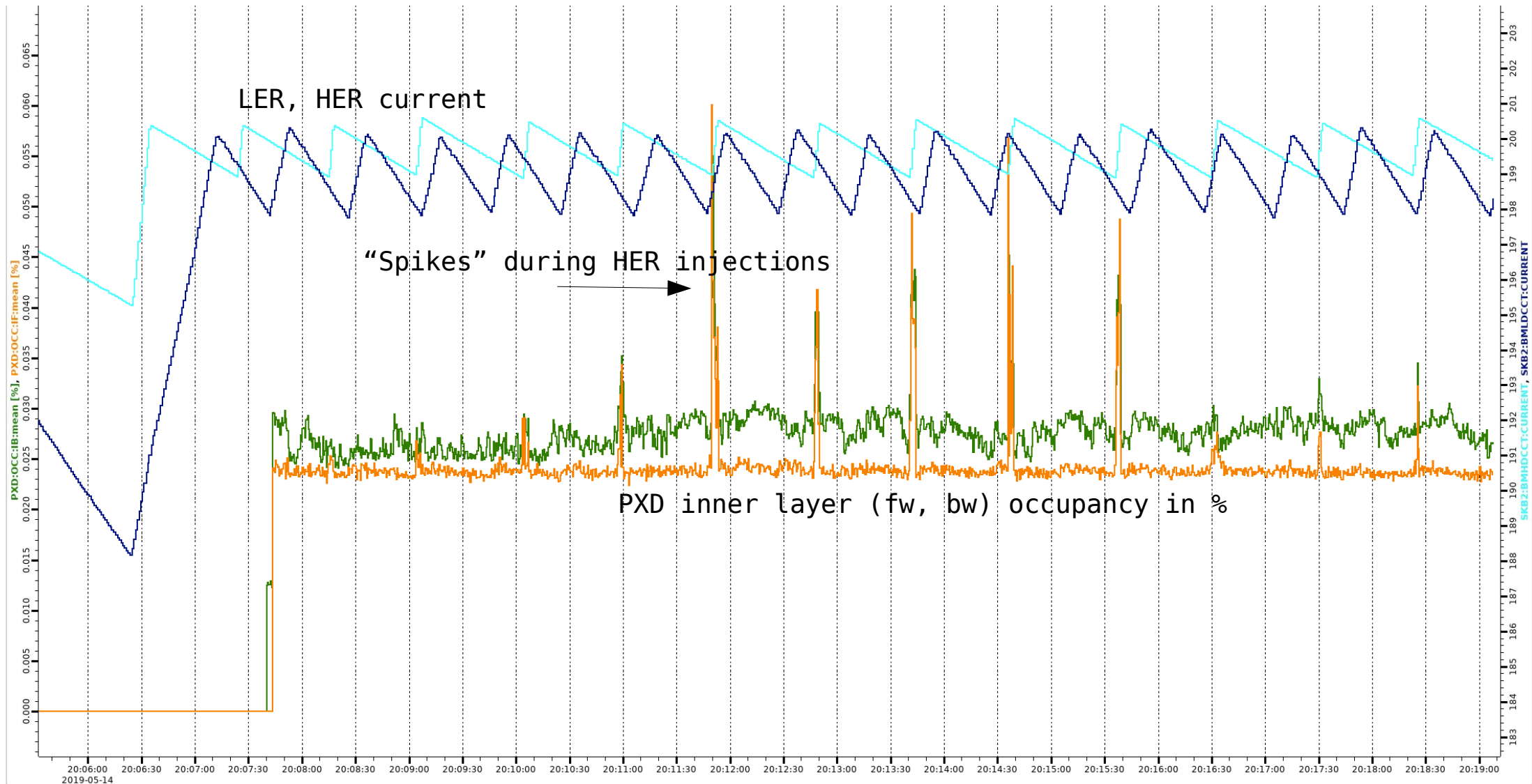
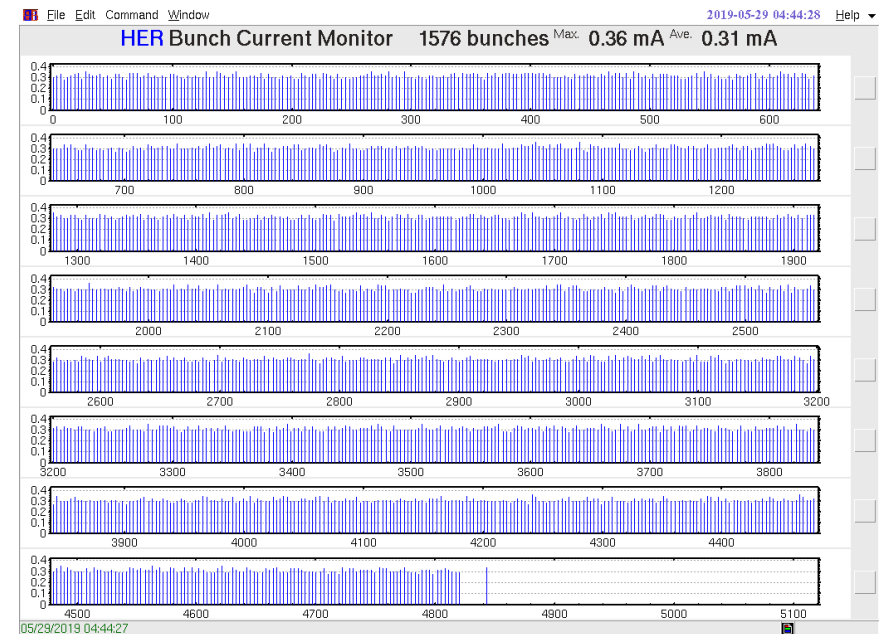


Continuous Injection, ROI Selection, DQM \leftrightarrow Performance

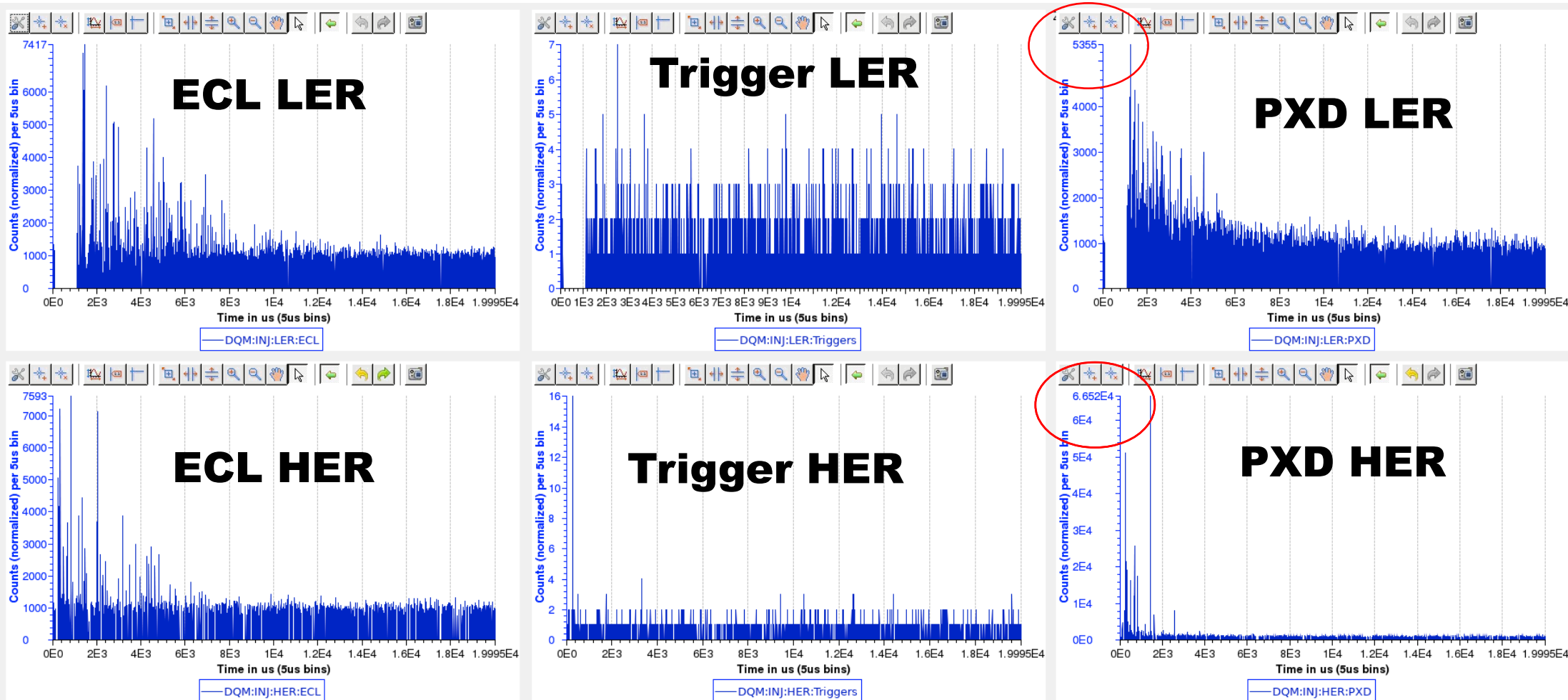
- Moved to continuous injection to increase the luminosity (to lumi drop during beam decay, no wasted time for run stop/HV off for refill)
- Refill Buckets if current has dropped (not really continuous)



