

# Negative Signal Tracking

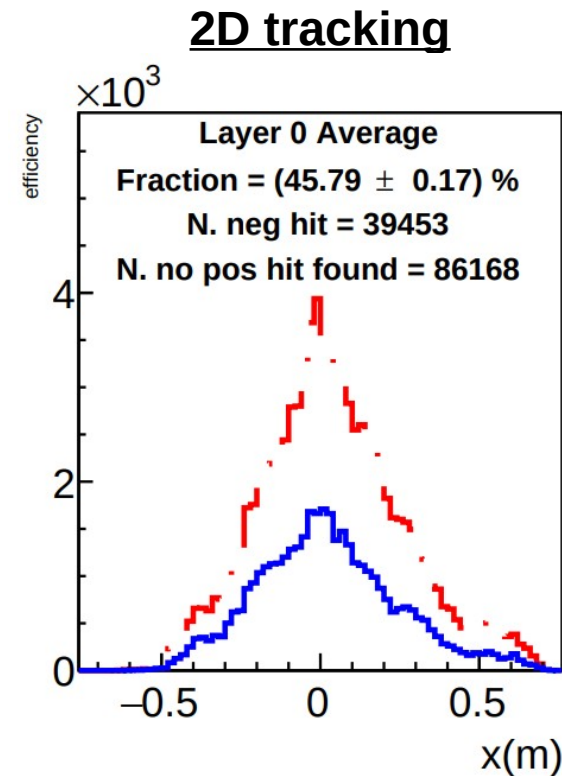
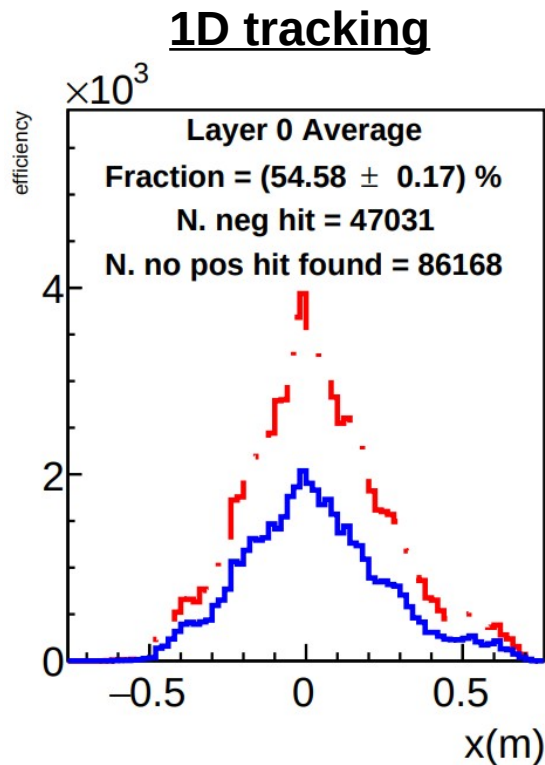
Sean Jeffas  
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# Negative Signal Tracking

