:
use one for calibration and one for “analysis”

Test with two statistically independent samples confirm tuning to statistical fluctuations in background and making “proper” gain adjustments to signal.

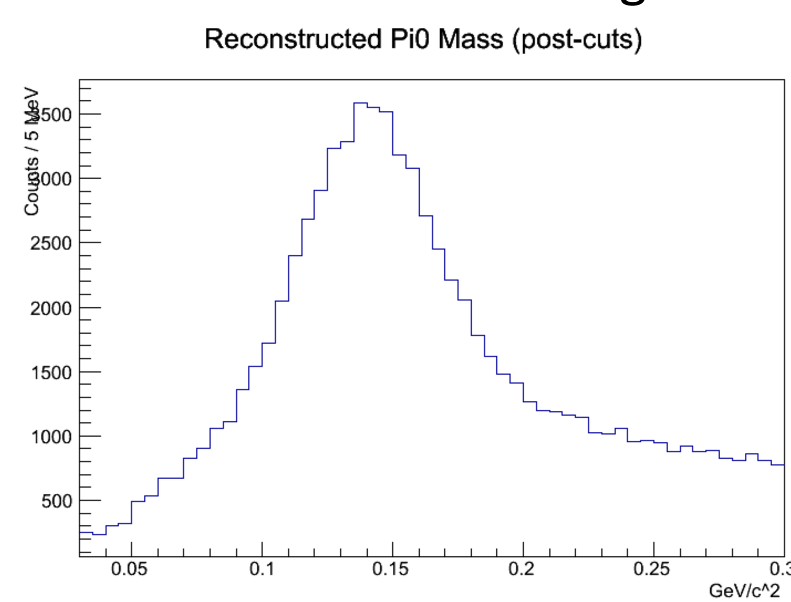
Half not used for gain factors



Used for gain factors (post-convergence)



