Two Ideas for Data Quality Requirements

Tom Junk

Fermilab

DUNE FD Sim/Reco Meeting

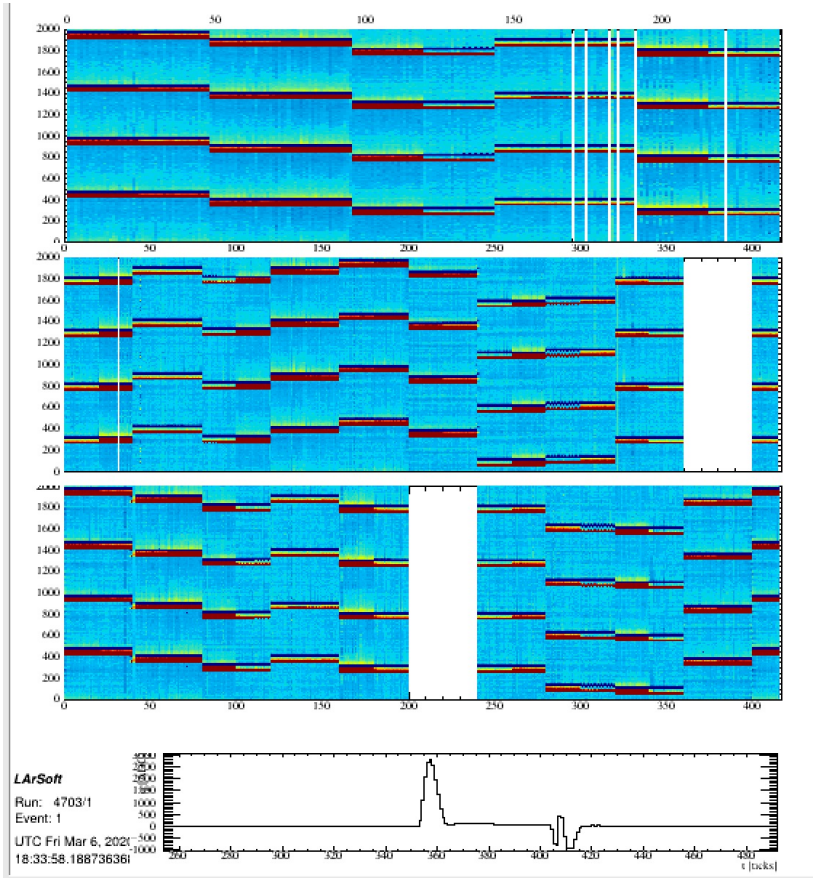
April 26, 2021

An ICEBERG Event with ProtoDUNE-SP FEMBs with DAC$_{Tick}$=20

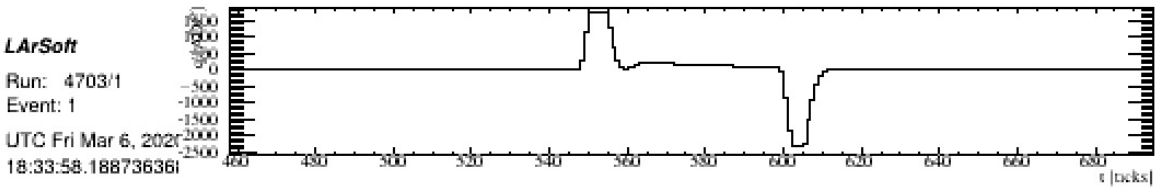
Run 4703

March 2020

Collection-plane waveforms



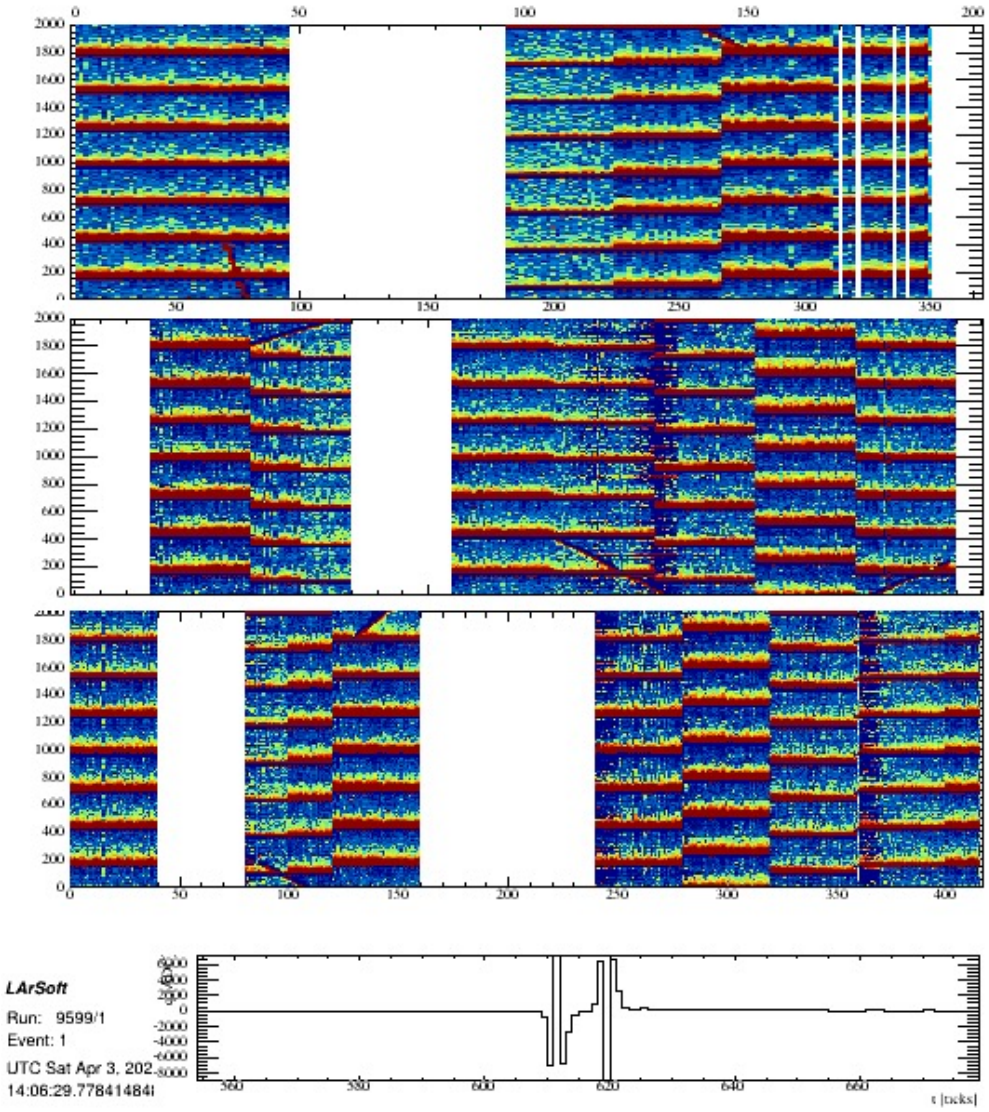
Another channel, showing correct behavior on the high end of the ADC range.



ICEBERG 3-ASIC Pulser Event

Run 9599
3-ASIC FEMB
14-bit ADCs

Gain 25 mV/fC, Shaping 1 µs,
DAC: 11



Requirement for ADC Saturation Response

- I was told this is "digital wraparound"

  ADC value was too big for 2^14 – 1 so it overflowed and wrapped instead of reporting the maximum value. (and minimum value for underflows).

