CRP5 Summary of Issues from Coldbox Test

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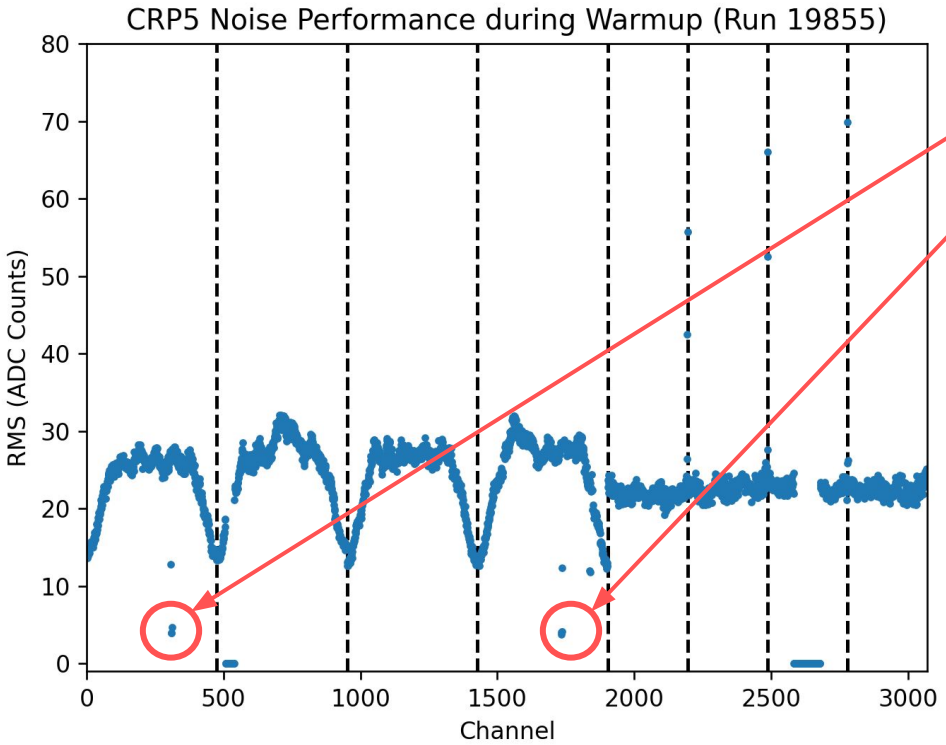
Issues Observed during CRP5 Coldbox Test

- FEMB-11 received no clock signal in LAr, and 7 other FEMBs (1, 6, 9, 10, 13, 14, 17) were seeing corrupted data with varying degrees of frequency
  - These problems all only first appeared in LAr, and disappeared again after warmup
  - FEMB-11 was unusable without a clock signal
  - FEMBs sending corrupted data were usable, but were not reliable
  - These issues are currently all suspected to be due to flaky connections in the cold
- FEMB-5 and FEMB-20 both had 3 channels die during warmup
  - These FEMBs are both now replaced, but the cause of this is still under investigation
- FEMB-5's short power cable was pinched and shorted at the patch panel during warm tests, but was insulated with a teflon wrap for the coldbox test
  - This cable is now replaced as well
- Low frequency microphonic-like noise on some strips when CRP HV bias is on
  - Most of CRP5B's U layer was missing the HV bias connection during this run, which may be related

Corrupted Data

- The WIBs verify a checksum calculated for each ColdADC's block of data, and raise a flag when this checksum is failed
  - Failure indicates a problem with the transmission of digital data between the FEMB and the WIB
  - Channels with this problem can sometimes still be usable, but will not be reliable
  - This can be caused by imperfect transmission at connection points
- In the best case, we still receive steady data, but with some blocks of channels sometimes having one digitization period flagged as bad
- In the worst case, these errors cause entire frames to get randomly dropped from a datalink (= loss of one digitized sample from 256 channels)
- FEMB 9 and 10 saw this problem most prominently, with error rates of >>1 Hz on half their channels
- Other FEMBs saw the errors with rates ranging from ~1 Hz to <0.01 Hz

