Negative Signal Tracking

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Negative Signal Tracking

- Implemented changes in the analyzer to handle negative strips on tracks.

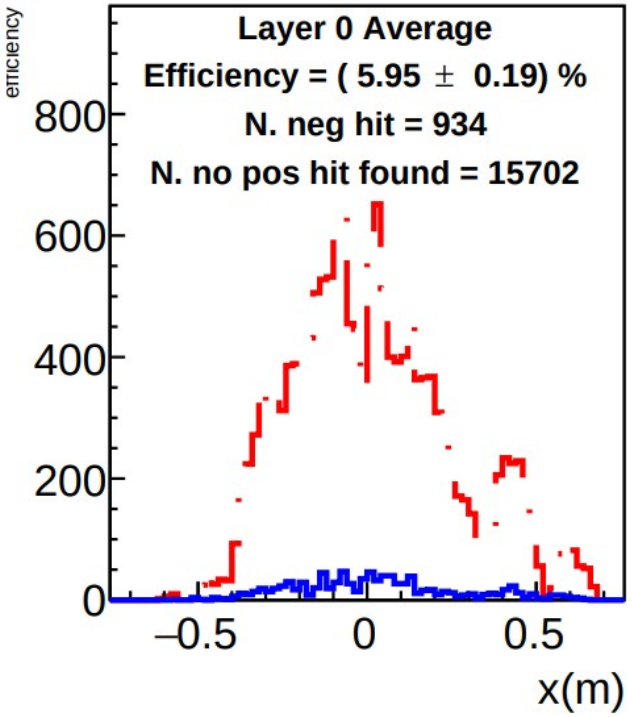
1) Goes through normal tracking procedure for positive strip signals.
2) Stores all negative strips passing “negative” zero suppression (< -5 sigma cut).
3) After tracking loop through all modules on tracks that do not have hits found.
4) Loops over all possible 2D combinations of negative strips.
5) Check if the negative strip position is withing 2 mm of the expected track hit.
6) Record this as negative strip on track or not on track.

- 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.
- Overall fractions are quite low and not indicative of a large number of positive hits being flipped negative.

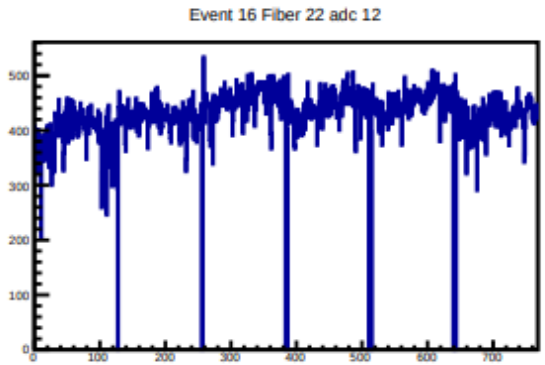
1 uA on LD2

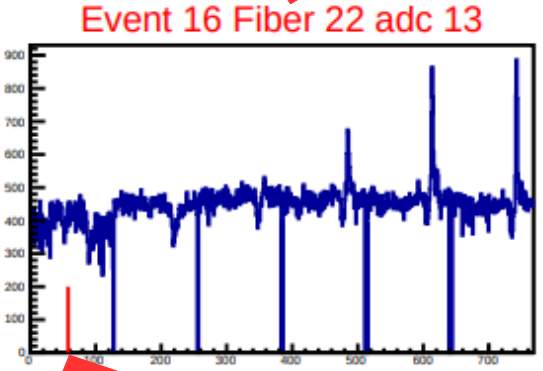


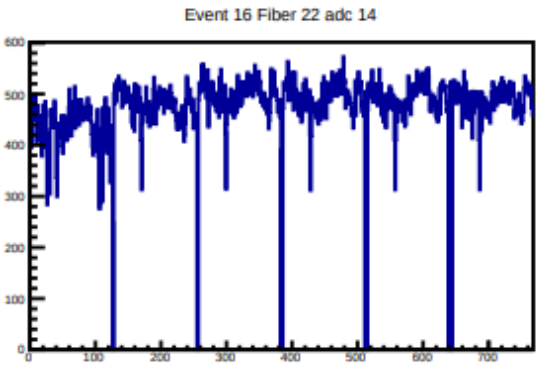
Negative Tracking Displays

- On the HALOG I have posted 100 events with negative tracks found, and highlighted their position.
  - https://logbooks.jlab.org/entry/3986717

Large red title shows which APV had the hit



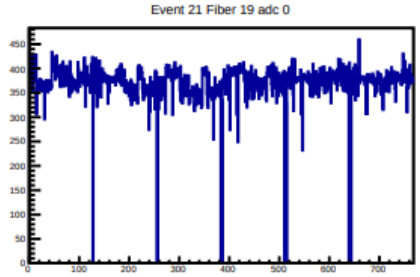


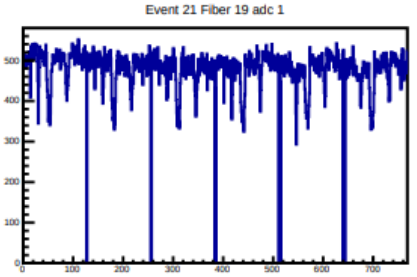


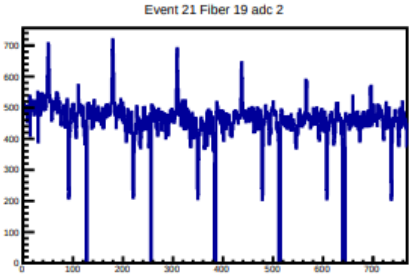
Red line shows the hit strip location.

