

Negative Signal Tracking

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Negative Signal Tracking

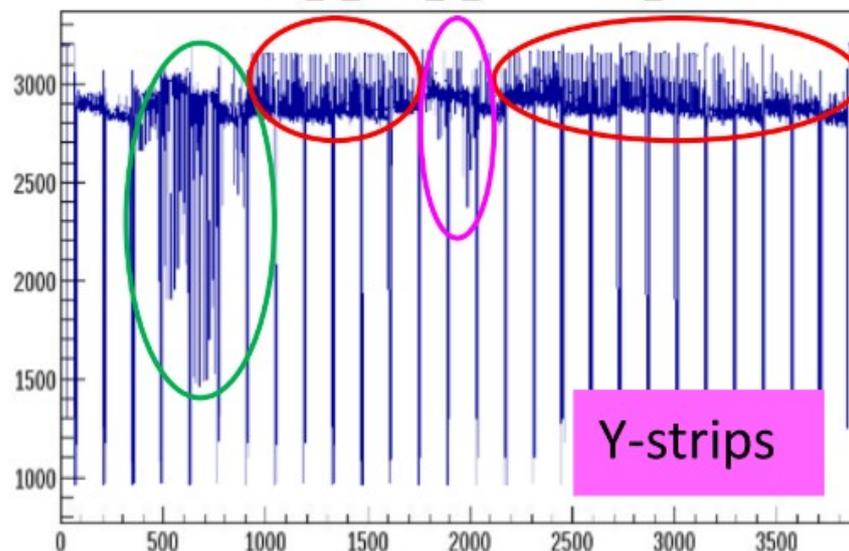
- Implemented changes in the analyzer to handle negative strips on tracks.
 - 1) Goes through normal tracking procedure for positive strip signals.
 - 2) Stores all negative strips passing “negative” zero suppression (< -5 sigma cut).
 - 3) Clustering separately on positive and negative strips.
 - 4) After tracking loop through all modules on tracks that do not have hits found.
 - 5) Loops over all possible 2D combinations of negative matched with negative or negative matched with positive strips.
 - 6) Check if the 2D position is within 2 mm of the expected track hit.
 - 7) Record this as negative cluster on track or not.
- This analysis is done for any events with no zero suppression (1/100 full readout events).
- ~60M events analyzed for each beam current to acquire enough statistics.

Signal “Flipping”

- One possibility is that the negative signal is some positive signal that flips between positive and negative
- Checked if a strip ever passes negative and positive zero suppression in the 6 APV time samples.
- Compare the minimum and maximum ADC values in a single strip.
 - Check if large positive ADC swings to large negative ADC
- Compare the ADC values between the two time samples where the ADC changes polarity.
 - Check if the transition is large negative to large positive.

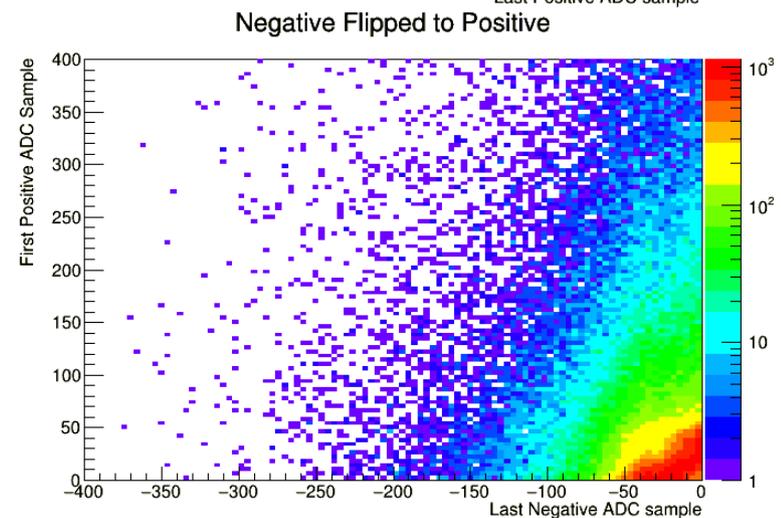
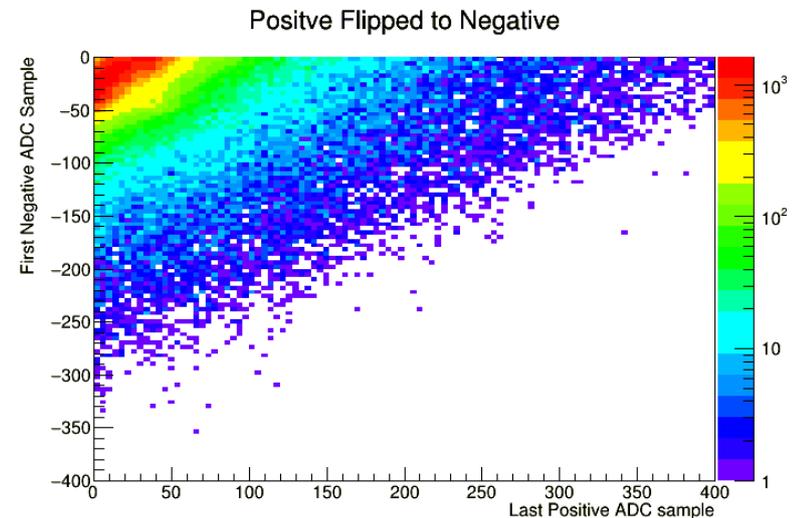
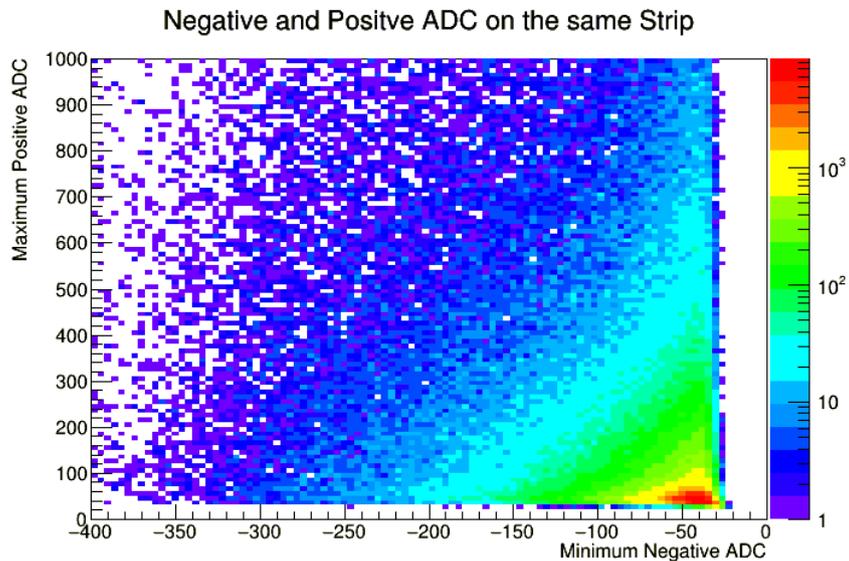
Plot from Kondo, SRS system