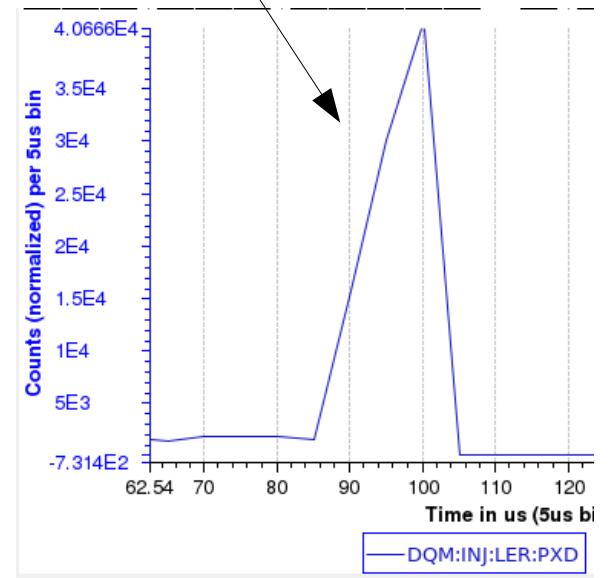
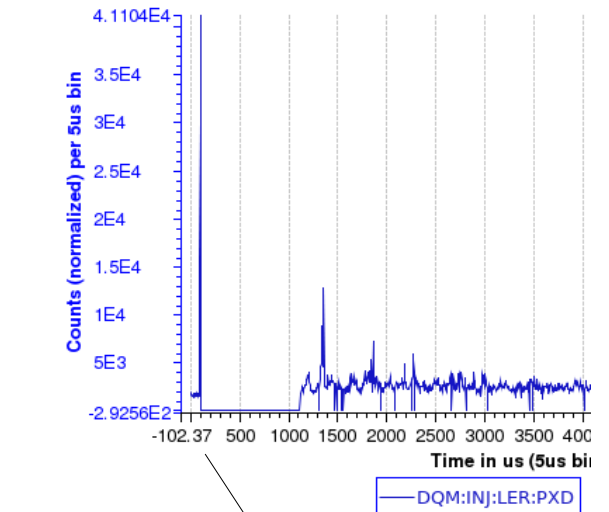
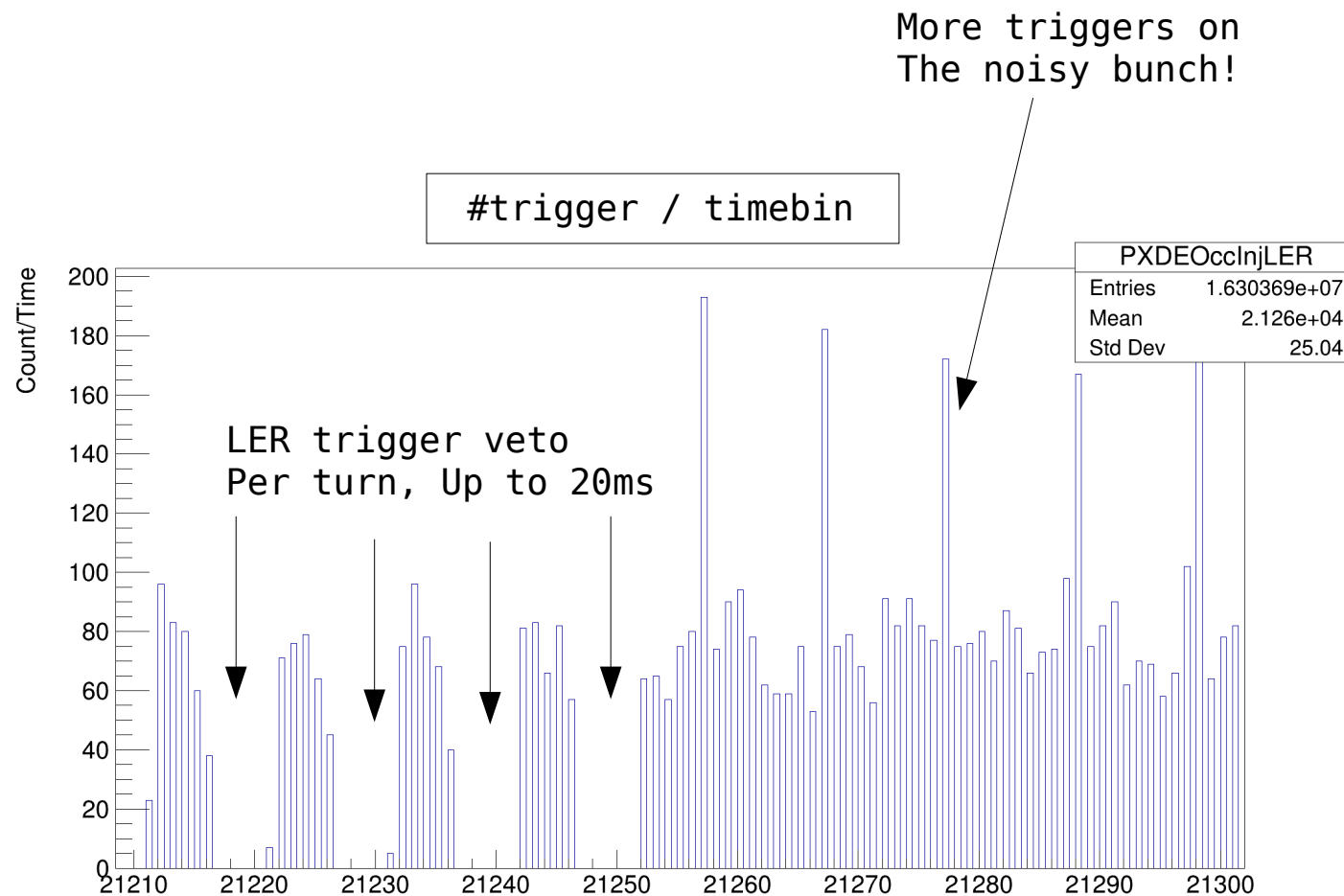


- Bunches are refilled with 6.25, 10 or 12.5 Hz (→ goal 50 Hz)
 - Changed the number of bunches and beam current after optimizing injection
- The following plots sum over several bunches and several injection
- But folded with trigger(!)
- Time after injection (and if LER/HER) is encoded in the FTSW TTU/trigger packet

- #nr of Hits after Injection (kicker signal)