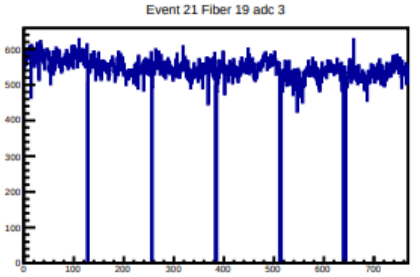
Event Examples

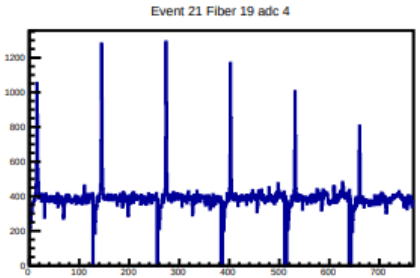
- Here the strip is clearly some random noise fluctuations.
  - Almost all examples look like this

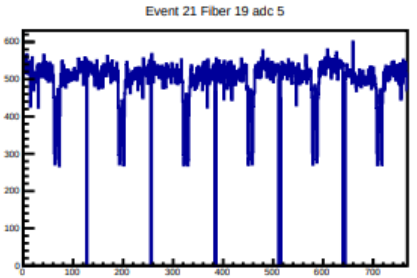


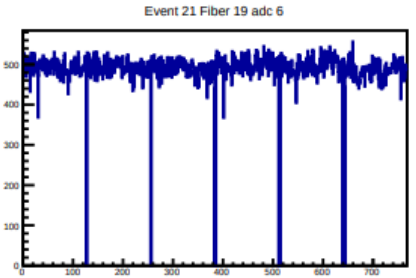


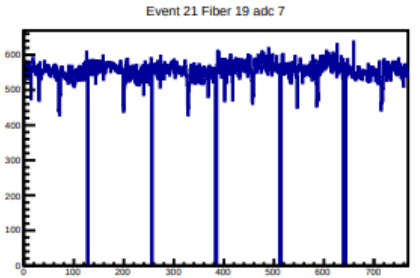


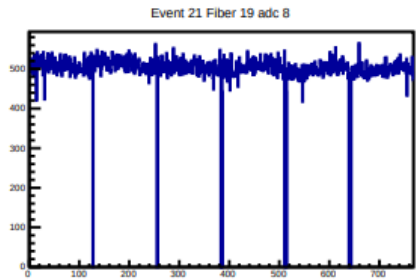


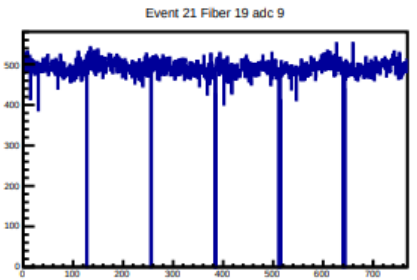


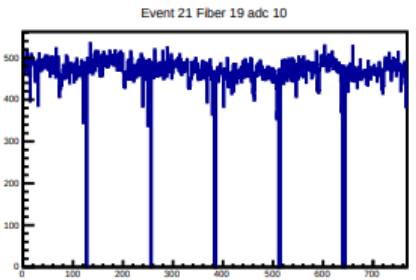


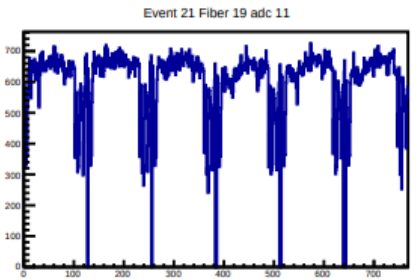


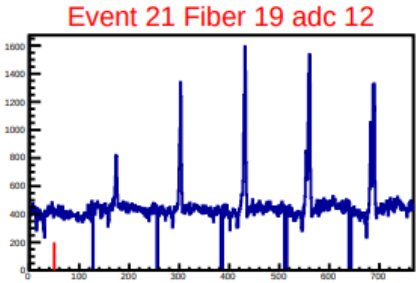


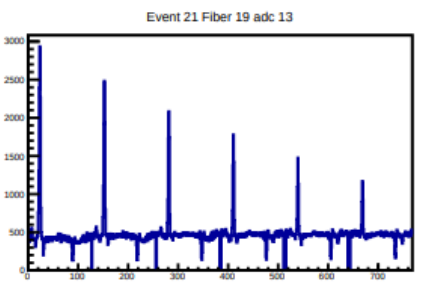


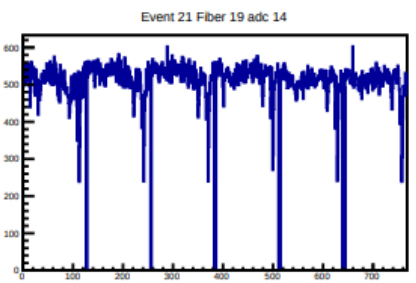




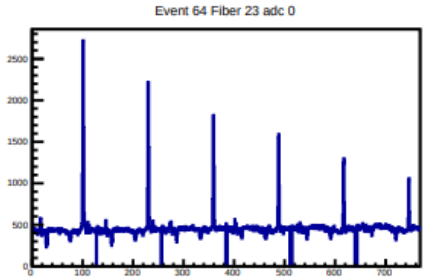


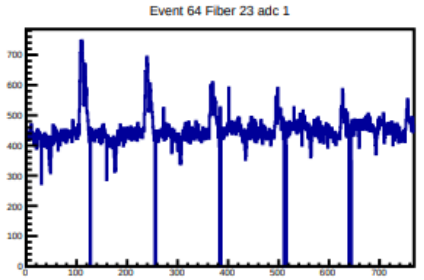


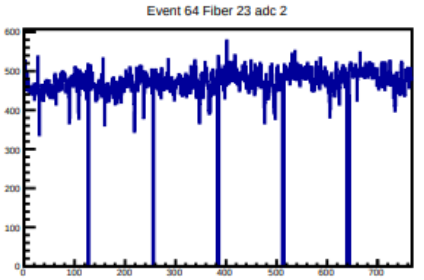


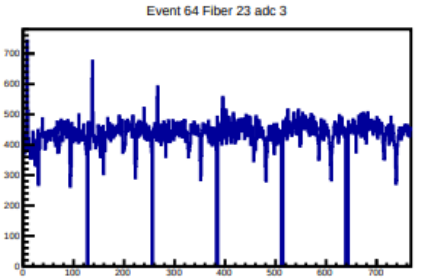