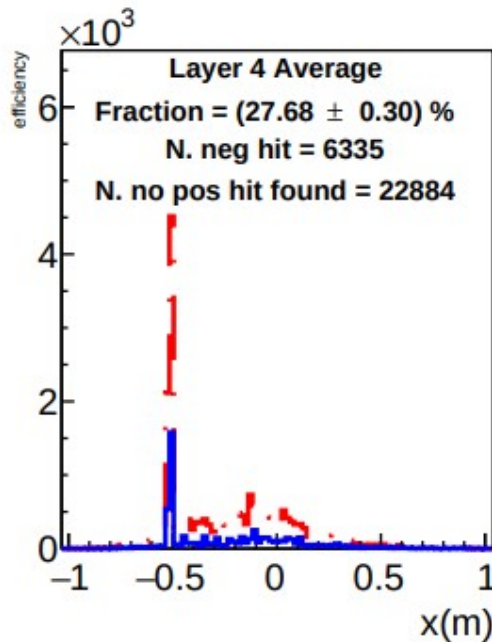
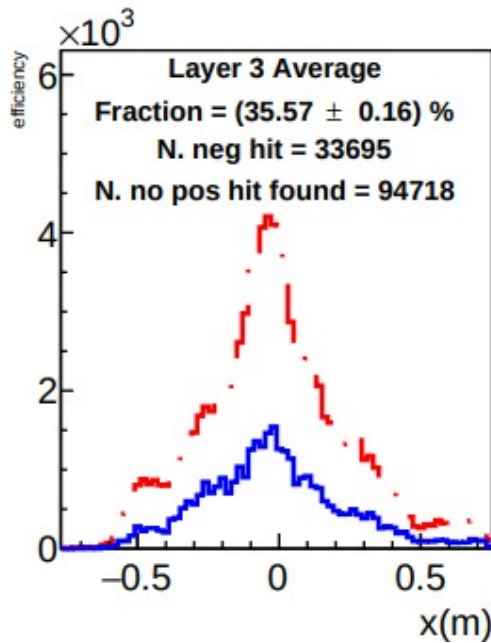
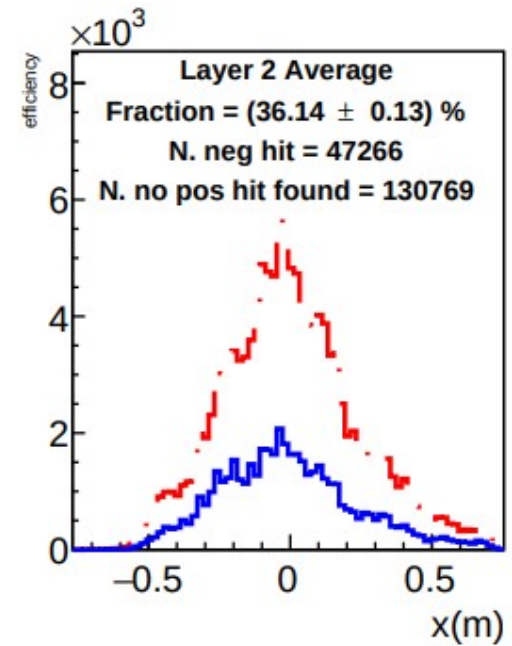
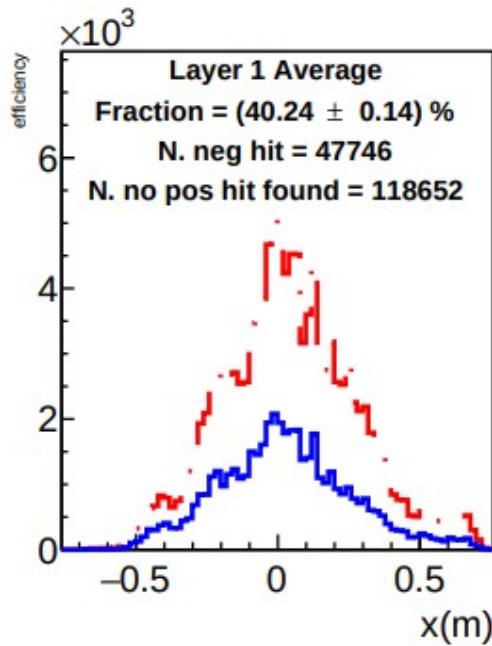
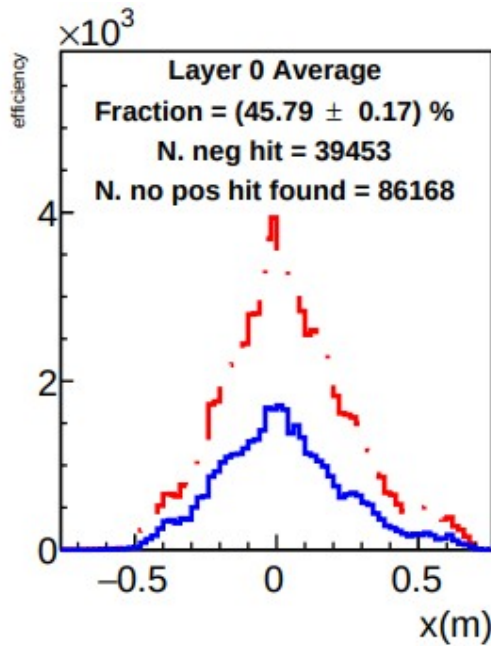
- Implemented changes in the analyzer to handle negative strips on tracks.
  - 1) Goes through normal tracking procedure for positive strip signals.
  - 2) Stores all negative strips passing “negative” zero suppression ( $< -5$  sigma cut).
  - 3) After tracking loop through all modules on tracks that do not have hits found.
  - 4) Loops over all possible 2D combinations of negative matched with negative or negative matched with positive strips.
  - 5) Check if the 2D position is within 2 mm of the expected track hit.
  - 6) Record this as negative strip on track or not on track.
- This analysis is done for any events with no zero suppression (1/100 full readout events).
- All raw negative strips passing zero suppression are used.
  - There is no correlation cuts or clustering.
- **This is extremely biased in favor of finding negative tracks.**
- Creating a more robust method would take a bit more work.

