Module 2 CRS Performance Update

December 2, 2022

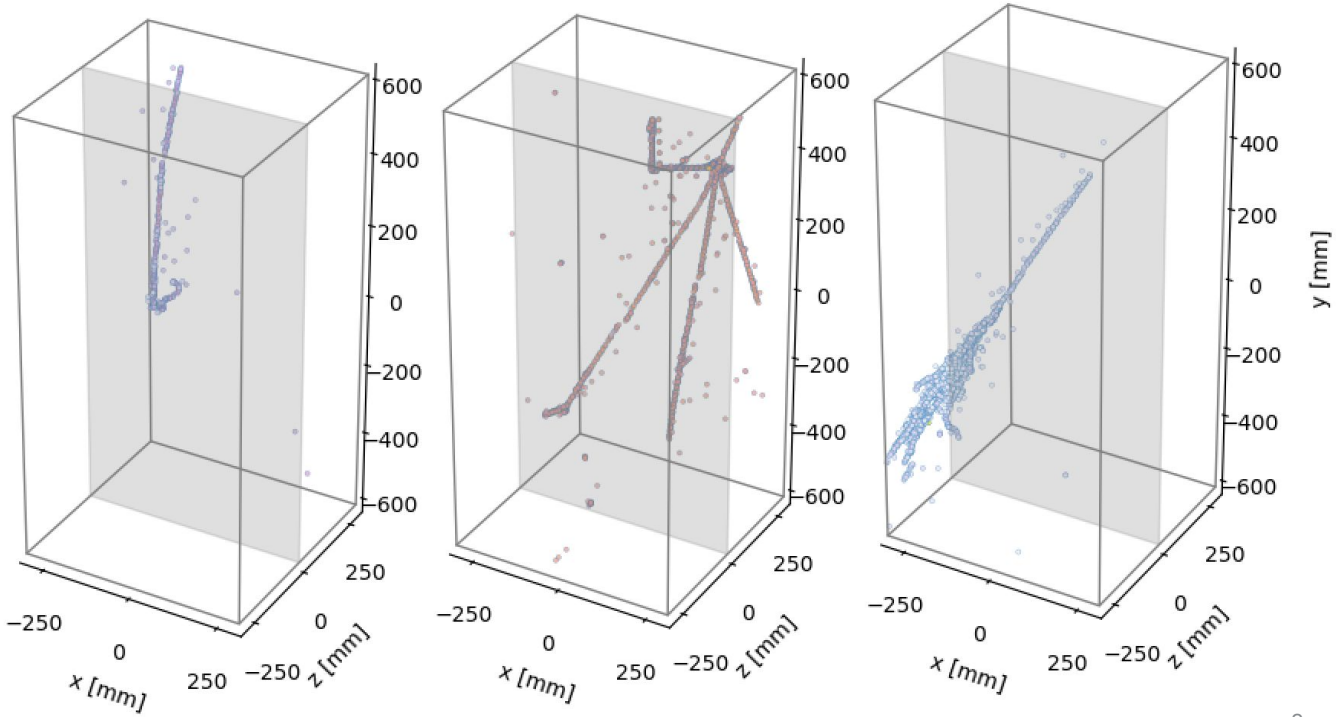
Stephen Greenberg

Overview

Operating at 64 (rolling) periodic reset cycles

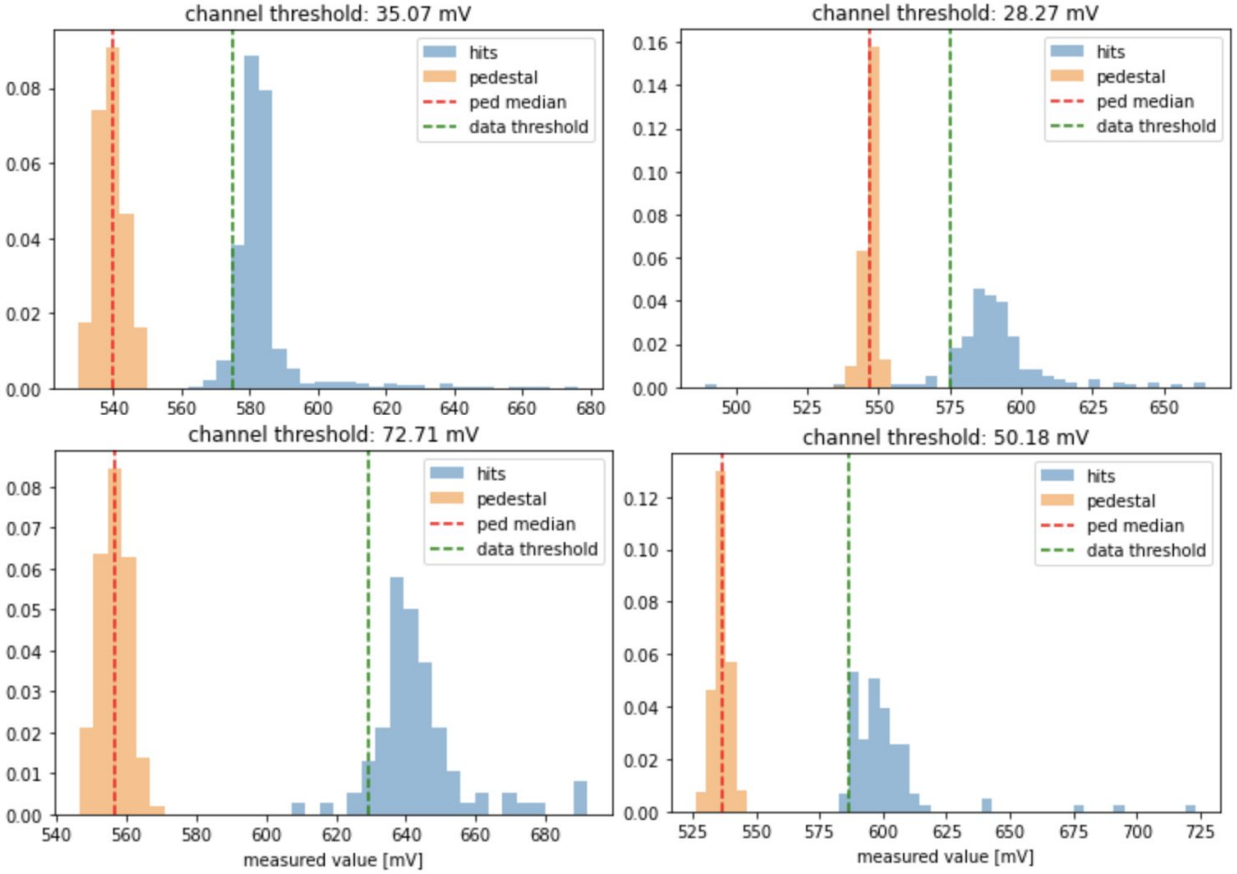
- As of yesterday evening (Bern time), stable self triggering with 55-60 mV ‘target’ thresholds
- Quality appears to be good
  - Stable packet rate
  - Low rate of ‘hot channel’ emergence
- **Mainly operational considerations limiting thresholds for now**
  - Difficulty enforcing ASIC considerations with noisy channels