APV_2_FEC_0_TRDGEMY_0



Signal “Flipping”

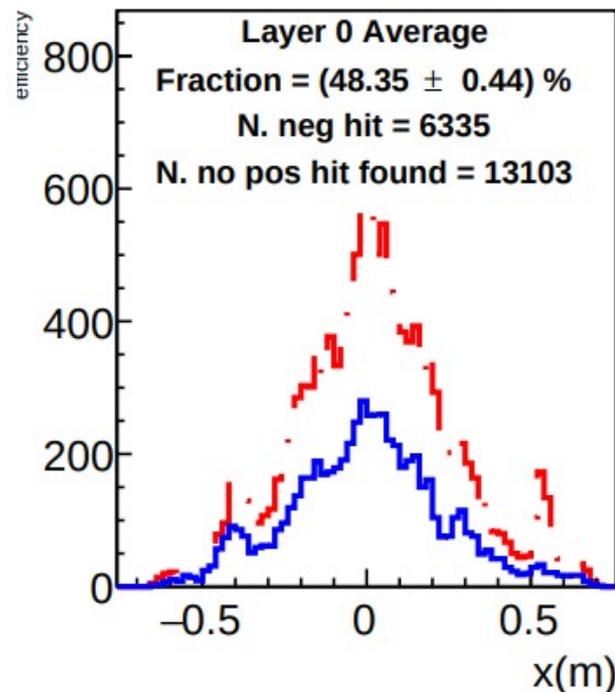
- Generally if the positive ADC is large, then the negative ADC is small, and vice versa.
- At the two time samples where the “flip” happens the ADCs are likely to be small.
- Implies that usually the ADCs gradually transition between polarities instead of abruptly changing.



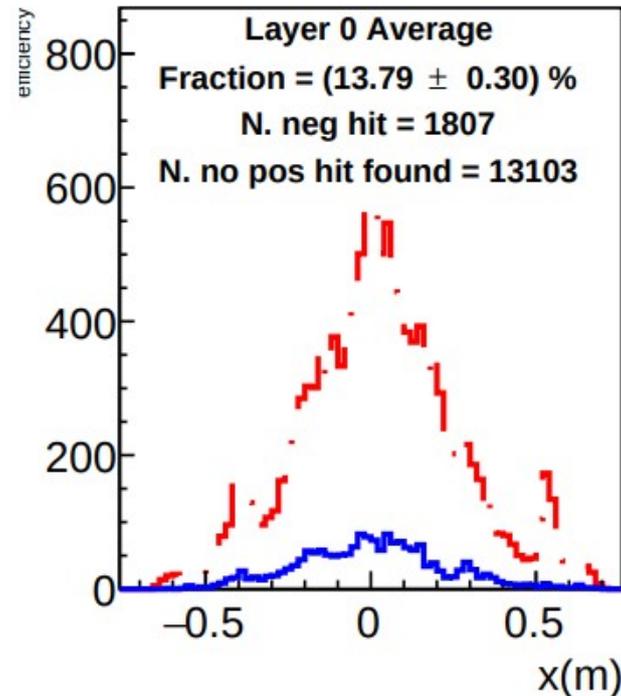
Negative Tracking Efficiency

- 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.
- 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 can be expected from random noise.
- 2D tracking checks using all 2D combinations between negative and positive hits.
- 2D tracking significantly reduced the number of negative hits on tracks to ~15%