# Negative Tracking Efficiency

- The red histograms are tracks where no positive hit is found.
- The blue histograms are the tracks where a negative hit is found instead of a positive hit.
- Not a true efficiency, but the fraction of how often we find a negative hit on the tracks when the positive hits are missing.
- 1D tracking simply checks if any negative hits on one axis are within 2 mm of the track.
  - ~40% numbers are expected for random noise.
- 2D tracking checks using all 2D combinations between negative and positive hits.



# 2D Tracking Efficiency



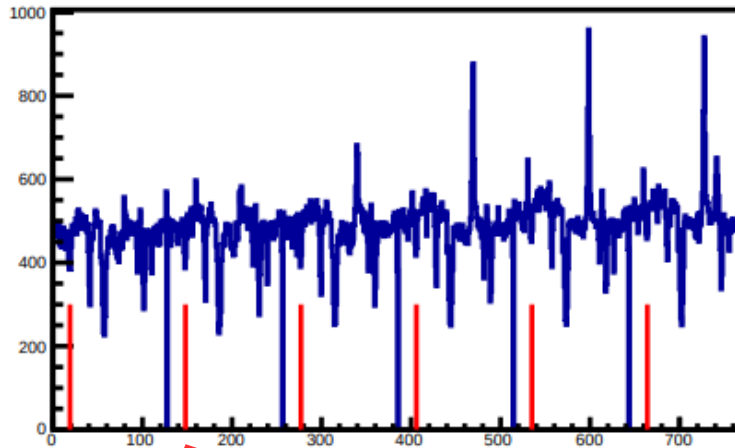
**34.5  $\mu$ A on LD2**

# Negative Tracking Displays

- On the HALOG I have posted 100 events with negative tracks found, and highlighted their position.
  - <https://logbooks.jlab.org/entry/3989020>

Large red title shows which APV had the negative hit on a track

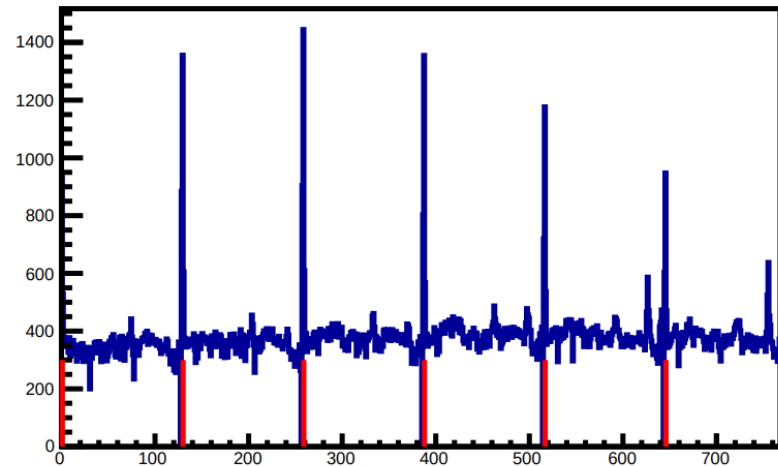
Event 23 Fiber 7 adc 11 Negative



Red line shows the hit strip location.