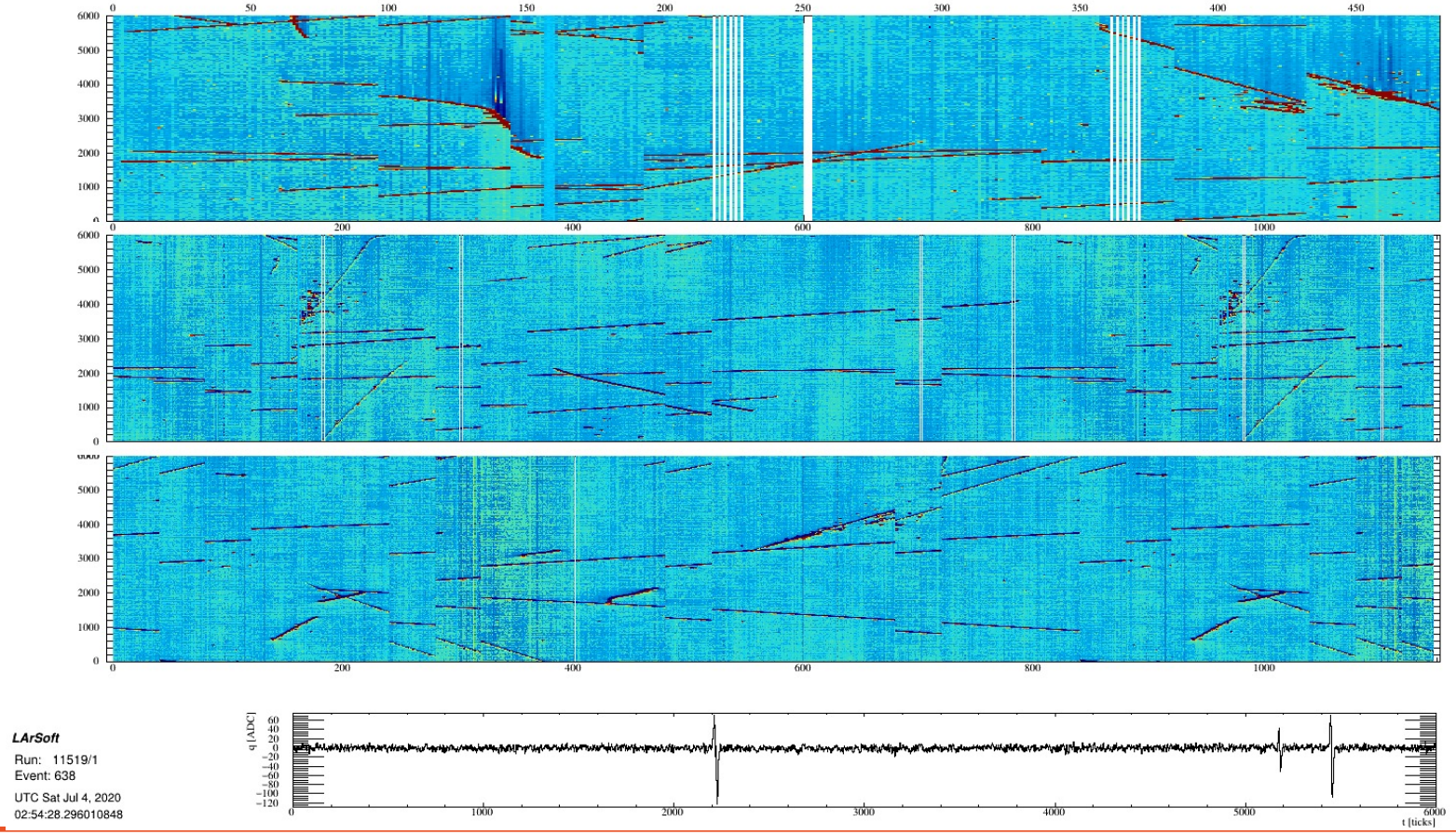
- I was told this is known and will be fixed in the next iteration.

- We should require that it is to be fixed, and reject