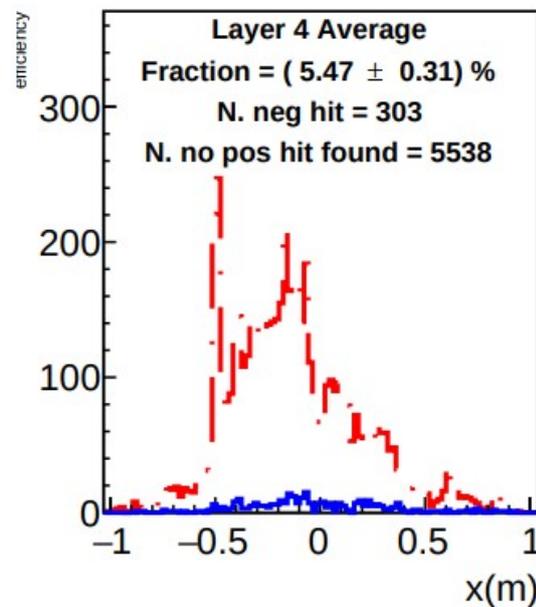
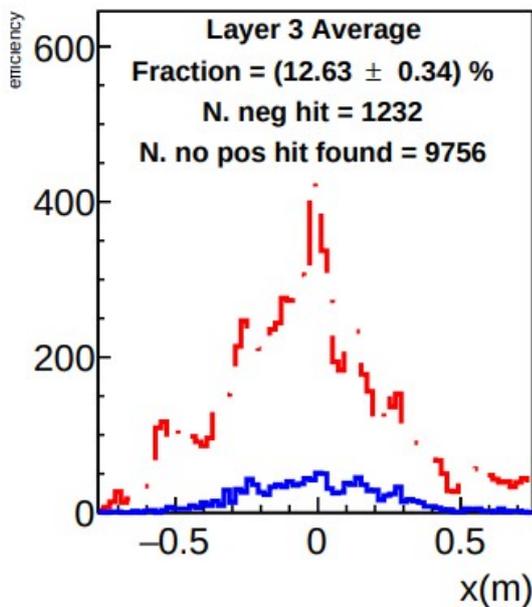
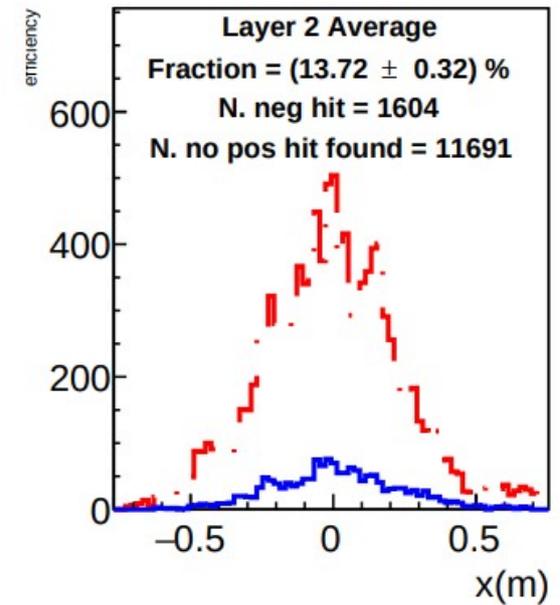
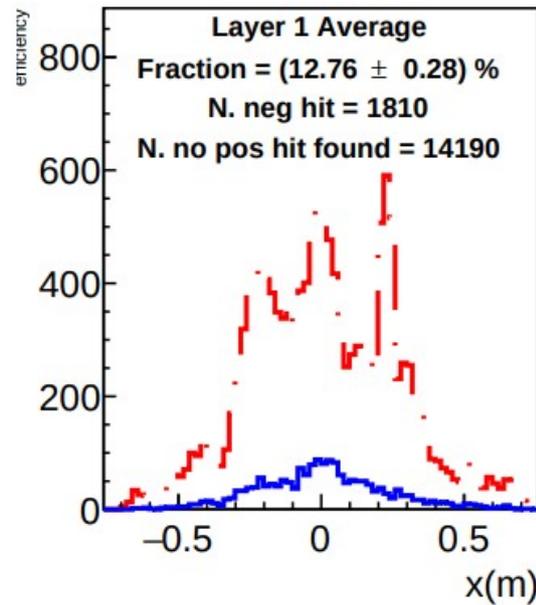
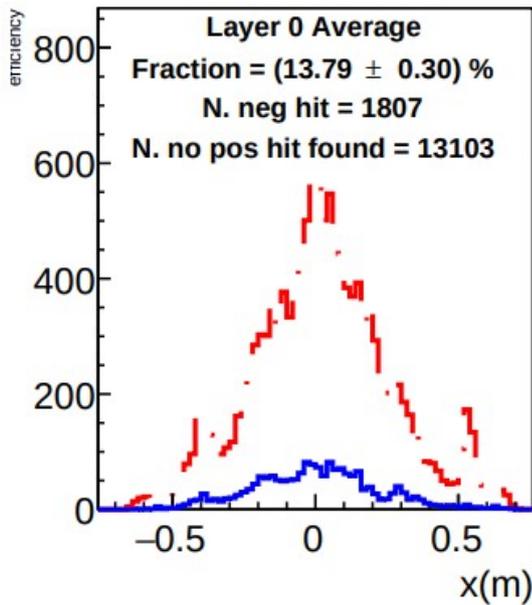
1D tracking