Large blue title shows which APV had the positive hit on a track

Event 73 Fiber 20 adc 14 Positive

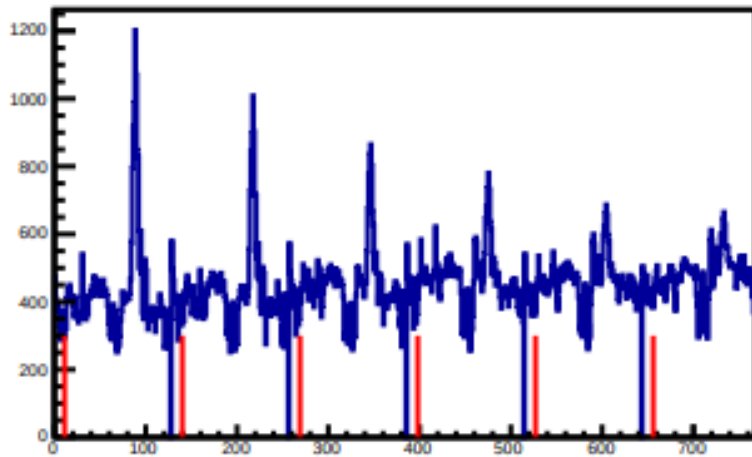


# Negative Event Types

- 70 events from 34.5 uA have been investigated by eye.
- Majority of “negative hits on tracks” are either:
  - Random fluctuations near the track
  - Negative strips directly next to a large positive hit.
- More examples and some estimations coming later.