Events from 55 mV Threshold Run 12/02/2022



Approximate Threshold Extraction

- Threshold extraction done on channel-by channel basis
- Take packet threshold to be 5th percentile of dataword from packets
- Define threshold as difference between packet threshold pedestal median on a given channel

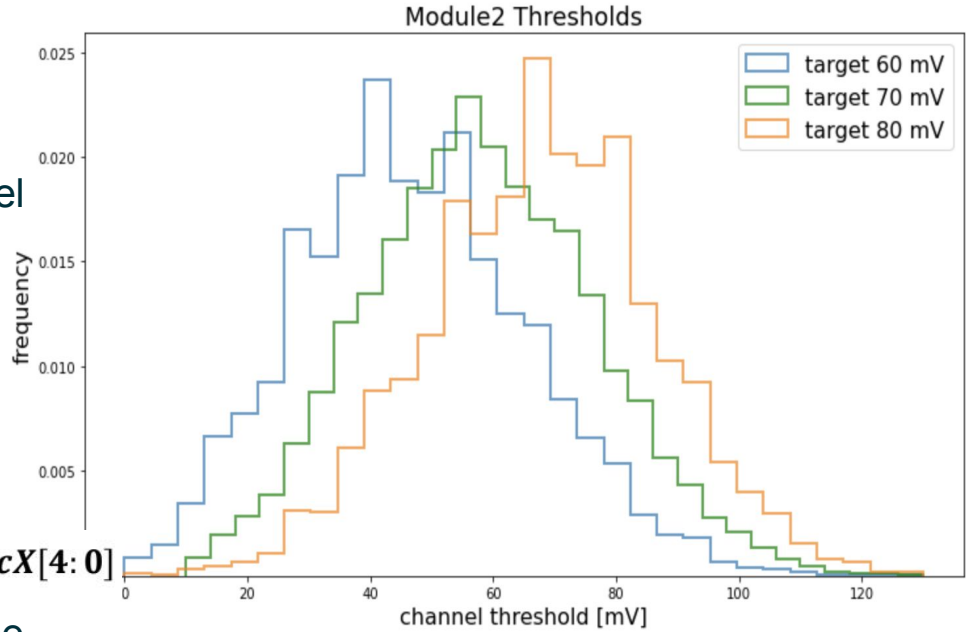


Target Threshold Accuracy

- Target threshold is converted to global_threshold and pixel_trim_dac on channel by channel basis
- **Conversion difficulties**:
  - Conversion of global_threshold and pixel_trim_dac based on simulation of front end, known to be unreliable at cold due to mismatch

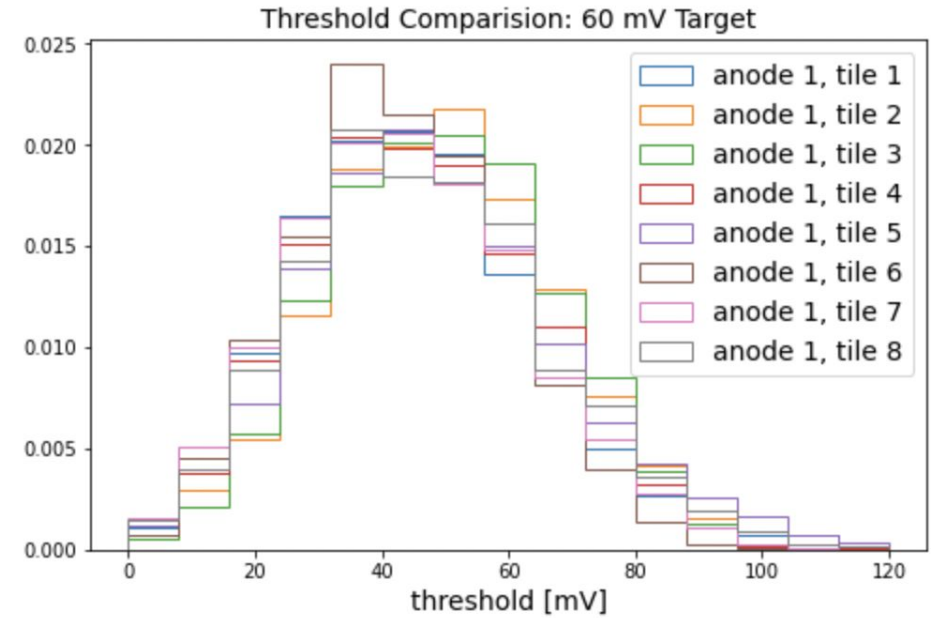
$$Th\_chan\_88K_X = Th_{Gl} + 465\ mV + 2.34mV * \boldsymbol{pixel\_trim\_dacX}[\mathbf{4:0}]$$

