

NP04 and CRP6 Updates

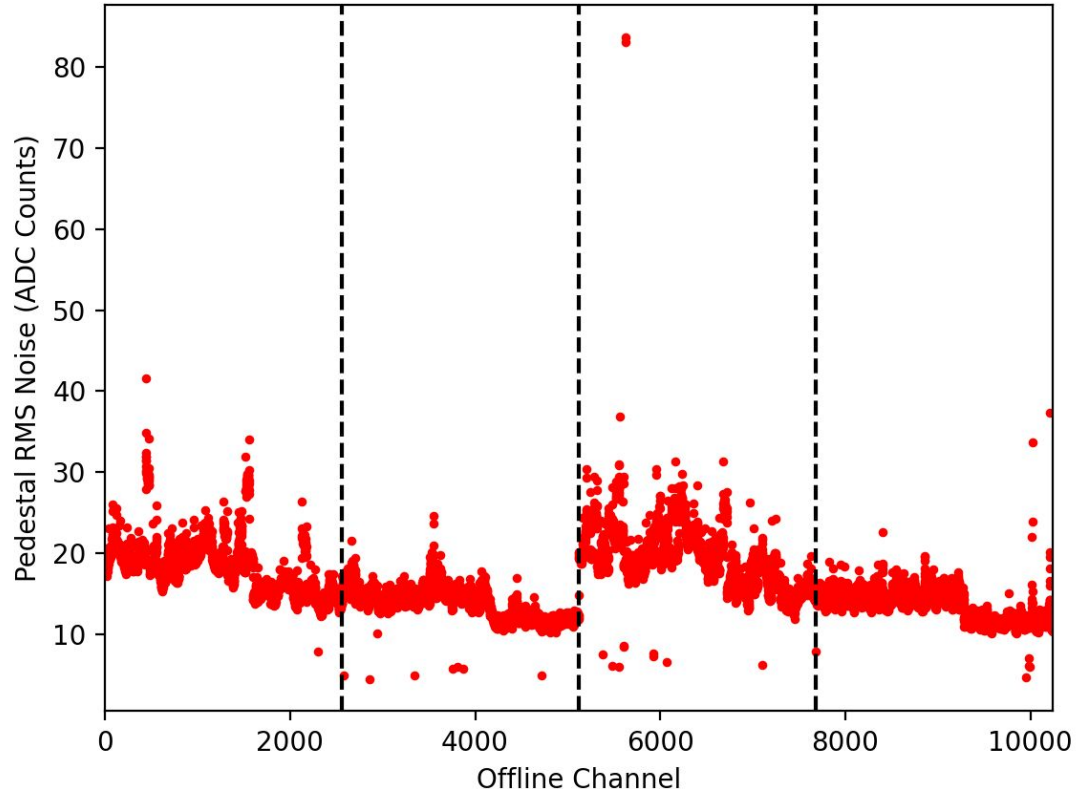
CE Consortium Meeting 4/16/2024

Roger Huang

NP04 Status

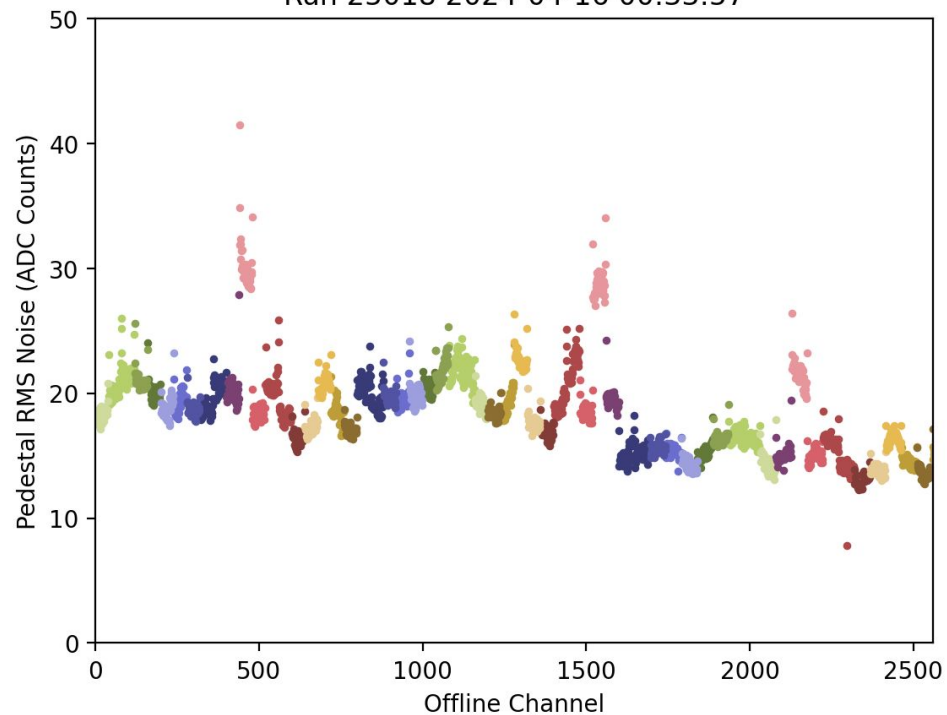
- Filling still in progress, anticipated to finish around end of month
- No errors from WIBs/FEMBs since last update
- More new open channels have appeared as the cooldown continues
- Anomalous channel tracking in [this spreadsheet](#)

