Negative Signal Study

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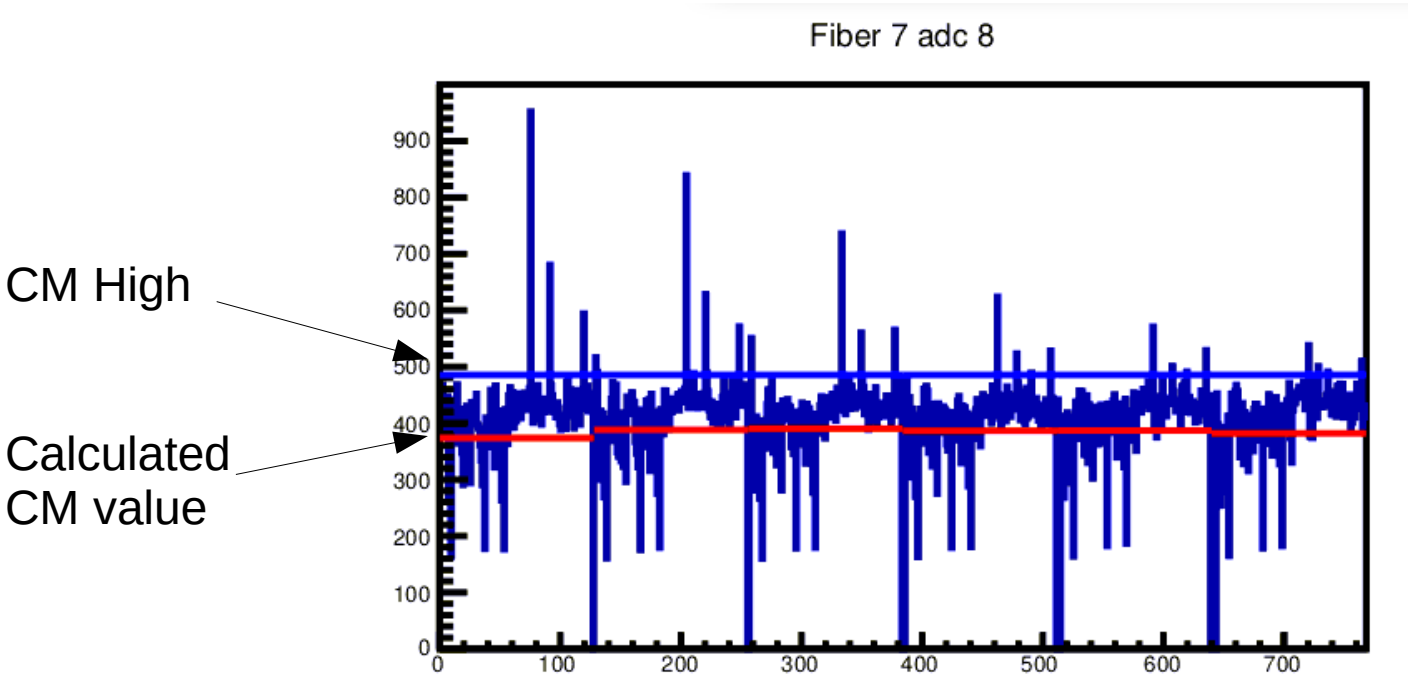
Negative Pulse Study

- Last week we took several runs with beam and full readout to study this effect.
  - 13598 - 1 uA, LD2, GEMs at operational HV
  - 13599 - 3 uA, LD2, GEMs at operational HV
  - 13600 - 3 uA LD2, GEMS at 1500 V
  - 13601 - 5 uA, LD2, GEMs at operational HV
  - 13602 - 7 uA, LD2, GEMs at operational HV
  - 13603 - 7 uA, LD2, GEMs at 1500 V
  - 13604 - 7 uA, LD2, GEMs at 0 V

- All the data I will show will be from one MPD on UV layer 0, to study the simplest case.
- Only 5000 events have been analyzed from each run.