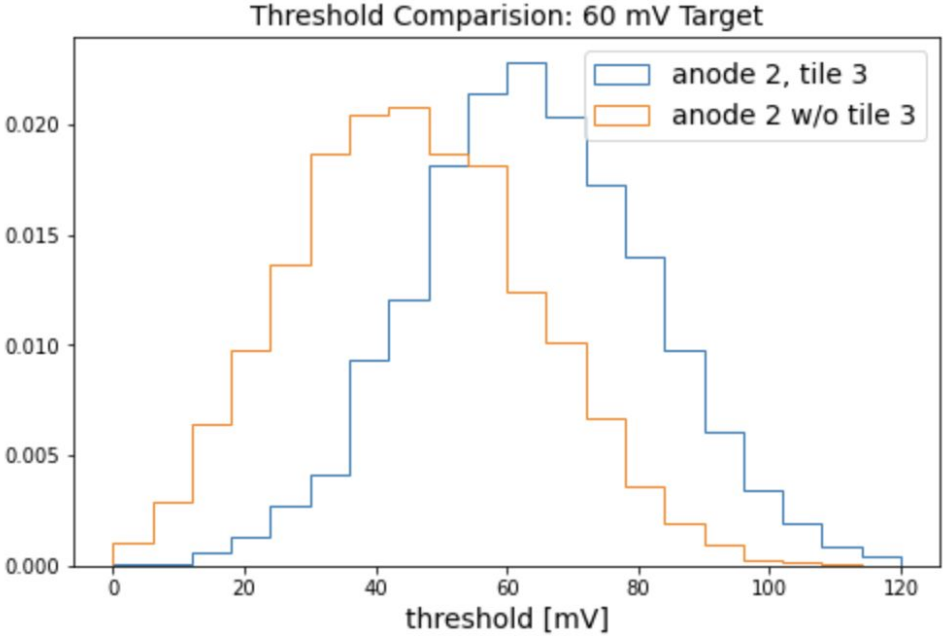
  - Threshold offset estimated from data to be closer to ~350 mV, some variation between ASICs possible.
    - *Using this offset when setting thresholds*



- 'Target' threshold appears to be an OK (but conservative) estimate of actual thresholds