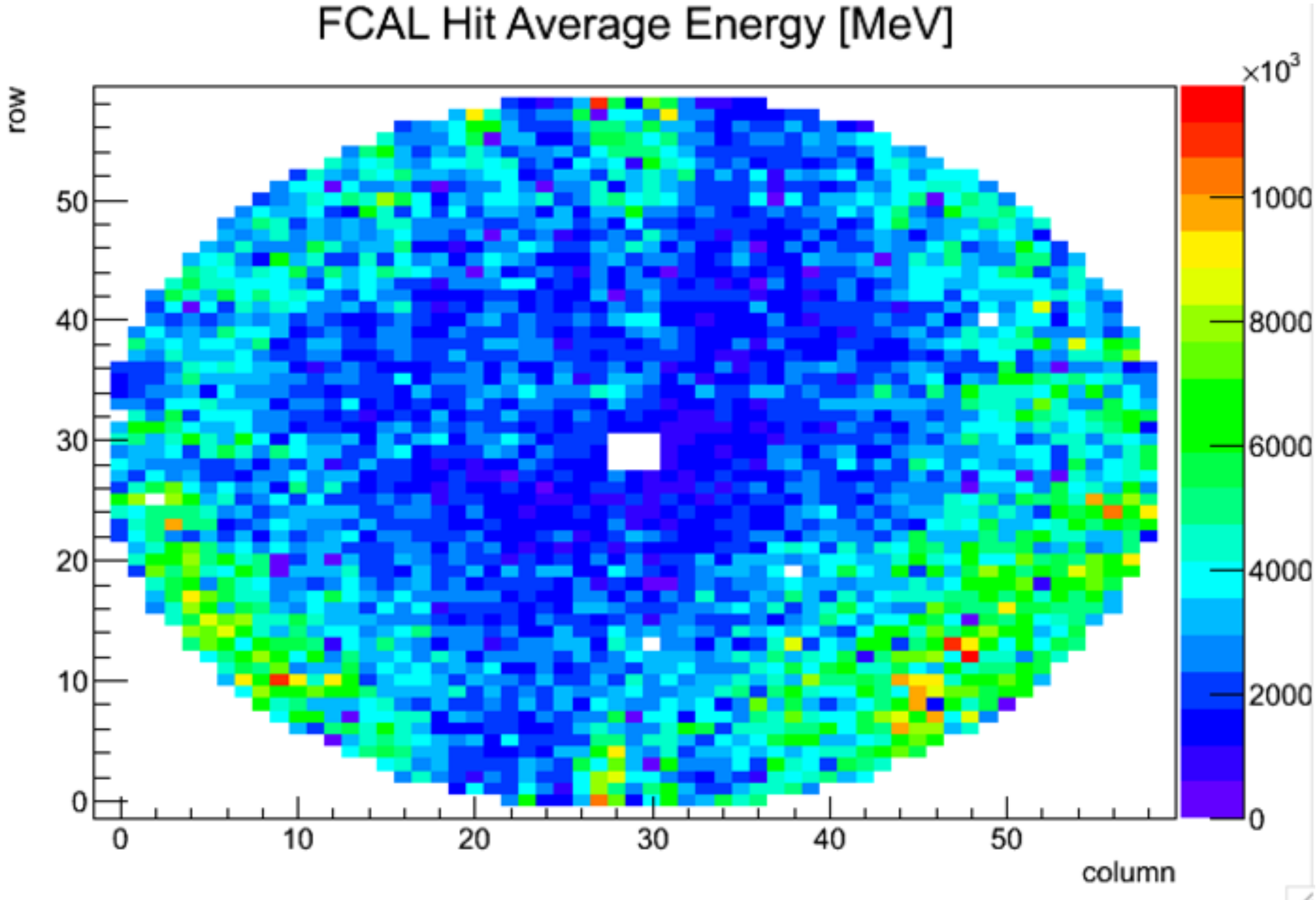
No Gain Balancing



π^0 Width Technique

- Need:
  - More statistics
    - minimize ability of the algorithm to latch onto statistical fluctuations in the background
  - Or Better purity
    - minimize probability that a channel's gain will be set by how it behaves when used in background events
  - working on trying to quantify each of these
- May be able to enhance purity by using a different technique to determine the gains of elements

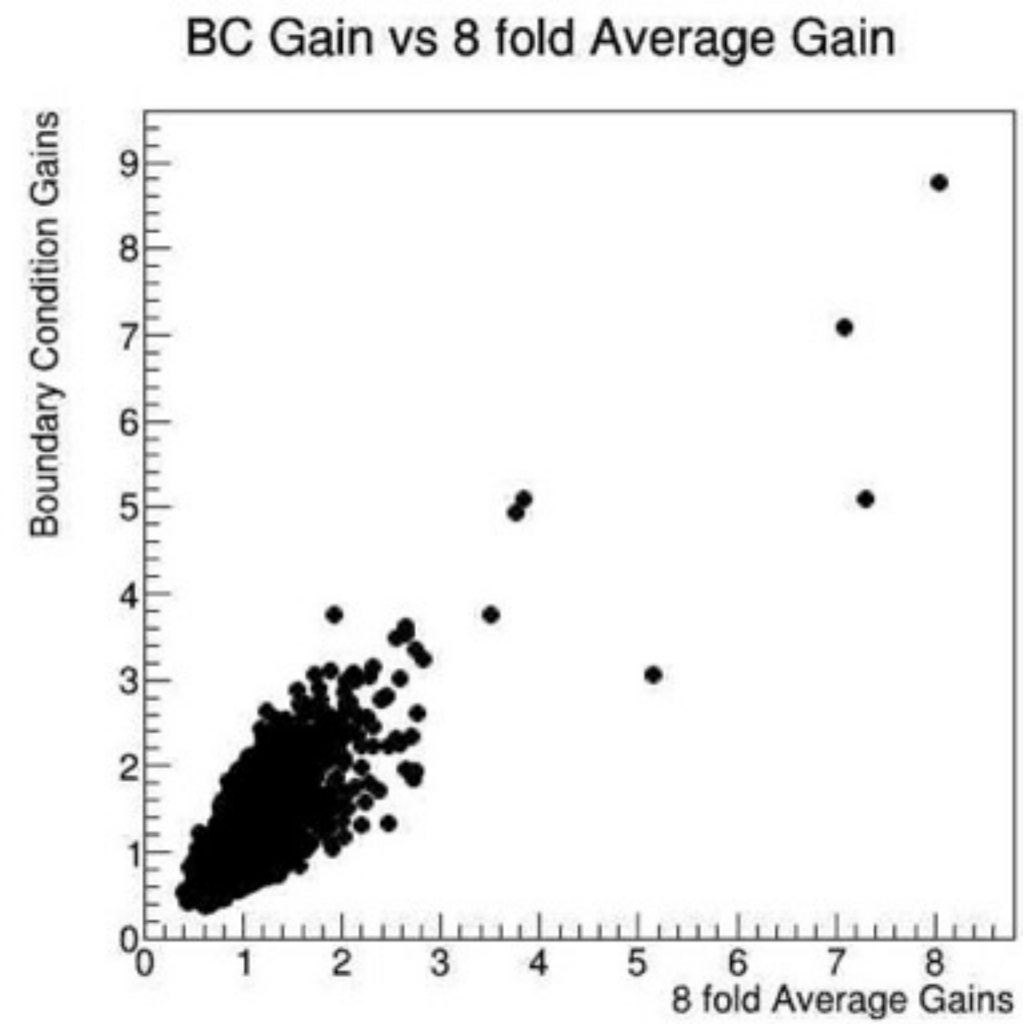
Using the LED Monitoring System



We know the light output of the monitoring system
is likely smooth but not constant.
Introduce gain factors to minimize local fluctuations.