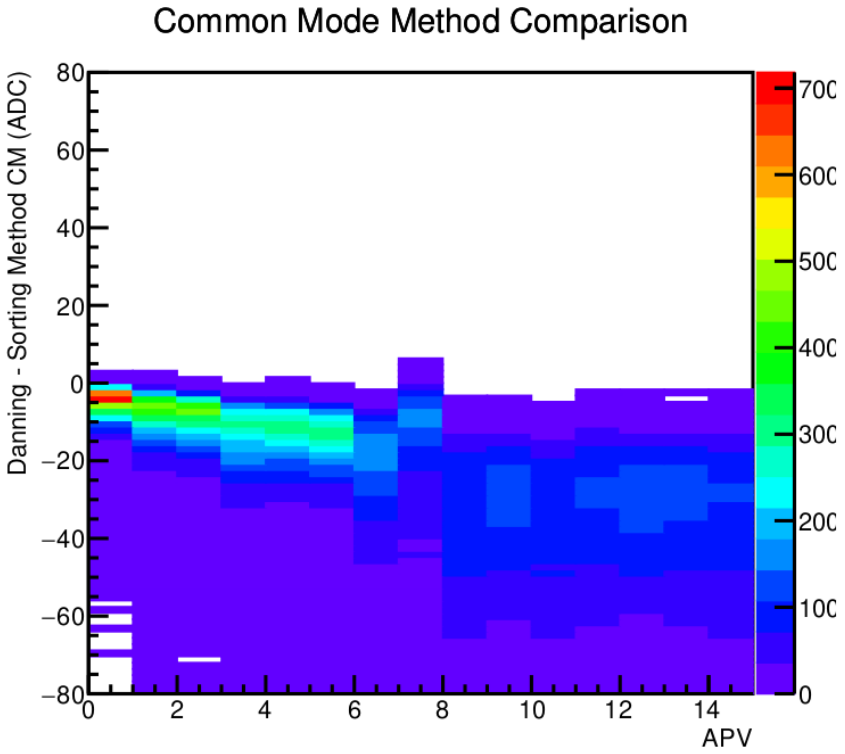
Common Mode Calculation

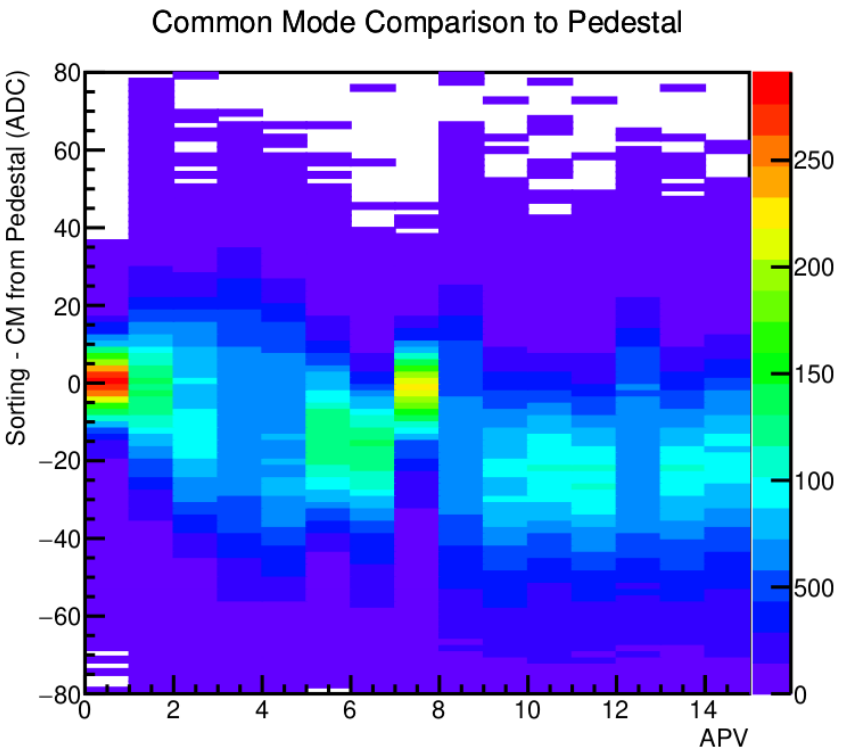
- The DAQ reads in a “high” CM and removes any strips above this number.
- The mean is then calculated and then calculated again with strips < new mean + 3 * ped rms.
- Therefore our current setup uses all strips below these numbers, and are greatly affected by the negative pulses.