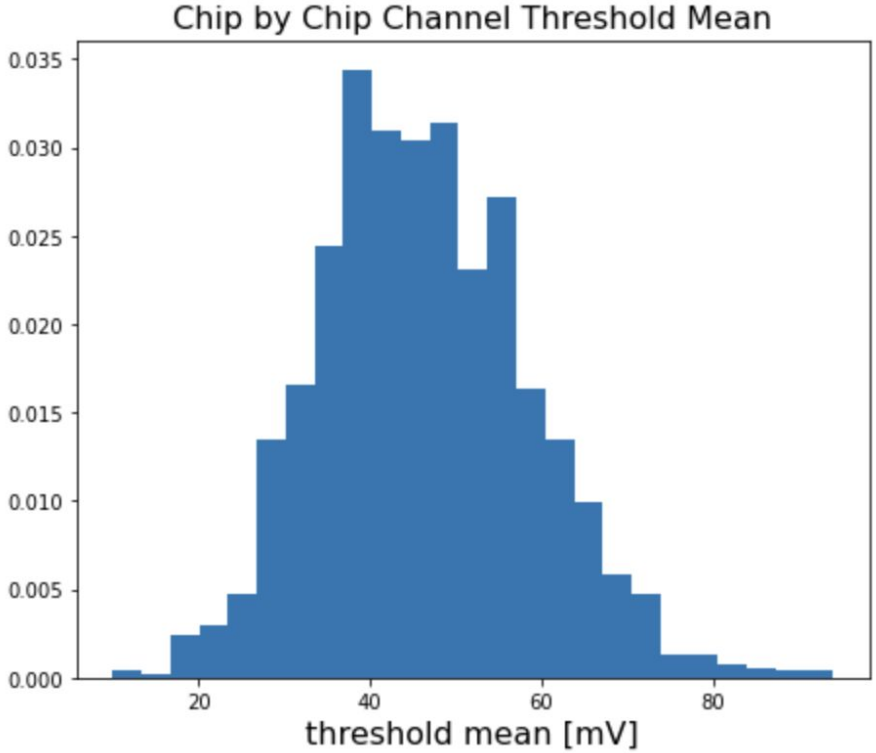
Tile-by-tile Threshold Variation

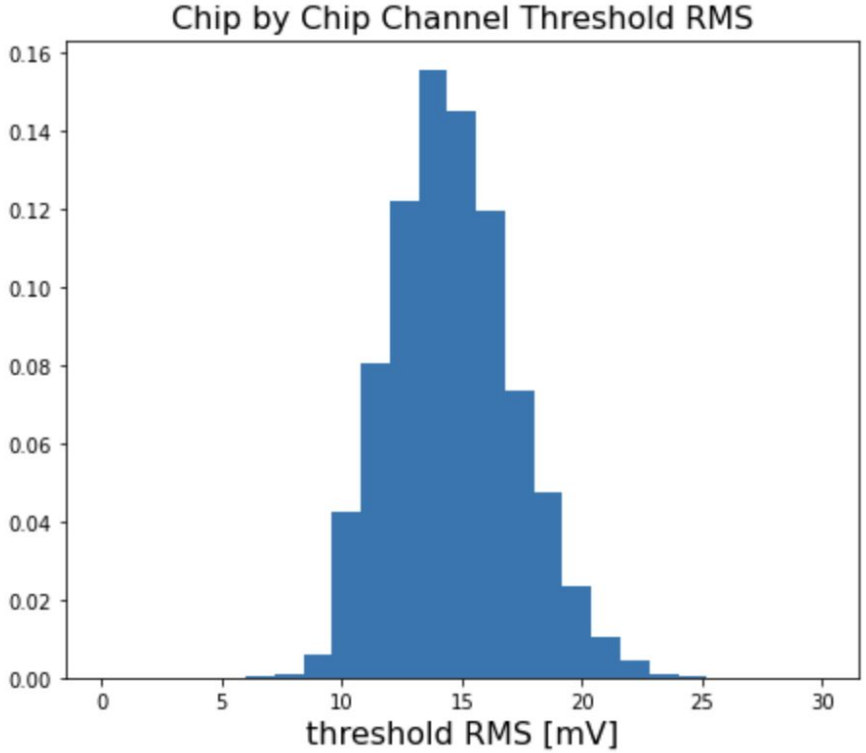




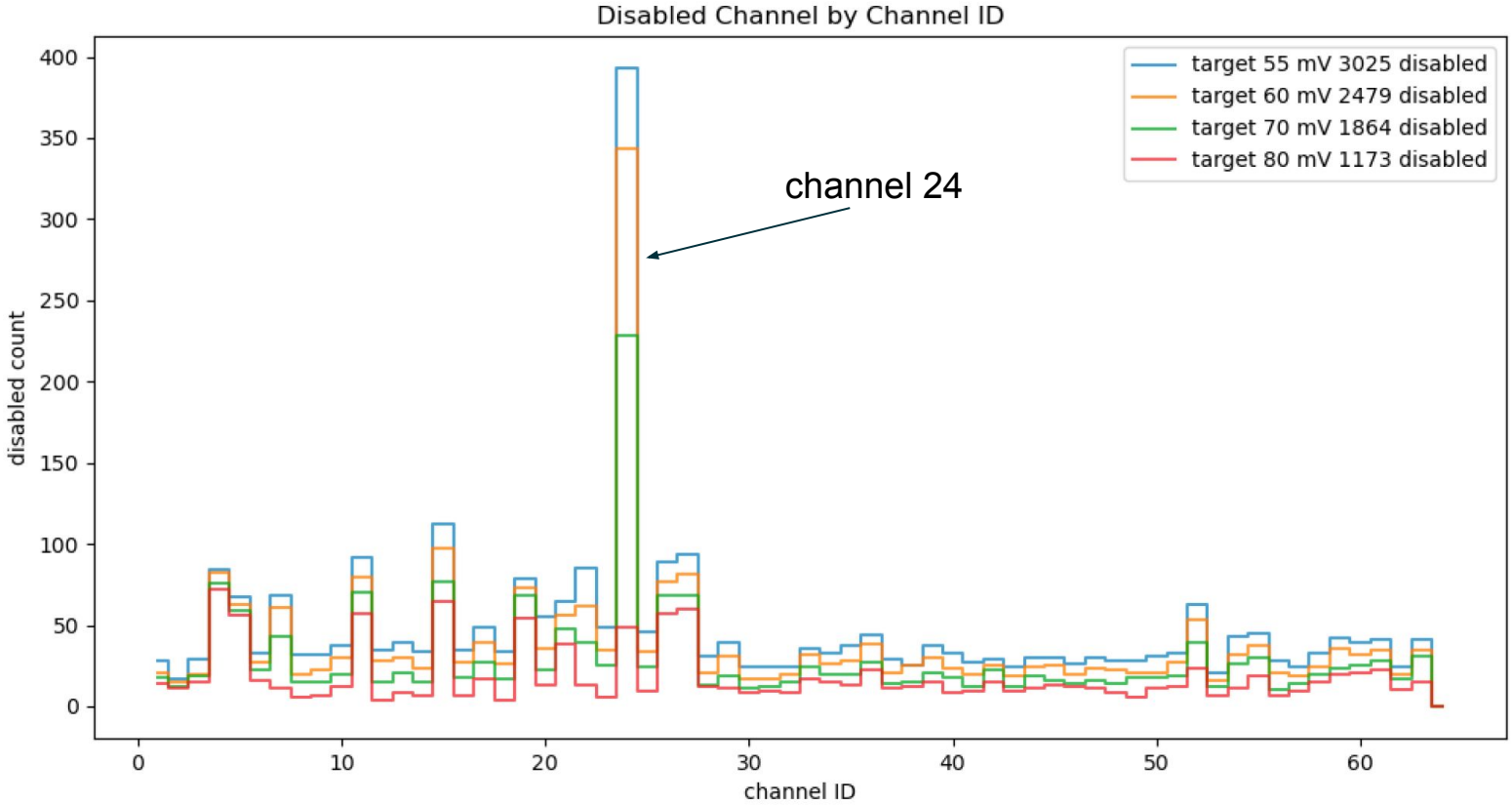
Chip-by-chip Threshold Variation

