Dataprep status and results

VD coldbox analysis

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November 5, 2021

Introduction

VD coldbox

- BDE (bottom drift electronics) are being tested in the CERN coldbox
- Much work this week to reduce warm noise levels (see following)
- Yesterday was first attempt to run cold
  - Noise shot up, not yet resolved

Dataprep

- Others (Jake, Tom, …) manged to get the dataprep module running for the VD coldbox data
  - Primary motivation to write out wires
- I am using dataprep to look at and process the data
- Plots here use channel map that accounts for cable swaps (9/10, 12/13) in readout
- Fcl config used for plots here is in appendix

First results: ADC noise
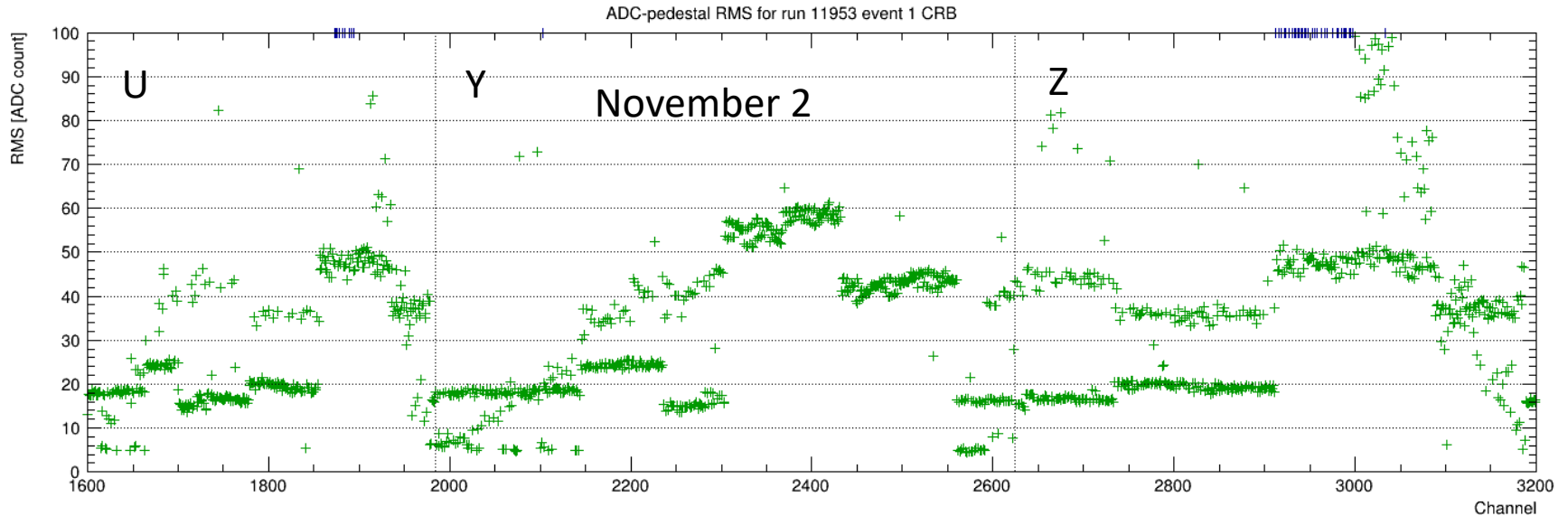
Begin by looking at ADC RMS 11/2 data