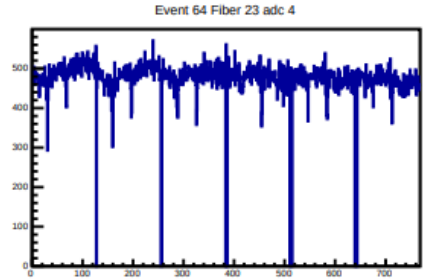
Event Examples

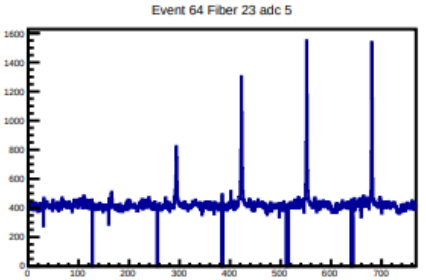


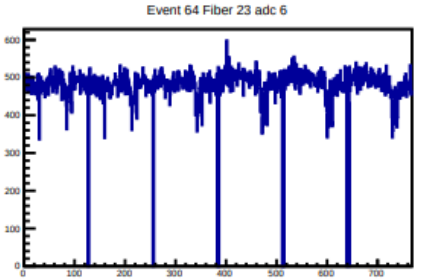


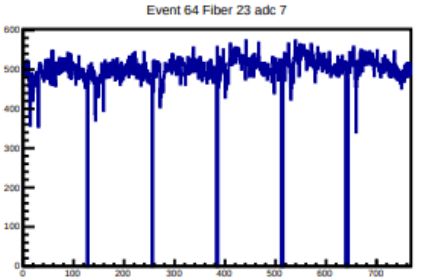


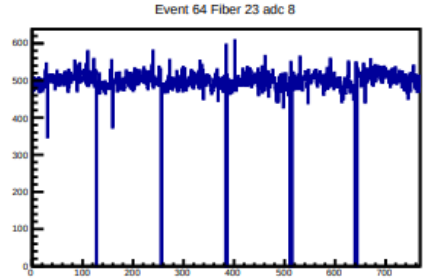


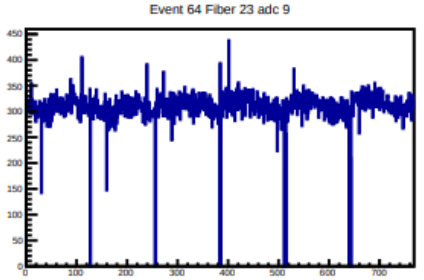


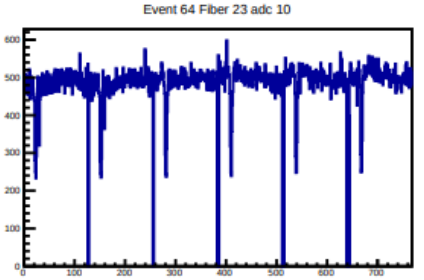


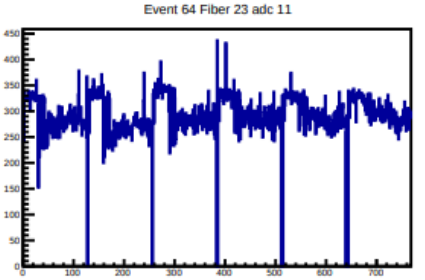


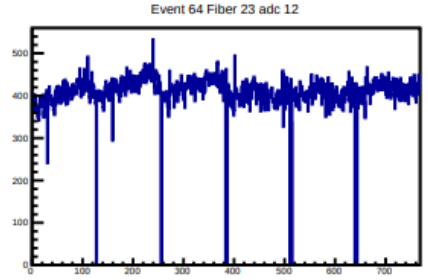


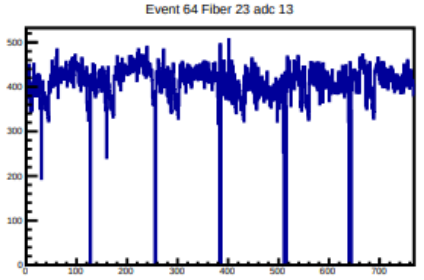


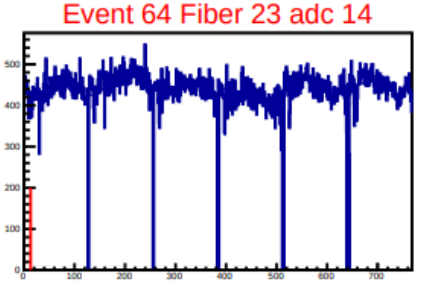






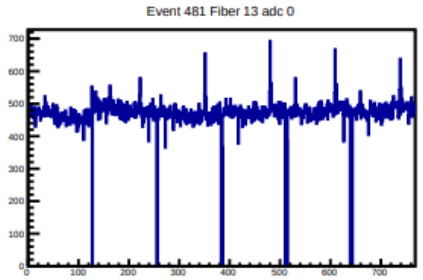


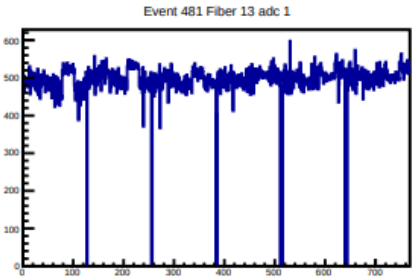


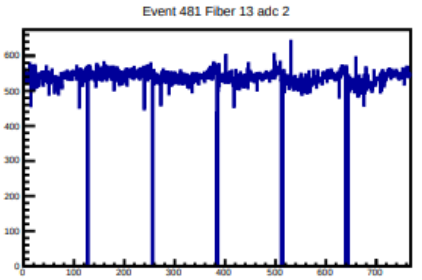


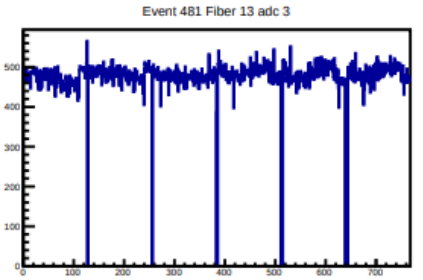
Event Examples

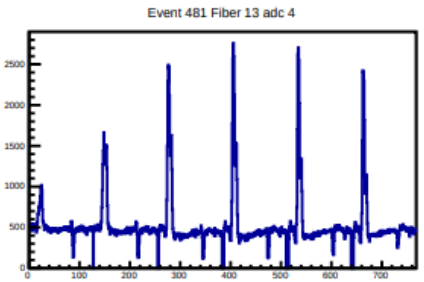
- Some events do like like negative clusters, but a small fraction.
  - Only about 10% of event displays I looked through.