Coming soon: anode map of thresholds



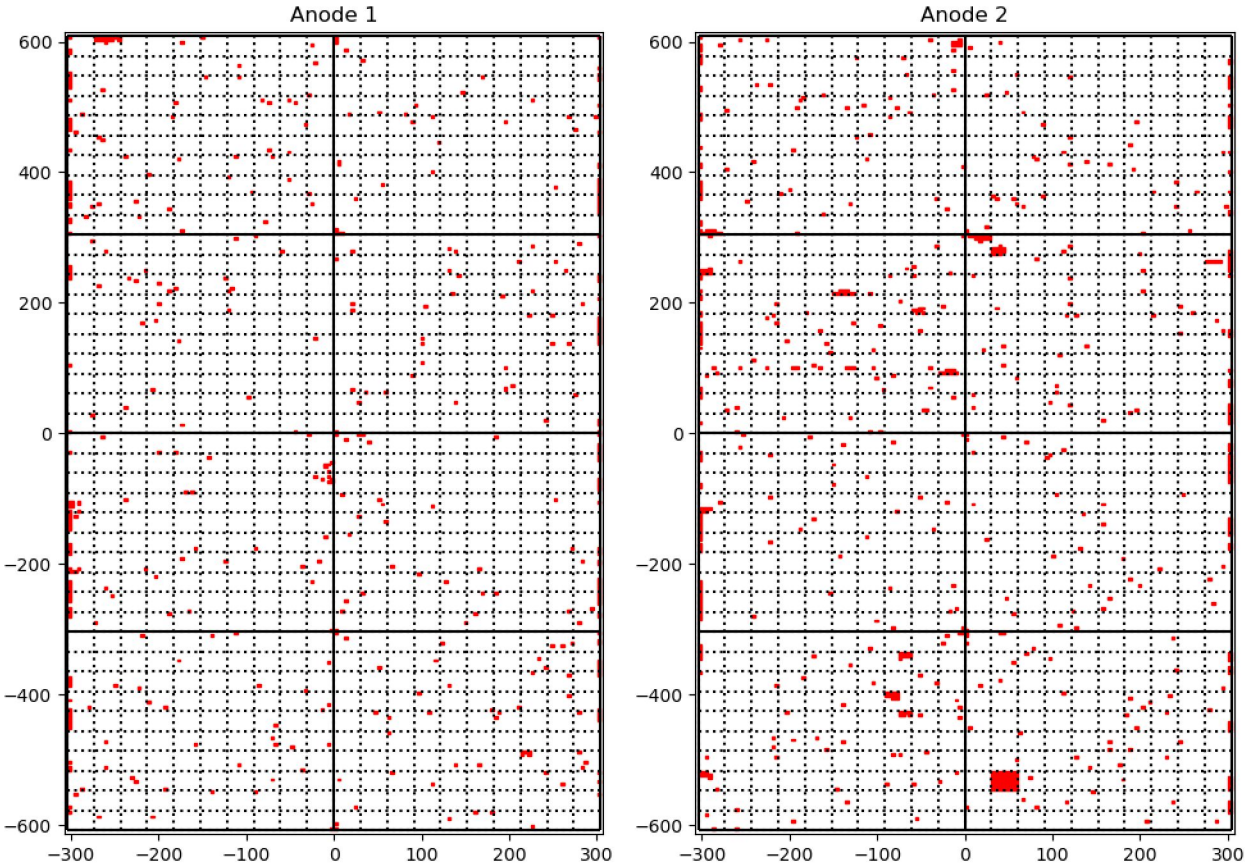


Disabled Channel Breakdown



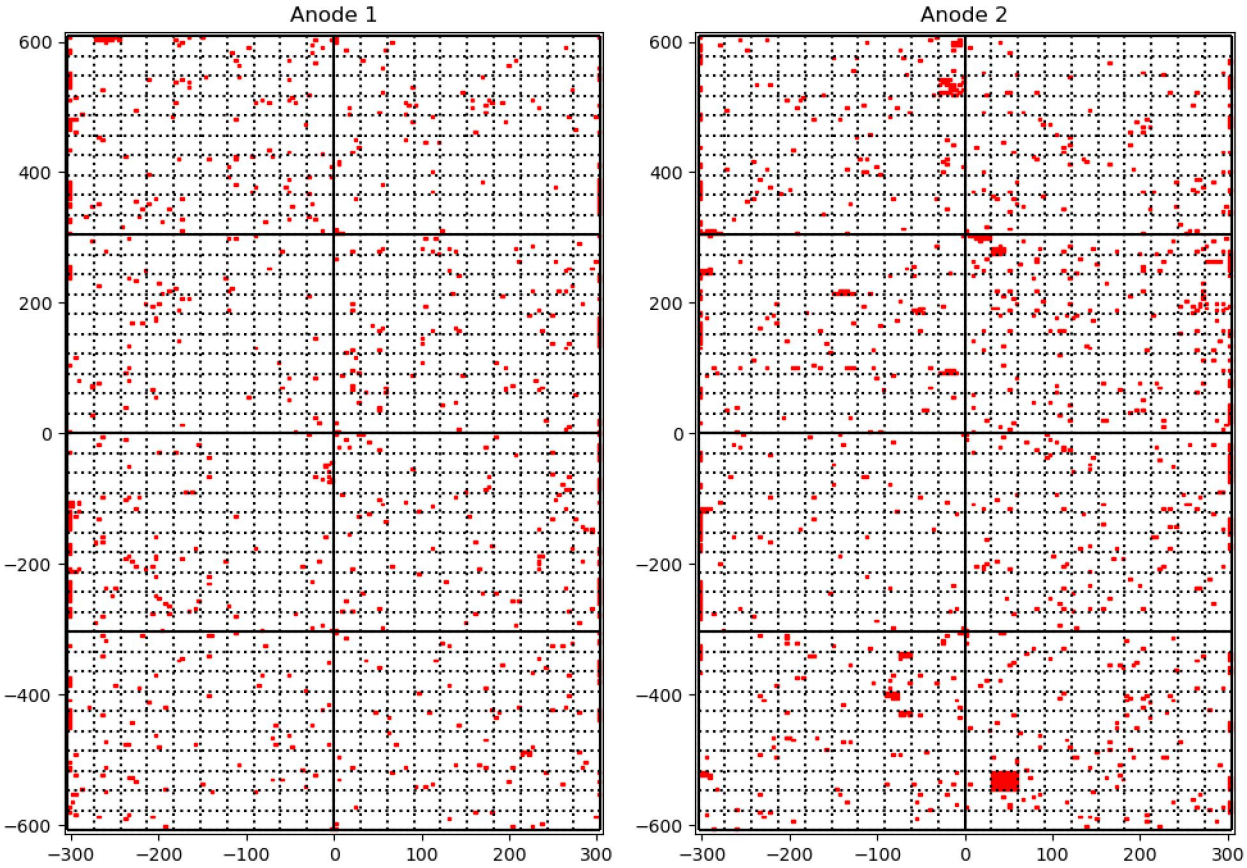
Target 80 mV Disable Map

98.9% Active