- Plot RMS(ADC – pedestal) for all samples in each channel
  - Pedestal take from decoder (mean value)
  - Will later look at evaluating pedestal with dataprep tool
- Lots of variation in noise
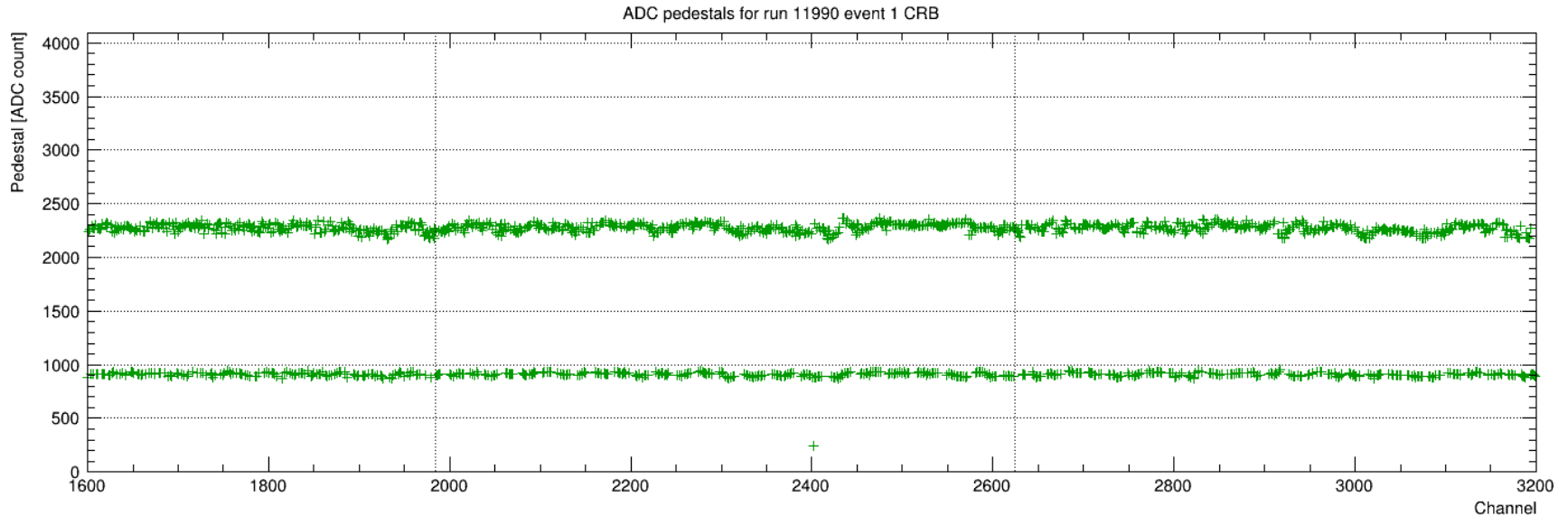 - Work done to remove noise sources →

After removing some noise sources

ADC-pedestal RMS for run 11990 event 1 CRB
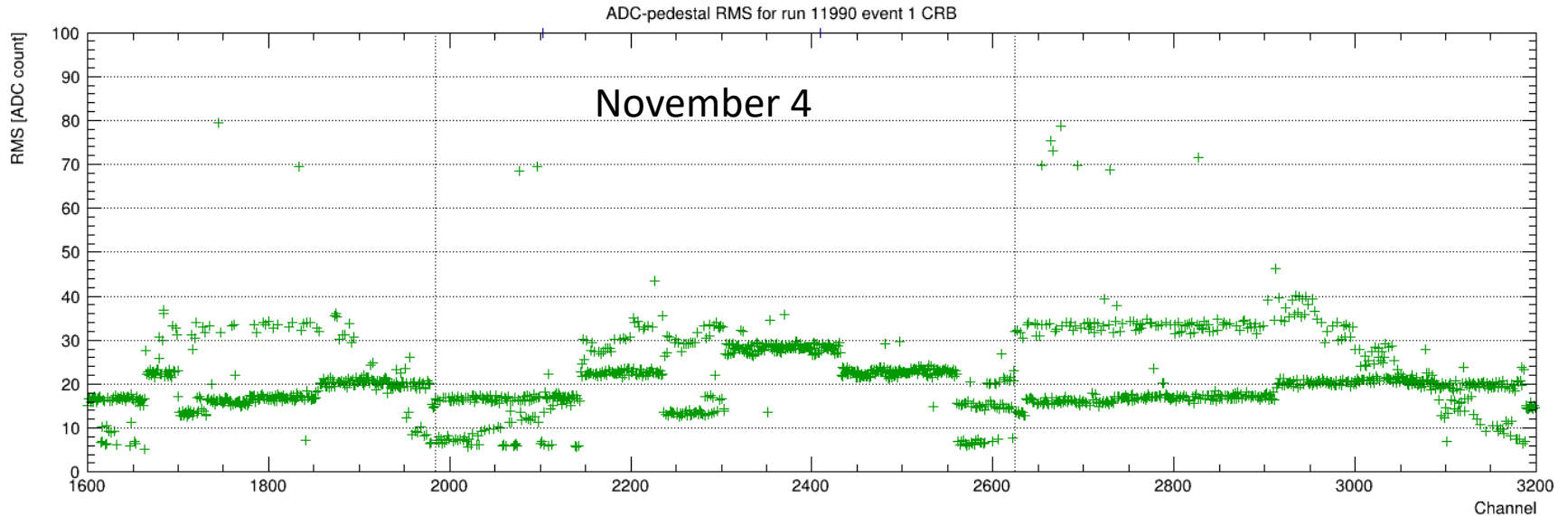
Two days later