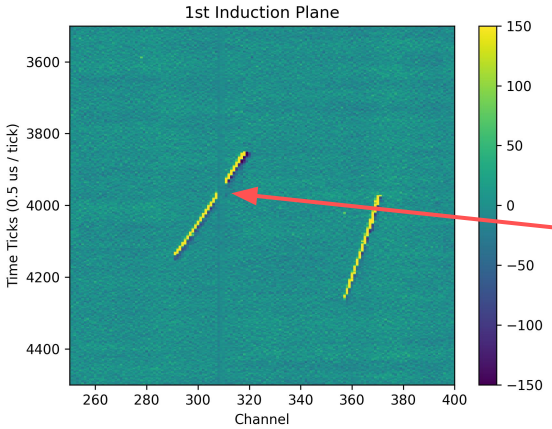
Dead Channels

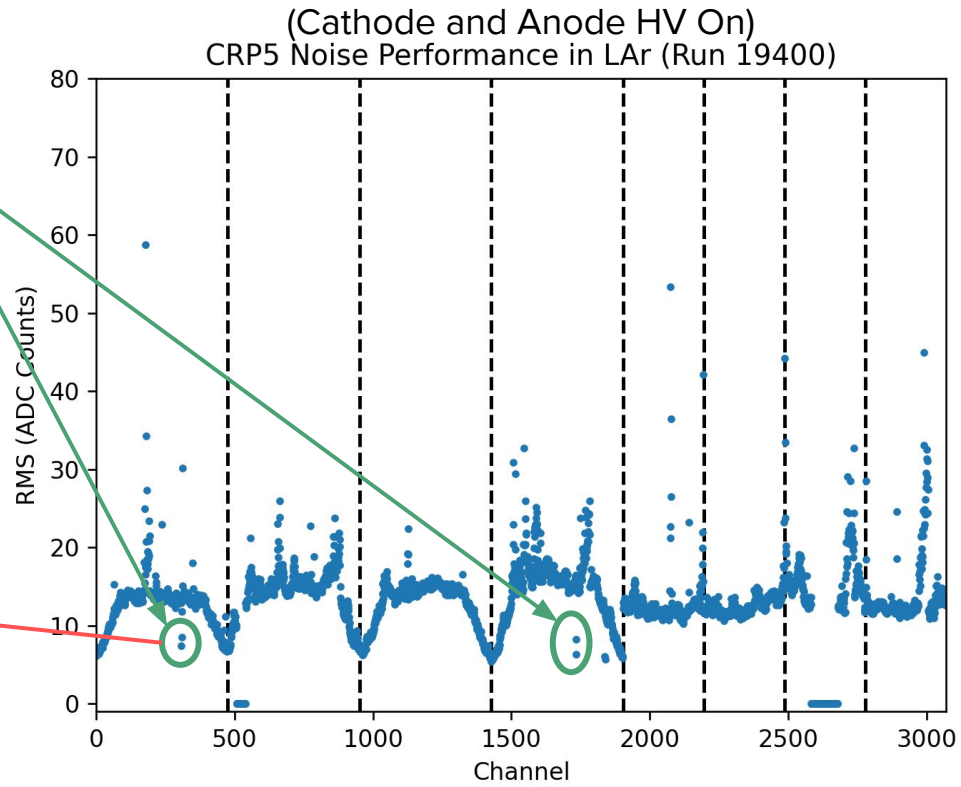


- During warmup we lost 3 channels on each of FEMB-5 and FEMB-20
  - Channels no longer respond to pulsers
- Channels all had normal response in initial LAr data
- Channels died one at a time during warmup

Dead channels before they died

- The channels that eventually died were part of channel clusters that had connectivity issues at cold
  - But were still responding normally to internal pulsers at the time





Summary of Dead Channels

List of dead channels :

- **Feb 18, 11 : 42 am : Channel 311 – FEMB 20**
- **Feb 20, 05 : 28 am : Channel 1736 – FEMB 5**
- **Feb 20, 06 : 38 am : Channel 1734 – FEMB 5**
- **Feb 20, 08 : 10 am : Channel 310 – FEMB 20**
- **Feb 20, 09 : 58 am : Channel 309 – FEMB 20**
- **Feb 20, 10 : 14 am : Channel 1735 – FEMB 5**

Dead channels for FEMB 20 : 309, 310, 311

- 309 : ASIC 7 ------ Channel 8
- 310 : ASIC 7 ------ Channel 7
- 311 : ASIC 7 ------ Channel 6