Full Readout Events

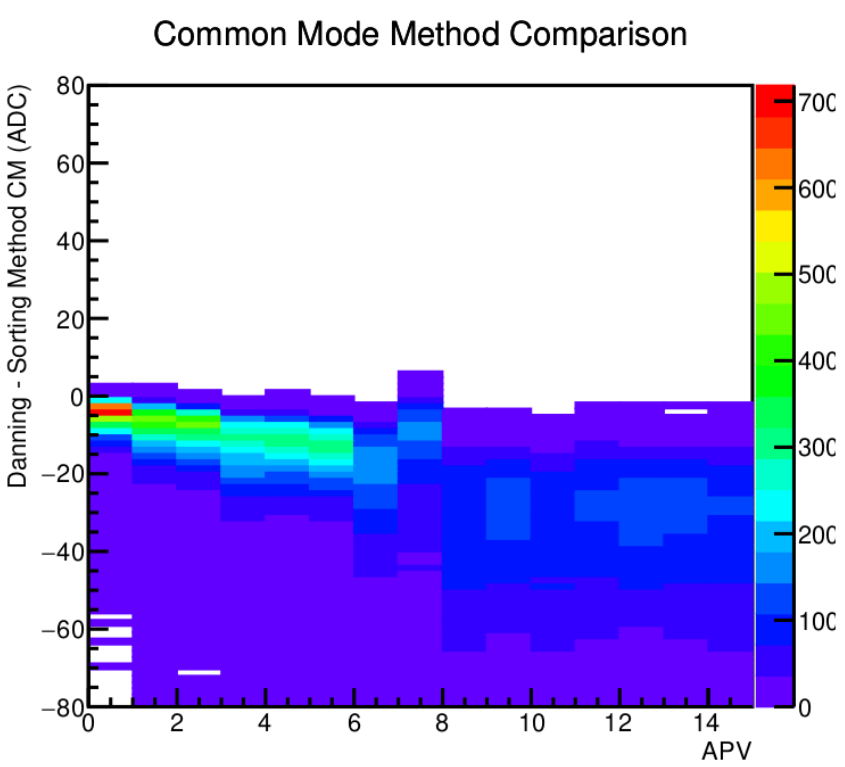
- 100 Events can be seen of the 7 uA run here: https://logbooks.jlab.org/entry/3984280
- Clearly the current Danning calculation is significantly affected by negative signals.
- The sorting method uses only the “middle 20 strips” (in order of ADC) and is resistant to this.
- Due to the APV circuit, we believe the voltage is shifted downward in high occupancy events.
  - Ben suggested that we can use the occupancy to calculate the expected shift.
- On top of this affect the Danning method is also shifted lower from the negative signals.