2D tracking



2D Tracking Efficiency



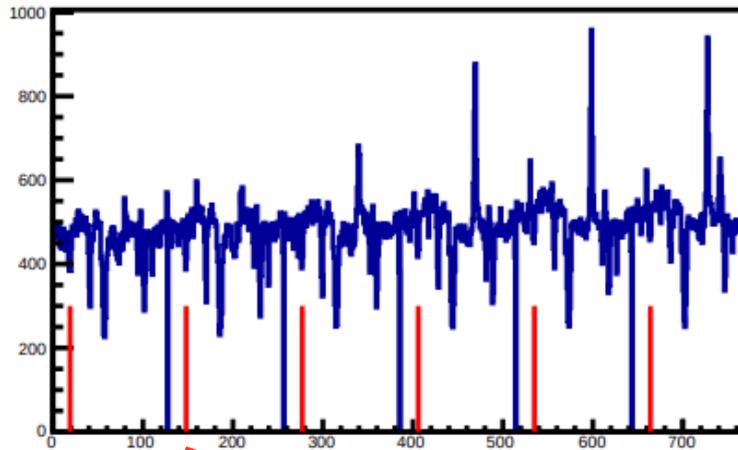
12 uA on LD2

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

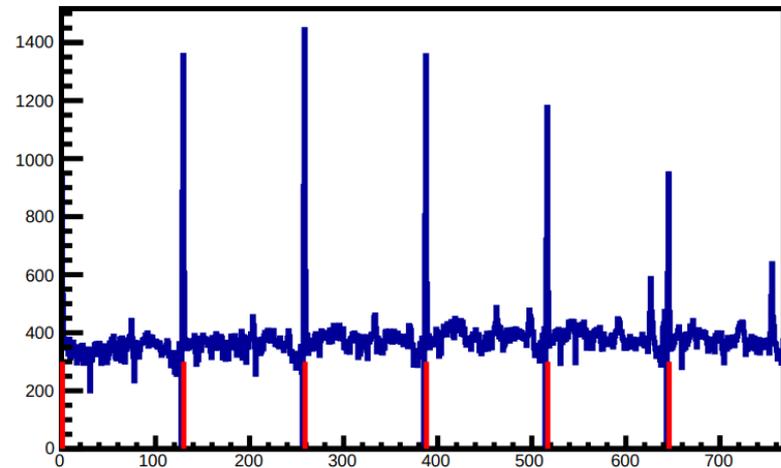
Event 23 Fiber 7 adc 11 Negative



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

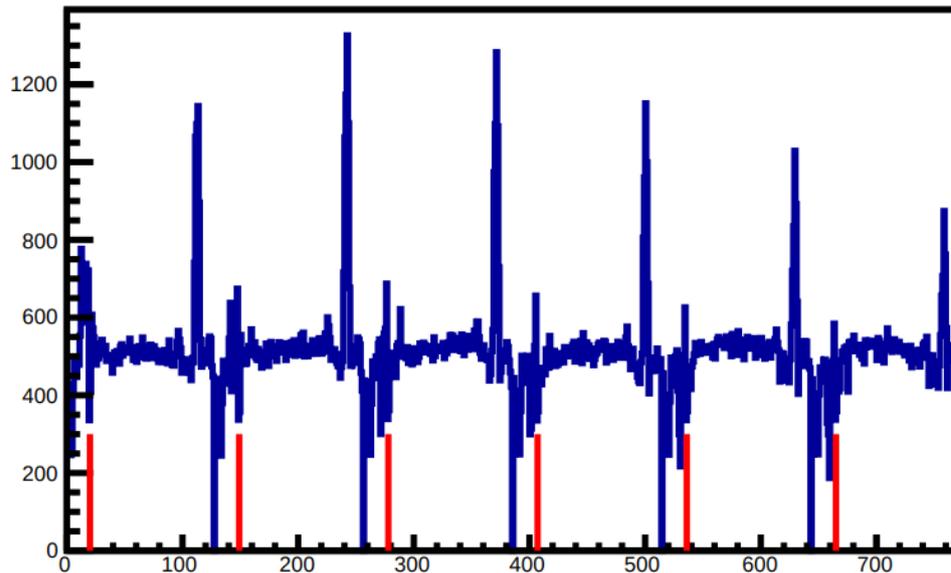


Negative Event Types

- Many events investigated by eye.
- Majority of “negative clusters on tracks” are directly next to a large positive cluster.
- Very few examples look like real negative clusters on tracks.