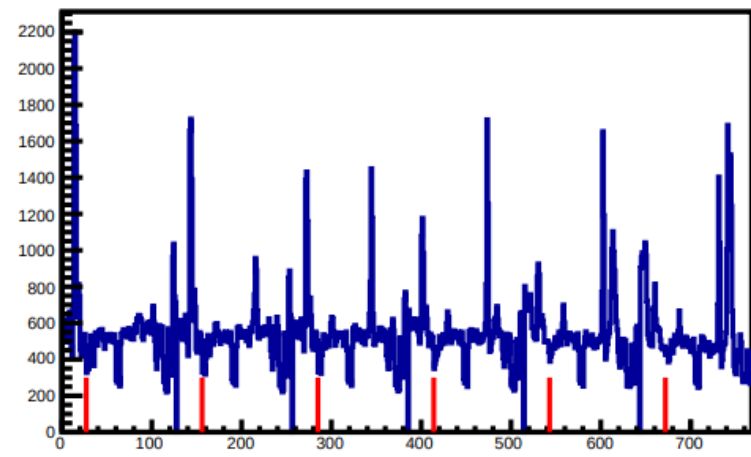
Random Fluctuation Example

Event 46 Fiber 19 adc 2 Negative



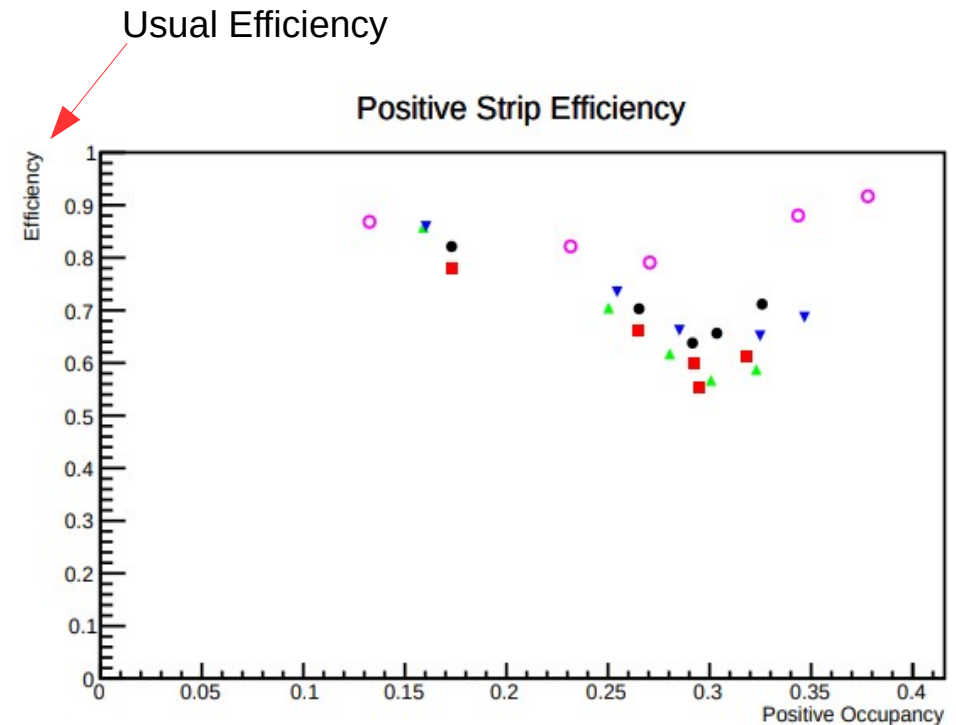
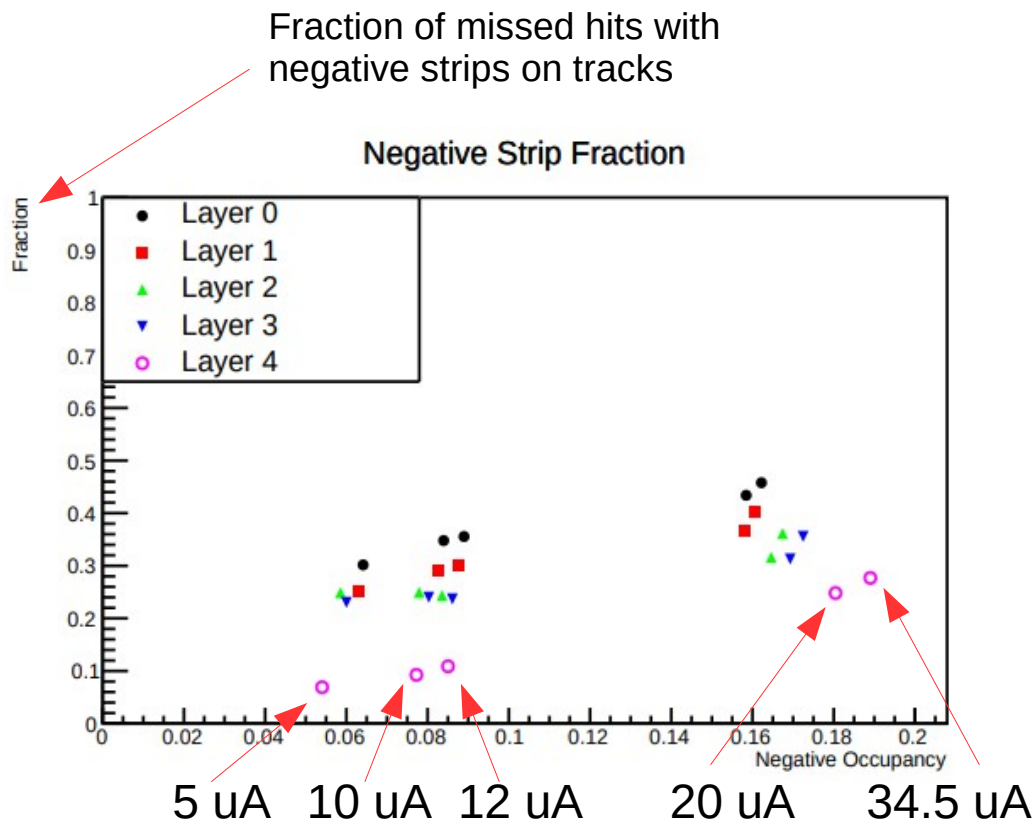
Negative strips next to positive hit example