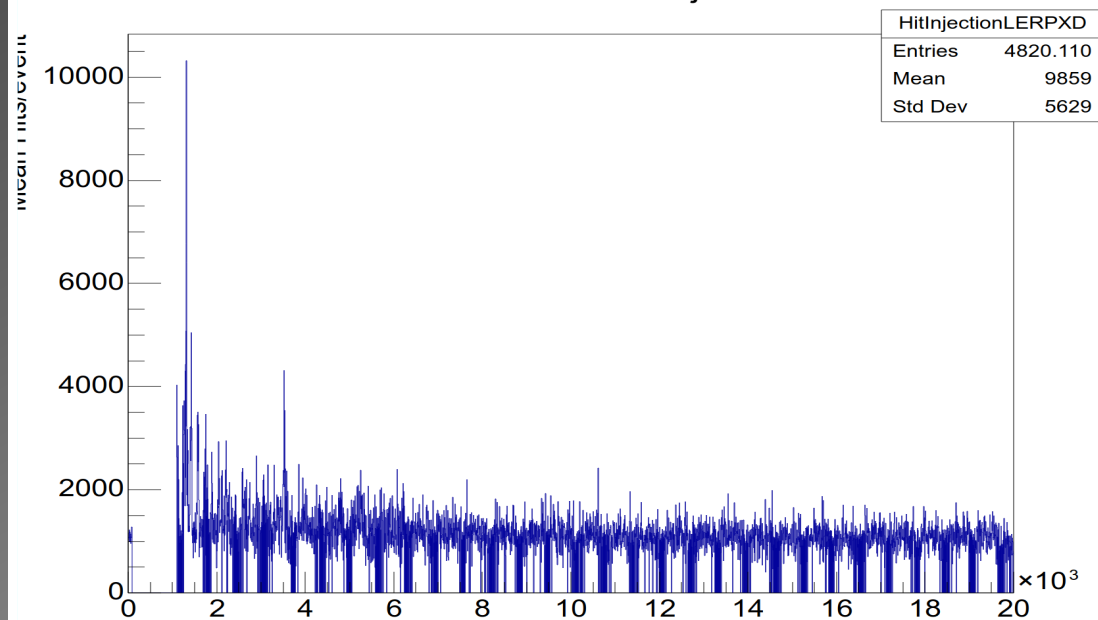


- Can be used to set (and check) trigger veto and gated mode

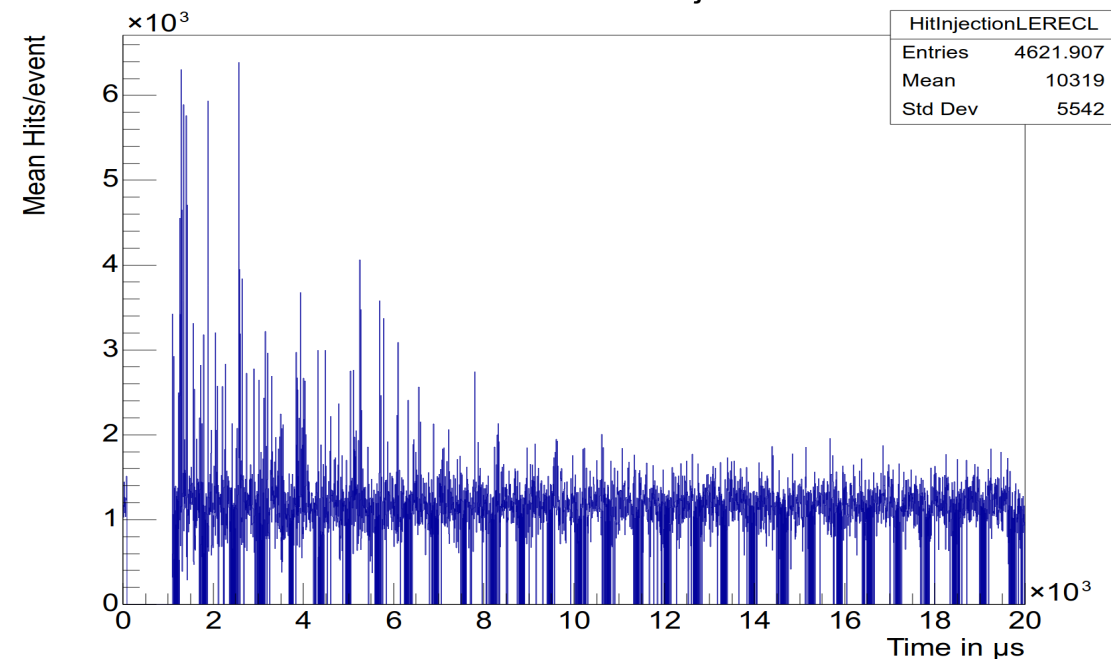


Trigger Full Veto
was ~15us too late

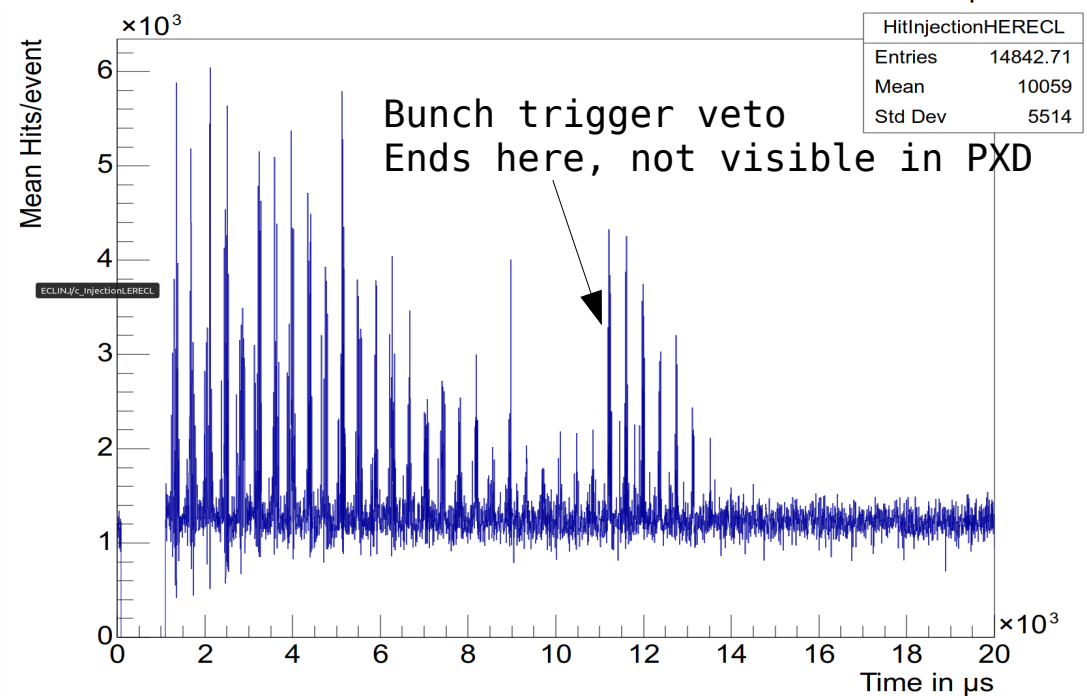
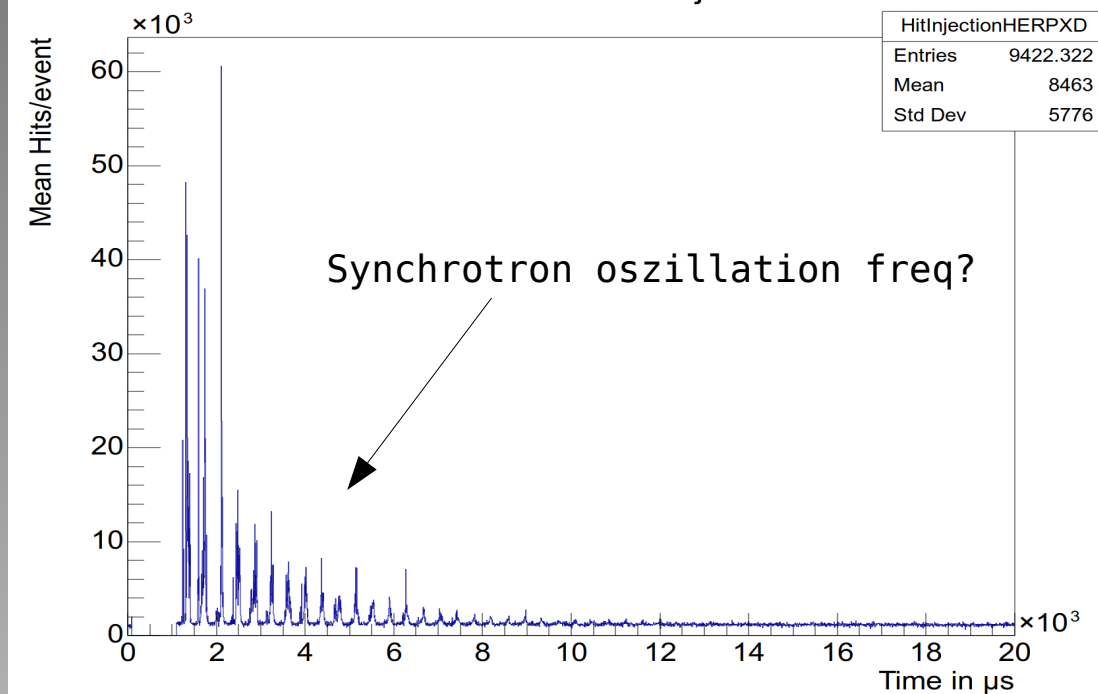
PXD Hits after LER Injection