Dead channels for FEMB 5 : 1734, 1735, 1736

- 1734 : ASIC 1 ----- Channel 11
- 1735 : ASIC 1 ----- Channel 10
- 1736 : ASIC 1 ----- Channel 9

Slide from Herilala Razafinime

FEMB-5 Damaged Power Cable

- Short power cable was damaged by the patch panel clamp, causing an electrical connection between the clamp and the inner conductor
- This was found before the coldbox test and remedied with a teflon sleeve, but the **cable is now replaced**

Other fixes on CRP5

- **Patch panel + patch panel support for FEMBs 7-12 have been replaced, using a new patch panel support as well**
  - Inspection of the removed patch panel shows a possible damaged solder joint for the FEMB11 connector (which lost its clock signal in LAr)
- **FEMBs 5 and 20 have been replaced with new ones**
  - New FEMBs show normal electronics response, but the channels that died on the old FEMB 5 and 20 still show as open-like channels on the new ones

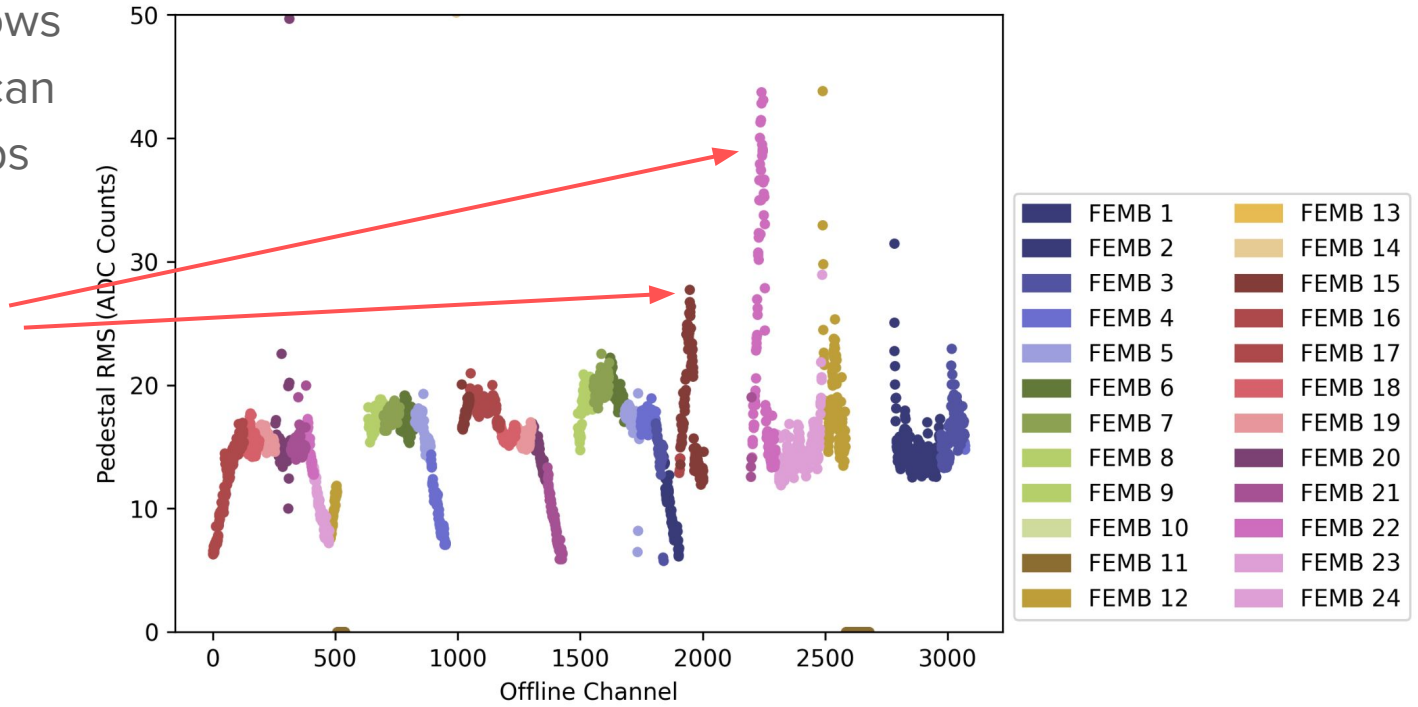
Summary

- The driving issue for considering a retest of CRP5 is the clock/data issue that appeared in LAr, which is **presumed to be due to imperfect data connections at the patch panel level when cold**
- Whether this is a systematic problem or a human-error problem, we need to better understand it or it may just happen again when NP02 is filled
  - The forthcoming cold results from CRP4 will shed light on which case is more likely
- Warm tests may shed light on the possible causes, but we probably cannot be confident of any proposed solution unless we actually test it in cold again