designs in which it is not fixed.

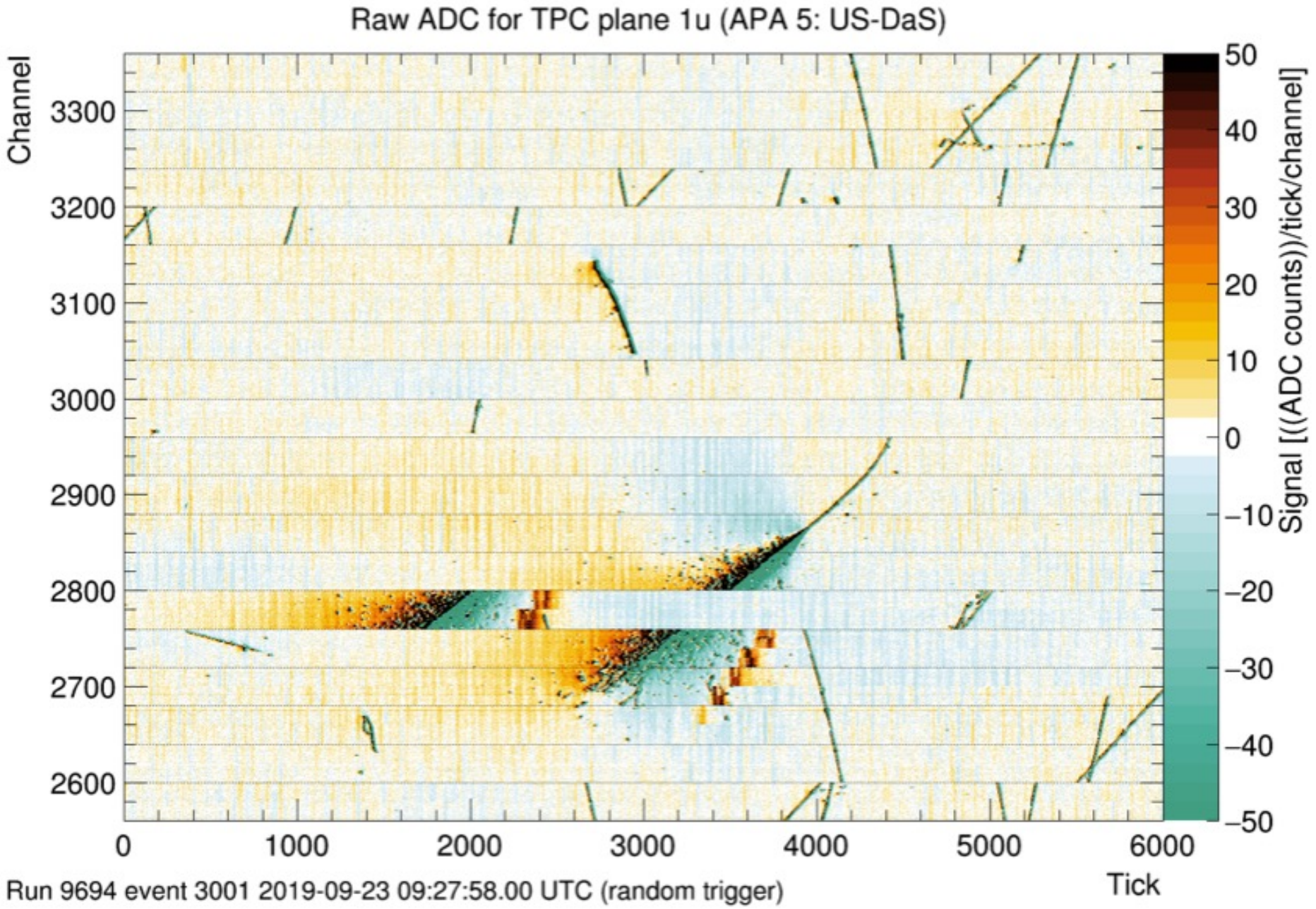
- Affects high-energy events (UHE cosmic rays, some BSM physics, e.g., WIMP searches)