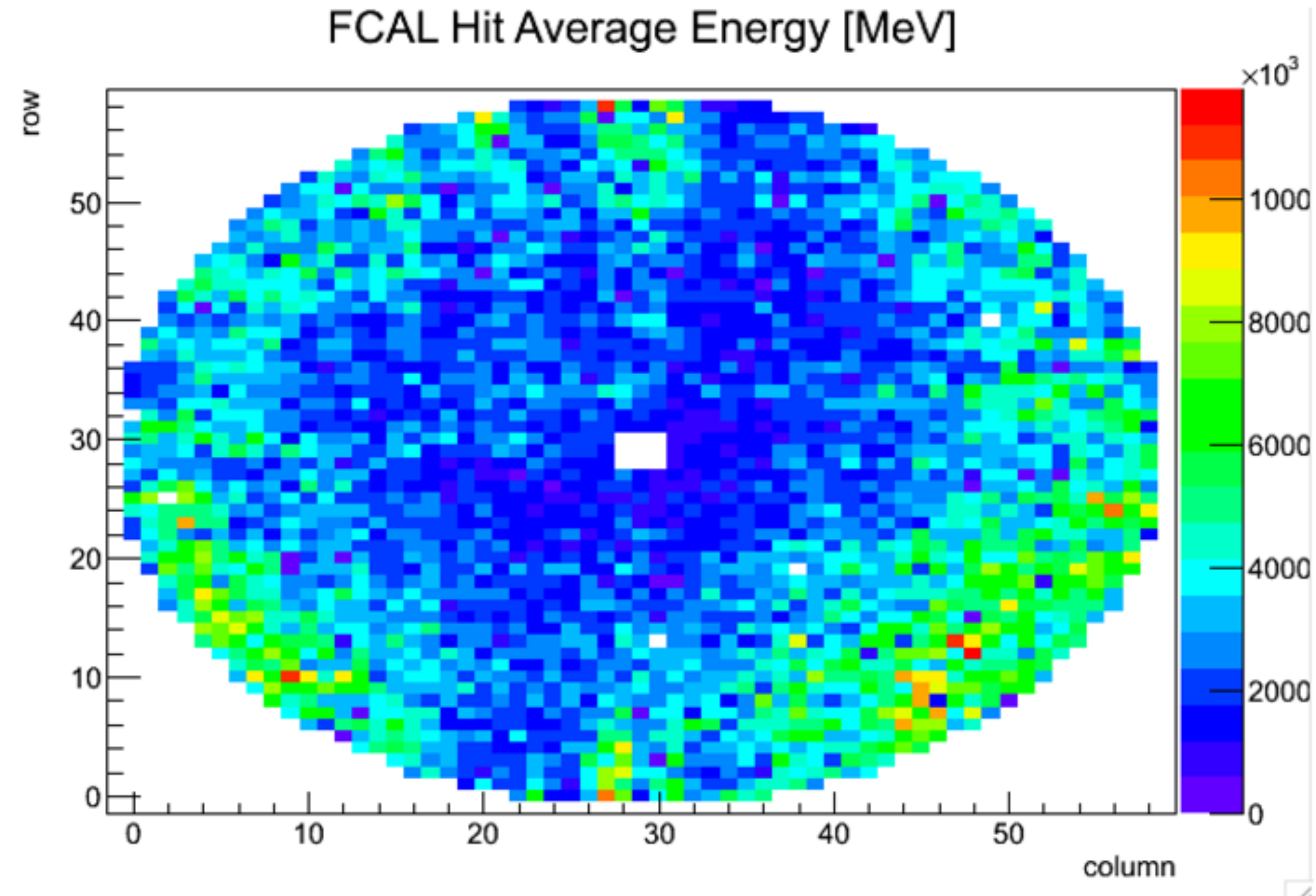
How to Smooth?