- The damaged FEMBs are also a concern, but it's not clear that a retest of the whole CRP would shed light on how they were damaged
  - (Unless it happens again)
  - Damaged FEMBs will be sent to BNL for more thorough debugging

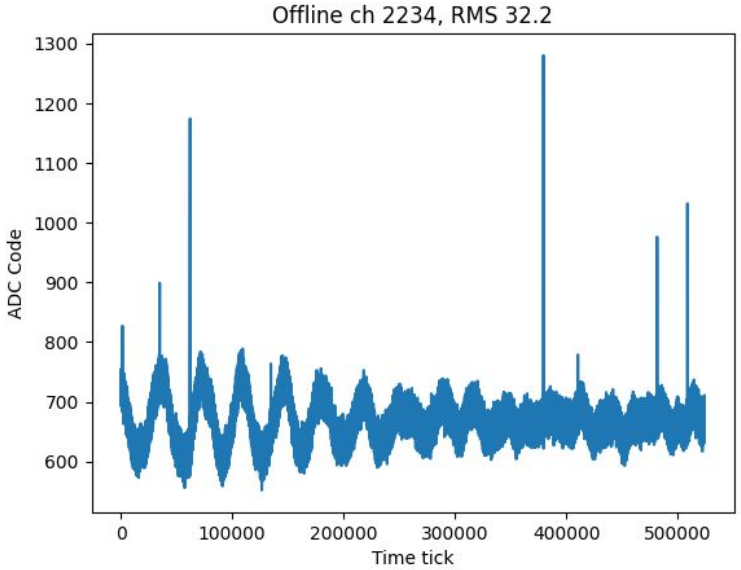
Microphonic Noise

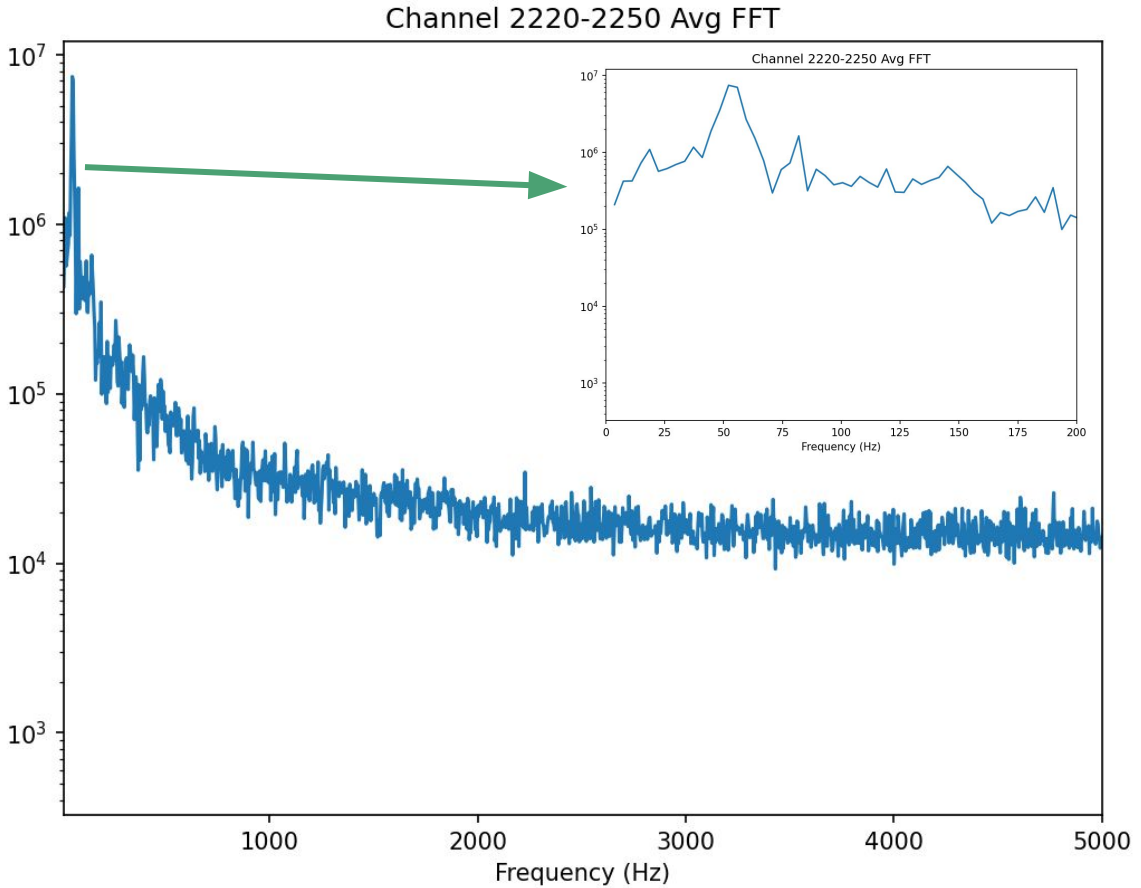
- Using very long readout windows (268 ms), we can see some strips experiencing large baseline oscillations