ECL Hits after LER Injection



PXD Hits after HER Injection

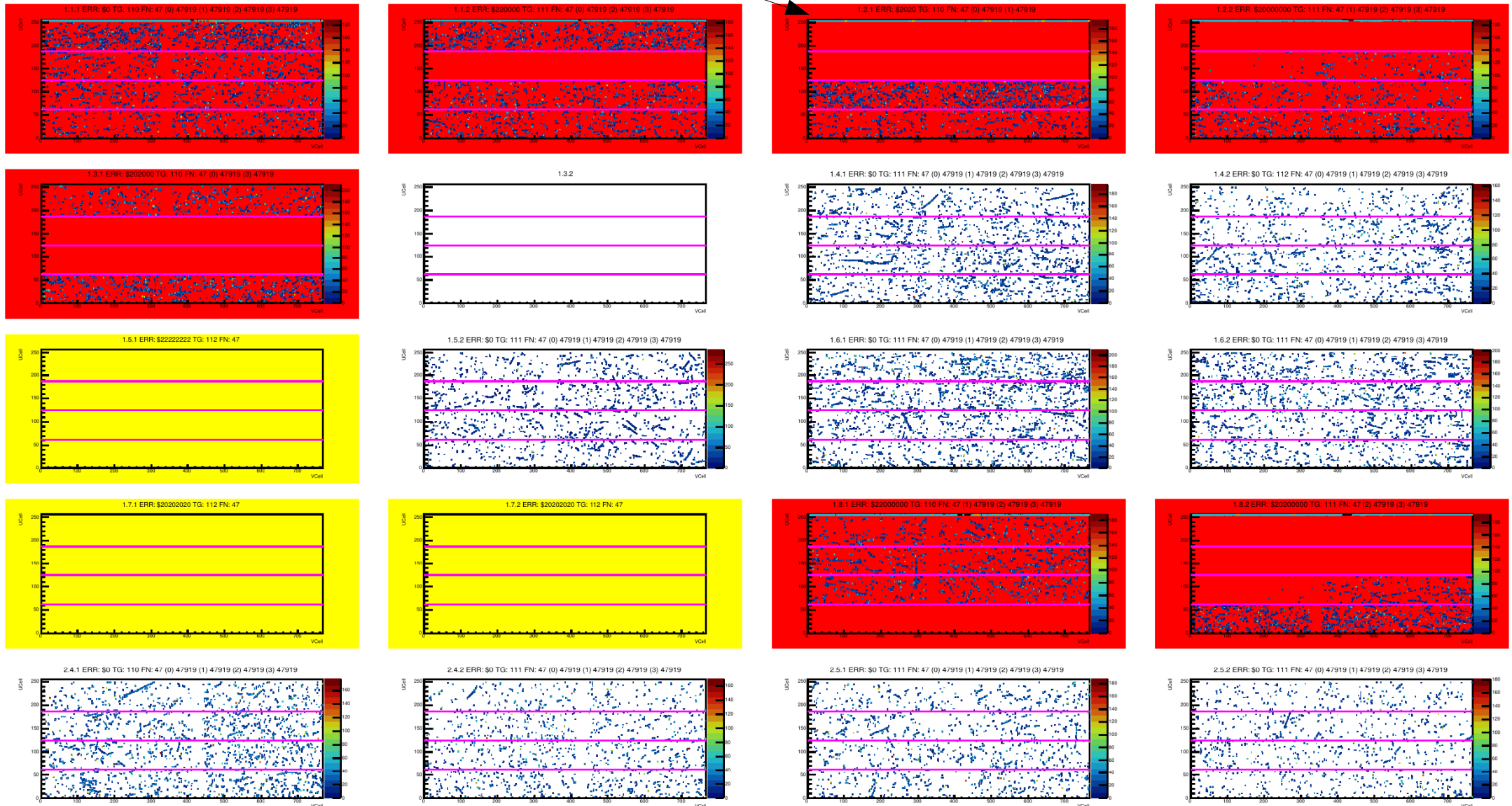


Loss of Data Due to High Occupancy During Injections

<https://pxd.belle2.org/DQM/qasrv/fwtests/>

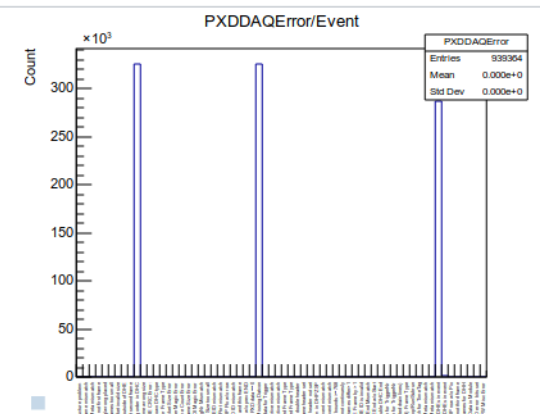
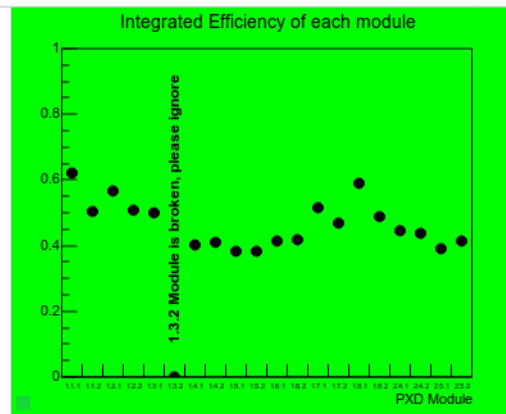
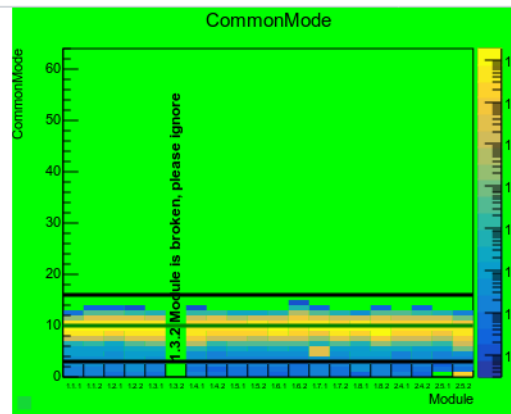
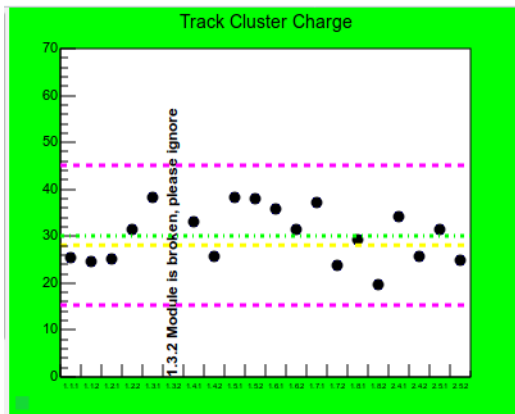
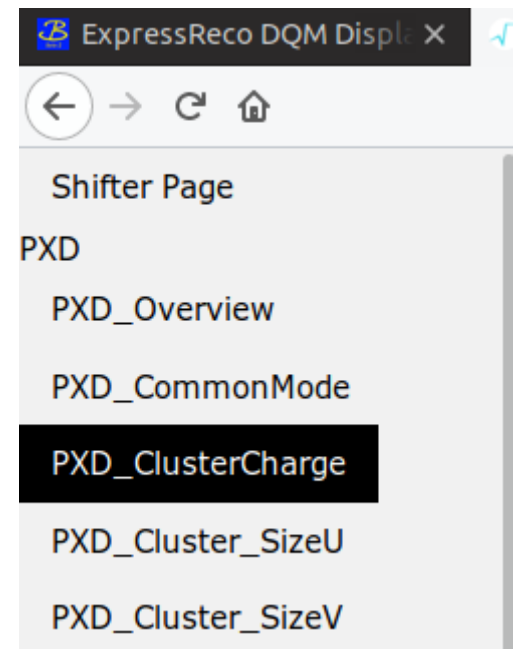
Yello: DHE_End Error Flags

Red: CM 63 ... plotted as top line



(with the firmware used in e8r333, the errors “recovered” after few events)

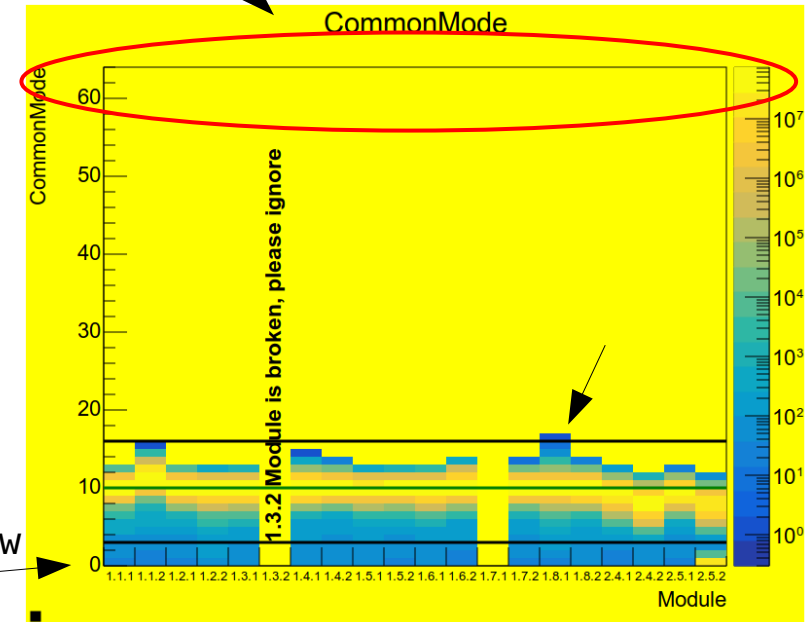
- Analysis and histogram filling on ERECO, does process subset of events
- DQM analysis on histogram basis (fit and/or decide about acceptable limits)
- But: Too many histograms nobody is looking at, mainly we cannot read off directly useful information (Cluster charge, size ...)
- Matching with other detectors needed to select triggered data from physics/non-physics background, noise, etc ...



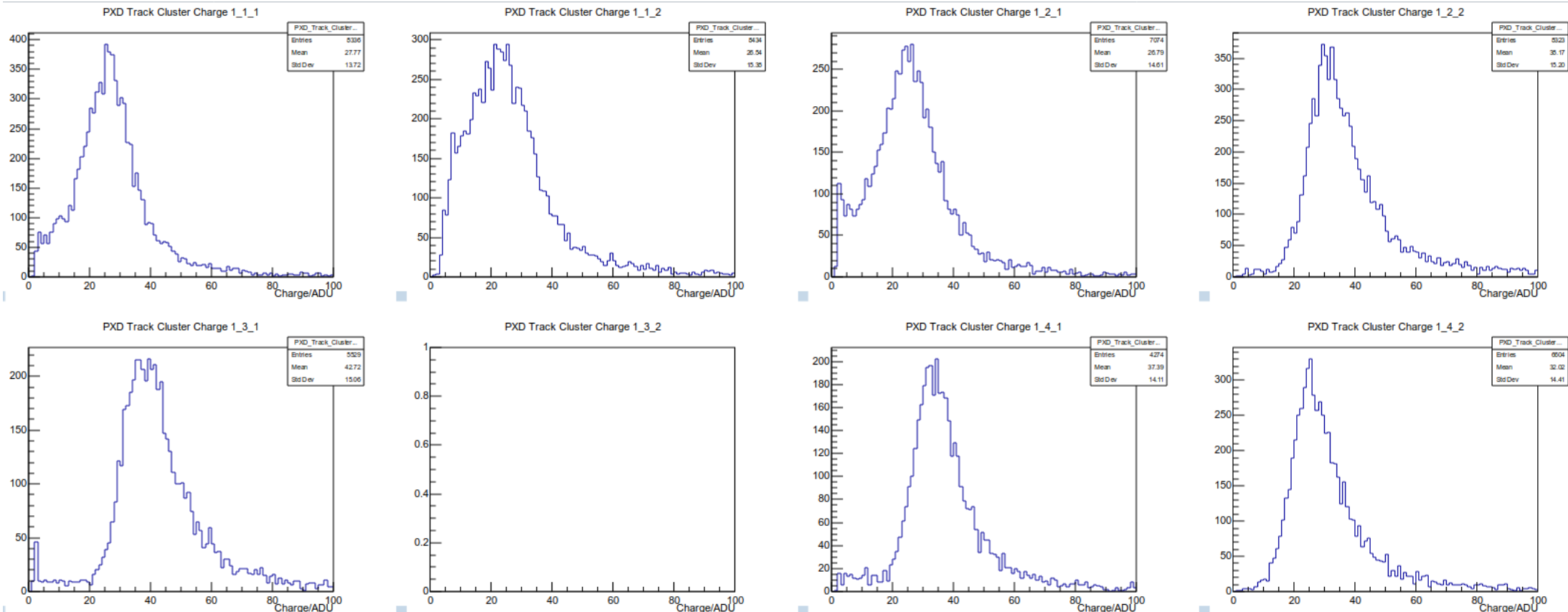
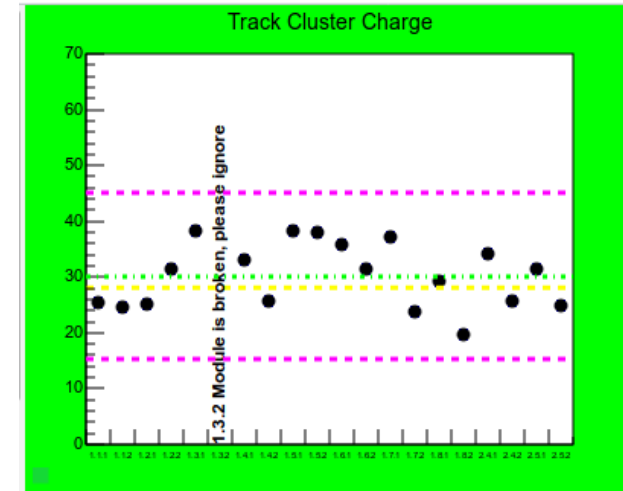
- Should peak at 10, no (few) entries
- Outliers point to bad setting, high noise, 'broken' pixels (eg for gate 192) ...
- CM 63 point to data loss from high occupancy spikes