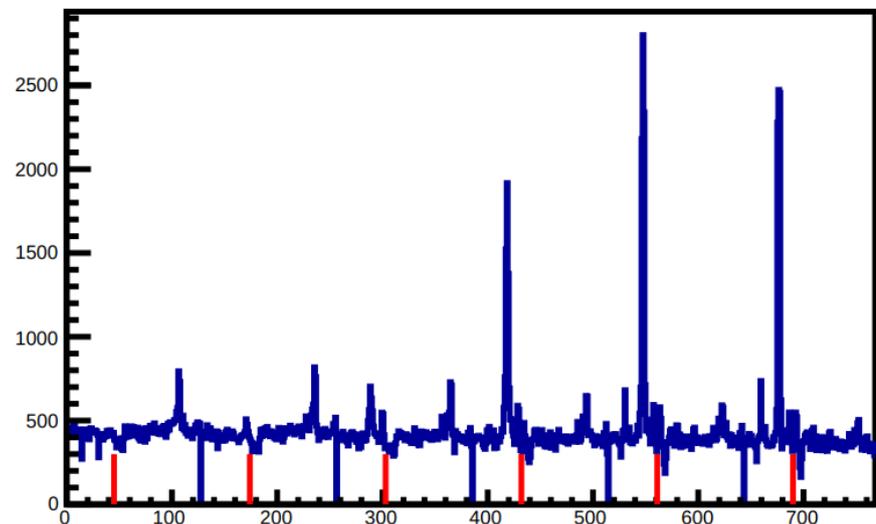
Possible cluster on track

Event 527 Fiber 12 adc 3 Negative



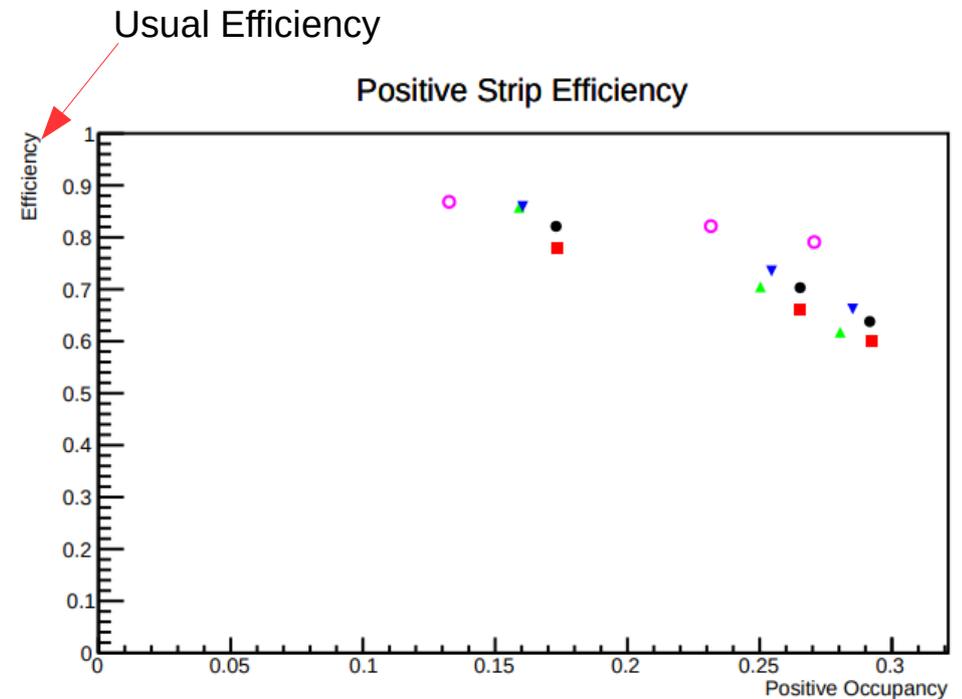
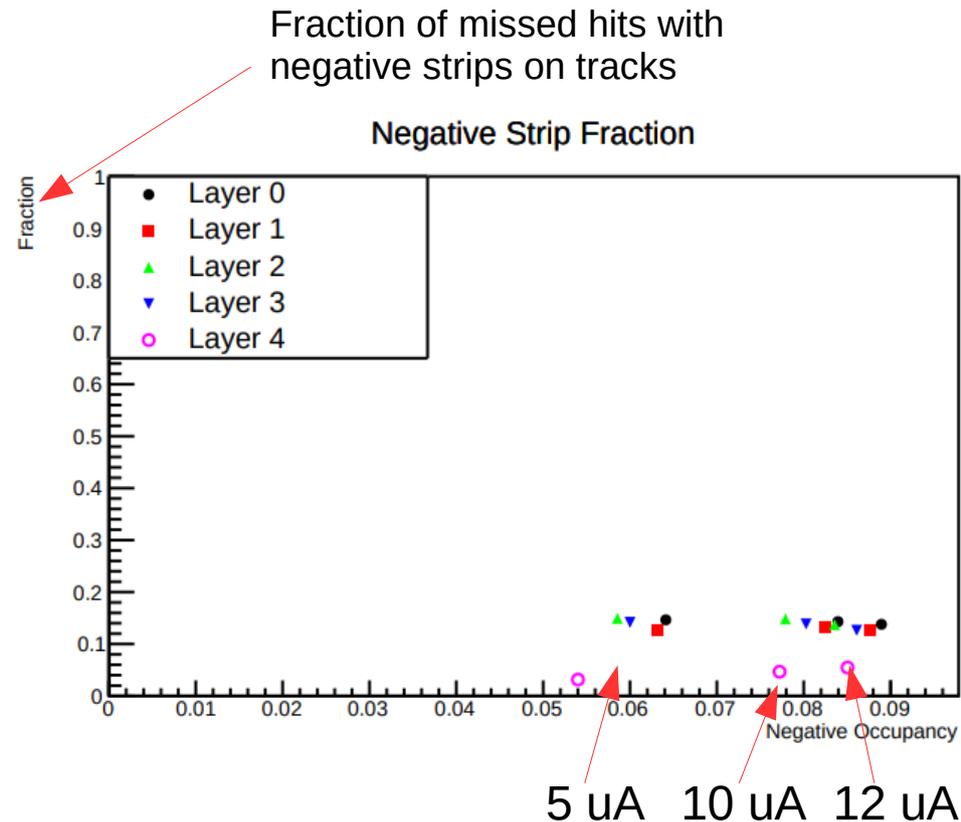
Negative strips next to positive hit example