NP04 Channel Pedestal RMS Noise
Run 25018 2024-04-16 00:33:57

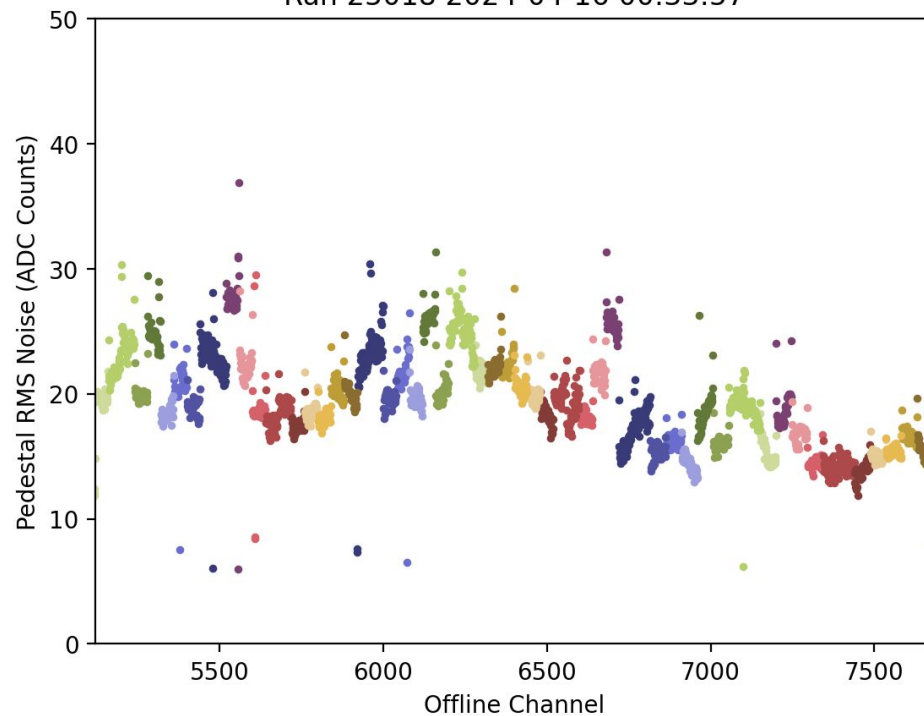


Upper APAs

APA1 Pedestal Noise Levels
Run 25018 2024-04-16 00:33:57

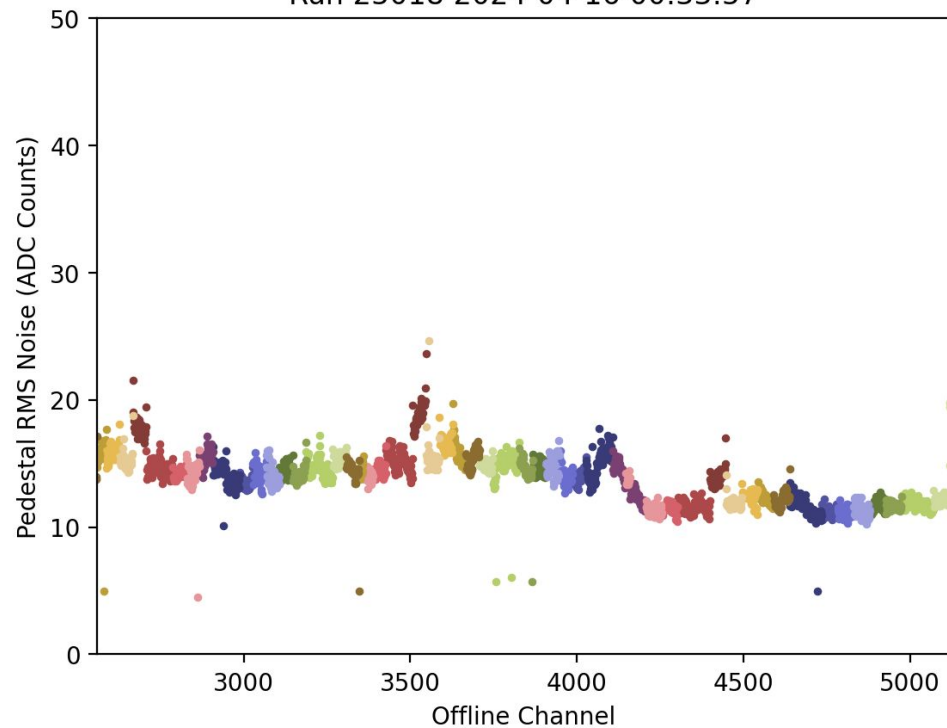


APA2 Pedestal Noise Levels
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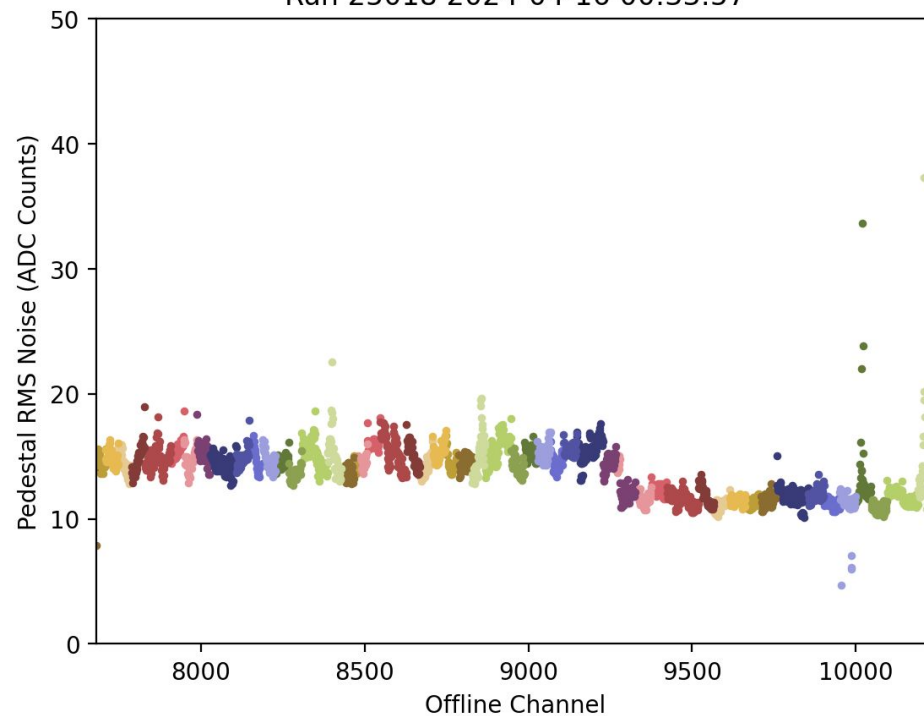


Lower APAs

APA3 Pedestal Noise Levels
Run 25018 2024-04-16 00:33:57



APA4 Pedestal Noise Levels
Run 25018 2024-04-16 00:33:57

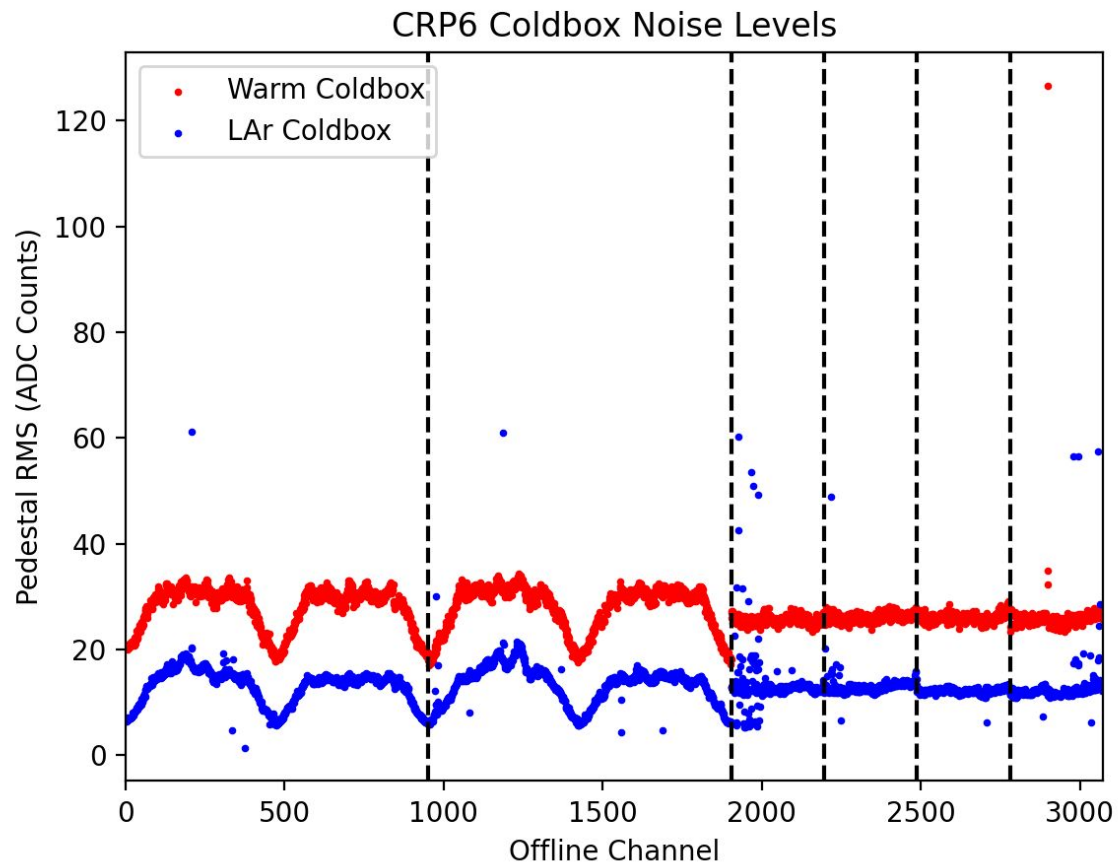
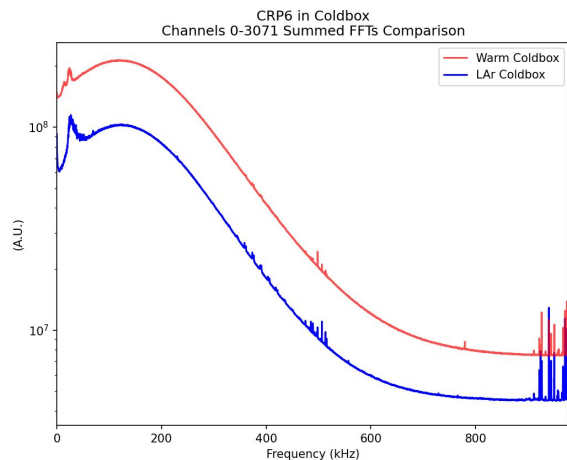