Event 50 Fiber 11 adc 10 Negative



# Tracking Efficiency Comparison

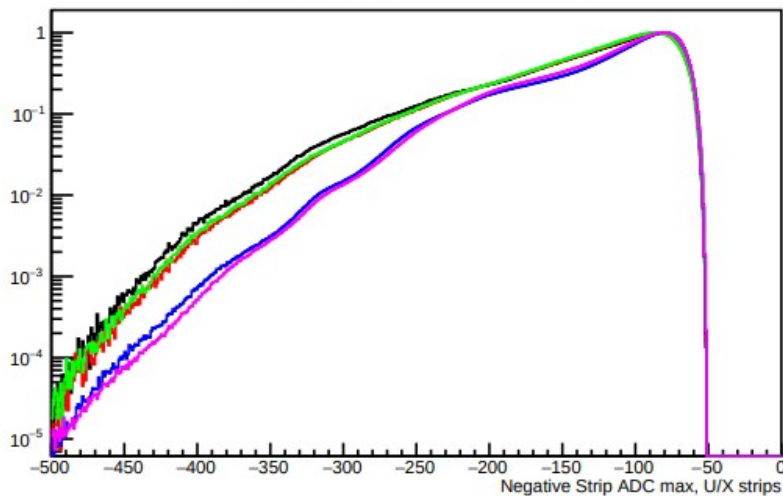
- Below is the tracking results for different beam currents, shown on the x-axis as different negative and positive occupancy
- Interestingly the efficiencies increase when the beam current goes to 20 and 34 uA.
  - Does this make any sense?
- The first 3 data points the efficiency drops about 20% for the front 4 layers, while the negative strip fraction only increases by about 2%.
  - Does not indicate that a large portion of the efficiency drop can be due to negative strips.



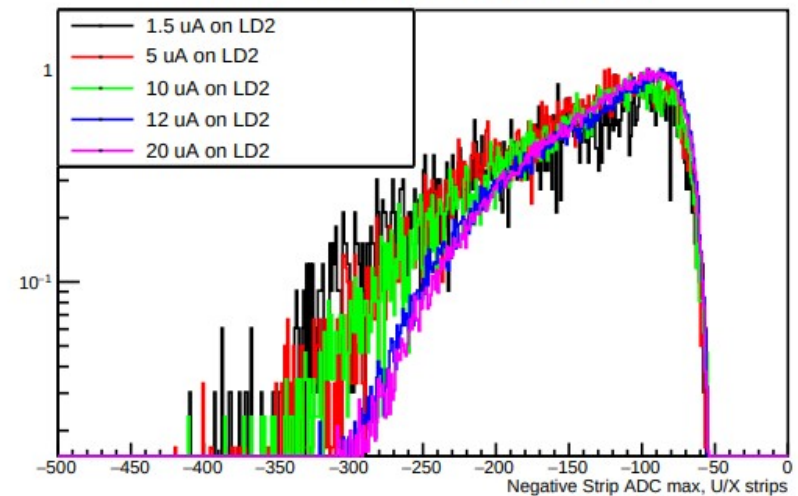
# ADC Comparisons

- Unlike the positive ADC distributions, the average negative ADC is significantly reduced when cutting from all strips to just strips on tracks.
  - Another sign that the strips on tracks are mostly lower ADC noise.