Microphonic Noise

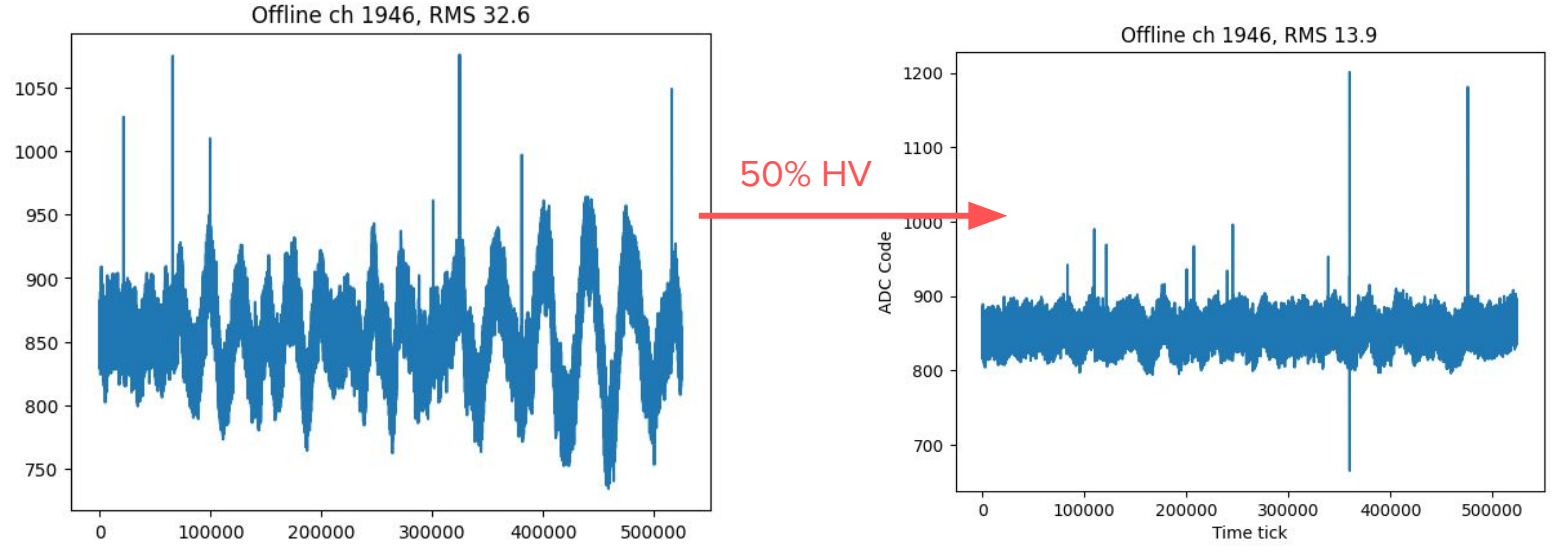
- Very slow (<100 Hz) baseline oscillations, but with significant amplitude