Event 174 Fiber 7 adc 12 Negative



Tracking Efficiency Comparison

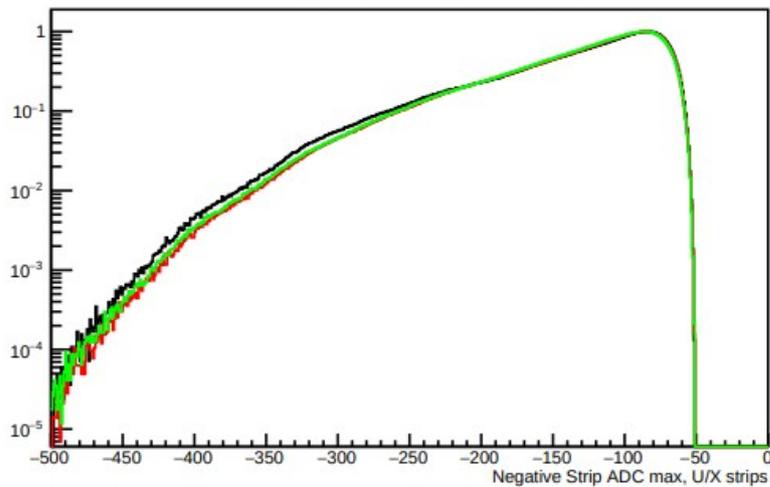
- Below is the tracking results for different beam currents, shown on the x-axis as different negative and positive occupancy
- Efficiency drops about 20% for the front 4 layers, while the negative strip fraction is steadily ~15%.
 - If the negative strips caused a significant part of this drop the fraction should be increasing.
 - Constant negative fraction implies that they are likely random coincidences.



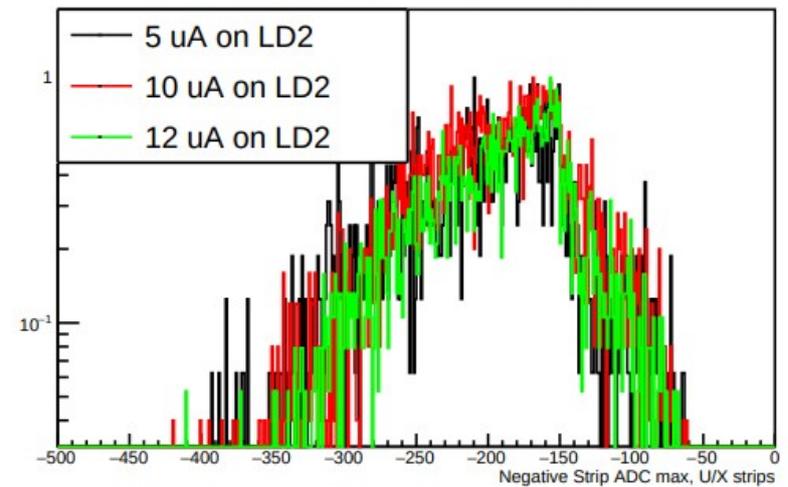
ADC Comparisons

- 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.