- Noise is much reduced
- Level is still high but we are still at room temperature
- Cooldown begun after this run
  - Noise gets much worse later—new problems…

Pedestals

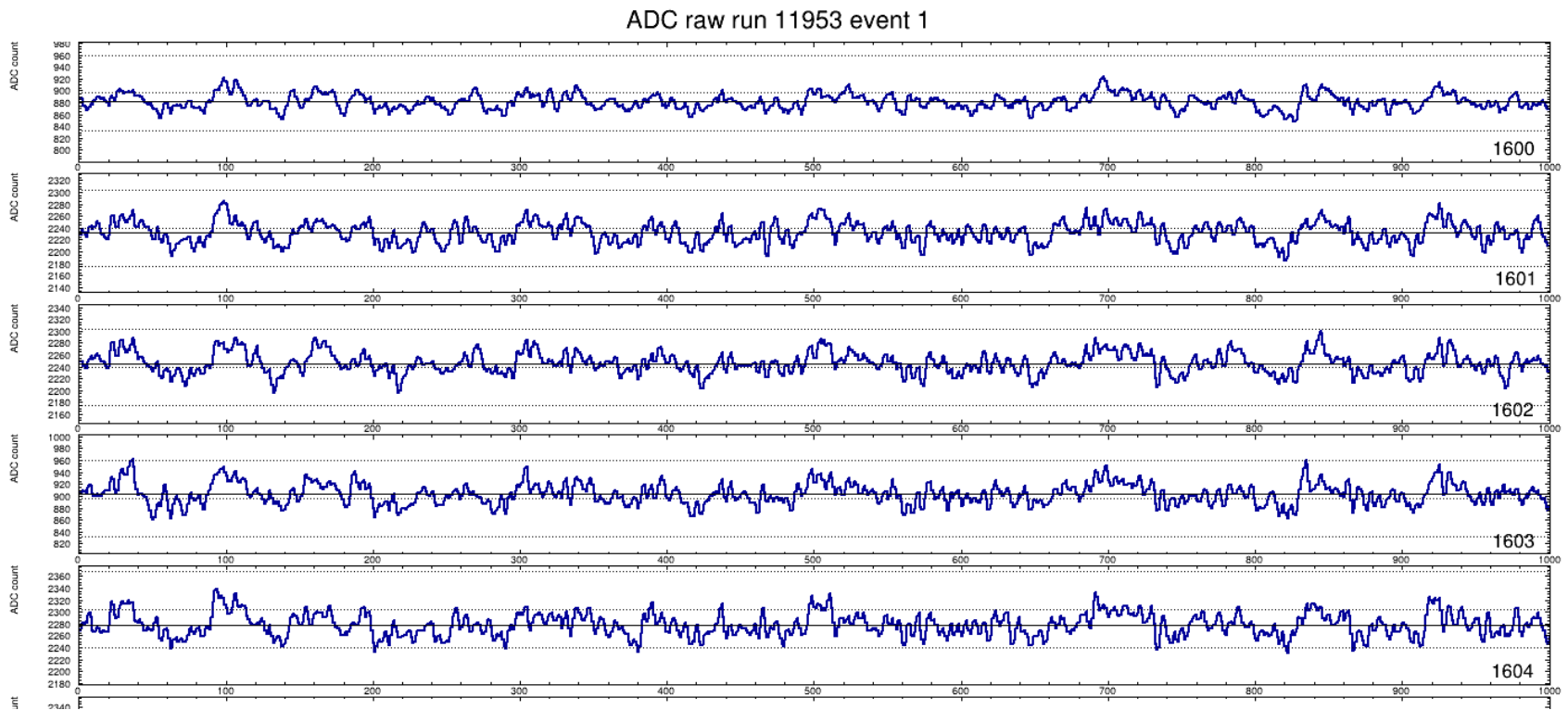ADC pedestals for run 11990 event 1 CRB

Pedestals shown in plot above

- Bi-level pattern is left over from protoDUNE
  - High pedestal is for induction, low for collection
- Mapping to views is very different here
  - Pedestals may be fixed
  - But probably doesn't make much difference for noise measurement

Waveforms

I have posted waveforms:

- https://internal.dunescience.org/people/dladams/protodune/vdcoldbox/wfraw/run011953/plots.html

- Access with DUNE docdb account