CRP6 Status

- Reminder: a second coldbox test of CRP6 was run in January, restoring the copper sheet grounding on both sides and adding shield plates underneath the cables on B-side
 - Overall noise improved everywhere
 - Localized pickup on collection channels mostly went away on B-side, but remained on A-side, suggesting shielding the power cables actually helped
- Afterwards, CRP team made a number of additional improvements/changes:
 - A new ground plane on the A-side
 - Replacing one adapter board on A-side, where there had been many disconnected channels at cold
 - Replaced shield and 1st induction anodes on A-side
 - Soldered grounding braids on both sides
- A third coldbox test of CRP6 is running throughout this month

CRP6 Cooldown

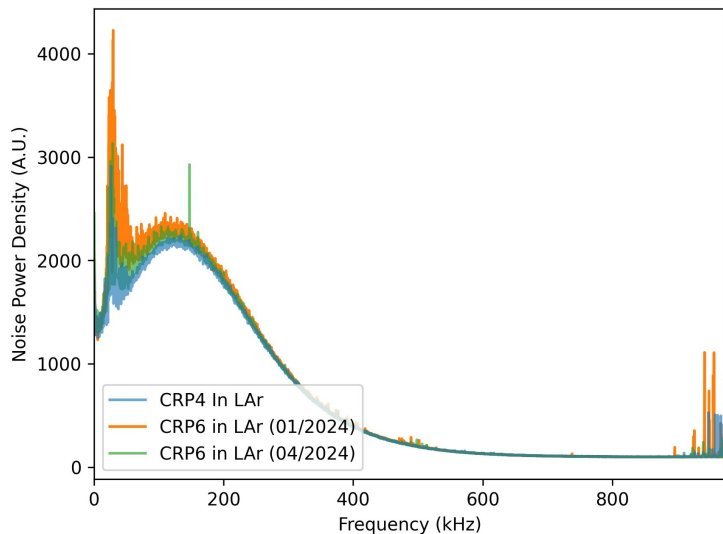
- CRP6 cooldown saw the loss of several channel connections, in particular in one corner of B-side X plane
 - Like last time, these started appearing while still in gas



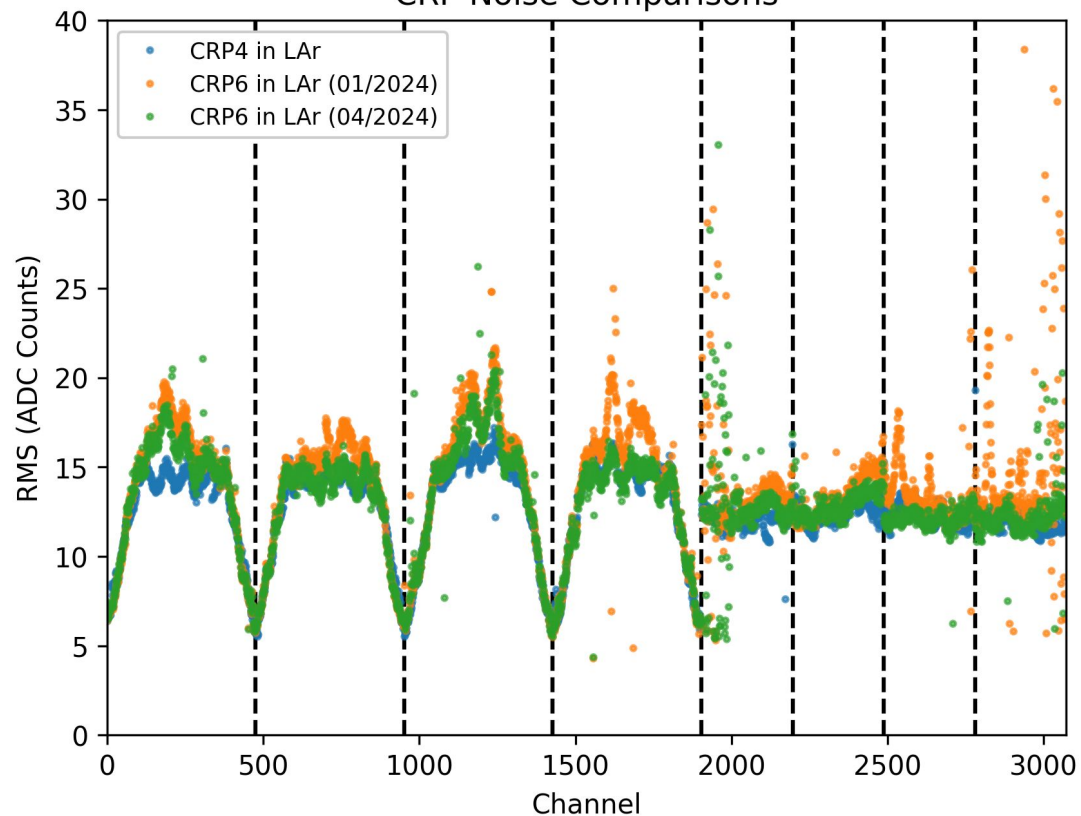
Comparison to Previous Runs

- Noise level on A-side is now comparable to best levels achieved in CRP4
 - This is the side where the new grounding plane was added