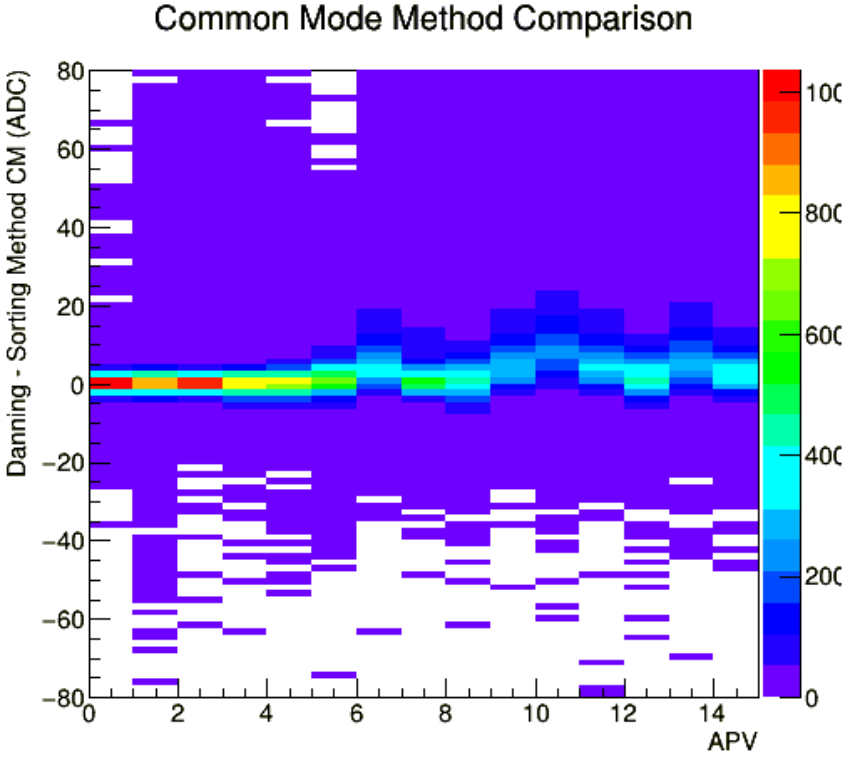




CM Improvements

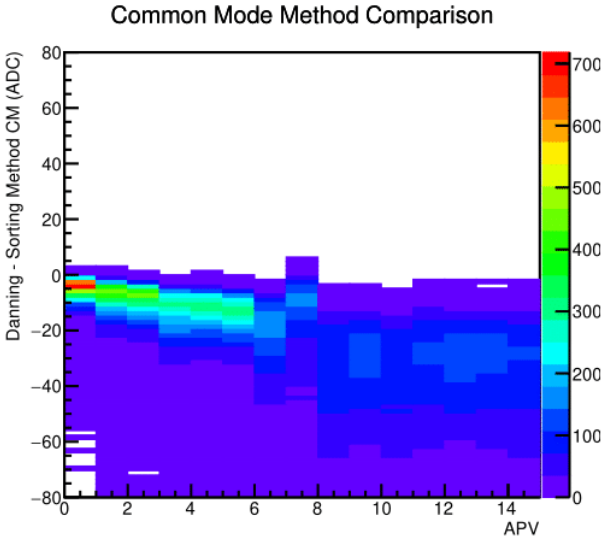
- New CM algorithm:
  - Calculate mean using all strips within 5 RMS of the DAQ CM mean.
  - Second iteration using all strips within 3 RMS of CM mean from last step.
- Improves the CM bias from ~30 ADC in the negative direction to ~8 ADC in the positive direction (from the positive signals).
- We can refine these ideas and implement them.