- Examples below

ADC raw run 11953 event 1

Charge calibration

Calibrate the signal

- So integration of a collection-plane pulse (if we had one) gives the collected charge
- I don't think we have pulser data
  - If we did, it would be more work for someone
  - Good to have at least one run to verify amplifier settings
- But these are electronics from protoDUNE
  - With nominal 14 mV/fC gain and 2 us shaping
  - Right??
- Use nominal calibration: 40 e/(ADC count)
  - ProtoDUNE was within a few percent of this
  - with 5% channel-to-channel variation
- Noise plot is shown on following page
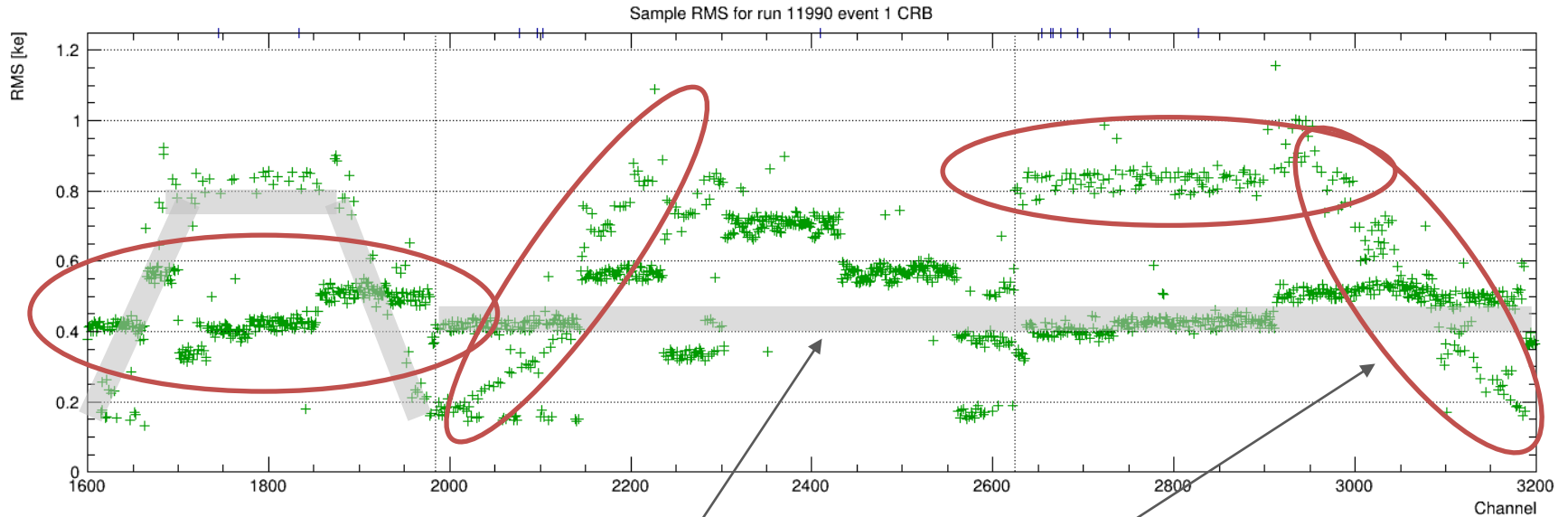 - Scale chosen to make noise appear twice as high as ADC plot