CRP4/6 Noise Power Spectrum Comparison
All Channels Summed

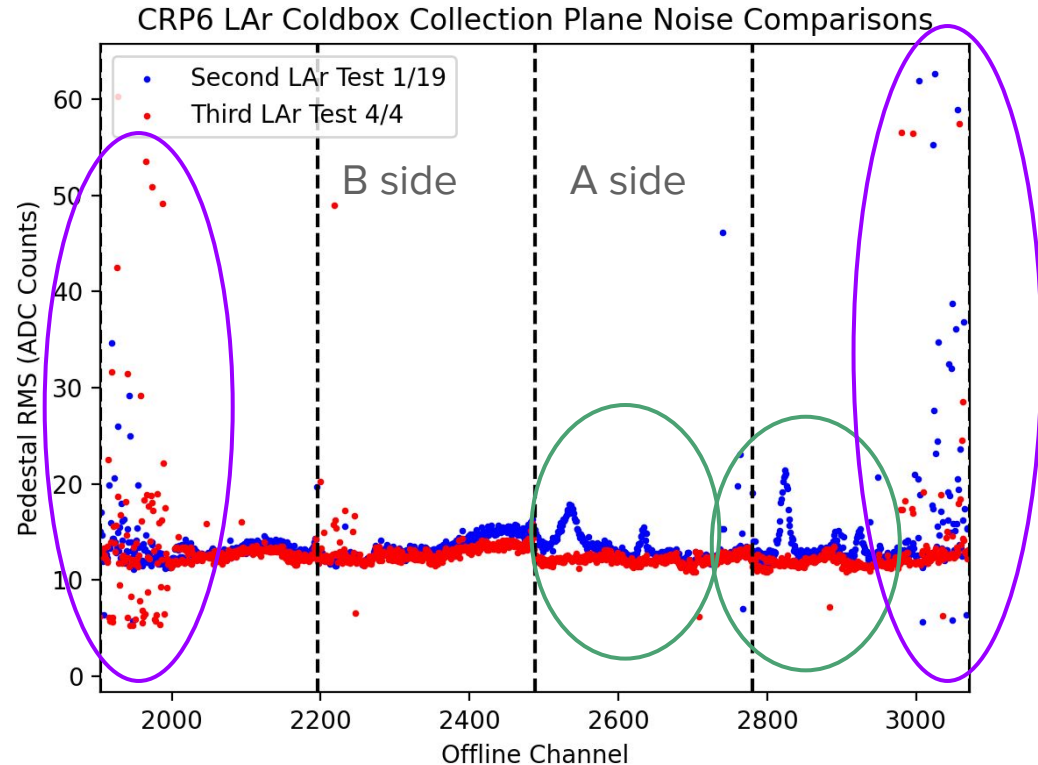


CRP Noise Comparisons



Collection Plane Behavior

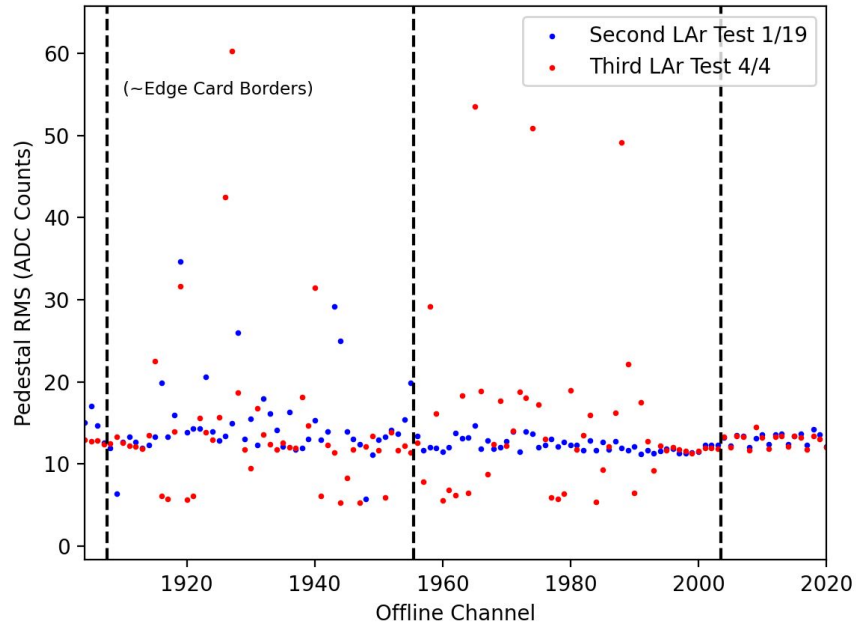
- **Noise peaks on A-side** that were believed to be pickup from power cables running over them are now gone
 - Recall that some shielding was placed beneath the B-side cables prior to the January coldbox test already
- **Scattered high/low noise channels in CRP corners** are still present, appearing only at cold



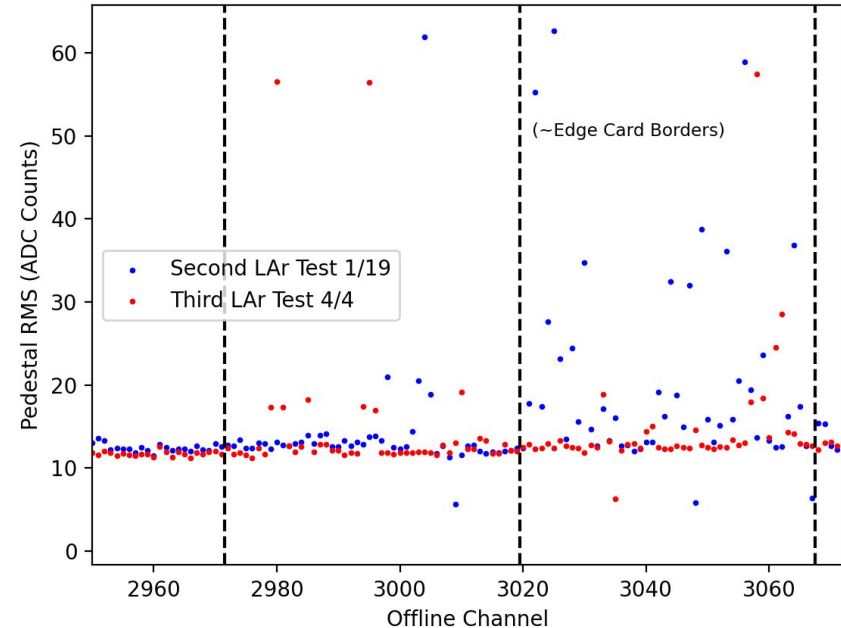
High/Low Noise Collection Channels

- The random high/low noise channels seem unrelated to any electronics settings, and appear only at cold
- The problem seems worse on B-side and less severe on A-side during this cooldown

CRP6 LAr Coldbox - Collection B Side

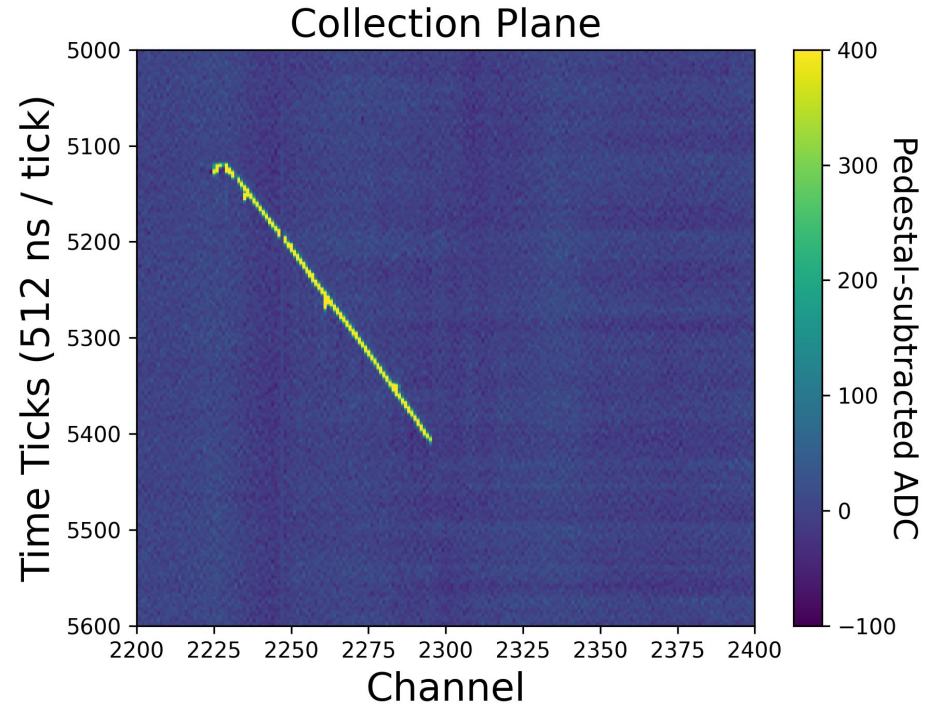
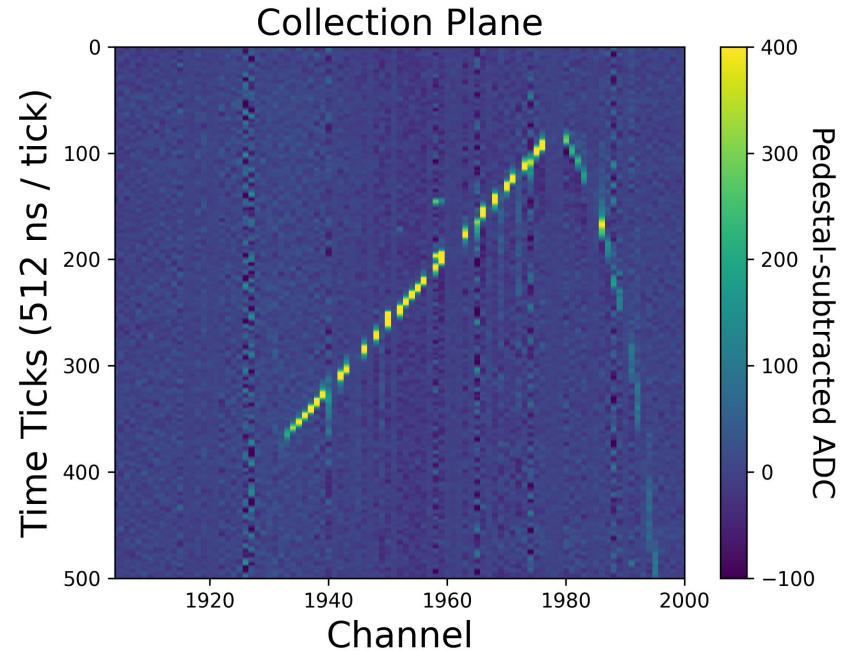