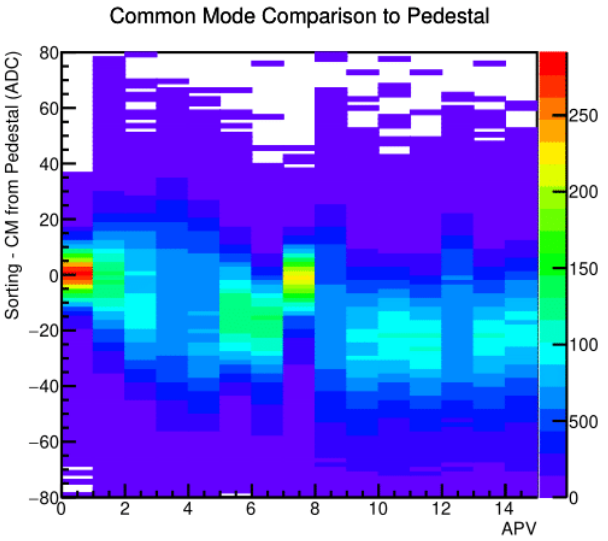


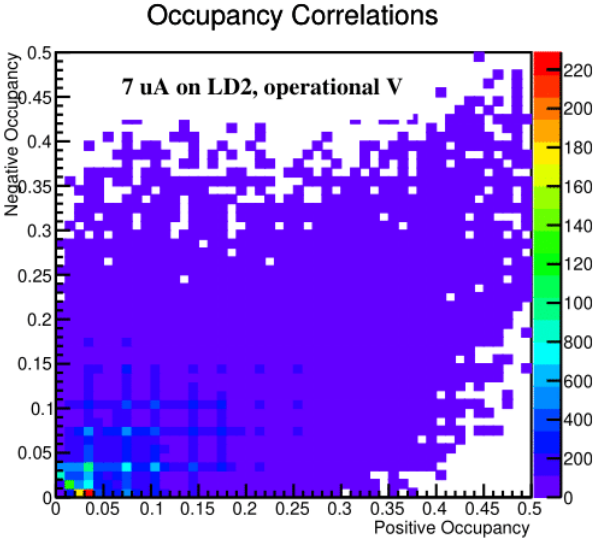


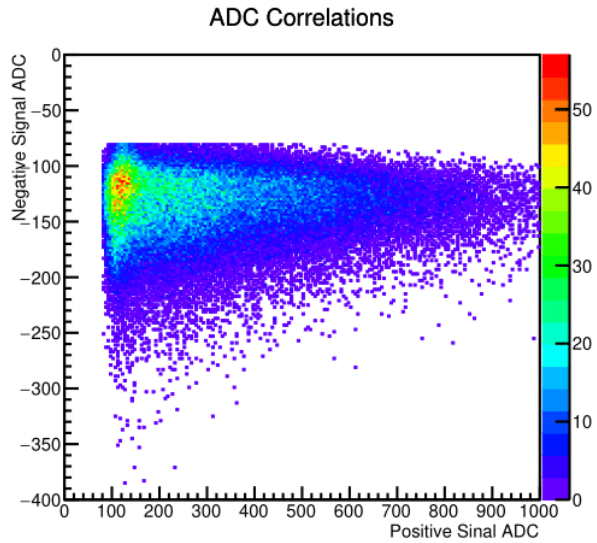
Negative Pulse Analysis

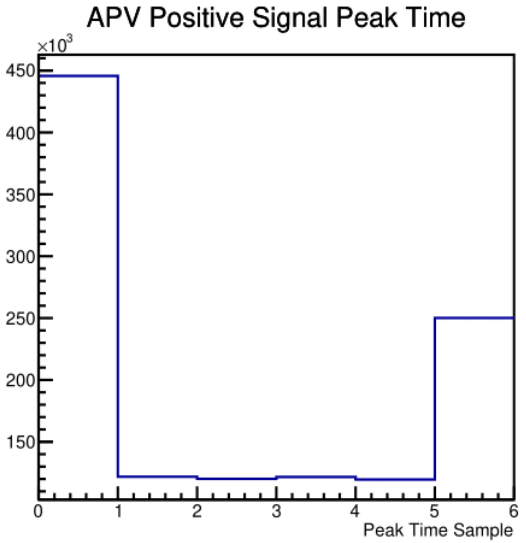
- Using the sorting method to calculate the “correct” ADC value.
- Positive signal as an strip with maximum ADC > 80 and negative as ADC < -80.
- See all the data here: https://logbooks.jlab.org/entry/3984417

