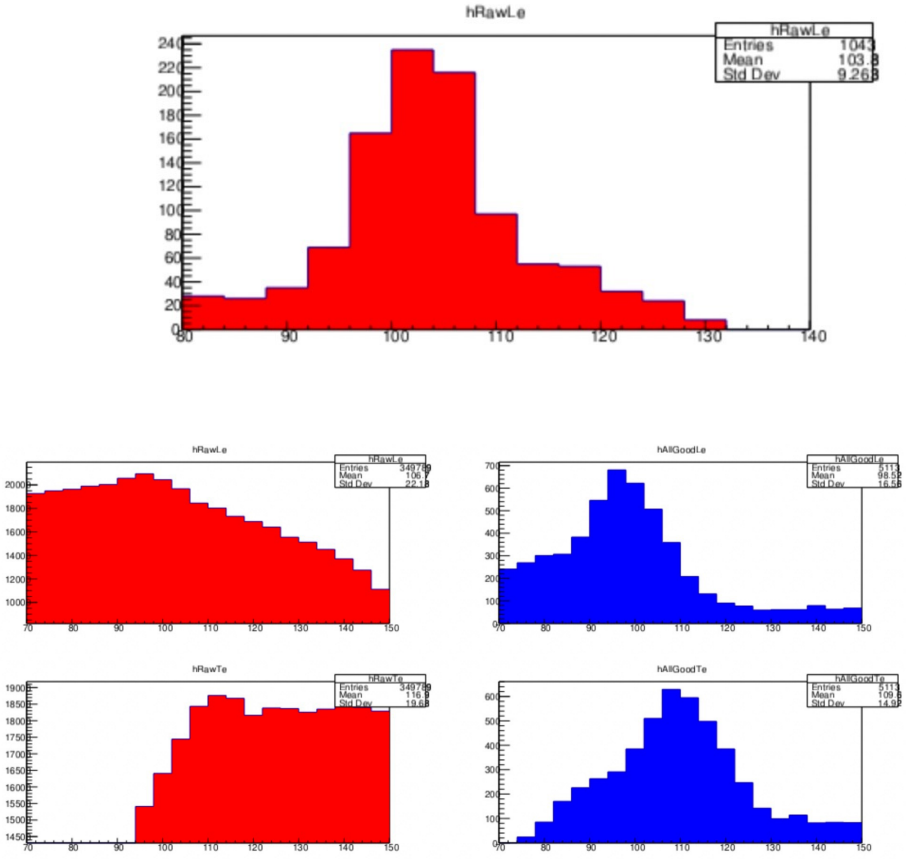
CDet Update

April 29, 2025

CDet Readout Latency and Window

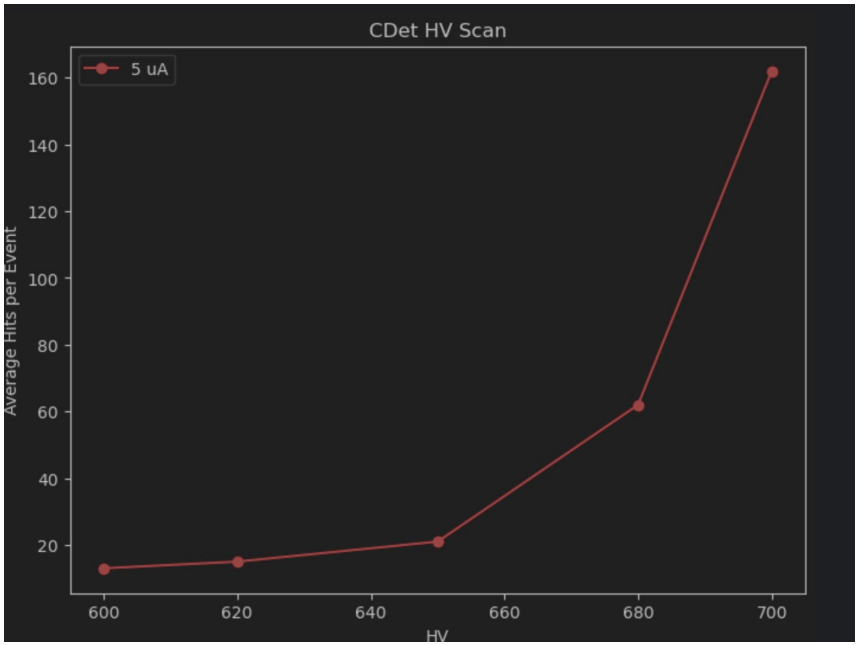
- Latency = 3216 ns, Window = 52 ns
- Clear peak in timing spectra – established at low current running