CRP6 LAr Coldbox - Collection A Side



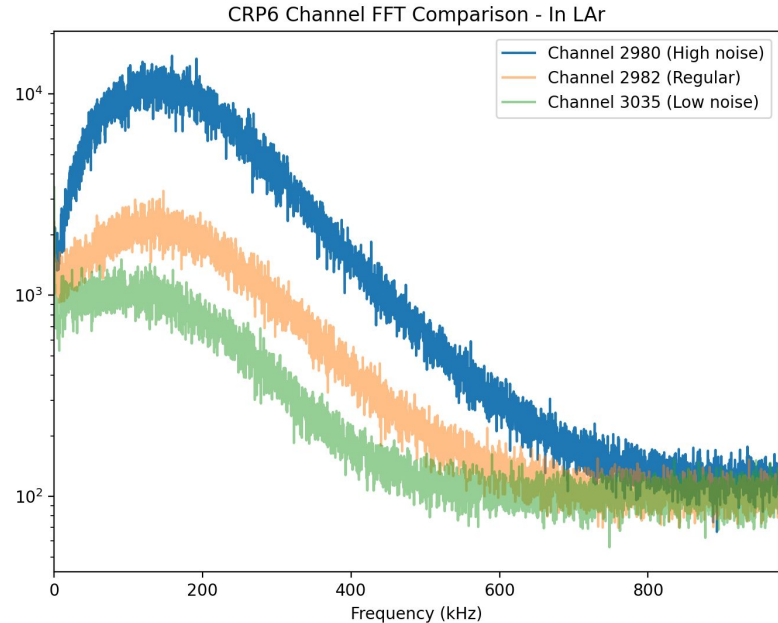
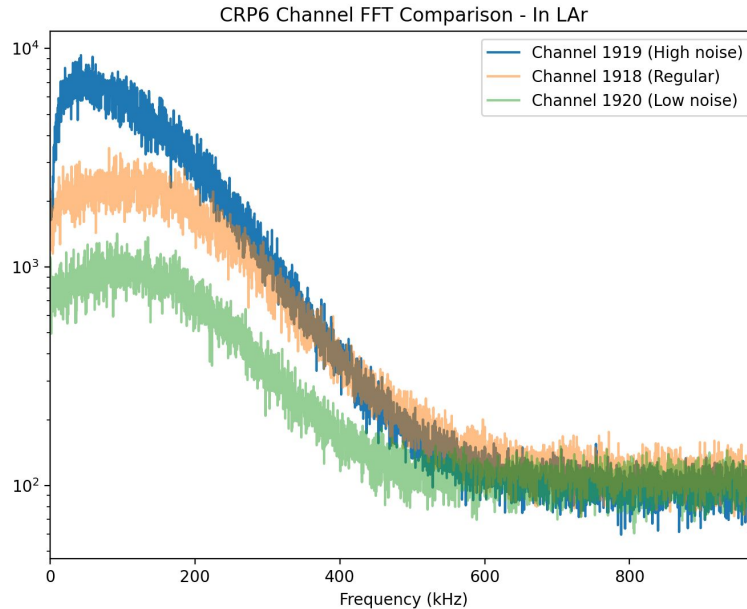
Broken Tracks

- Effect of the open collection channels clearly visible in tracks passing through the afflicted regions



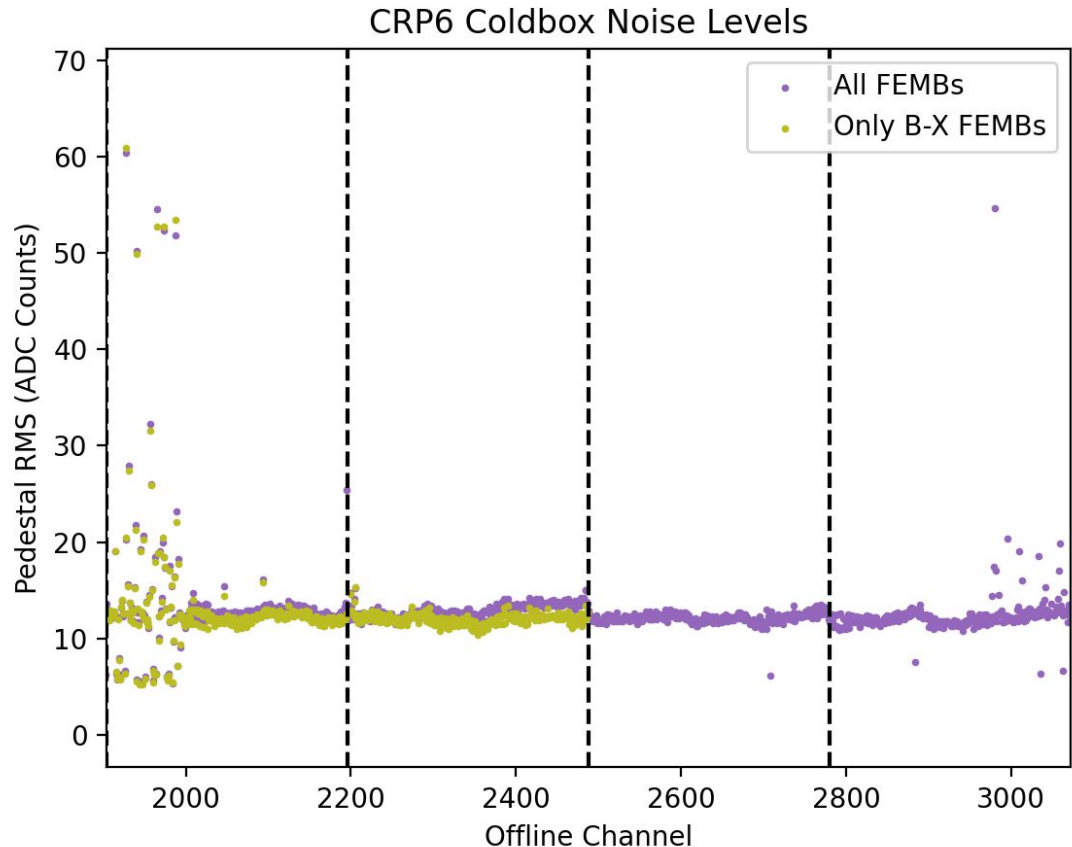
High/Low Noise Collection Channels

- The scattered high/low noise channels on the collection plane show no distinctive features in their noise power spectra
 - Consistent with respectively being improperly shorted to something and simply disconnected