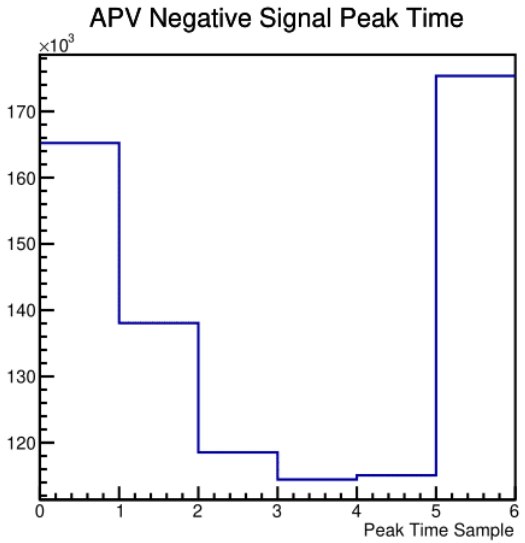






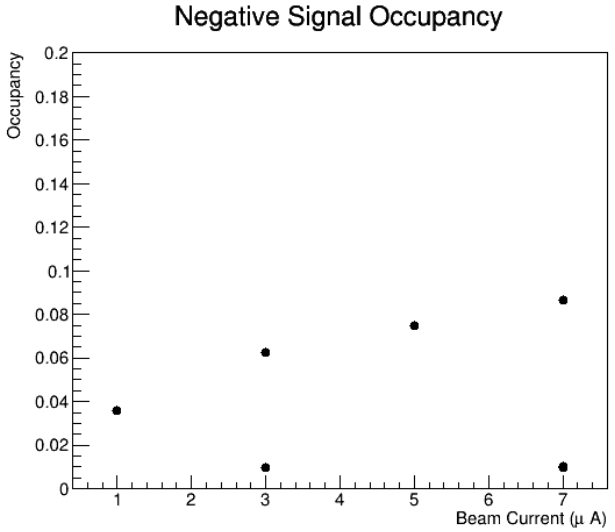


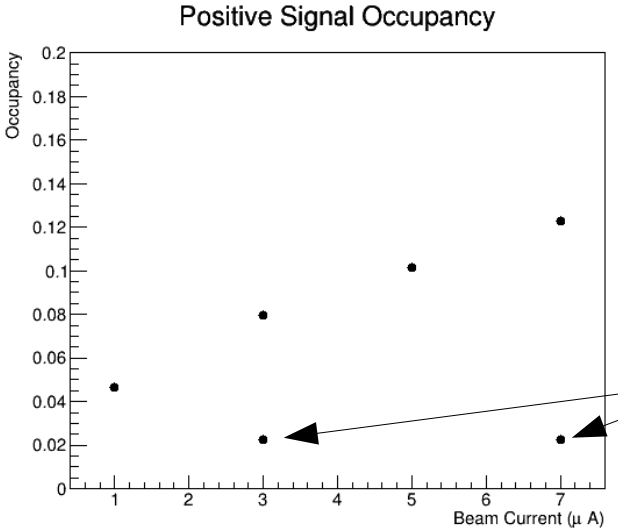




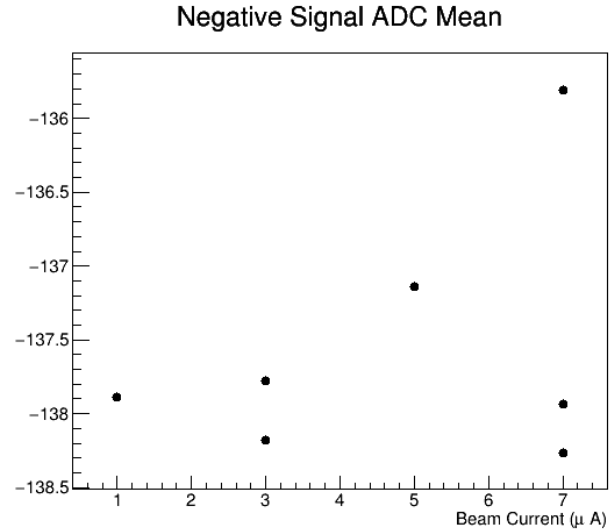
Negative Pulse Analysis

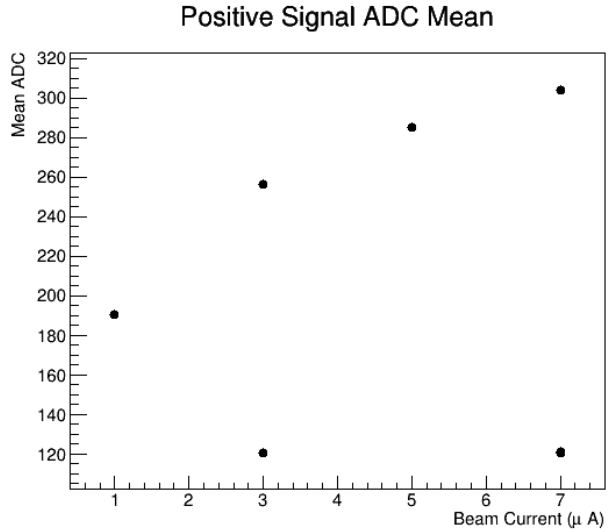
- Summarized all runs from study.
- Negative occupancy increases with beam current, just like regular occupancy.
- Mean negative ADC signals is largely constant throughout the entire study.





Runs with 0 or half Voltage





Work In Progress

- Still testing if negative of positive strips are ever “flipped”
  - Preliminary results say no
- Calculate the expected CM shift from the APV circuit.
- Use tracking to see if negative strips are often in the area that we expect a hit.
- Understand the source of the negative pulses.