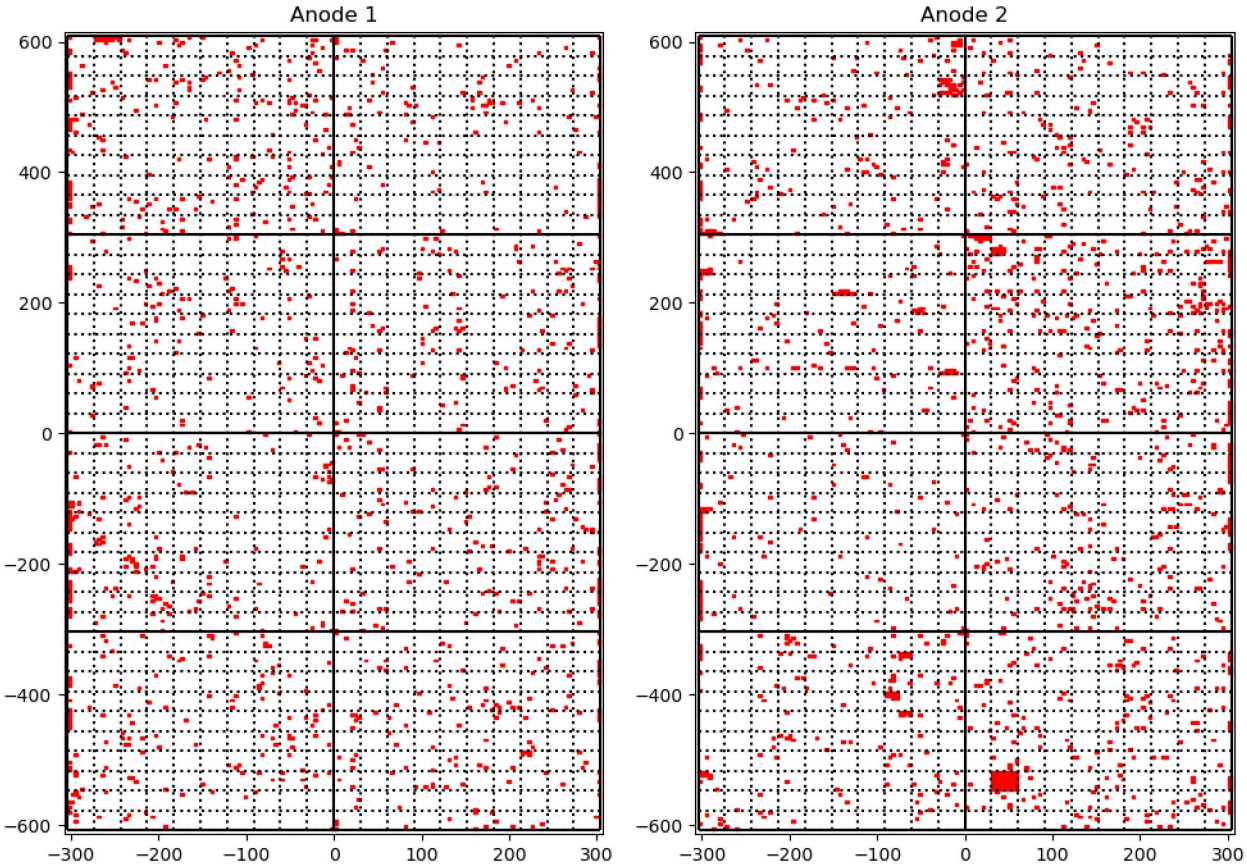
Target 70 mV Disable Map

98.2% Active



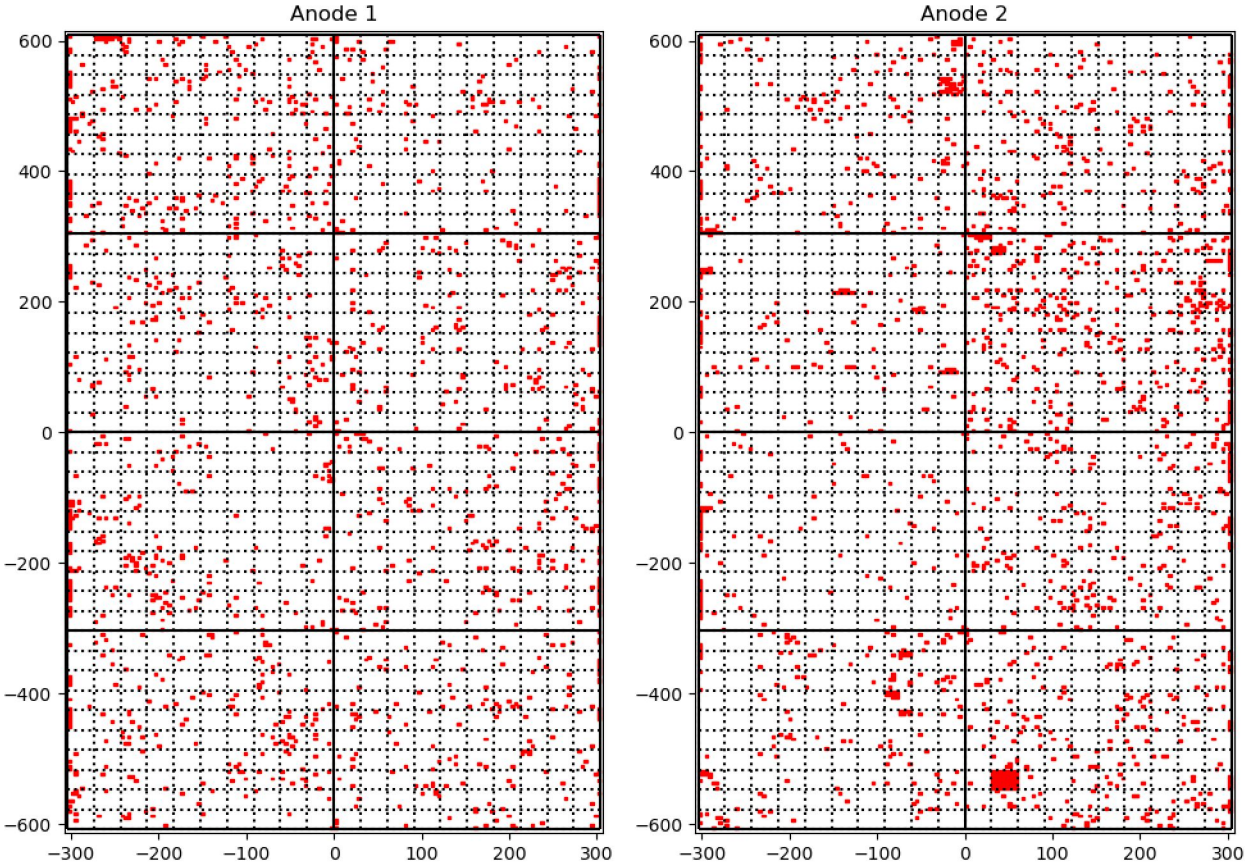
Target 60 mV Disable Map

97.6% Active



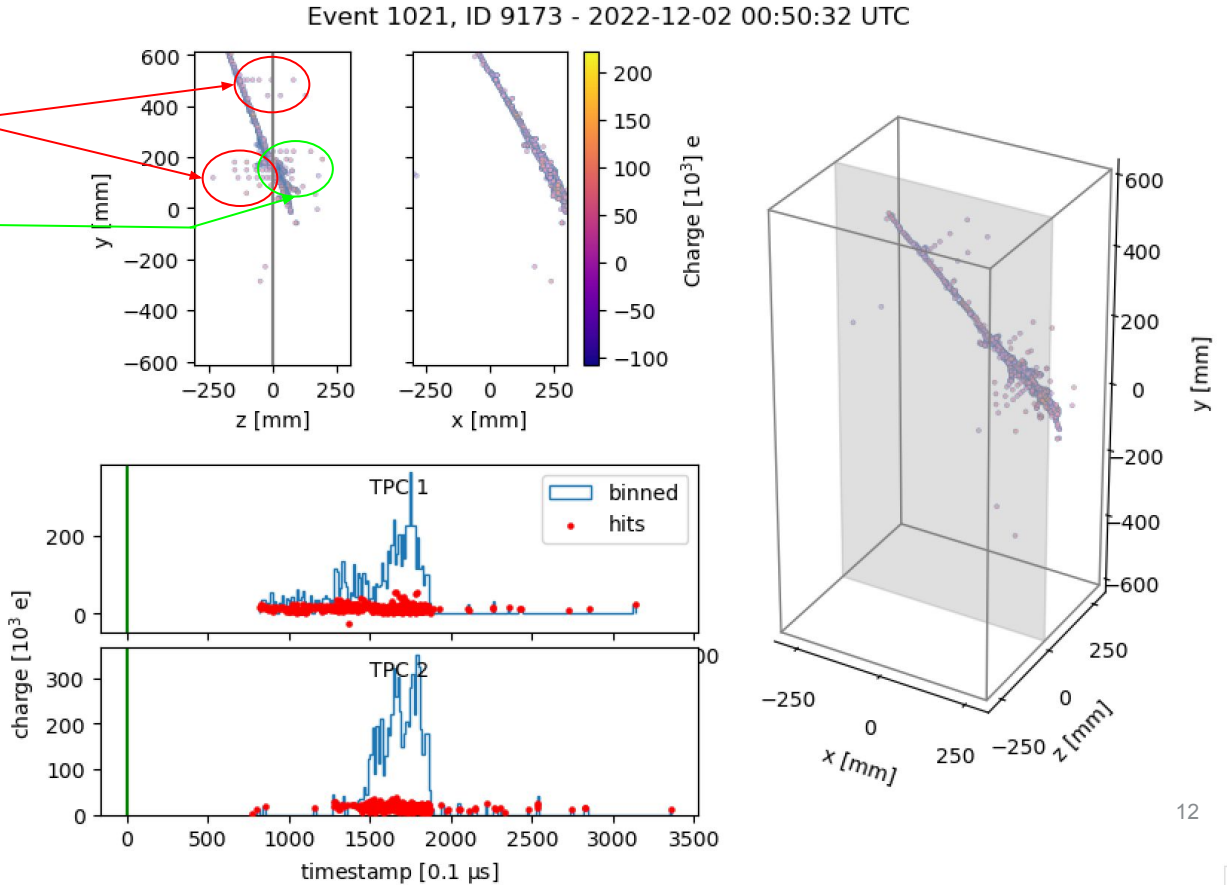