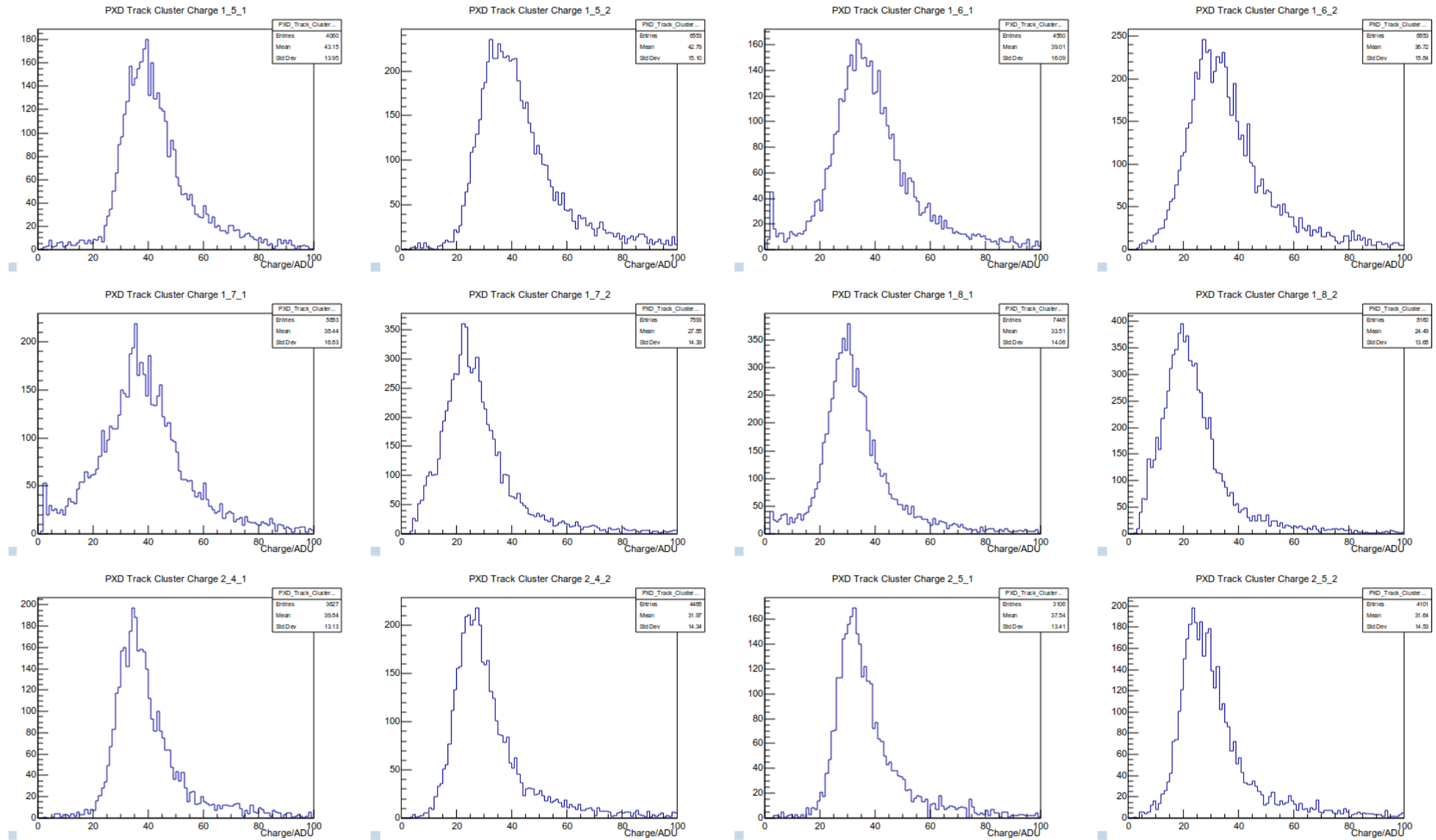
Watch for CM=63

Nothing should be below
Here, ignored

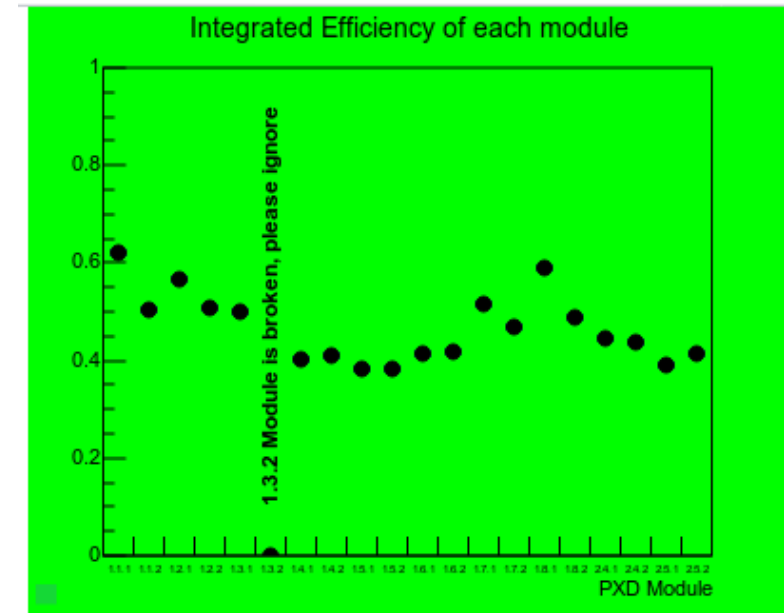


- Charge of Cluster associated with a track and corrected by track length in sensor to reduce fw/bw asymmetry (first order, only theta)
- MPV is used in overview plot (fits not shown)

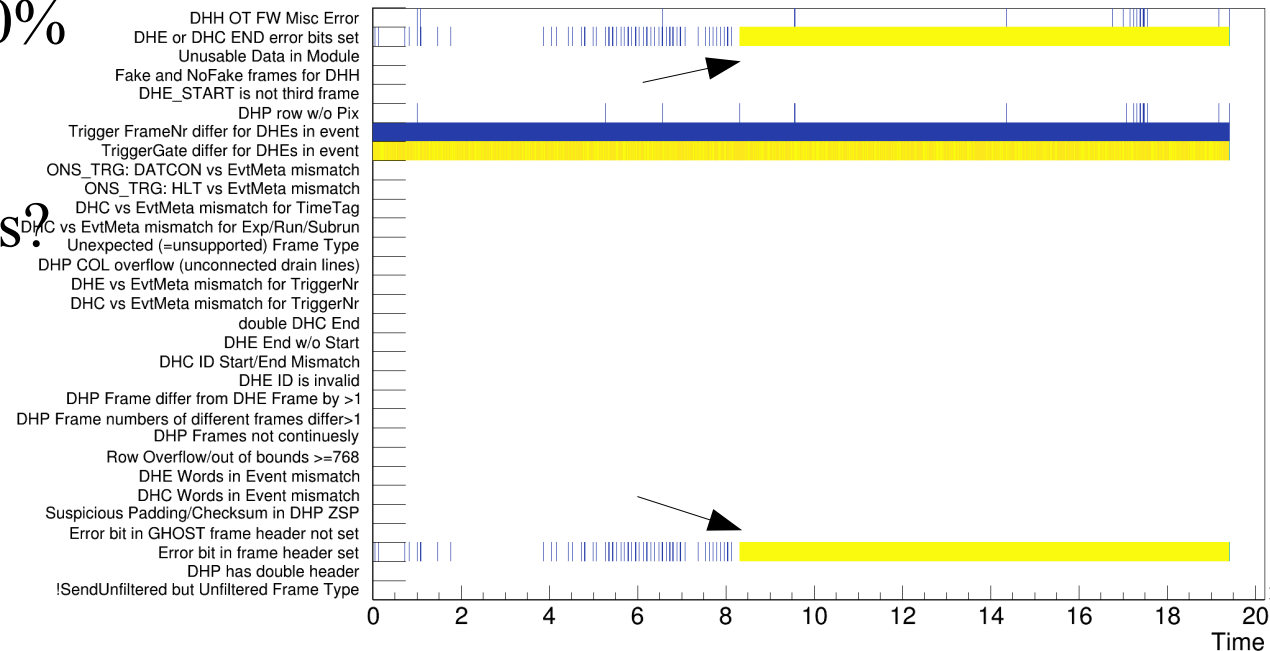




- Online \neq Offline code (track/hit finding bias)
- Online “broken” events count as inefficiency, broken mean MOST errors found in PXD data stream will mark the event unusable.
 - This depend on firmware versions, has (in principle) to be adjusted run by run for offline
 - \rightarrow reason for constant dropping efficiency during a run
- Unclear why online eff is max 60%
 - \rightarrow much high for cosmics
- Track selection criteria? Payloads?
- Offline shows $>90\%$



PXDDAQTimeError/Event

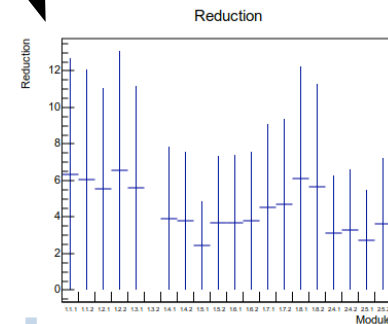
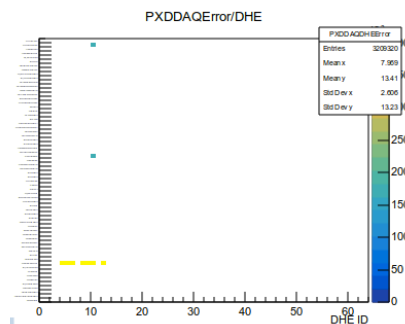
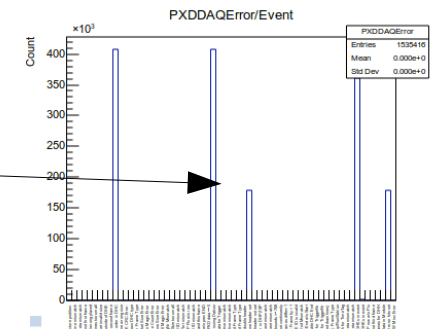
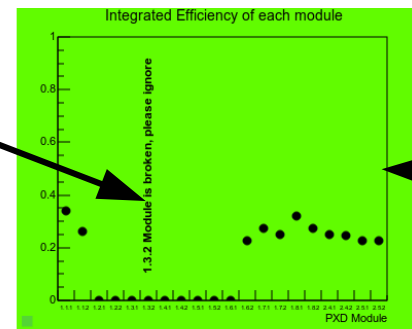
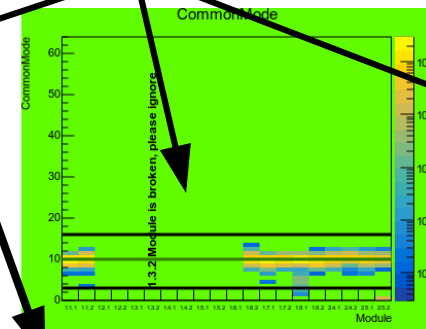
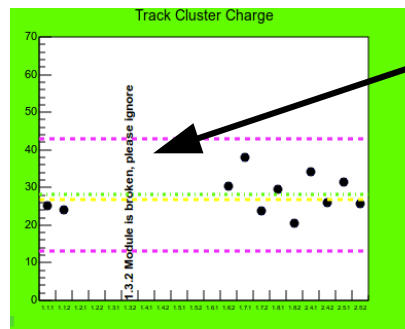


- DQM histograms for exp 7 <https://pxd.belle2.org/DQM/qasrv/>
 - service has been discontinued for exp 8, please use <https://dqm.belle2.org/> now (but web layout files might not match the state during the run.)
- Histograms created during analysis step do not show up there.