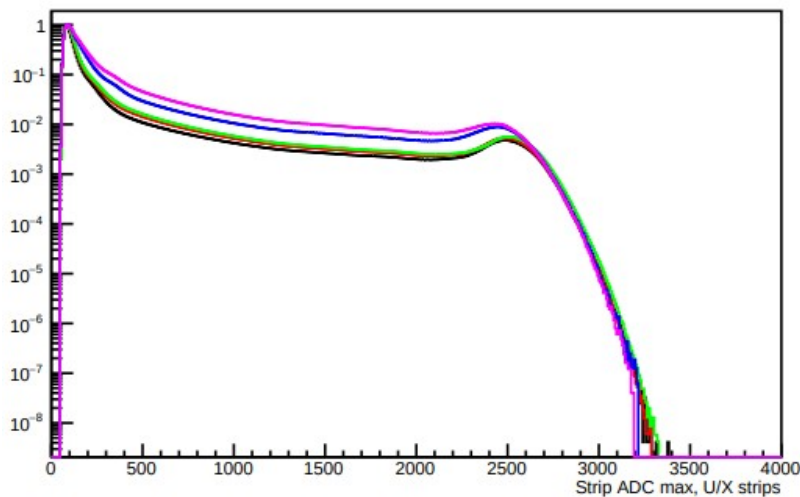
UV Layer 0 All Negative Strips



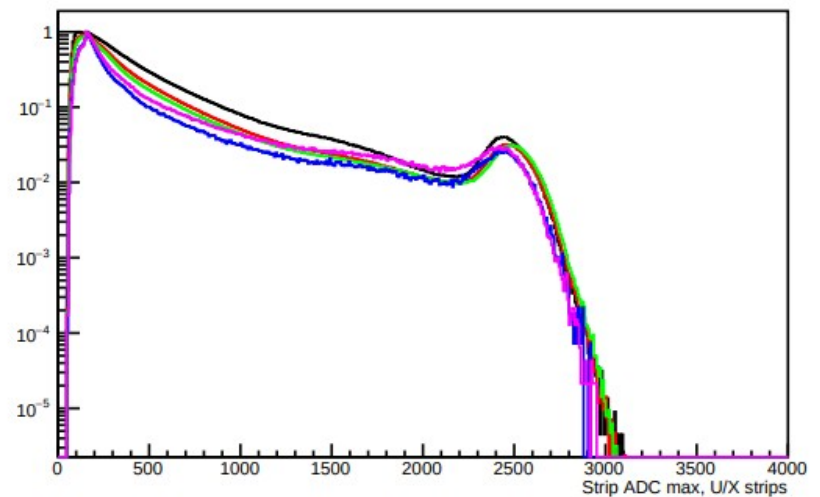
UV Layer 0 Negative Strips On Tracks



UV Layer 0 All Positive Strips



UV Layer 0 Positive Strips On Tracks

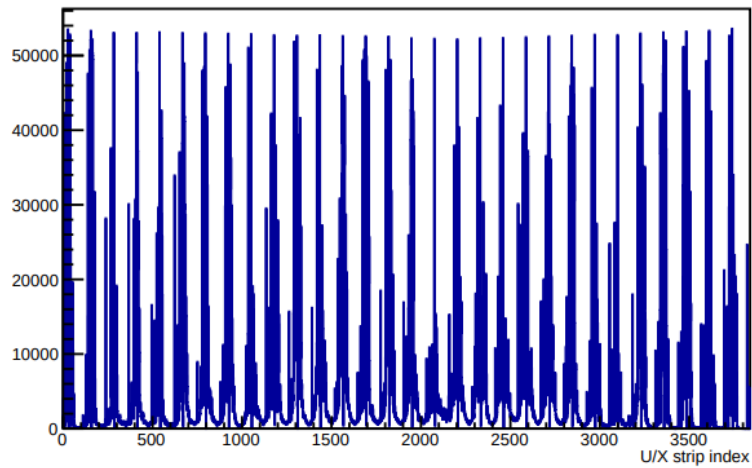




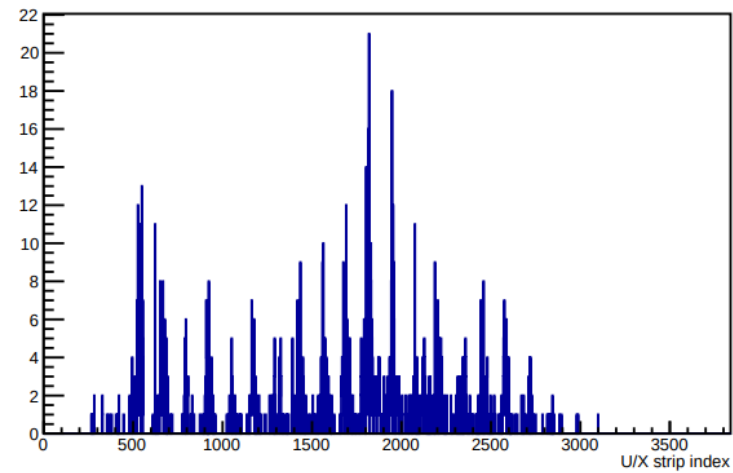
# Strip Distributions

- The left plots show many noise effects for both positive and negative, which is usual.
- When tracking cuts are added we see the negative strips retain most of the noise effects.

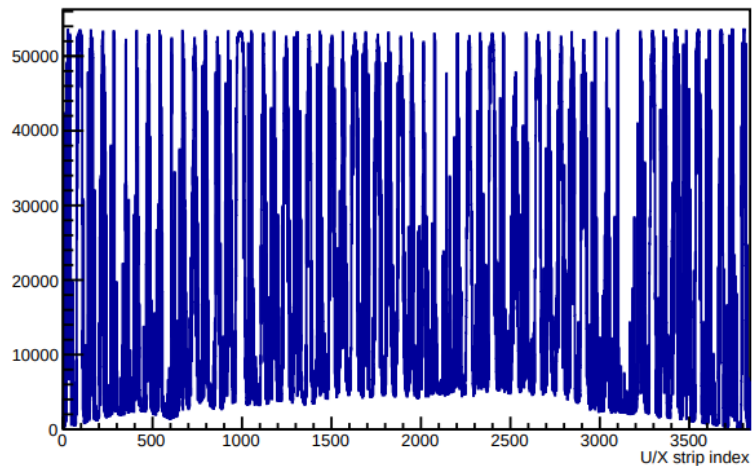