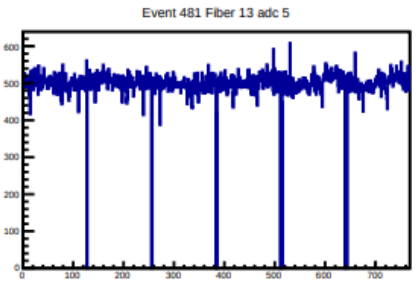


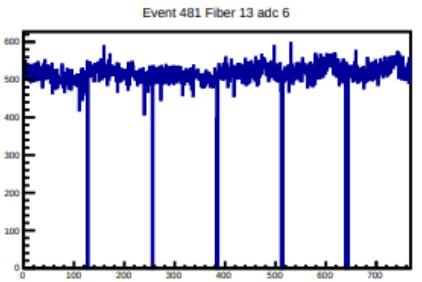


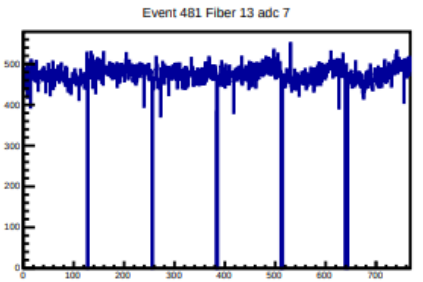


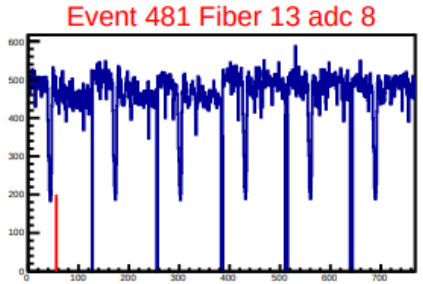


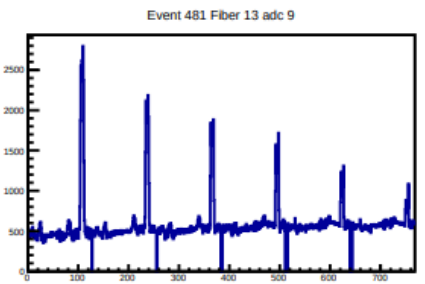


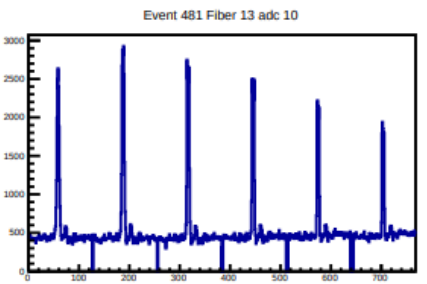


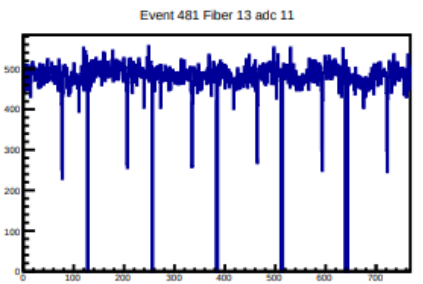


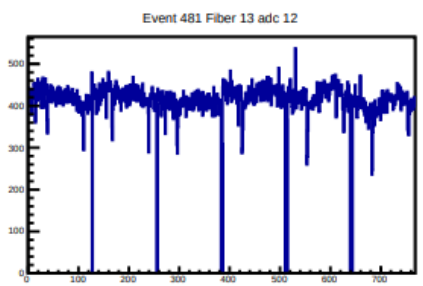


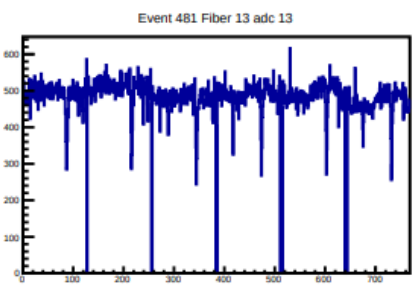


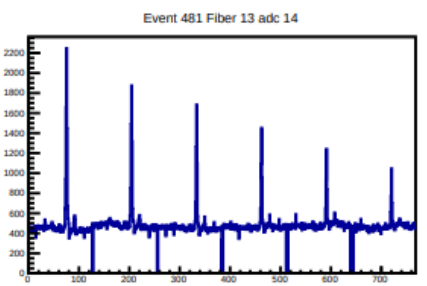






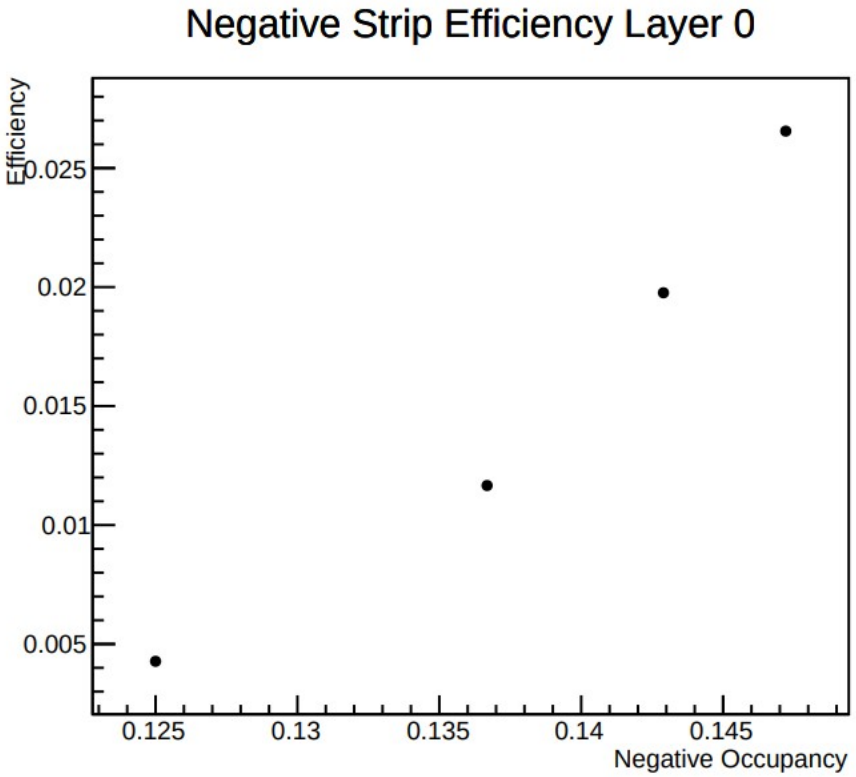


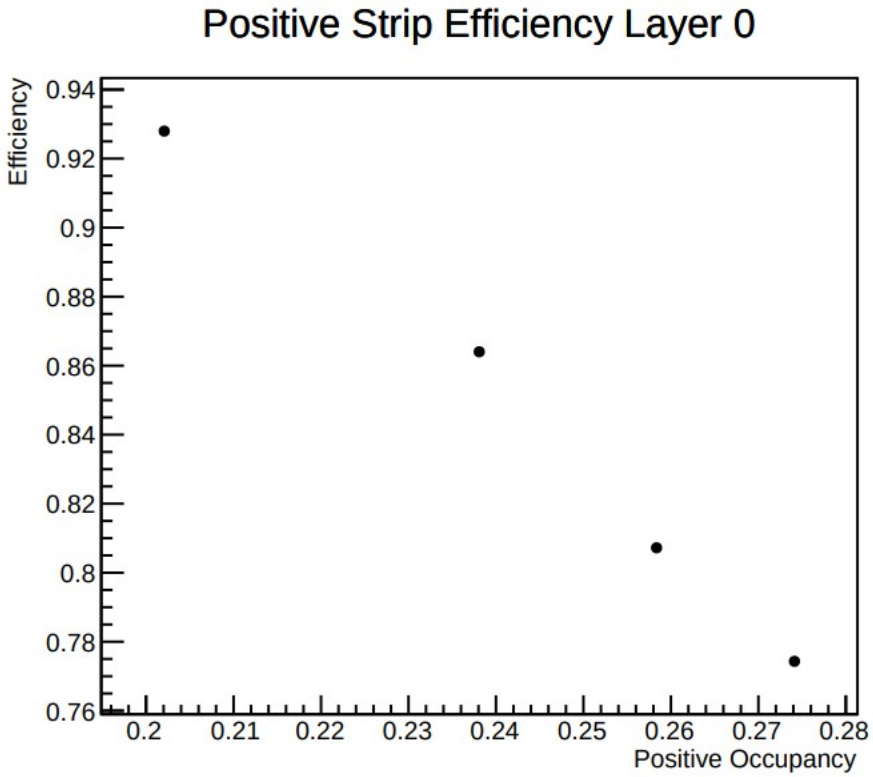