An Example non-Rectangular Trigger Record from ProtoDUNE-SP

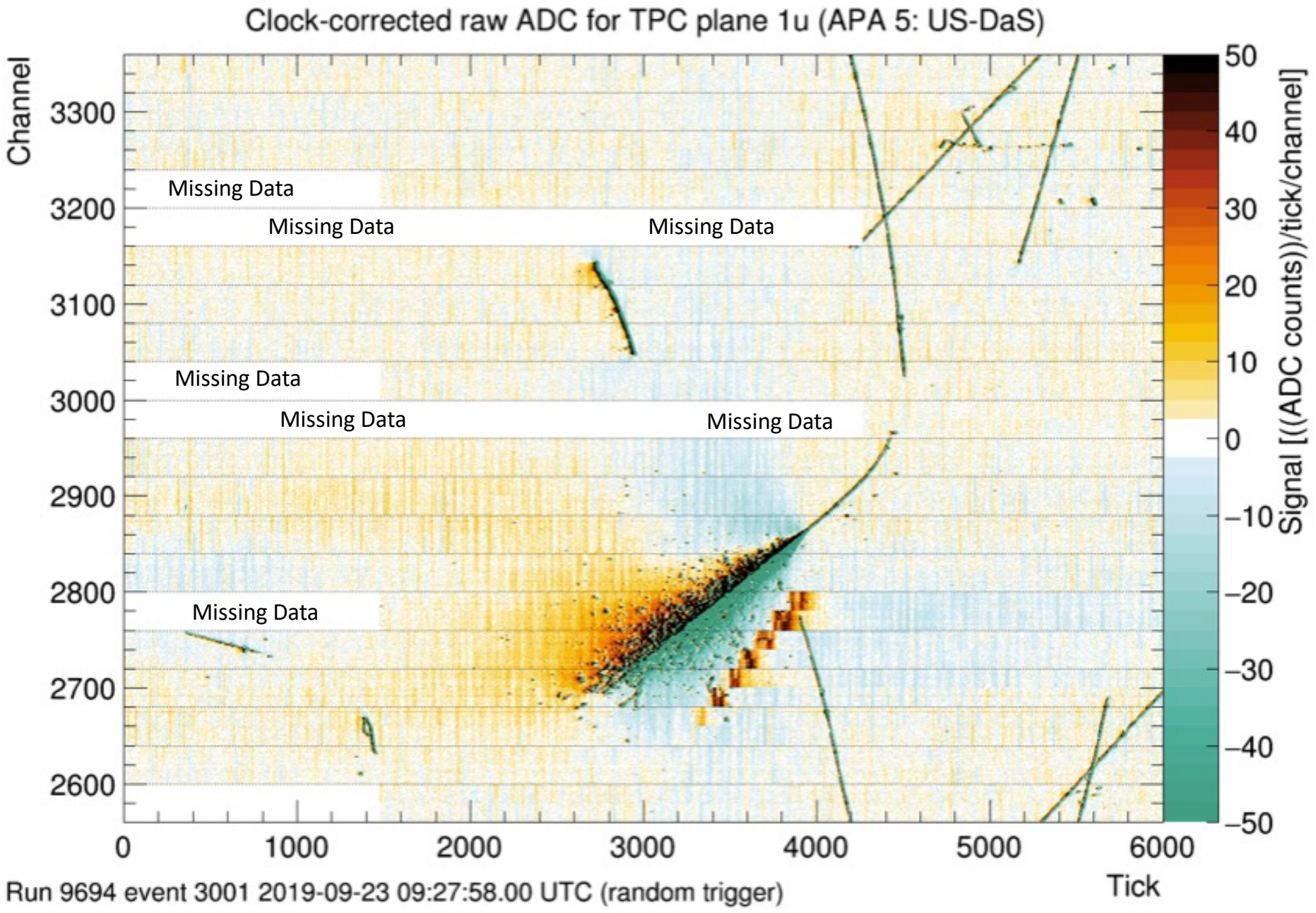
Timestamps are available so we can shift the data properly, but it would have a ragged edge. We could trim it, but then trigger records wouldn't all have the same size (containment, fiducial volume issues).