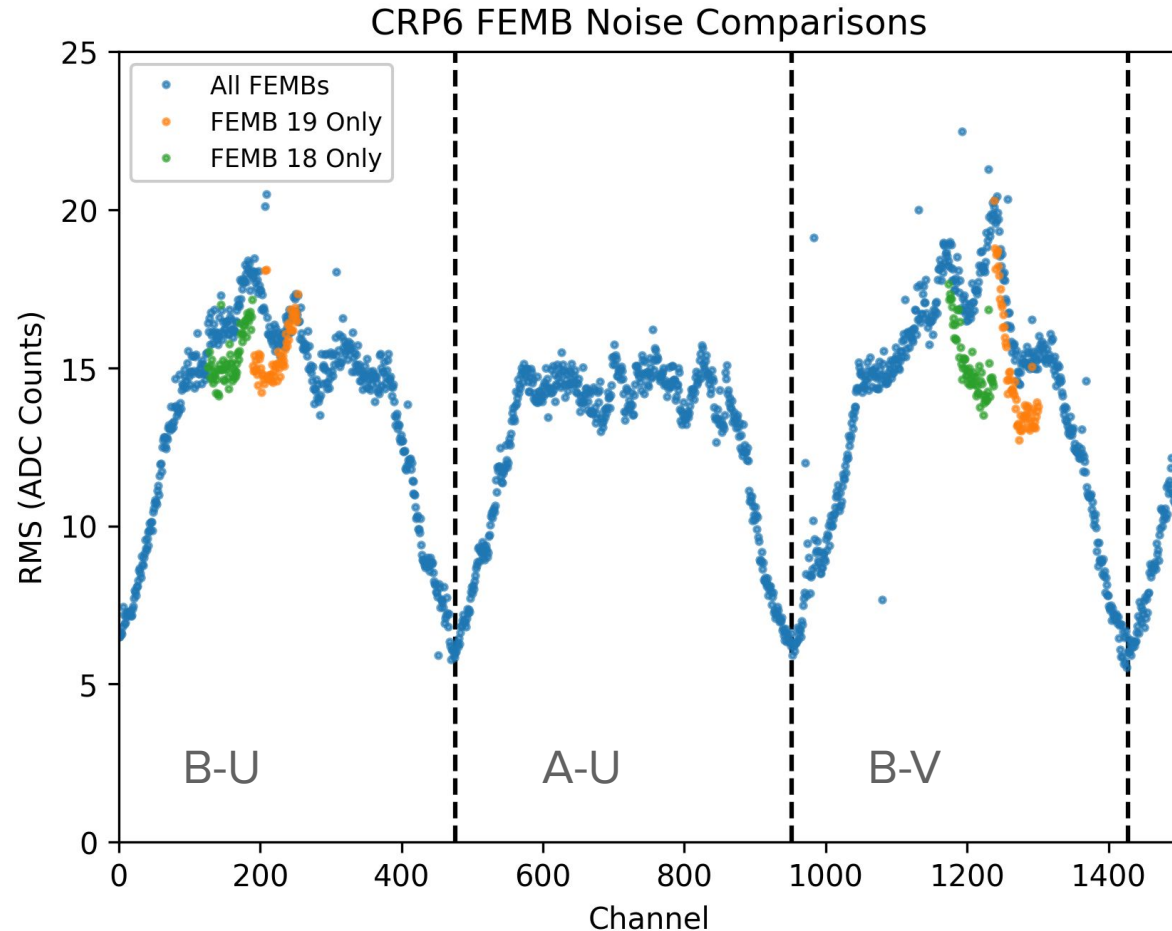
High/Low Noise Collection Channels

- The behavior of these scattered channels does not change with any electronics settings we have tried, including:
 - Powering only a subset of FEMBs
 - Differential/SE mode
 - Increasing LArASIC leakage current
 - Power settings



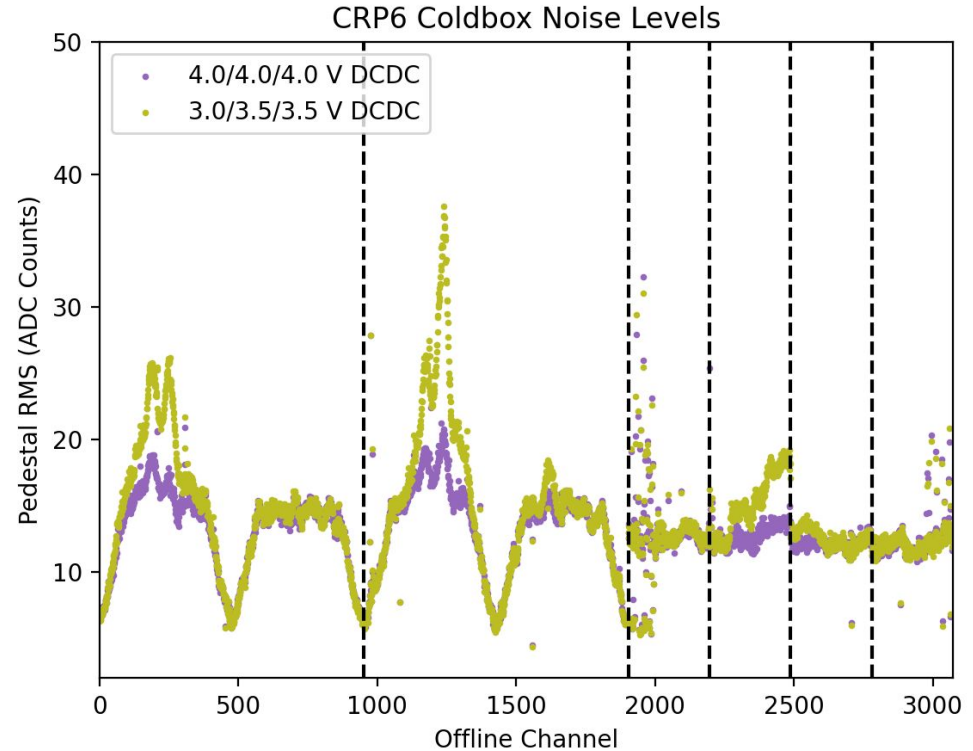
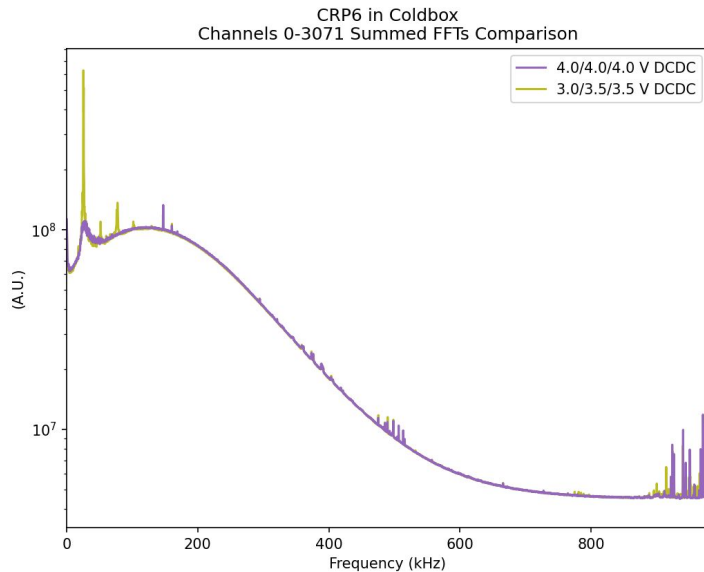
Single-FEMB Tests

- Powering only a single FEMB at a time suppresses noises in the regions with highest pickup
- But it does not eliminate the excess noise entirely



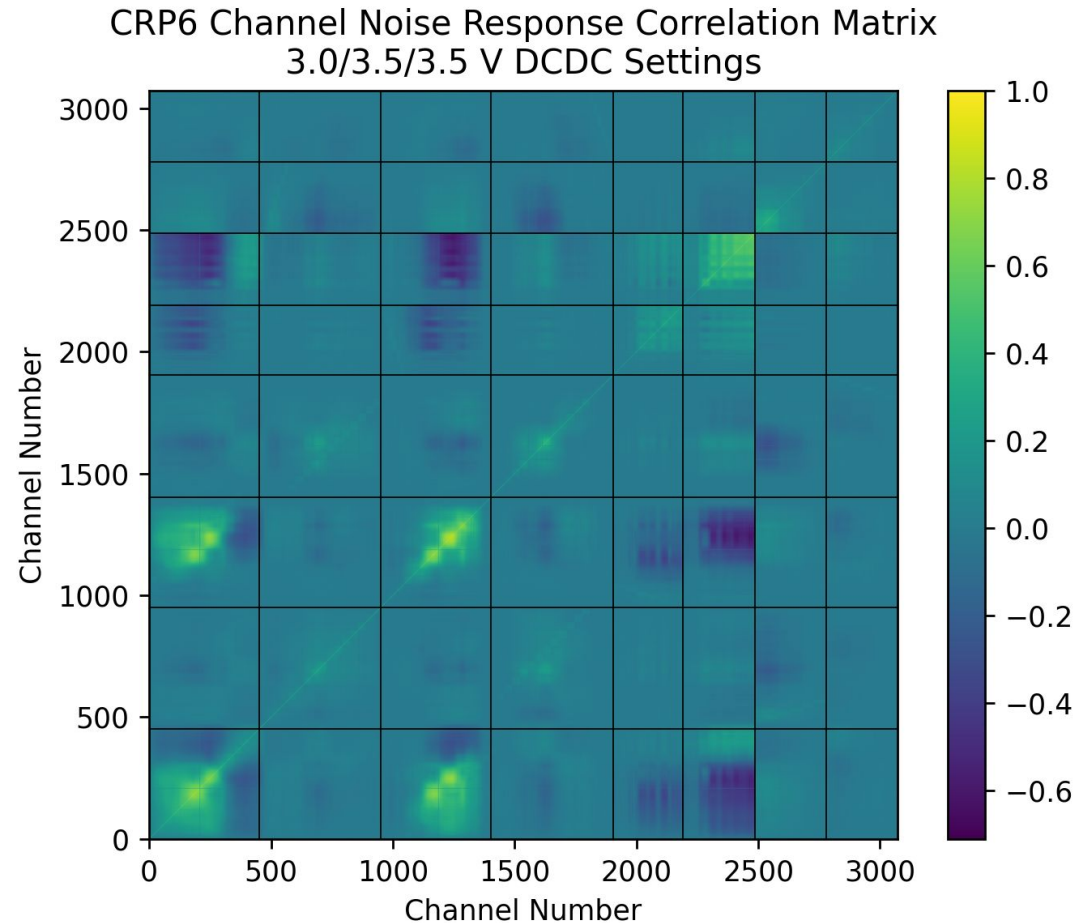
Effect of Power Settings

- Decreasing DC/DC power settings on the WIBs shows the usual effect of amplifying coherent noise
 - Note: little effect on A-side, where there was little pickup in the first place