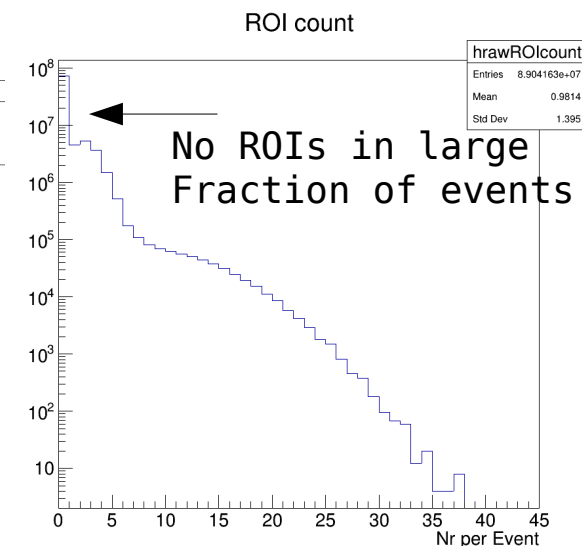
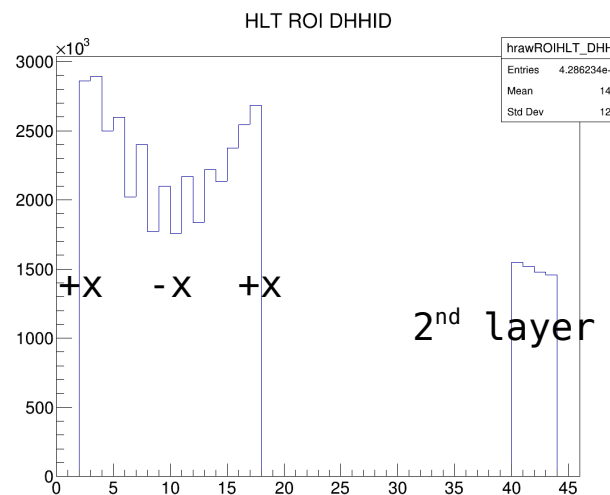
ROI Selection ON

- Data reduction at work!
- Effect of wrong DHE order

Event with errors show up as missing Efficiency for all modules (not only the one affected by the error)

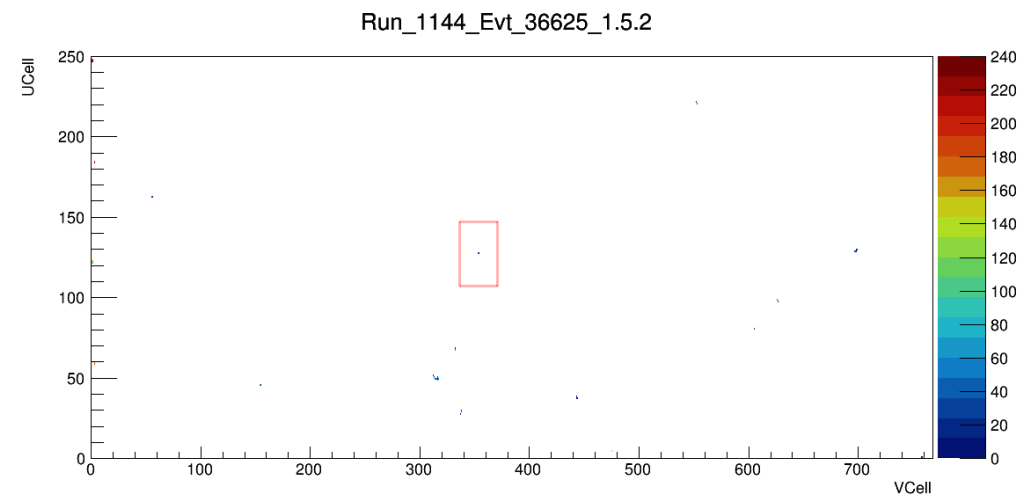
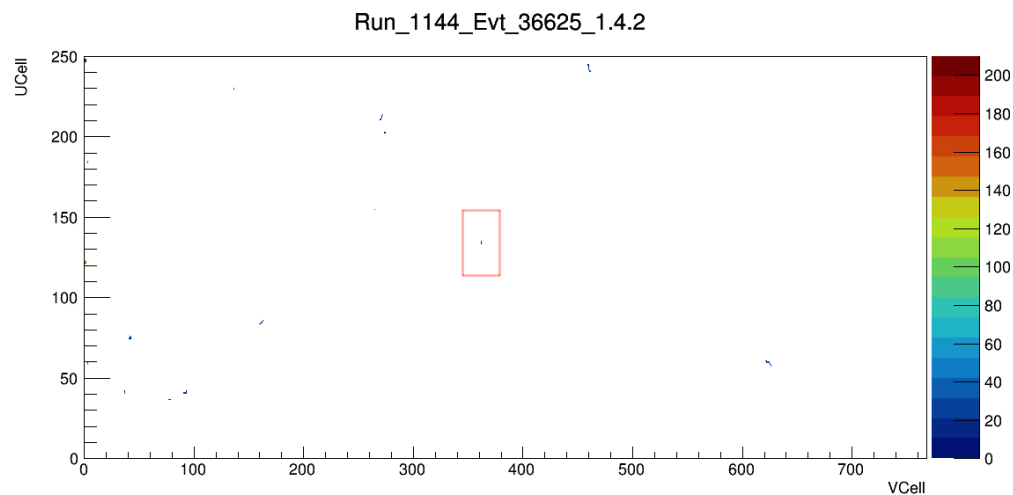
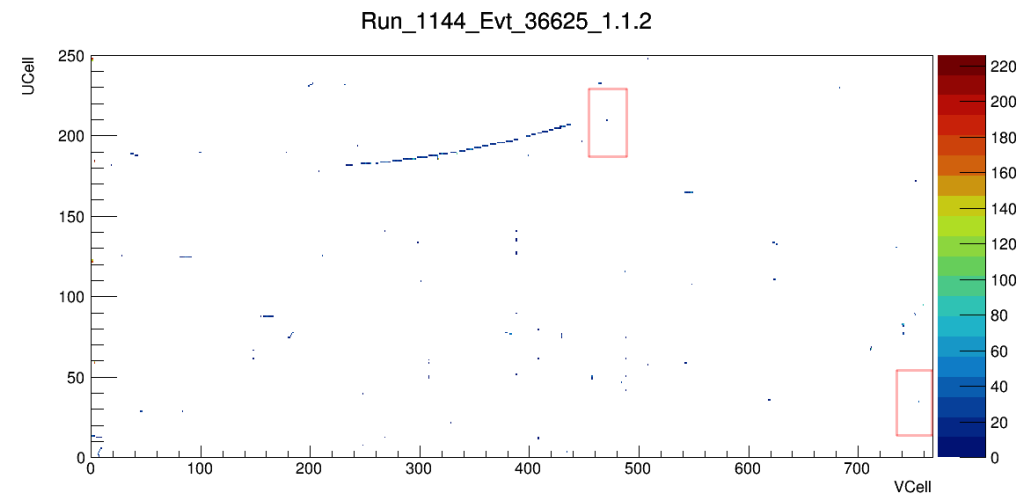
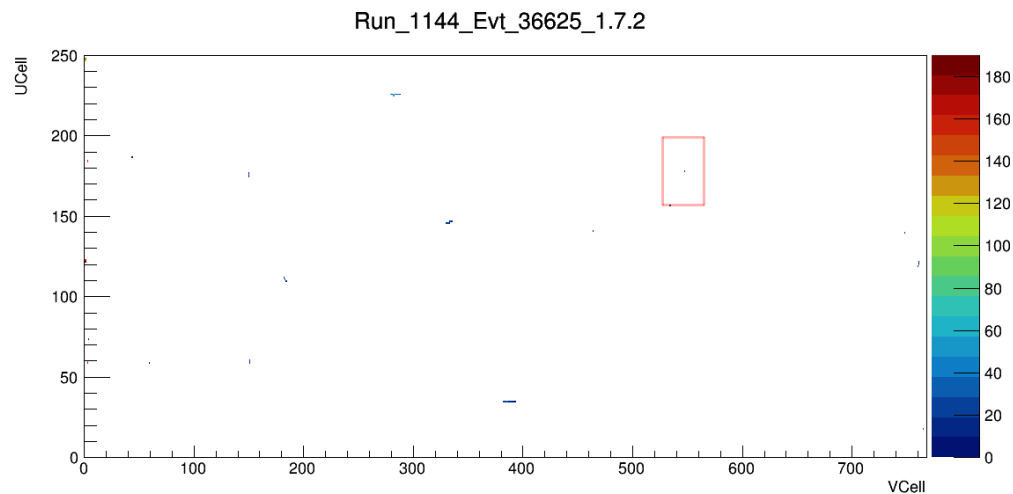