Target 55 mV Disable Map

97.1% Active



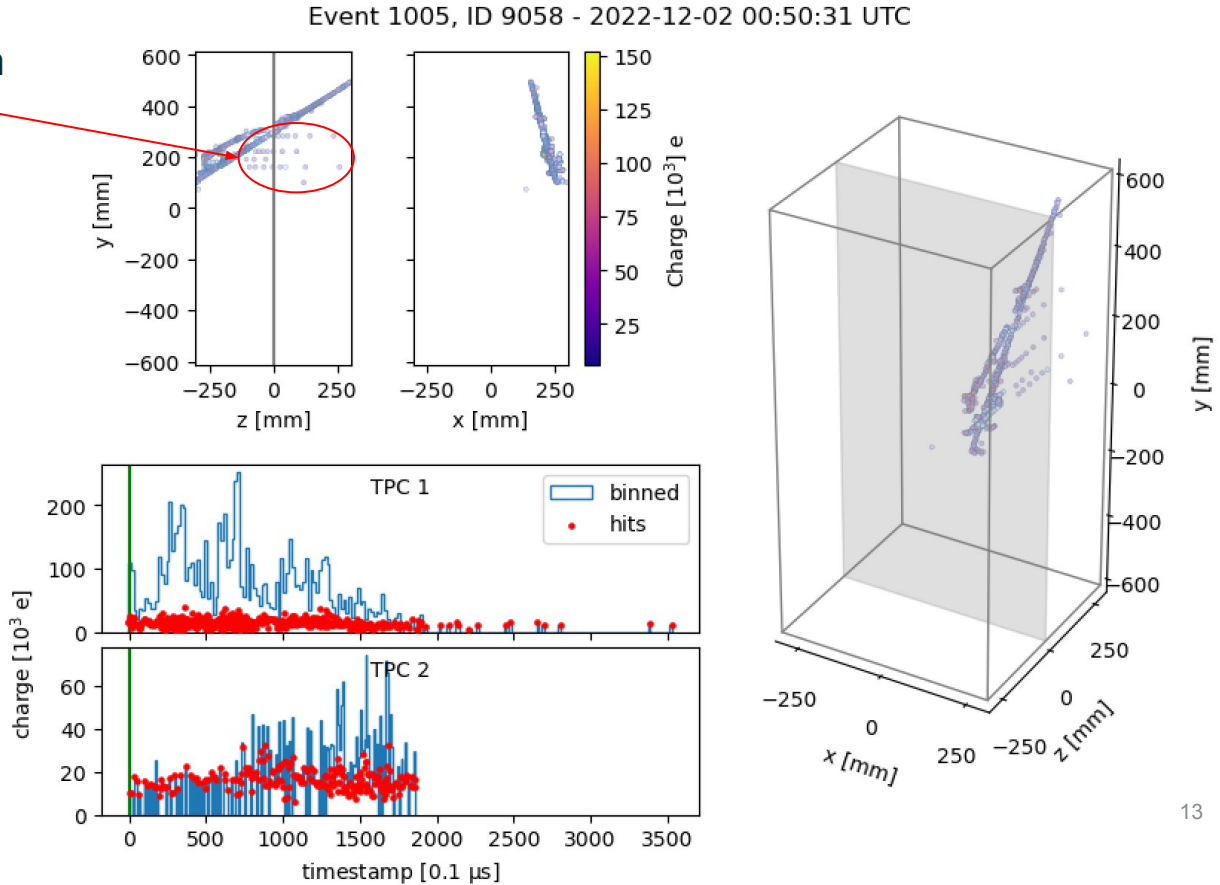
Hit-Correlated Noise

- ‘After-pulse’ like hits–noise on individual pixels after seeing charge
- Far-field induced hits