Calibrated noise

Sample RMS for run 11990 event 1 CRB
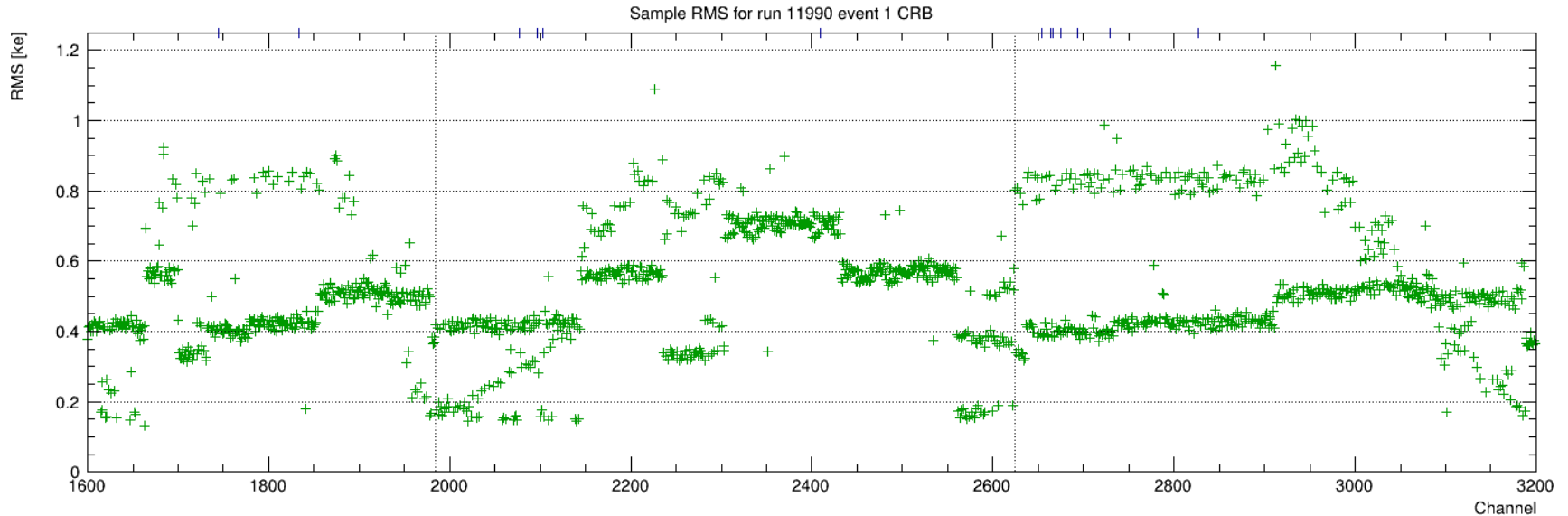
Plot shows calibrated sample noise vs. channel

- Vertical scale is ke (1000 electrons)
- ProtoDune was 0.08 – 0.09 ke cold
- This is still warm.

Channel map

Sample RMS for run 11990 event 1 CRB

Roughly expected noise shape is overlaid on the above

- Trapezoid due to decreasing strip length at ends in U plane
- Flat (constant strip length) for Y and X