Reasonable number of ROIs and Distribution on the modules



ROI Selection OFF, HLT ROIs Overlayed

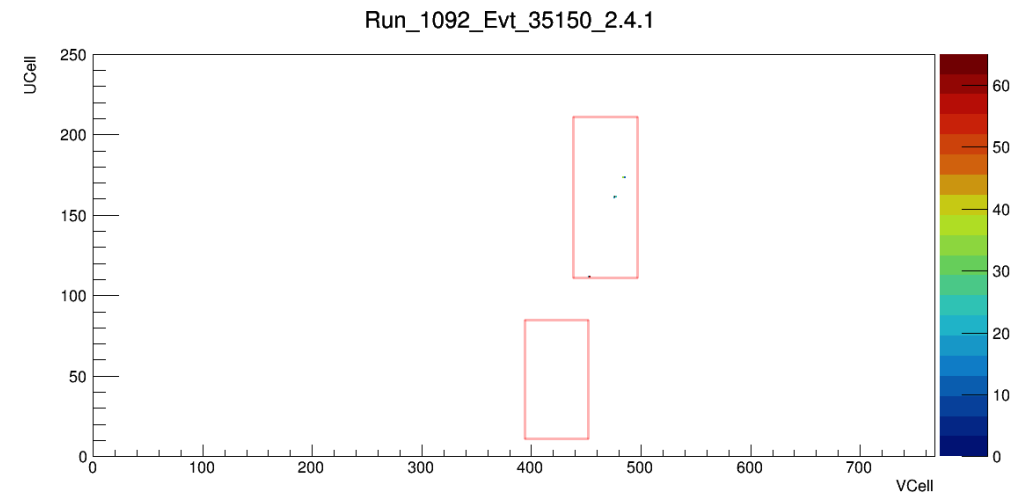
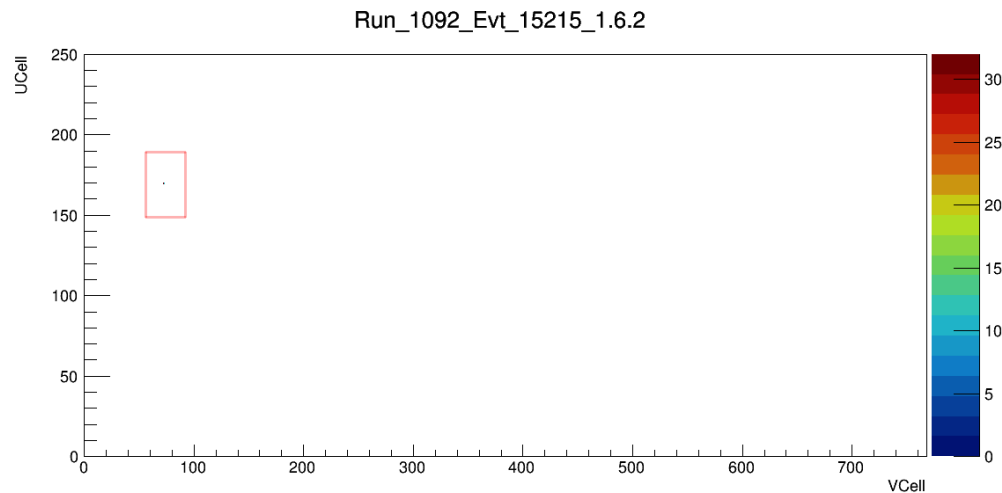
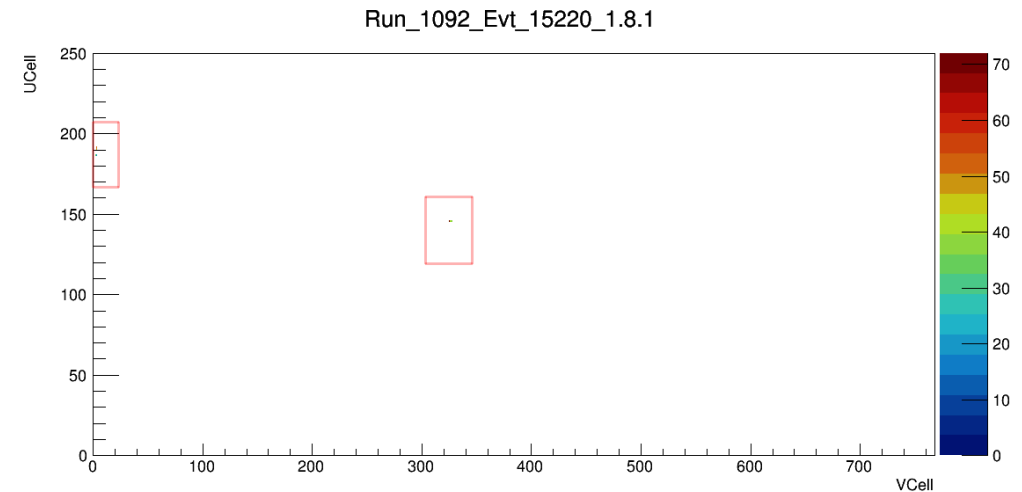
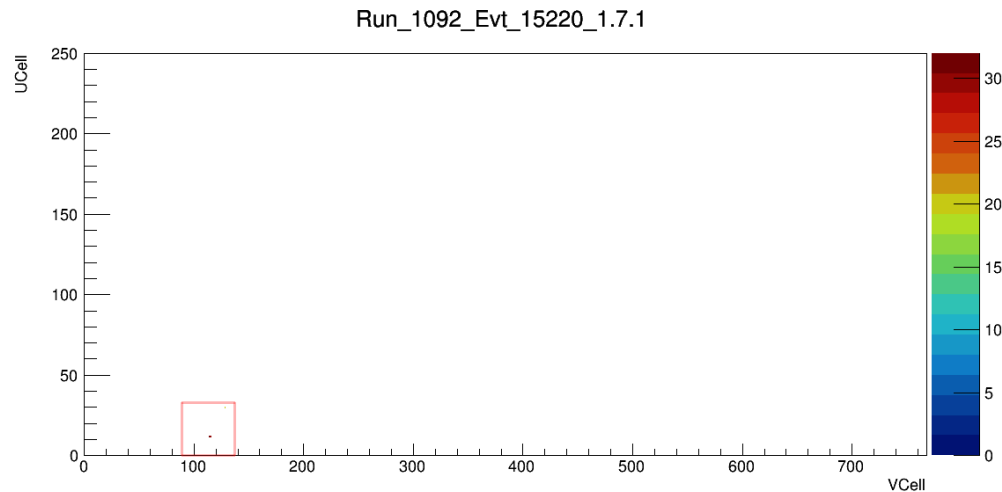
Randomly chosen good event



Cluster seem to be centered in ROI → extrapolation on HLT seem to have good quality

ROI Selection ON, HLT ROIs Overlayed

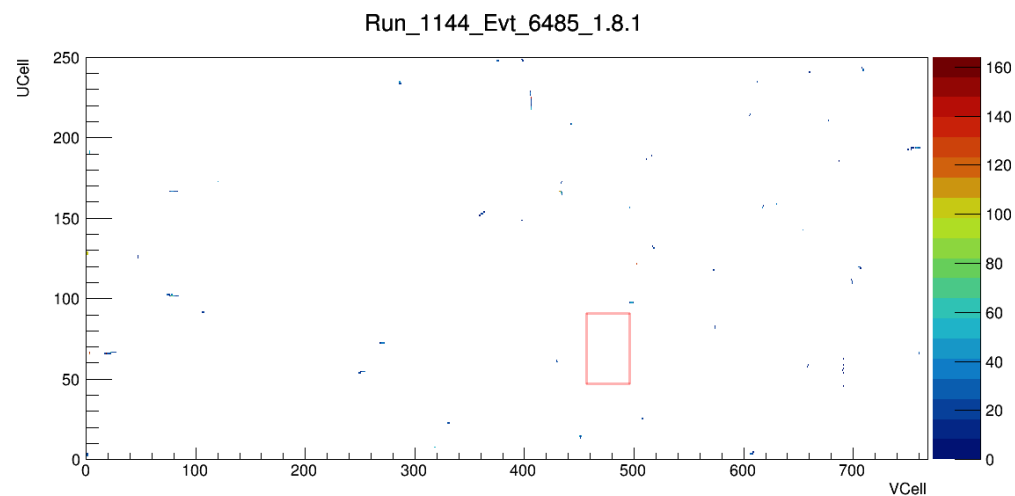
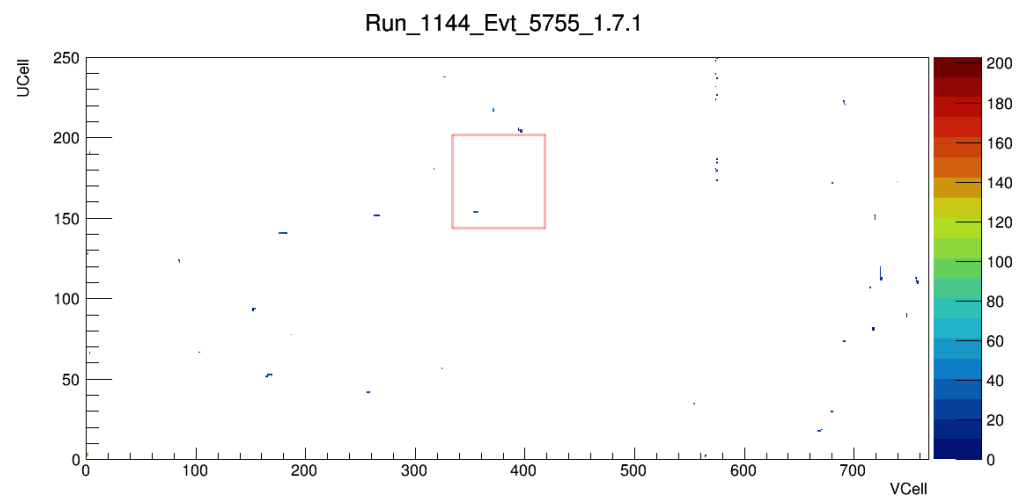
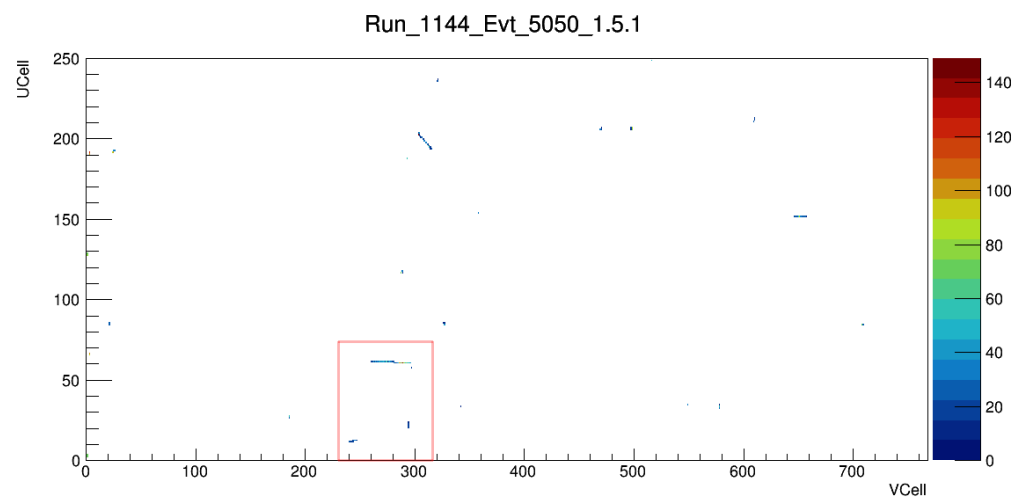
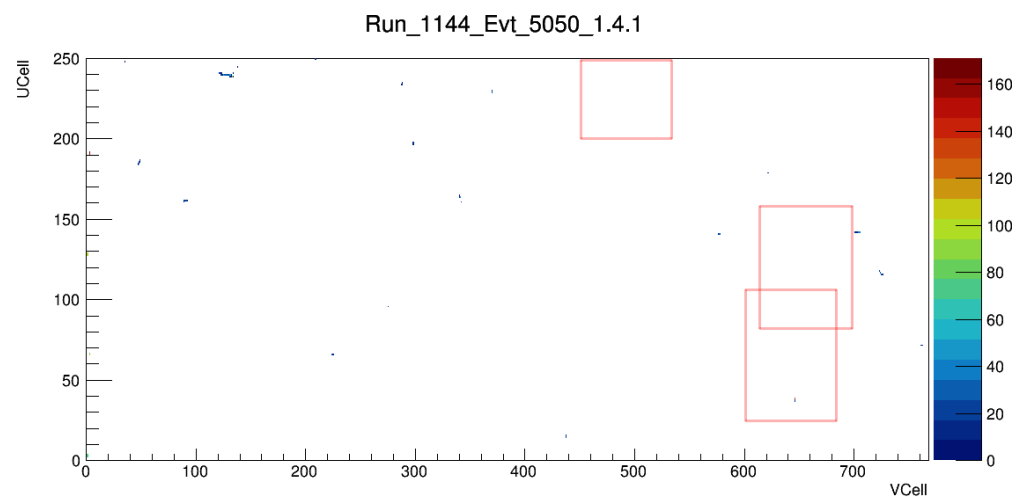
Randomly chosen good events