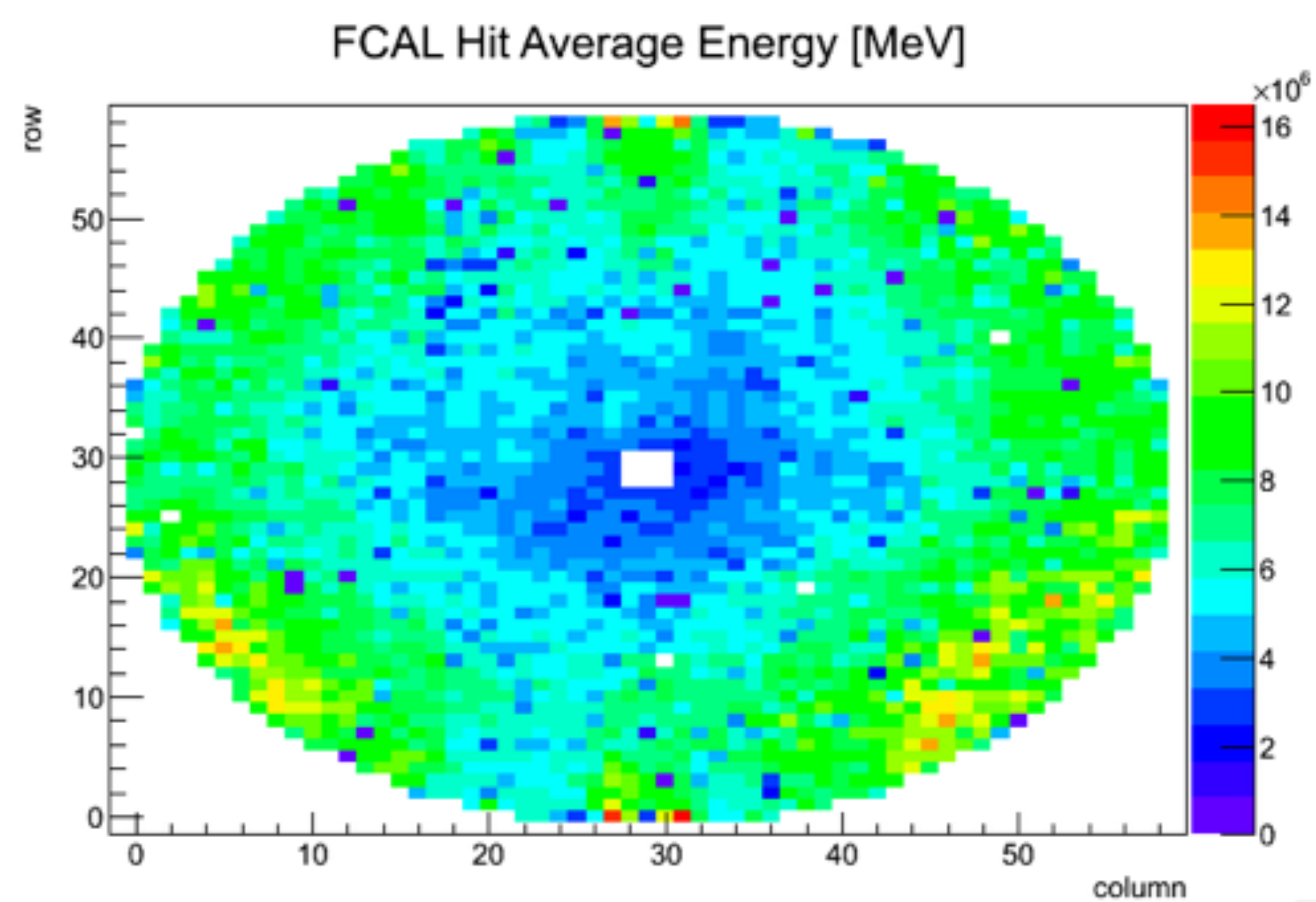
- Function 1
  - use four-fold symmetry and set boundary conditions around the edge of pane by averaging
  - iteratively solve Laplace's EQ (smooth) in the middle
- Function 2
  - set the function at point equal to the average of the function at the eight surrounding blocks (no iteration)
- Gain constant: (pulse peak from function 1 or 2) / observed pulse peak



Gain factors from two methods are correlated: average for now

- Before (top) and after (bottom) show the response has been smoothed
- Maintains some global features, but other global features have been introduced
- Need to test effectiveness by applying these gain constants to data and plotting π^0 mass





Summary

- FCAL gain calibration is top FCAL calibration priority
- RadPhi proven and GlueX-MC-tested technique using π^0's is turning out to be challenging
    - more statistics would be extremely beneficial — need to quantify this
- Pursuing parallel and complementary efforts to do the gain calibration.