Noise correlates with FEMB

- See following page
- Majority of channels have the same noise for given FEMB-view
- But many do not suggesting a channel map problems
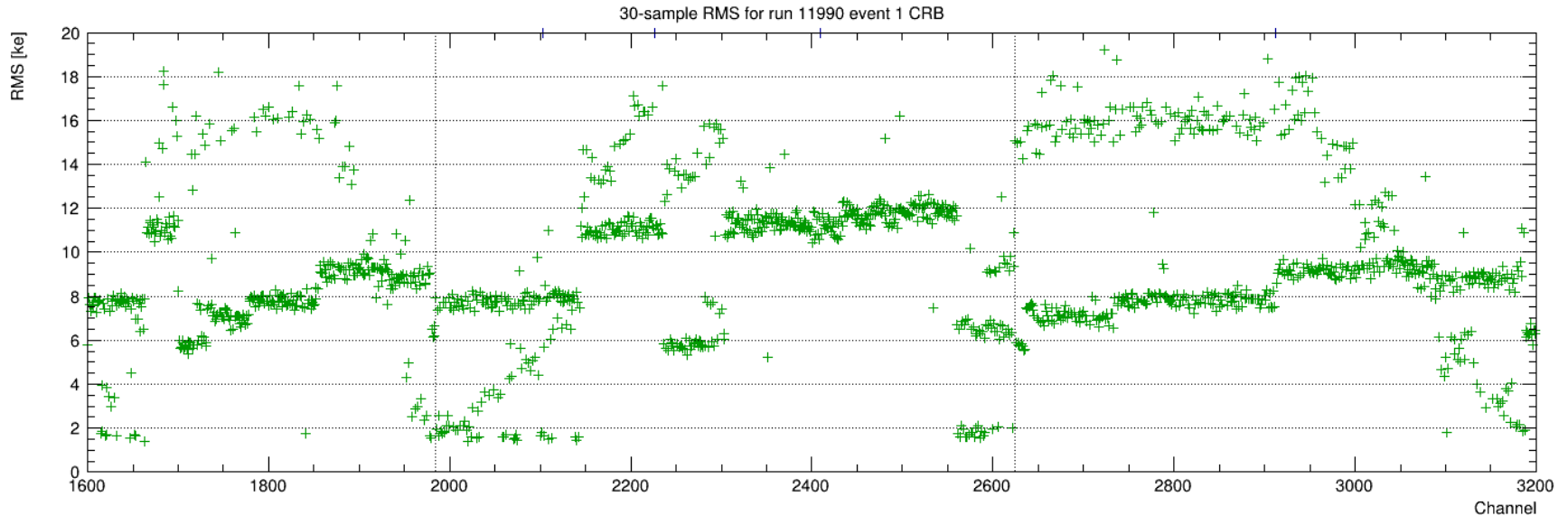 - This is being investigated

FEMB assignments

FEMB IDs for run 11990 event 1 CRB
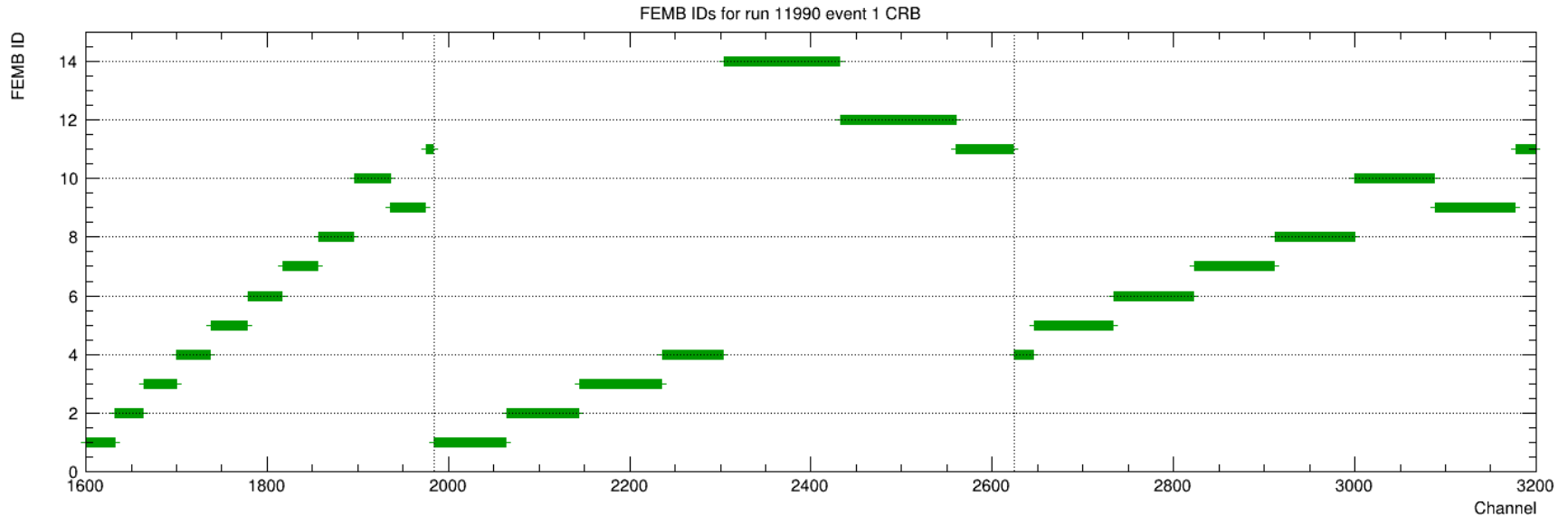
Plot shows which FEMB (1-14) reads each channel