Cluster seem to be centered in ROI → extrapolation on HLT seem to have good quality
But: DHE Order problem, half of the modules have not data after selection
Selection worked, but only checked by eye. Pixel-by-pixel check with BonnDAQ data missing

The Ugly ROIs

Randomly chosen bad events



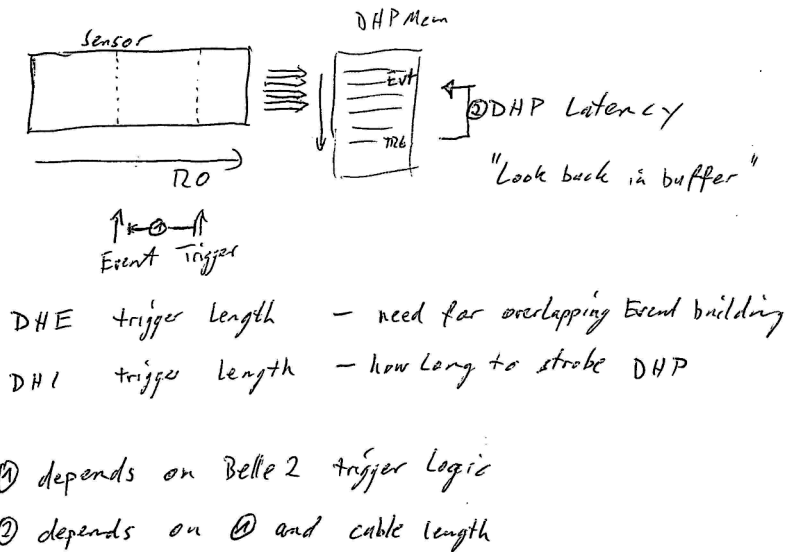
Not so clear why. Detailed analysis needed (momentum etc).

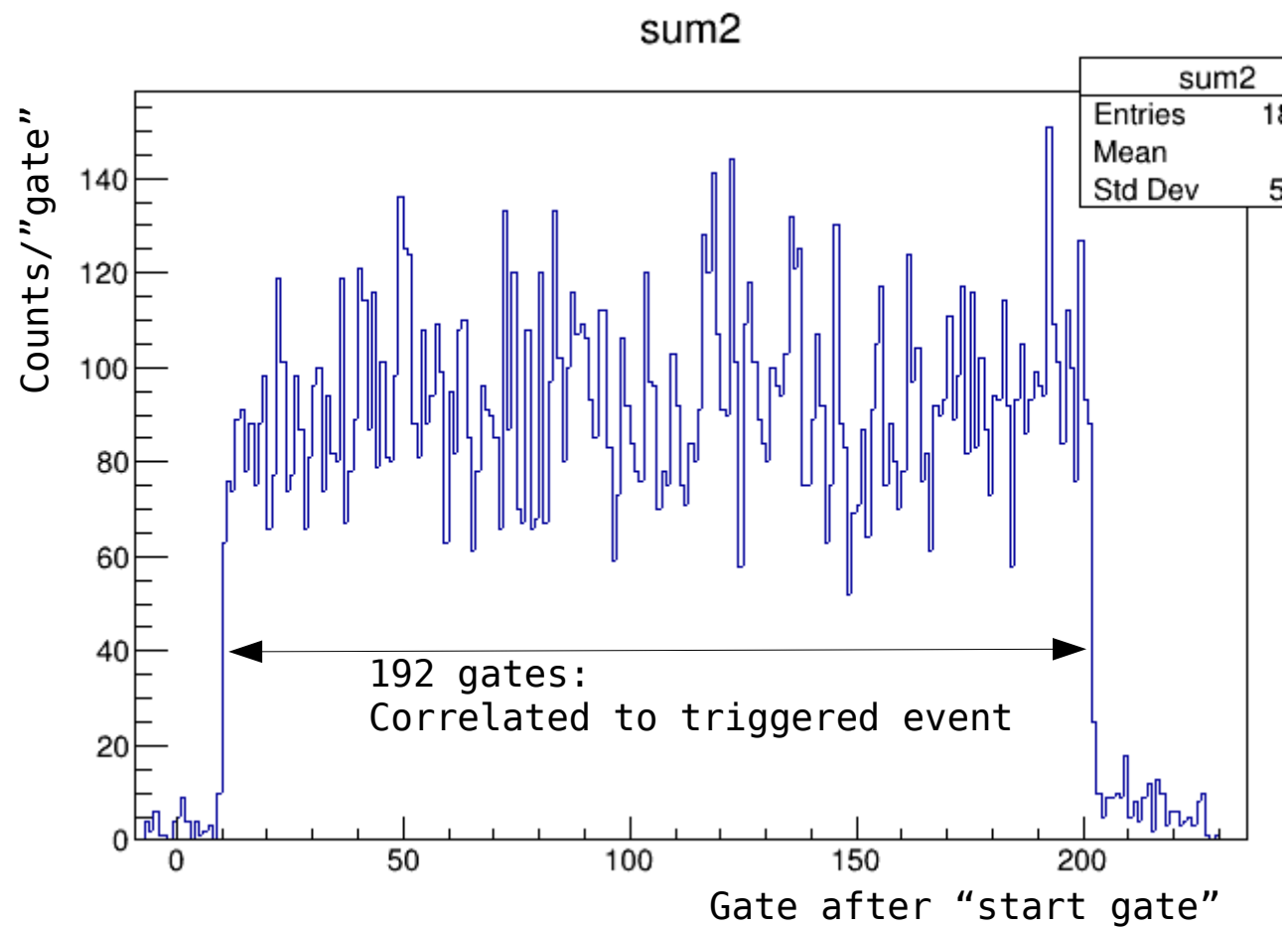
- ROI calculation on HLT is **always** on.
- ROI selection can be en-/disabled by ONSSEN slow control.
 - Avoid changes on HLT scripts
 - Can check offline for all runs
- ROI processing needs ascending DHE ID order
 - But cabling changed between B4 test and final setup
 - Correction in firmware pending
- ROI processing was turned on as a test for several runs. As expected, data for modules which were out-of-order is empty (→ no ROIs)
 - Offline check against BonnDAQ data pending
- Event selection (=HLT physics software trigger) – not used

Backups

PXD Trigger “delay”

- PXD trigger consists mainly on one parameter:
 - DHP latency (look back in time in DHP memory)
 - 1 gate \triangleq $\sim 100\text{ns}$
- Readout length depends on two parameters
 - DHI trigger length (strobe length to DHP)
 - DHE trigger length (used by the FW to build event)
- Latency depends on the trigger latency and timing of Belle2
 - DHP latency was ~ 50 in Phase2
 - Was set to 5 in early Phase3?
 - 45 gates off \rightarrow $\sim 23\%$ ($=45/192$) **loss of efficiency!**
- Finding correct timing only possible with “real” physic triggers (but low stat with cosmics)
 - Need correct trigger gate (timing pixels) \rightarrow can tune “Start Gate emulator” on DHE, x-check
 - Need to know the readout frame the pixel is firing in (timing pixels), determine when next readout frame starts (per DHP!). Information is lost in overlapping firmware due to event building





“Raw” Cluster Charge