- Issue: Currently, we use the vfTDC trigger time that is read out on per slot basis (this time is synchronized across all slots). The resolution on this trigger time is 4ns in these modules.
- Mitigation: Use additional vfTDC for trigger signal reference time (as in Hall B)



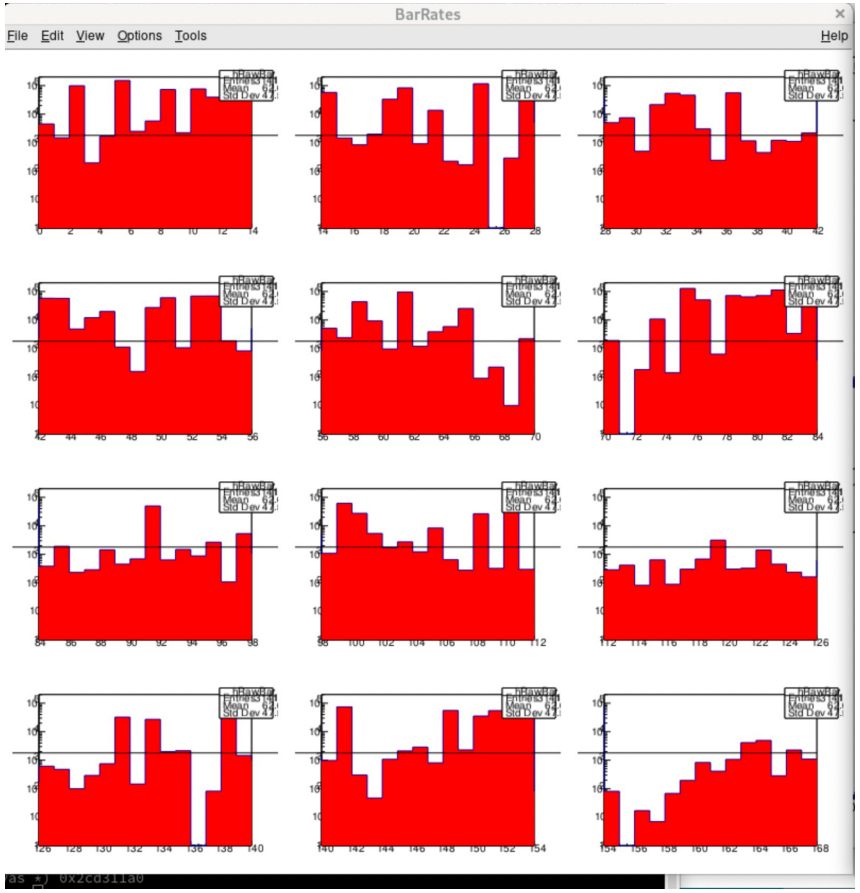
CDet HV Scan

- Five runs at 5uA on LH2 – 600V, 620V, 650V, 680V, 700V
- Goal is to determine optimum operating voltage that minimizes hits that are unrelated to primary electron from the target, and maximizes detection efficiency.