Hit-Correlated Noise

- ‘After-pulse’ like hits–noise on individual pixels after seeing charge
- Far-field induced hits



Operational Challenges in Lowering Thresholds

- Difficulty dynamically disabling channels when attempting to lower thresholds
  - Noisy channels filling FIFOs on upstream chips prevent configuration packets from reaching entire hydra network
  - Work around–hard reset+reconfigure, takes ~20 minutes
- DAQ machine memory consumption
  - When data rate is too high, DQM and hot channel identification takes >10-20 mins
  - Makes automatic hot-channel identification very difficult

Potential solution to be implemented:

- Disabling downstream receivers on chips in network of noisy channel when attempting to disable channels to stop FIFO from filling
  - If FIFO is full on other chips in network, this may fail

Summary and Next Steps

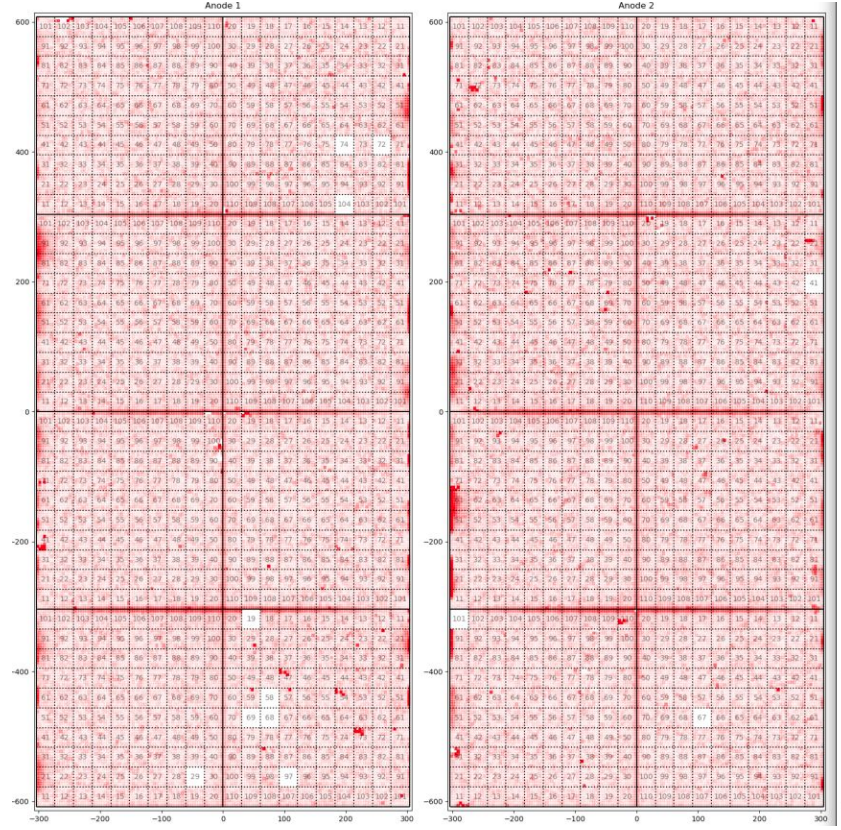
- **Summary**
  - Microphonics noise issues resolved in Run 2 (see backups), allows for lower, stable thresholds
  - Stable cosmic data at 55 and 60 mV target thresholds (cosmics and HV studies)

- **Next steps**:
  - Time permitting until the end of the run, iron out operational issues and lower thresholds
  - Extensive cosmic data taken at lowest stable thresholds, +2000e-, +4000e-
  - Alternative, data driven threshold extraction using leakage-induced trigger rate

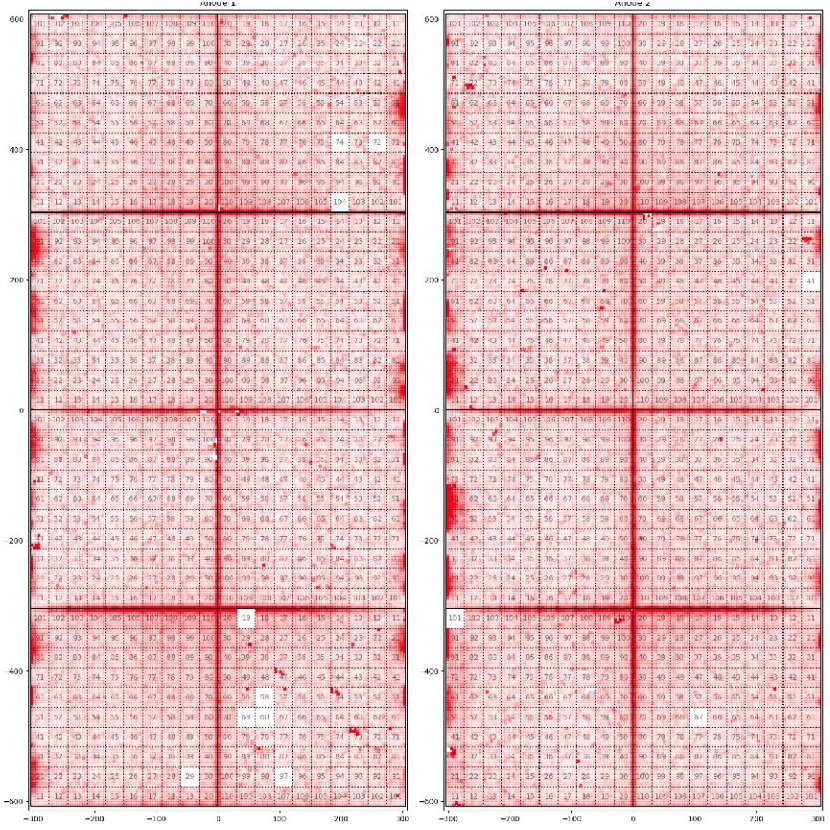
Backup

Run1 Noise Around E-board, Tile Boundaries

Pedestal RMS – Nominal



Pedestal RMS – Induced Vibration



Microphonics Resolved