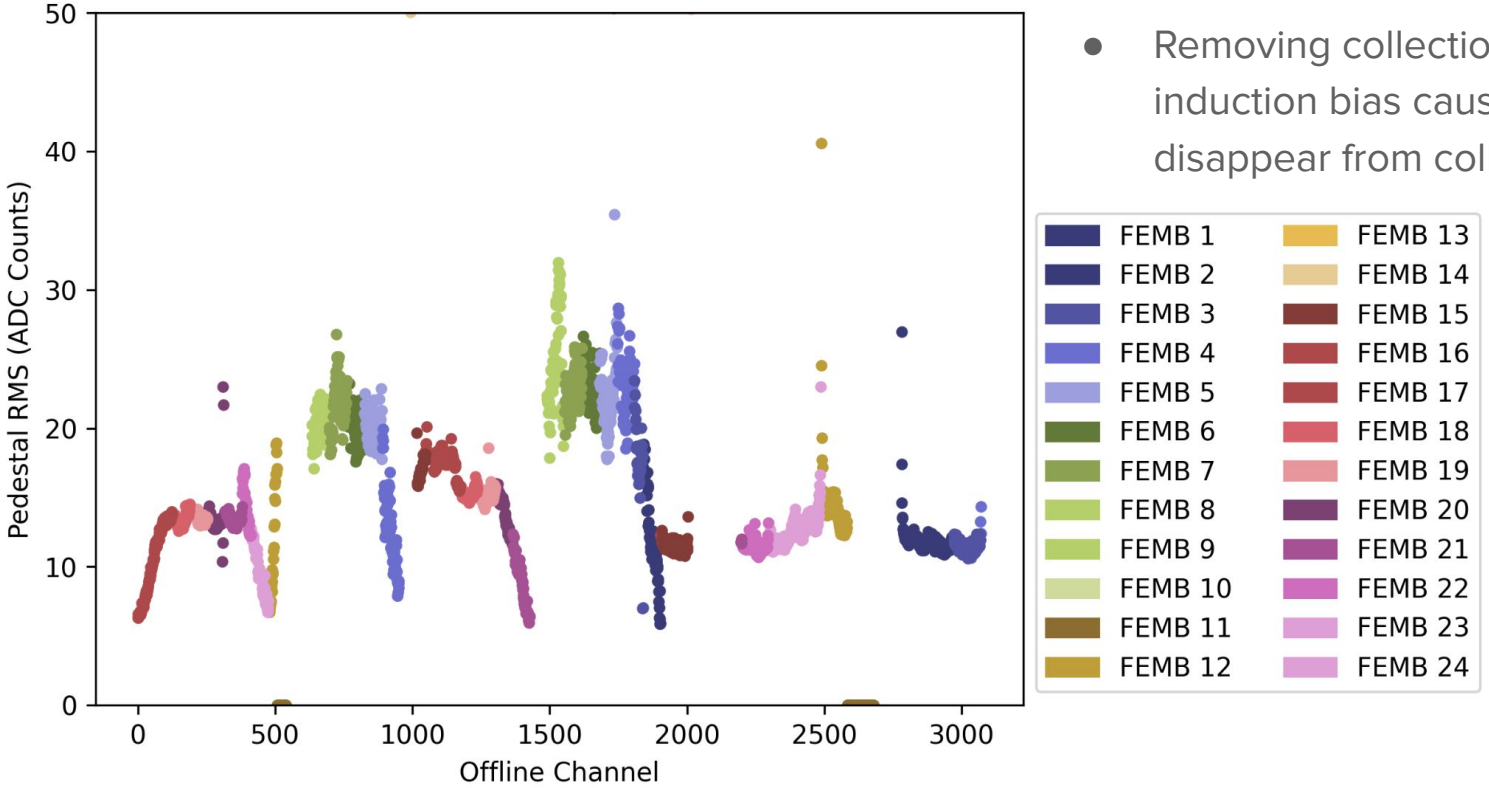


Relation to High Voltage Bias

- This very-low frequency effect only appears when anode bias is on
- Amplitude decreases as HV level is decreased
- Turning off collection bias but keeping induction bias results in visible oscillations on some induction strips but no collection strips



Without Collection Bias



- Removing collection bias but keeping induction bias causes oscillations to disappear from collection channels