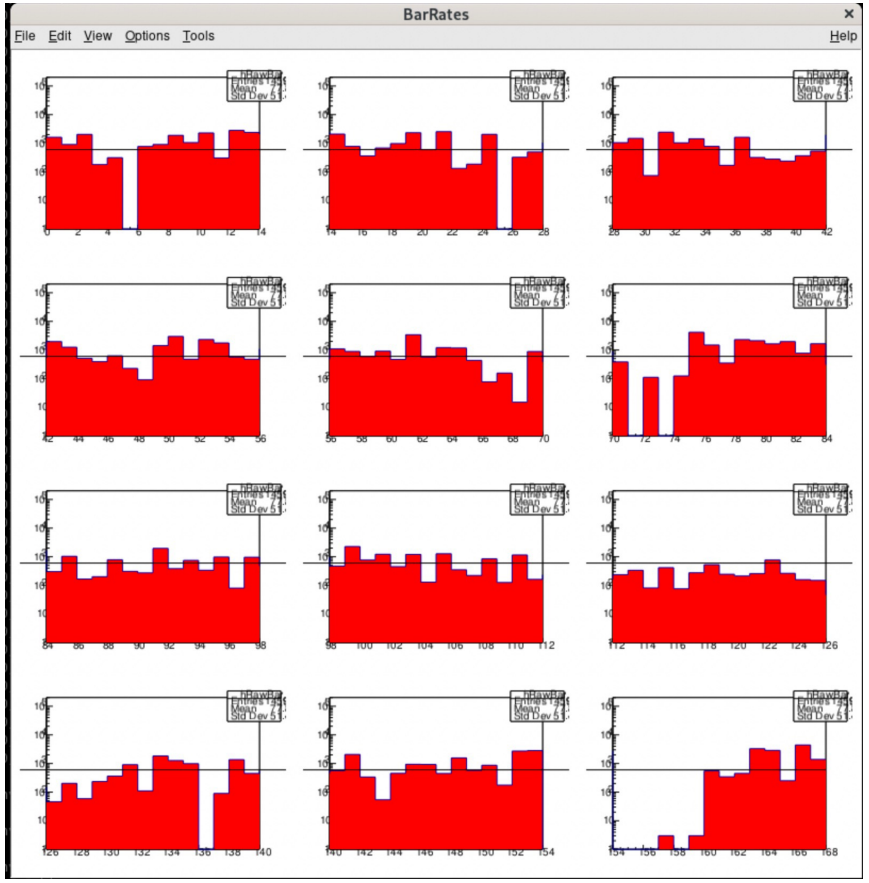
Hot/Missing Channel Issues

- Identified about 60 maPMT channels (out of 2688) that are firing at rates > 20 times naïve expectation
- Identified 4 bars (groups of 16) that have zero hits
- Issues with Layer 2, Module 3, Right, First Half

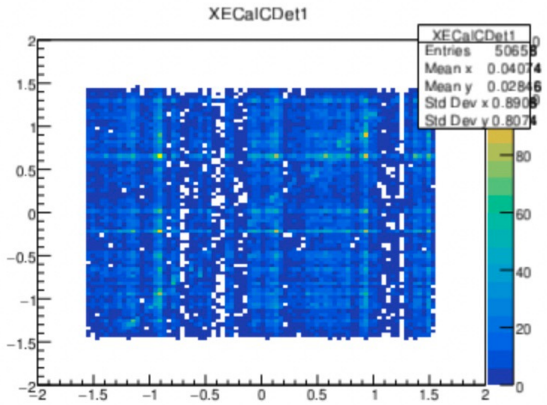


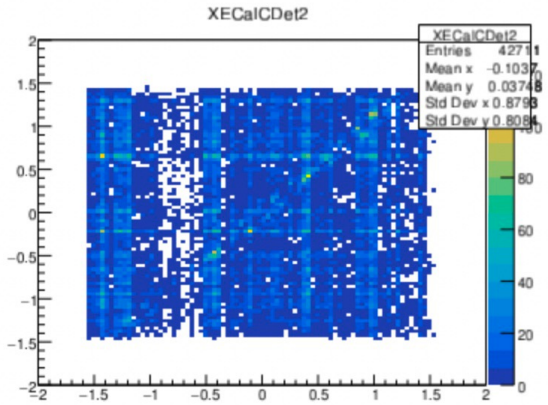
Cleanup of Hot Channels

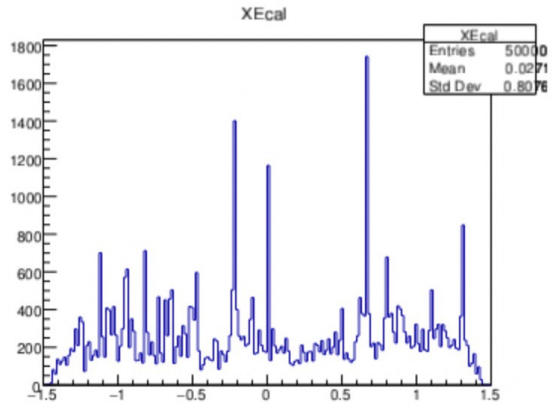
- After applying suitable cuts on TDC LE time, Time-over-threshold, rough correlation with ECal X position, and hit multiplicity, we can reduce background from hot channels reasonably.