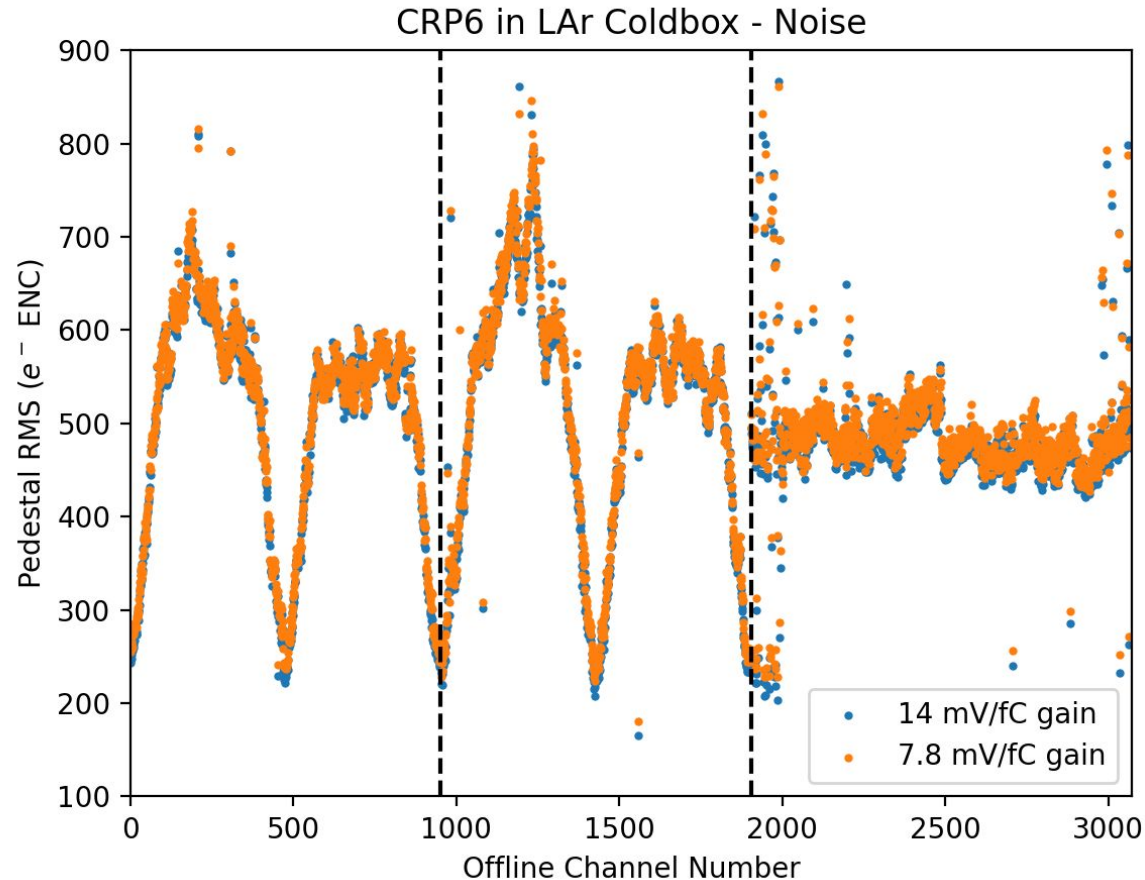
Noise Correlations

- **Correlation matrix of raw channel waveforms**
 - Note: at “nominal” DCDC settings, the shape is the same, but less intense
- **Notable features:**
 - Small positive-correlation squares corresponding to ASIC divisions
 - Large blocks of positive correlation on the high-noise B-side induction channels
 - Large anticorrelations between induction and collection noise on B-side



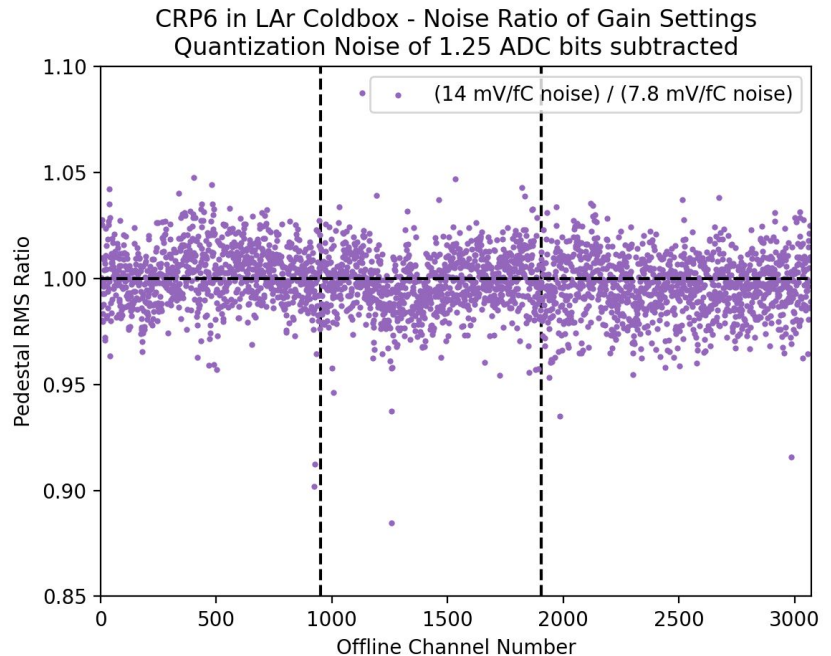
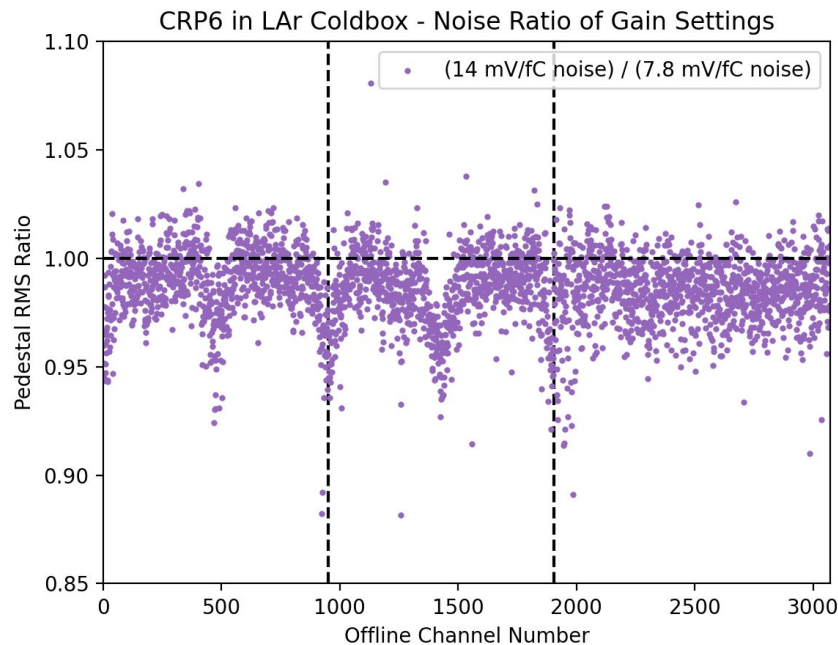
Gain Comparison

- Noise runs taken at 7.8 mV/fC and 14 mV/fC gain
- Calibrated with pulser scans from DAC = 0 to 31. Average channel gains are:
 - 14 mV/fC: **38.2 +/- 0.7 e⁻ / bit**
 - 7.8 mV/fC: **68.6 +/- 1.1 e⁻ / bit**
- Noise levels at the two gains are very similar
 - Note: effect of quantization noise is visible by eye for the shorter strips and open channels