Tracking Efficiency Comparison

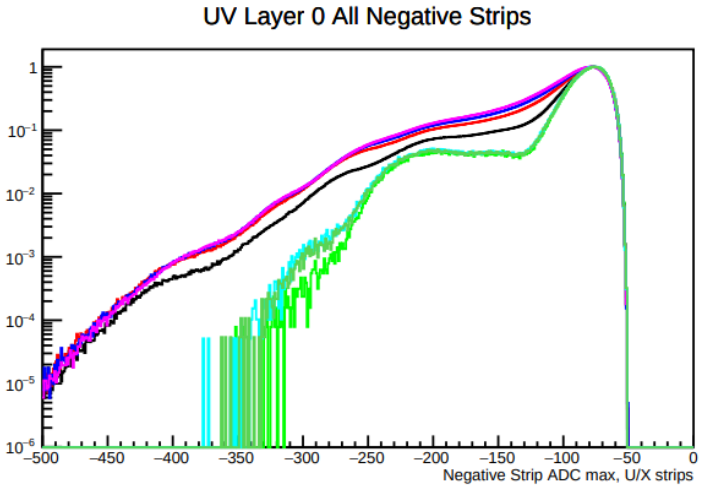
- Below is the tracking results for different beam currents, shown on the x-axis as different negative and positive occupancy
- **All efficiencies shown below are fractions of tracks that "should hit" a module.**
- The negative efficiency increases from 0.5% to 2.5%, likely due to the increased occupancy increasing the probability that a strip is randomly on a track.
- Even if actual good hits are being flipped, it is happening at most 2.5% of the time (in this study).