- One FEMB may read 1, 2 or 3 planes
- Unlike protoDUNE where each read 48 collection and 40 of each induction

Integrated noise

30-sample RMS for run 11990 event 1 CRB

Plot above shows the 30-sample integrated noise

- I.e. RMS of sums over 30 contiguous samples
    - About the smallest window that would be used to measure charge
- Provides an estimate of the collection charge resolution in the TPC
    - Induction planes are much worse
- Value here is 8 ke warm compared to 1 ke cold in protoDUNE

Next

Sticky code mitigation
- Quick look at waveforms suggests we might be able to avoid this
- Best FEMBs were selected for this run

Bad channels
- Flag these and exclude from noise measurements, CNR, …
- Does this include the many apparent mis-mapped channels?

Charge calibration
- Many pulser settings for channel-by-channel calibration
- At least something to validate approximate charge scale

Correlated noise removal (CNR)
- Ignoring mis-mapped channels, noise appears to be fairly constant for any give FEMB-view (view = U, Y, Z)
- Try to run protoDUNE CNR tool on this data
  - Subtracts mean (median?) signal in FEMB-view from all channels there
  - May be problems where ther are not many channels in a FEMB-view
  - Likely need to update tool to handle the VD geometry

Deconvolution
- I would like to get kernel to compare with that for APAs
- Not directly relevant to coldbox analysis

Extras

Fcl config

Config used to make plots shown here

```
# vdproc.fcl

#include "vdcoldbox_raw_dataprep.fcl"
#include "vdcb_tools.fcl"


physics.producers.caldata.LogLevel: 3


services.RawDigitPrepService.ToolNames: [
  digitReader,                 # Unpack the digits acd.raw[] and acd.pedestal
  vdcbb_adcChannelFembIdPlotter,     # Plot FEMB ID (1-14)
  vdcbb_adcChannelAsicPlotter,       # Plot ASIC ID (1-8)
  vdcbb_adcChannelFembChanPlotter,   # Plot FEMB channel
  vdcbb_adcChannelPedestalPlotter,   # Plot pedestals
  vdcbb_adcChannelRawRmsPlotter,     # Plot ADC-pedestal RMS
  vdcbg_adcChannelFembIdPlotter,     # Plot FEMB ID
  vdcbg_adcChannelPedestalPlotter,   # Plot pedestals
  vdcbg_adcChannelRawRmsPlotter,     # Plot ADC-pedestal RMS
  adcSampleFiller,         # Fill acd.samples from acd.raw - pedestal
  adcScaleAdcToKe,         # Apply (nominal) charge calibration.
  vdcbb_adcChannelSamRmsPlotter,     # Plot ADC-pedestal RMS
  vdcbb_adcChannelSamRms30Plotter,
  adcRoiTreeMaker,
  adcKeepAllSignalFinder  # Flag all samples as signal, i.e. acd.signal[] = true
]


tools.adcScaleAdcToKe.ScaleFactor: 0.025


tools.vdcbb_adcChannelRawRmsPlotter.MetricMax: 100
tools.vdcbb_adcChannelSamRmsPlotter.MetricMax: 1.25
tools.vdcbb_adcChannelSamRms30Plotter.MetricMax: 20


tools.adcRoiTreeMaker.MetadataFields: [apaFembID, fembChannel, samRms, samRms30]
#physics.producers.caldata.Event: 2


#include "evsel.fcl"
```