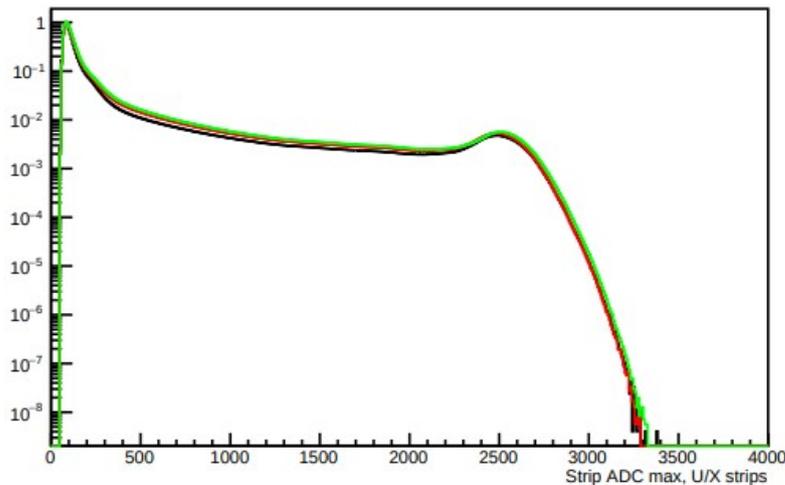
UV Layer 0 All Negative Strips



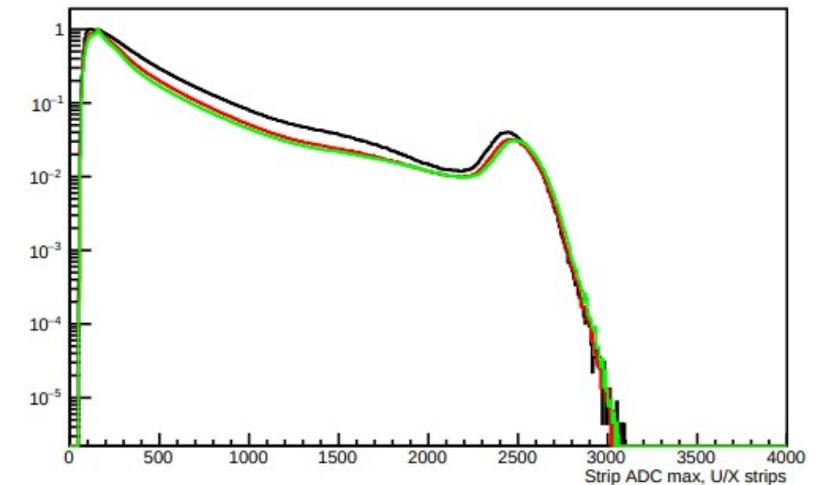
UV Layer 0 Negative Strips On Tracks



UV Layer 0 All Positive Strips



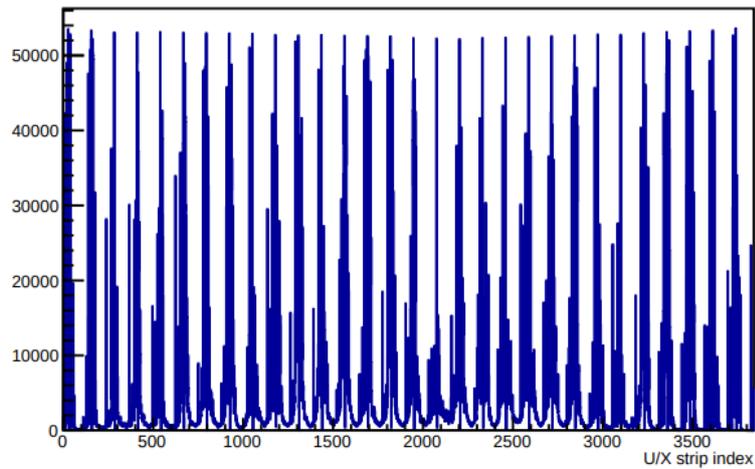
UV Layer 0 Positive Strips On Tracks



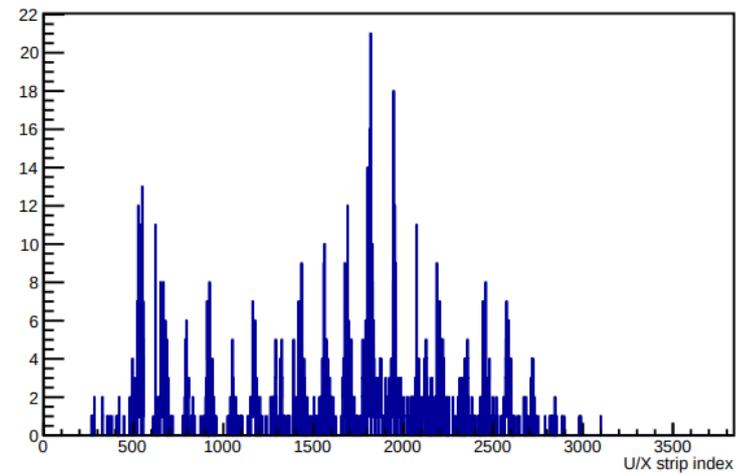
Strip Distributions

- 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.