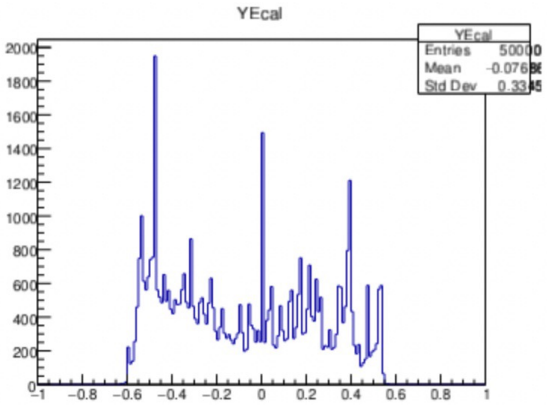


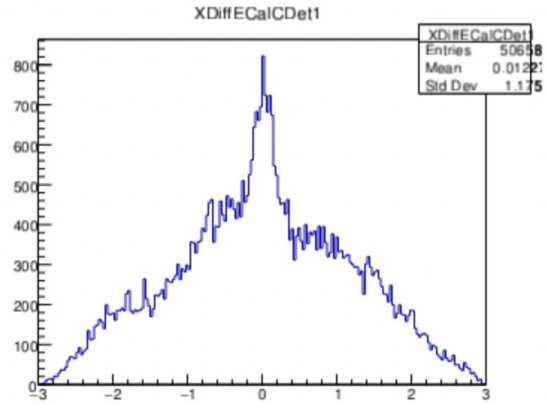
ECal Position Correlations (HV = 650 V)

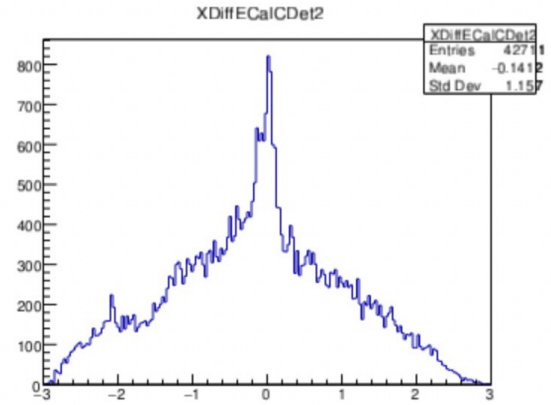












Issue: CDet effect on livetime/deadtime

- Observation is that at “higher” beam currents, including CDet in the readout decreases livetime (e.g. 55% -> 30%)
- Possible explanations:
  - Larger event size due to “hot" channels/bars
  - Crate busy configuration? (Alex)

```
Rate: 13 hits/event, Bytes/event: 304 bytes, Data rate: 1.06 MB/s
Rate: 15 hits/event, Bytes/event: 320 bytes, Data rate: 1.12 MB/s
Rate: 21 hits/event, Bytes/event: 368 bytes, Data rate: 1.29 MB/s
Rate: 62 hits/event, Bytes/event: 696 bytes, Data rate: 2.44 MB/s
Rate: 162 hits/event, Bytes/event: 1496 bytes, Data rate: 5.24 MB/s
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Status/Plans

- Further investigation of “hot” channels
  - Rate is correlated with beam current … “pile up” effect from lower energy particles?
  - Optimization of HV on a per maPMT basis … looking at relationship to testlab voltages
- Operating voltage of 650V gives reasonable apparent efficiency without an excessive amount of extraneous uncorrelated hits
- Request: Another HV Scan (1-2 hours) at the next kinematic setting at lower current (~few uA)
- Investigate configuration of busy setup in crate