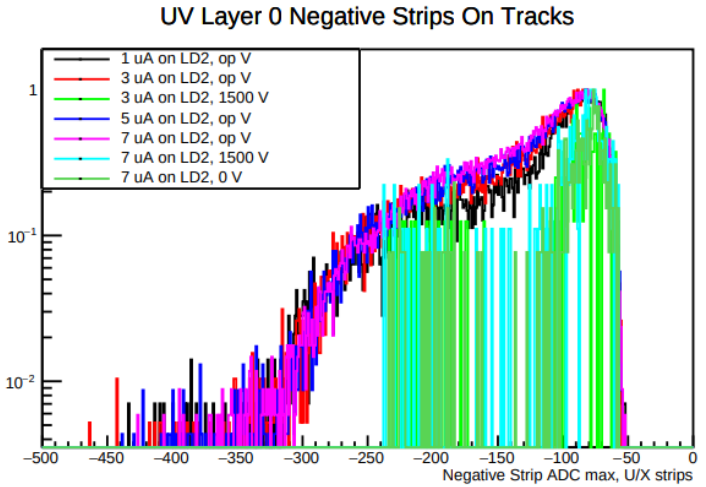


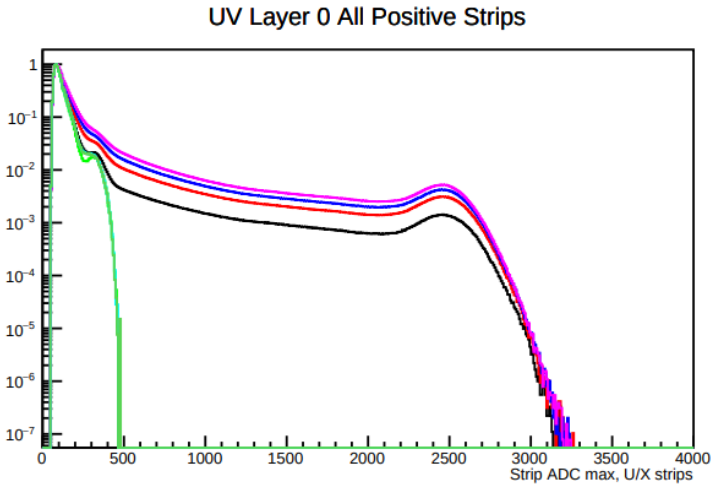


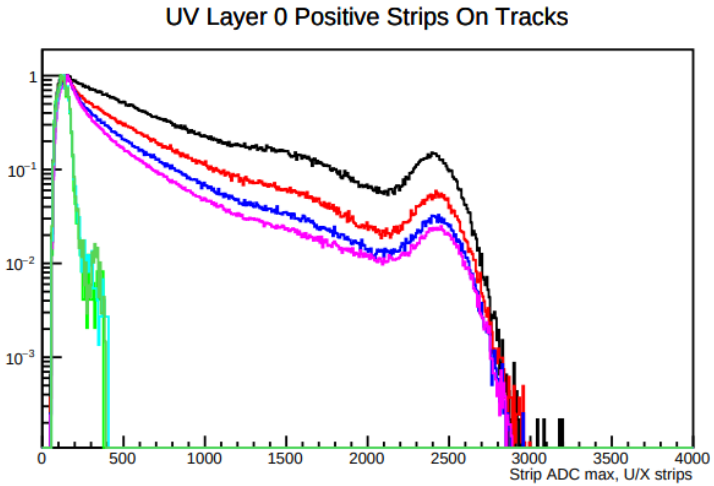
ADC Comparisons

- 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.