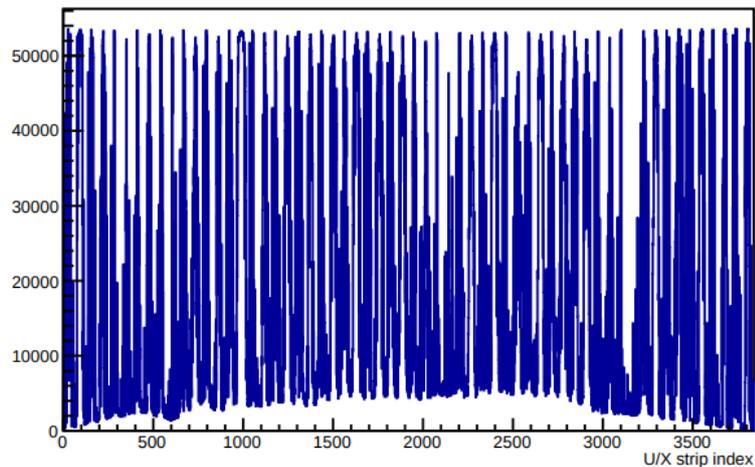
UV Layer 0 All Negative Strips



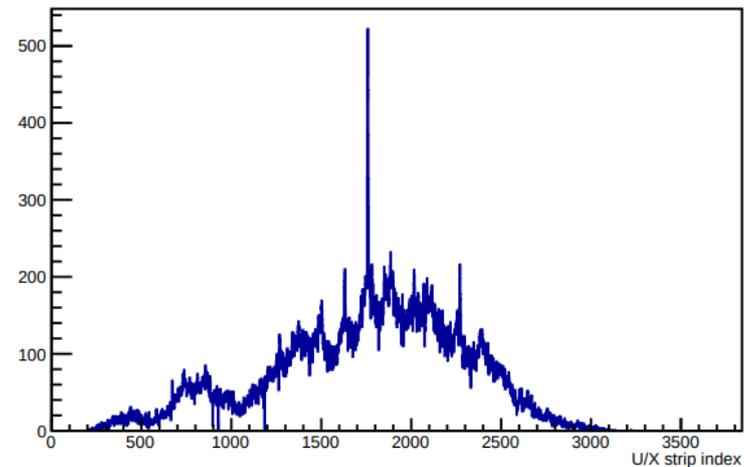
UV Layer 0 Negative Strips On Tracks



UV Layer 0 All Positive Strips

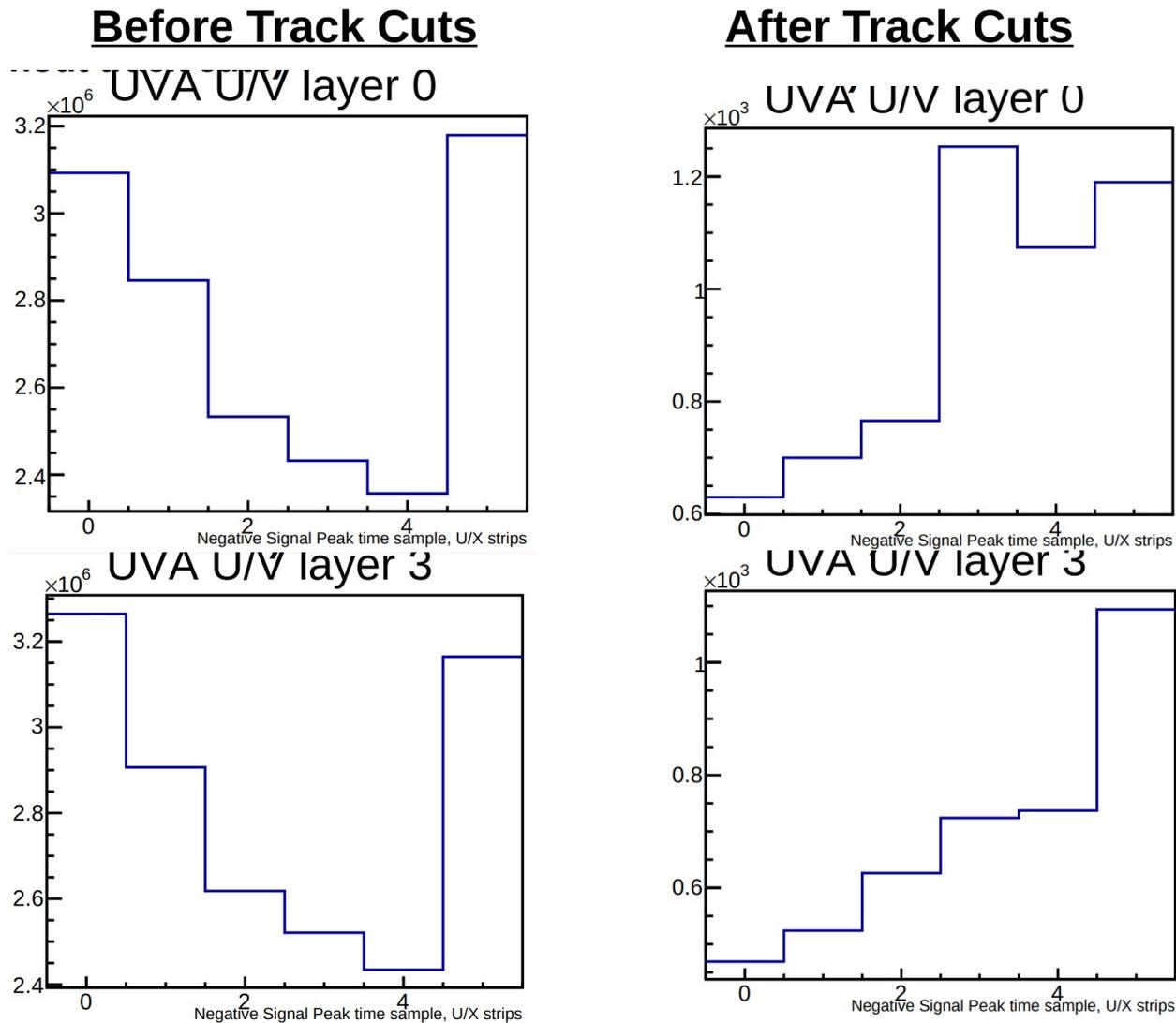


UV Layer 0 Positive Strips On Tracks



Negative Strip Timing

- Some negative strips “on tracks” do peak similarly to positive clusters but not similar for all layers.
 - Maybe this is because they are next to positive strips?



Conclusions

- See all plots and event displays here, <https://logbooks.jlab.org/entry/3989020>
- Minimal evidence of sudden polarity flips in the 6 time samples.
- ~15% of missed hits have a negative clusters on track (for front layers)
 - ~80% of these events are negative clusters directly next to positive clusters
- ~3% efficiency loss can possibly be attributed to negative signals.
 - Still refining this official number