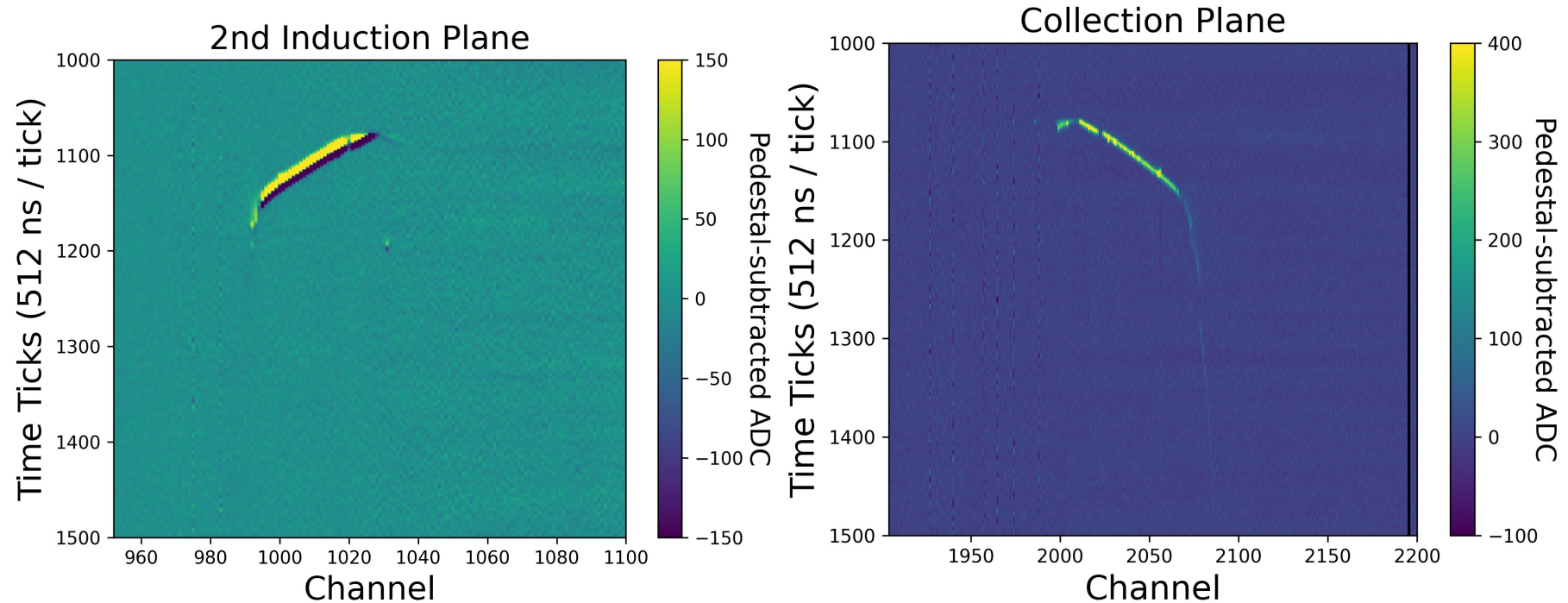
Gain Comparison

- The slightly higher noise with 7.8 mV/fC gain is consistent with a quantization noise RMS of **1–1.5 ADC bits**
- Below: subtracting 1.25 ADC bits of noise in quadrature from all channels evens out the noise ratio between the two gain settings



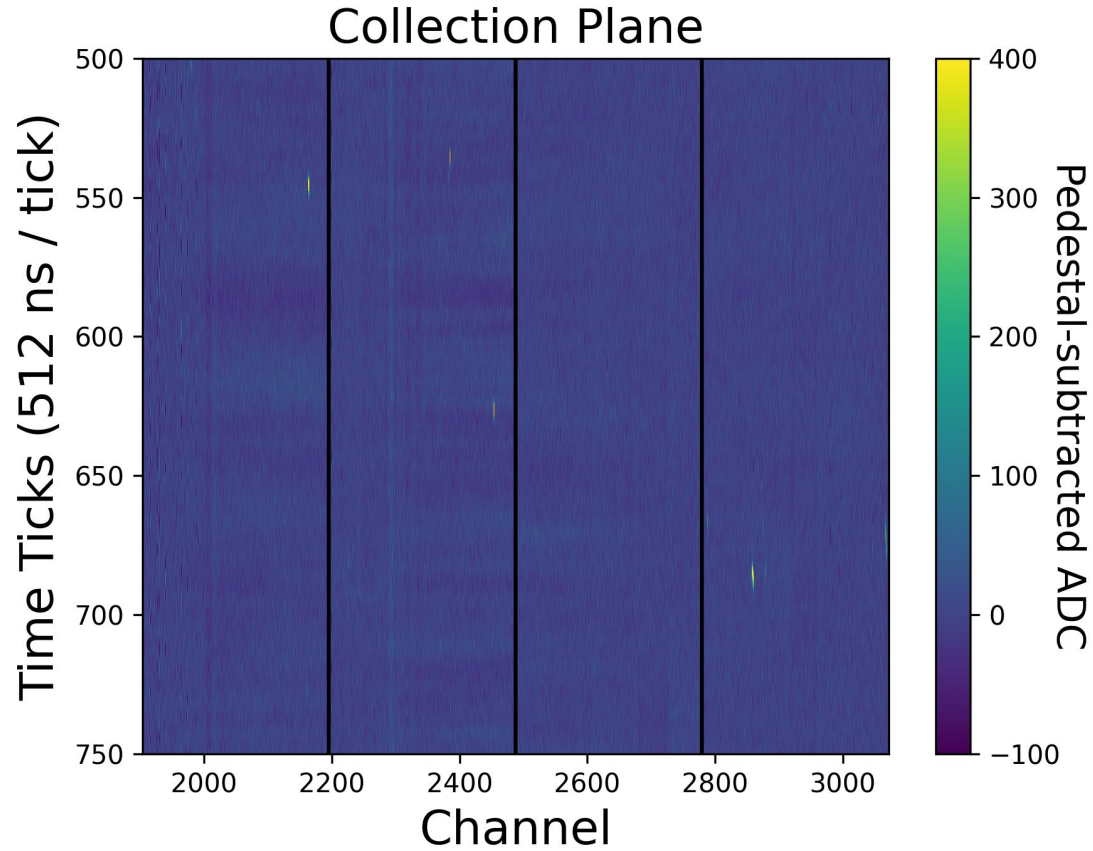
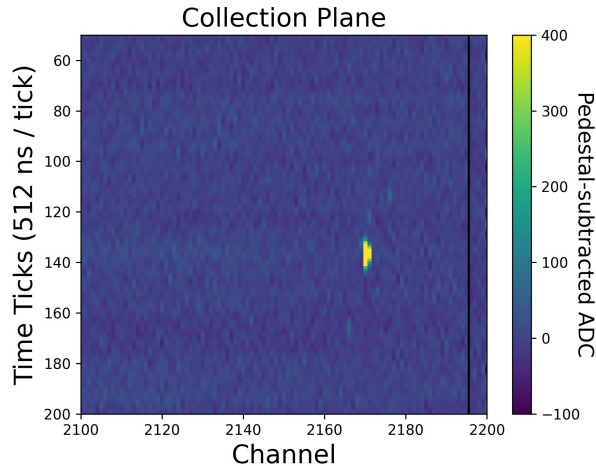
DAQ Self-Trigger Runs

- DAQ team took several runs using online triggers



Pulsed Neutron Source Data

- Recently took joint data with PDS with a Pulsed Neutron Source turned on
- Deposits are spatially and energetically consistent with expectations



Summary

- NP04 cooldown is proceeding without incident from electronics side
 - A few more disconnected channels have appeared, but a full catalog awaits completion of filling
- CRP6 coldbox test has been running since beginning of April and will continue to end of month
- Recent improvements to the A-side of CRP6 have brought noise down to levels of CRP4/5 tests
- Issues with anomalous channel responses appearing at cold in CRP6 persist, but the source is unclear
- Full set of CRP6 noise, pulser, and both cosmics/PNS runs in [this spreadsheet](#)
 - Also includes some DAQ self-trigger tests