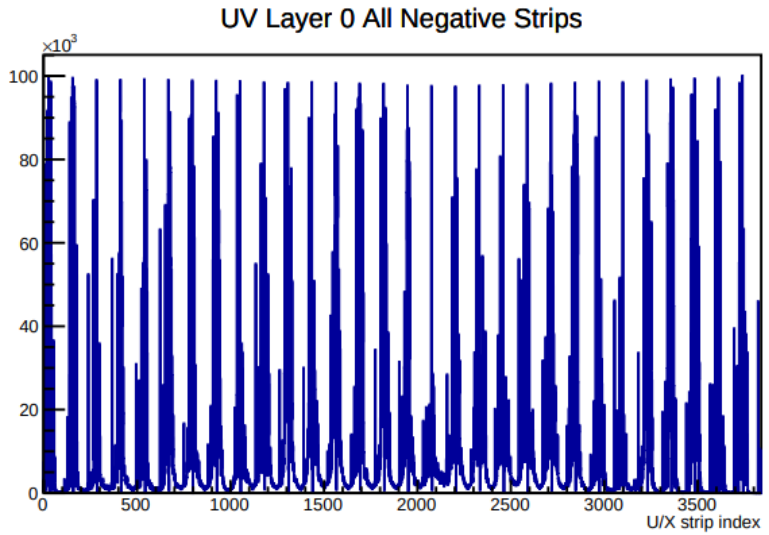


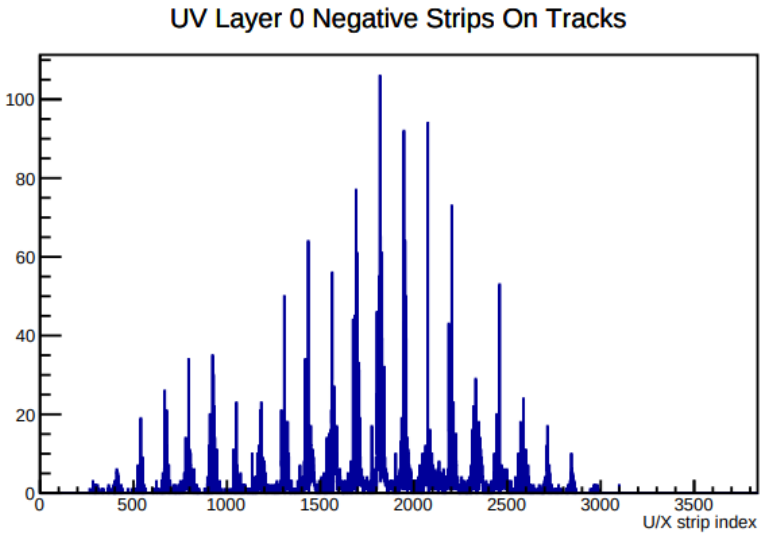


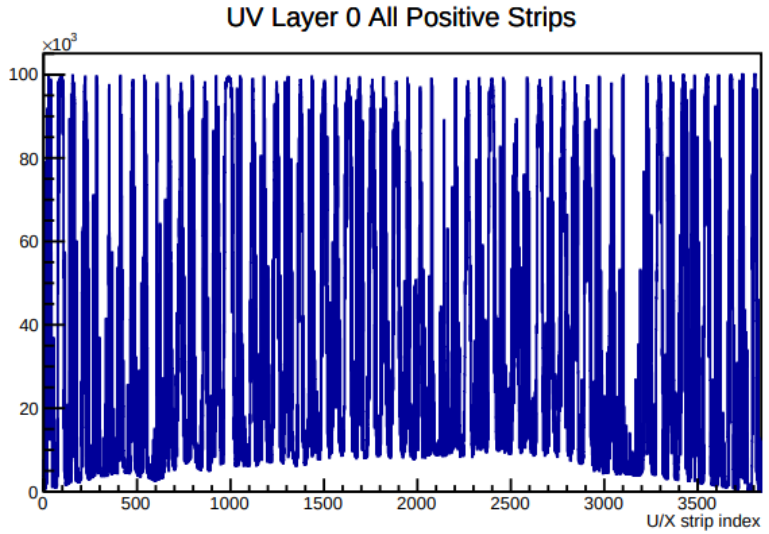


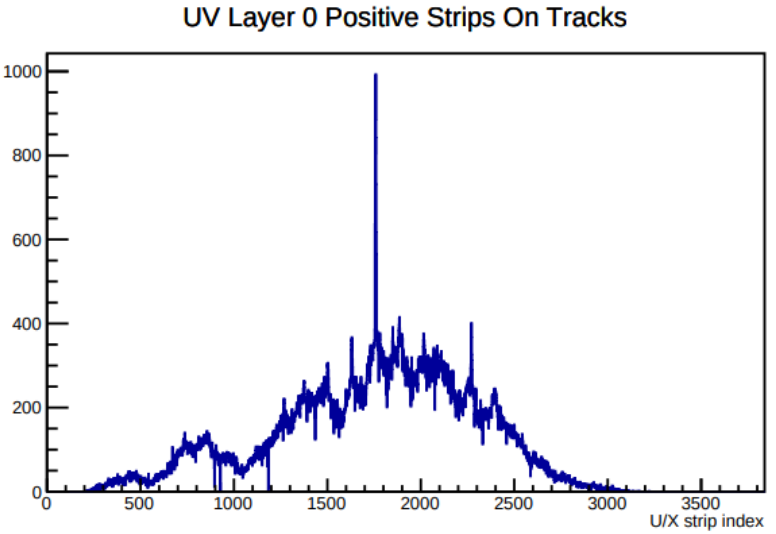
Strip Distributions

- 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.



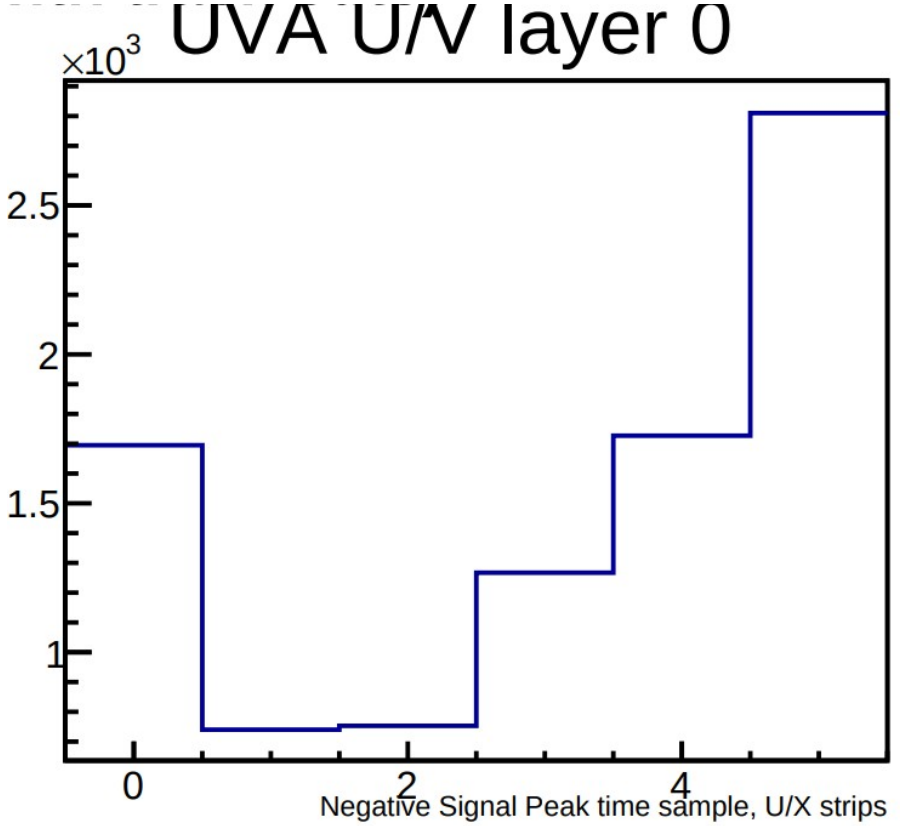






Timing Distributions

- Negative hits on good tracks does not give a good timing distribution, peaking in the center.
- However this can be explained by saturation ruining the shape of the pulse.
  - Cannot conclude that this shape is due to noise.



Conclusions

- See all plots and event displays here, https://logbooks.jlab.org/entry/3986717
- All results of negative hits on tracks point to random noise fluctuations.
  - Very basic tracking done with no clustering
  - Could be improved but would take time
- Only about 0.75% of all events visually had something that looked like a negative cluster on a track.
  - 0.75% number taken by looking though 100 events from the highest current setting
  - At the lowest current setting this number is closer to 0.05%.