UV Layer 0 All Negative Strips



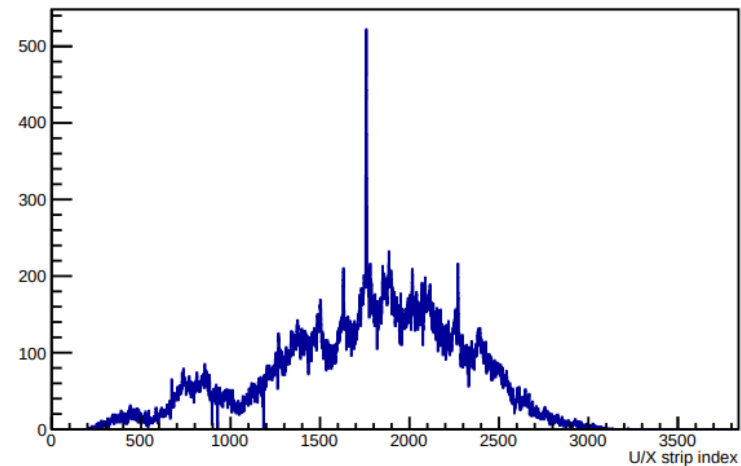
UV Layer 0 Negative Strips On Tracks



UV Layer 0 All Positive Strips



UV Layer 0 Positive Strips On Tracks



# Conclusions

- See all plots and event displays here, <https://logbooks.jlab.org/entry/3989020>
- Most results of negative hits on tracks point to random noise fluctuations and negative strips near positive strips.
  - Very basic tracking done with no clustering
  - Could be improved but would take time
- Still need to go through all results and get estimations