Example of serious synch problem last month



Same event using channel clock info



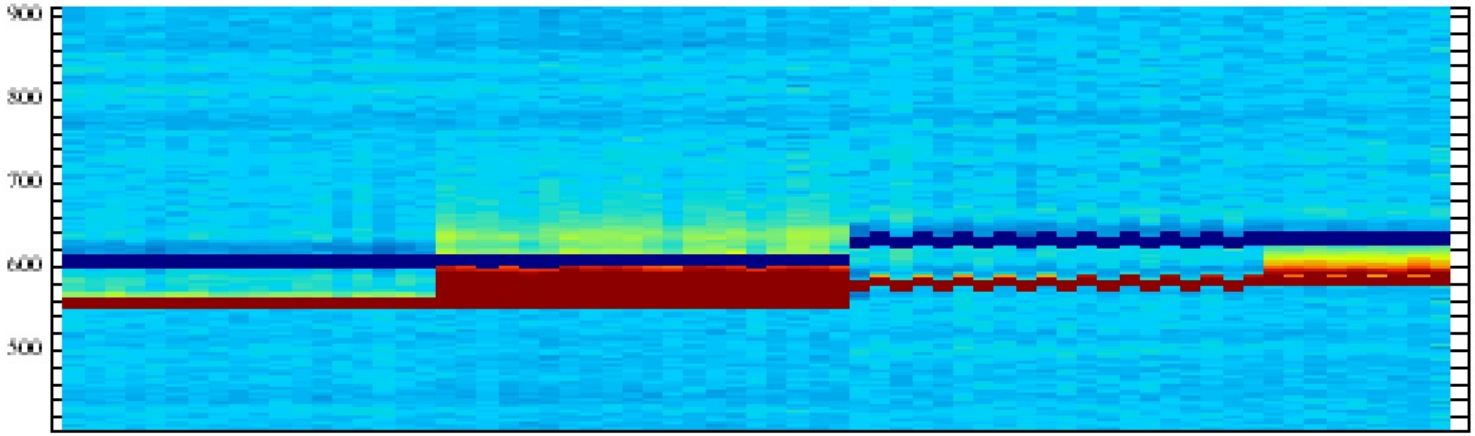
The Problem with Timing

- Non-ROI'd data (full waveforms) should produce rectangular trigger records (channels x ticks).
- The event display assumes this.
- Even raw::RawDigit does not have an easy way to represent a readout starting at different times for different channels.
- ROI readout will produce non-rectangular events.
- But we need to know that a particular (channel,tick) combination doesn't fall in an ROI because
  - hypothesis 1: no charge was deposited, or
  - hypothesis 2: data are missing
- Giovanna says that missing data are an error.
- We ought to require sufficient error reporting to tell what data are missing
- Sometimes this is intentional (APAs out for calibration, parts known to be broken, etc.)
- How to formulate this as a requirement?

Smaller Timing Problems

- Dropped frames (rare, but it happens). A "frame" is 256 channels x 1 tick.
- Some channels have timing skews relative to others within a frame:

ICEBERG
Run 4703,
event 1

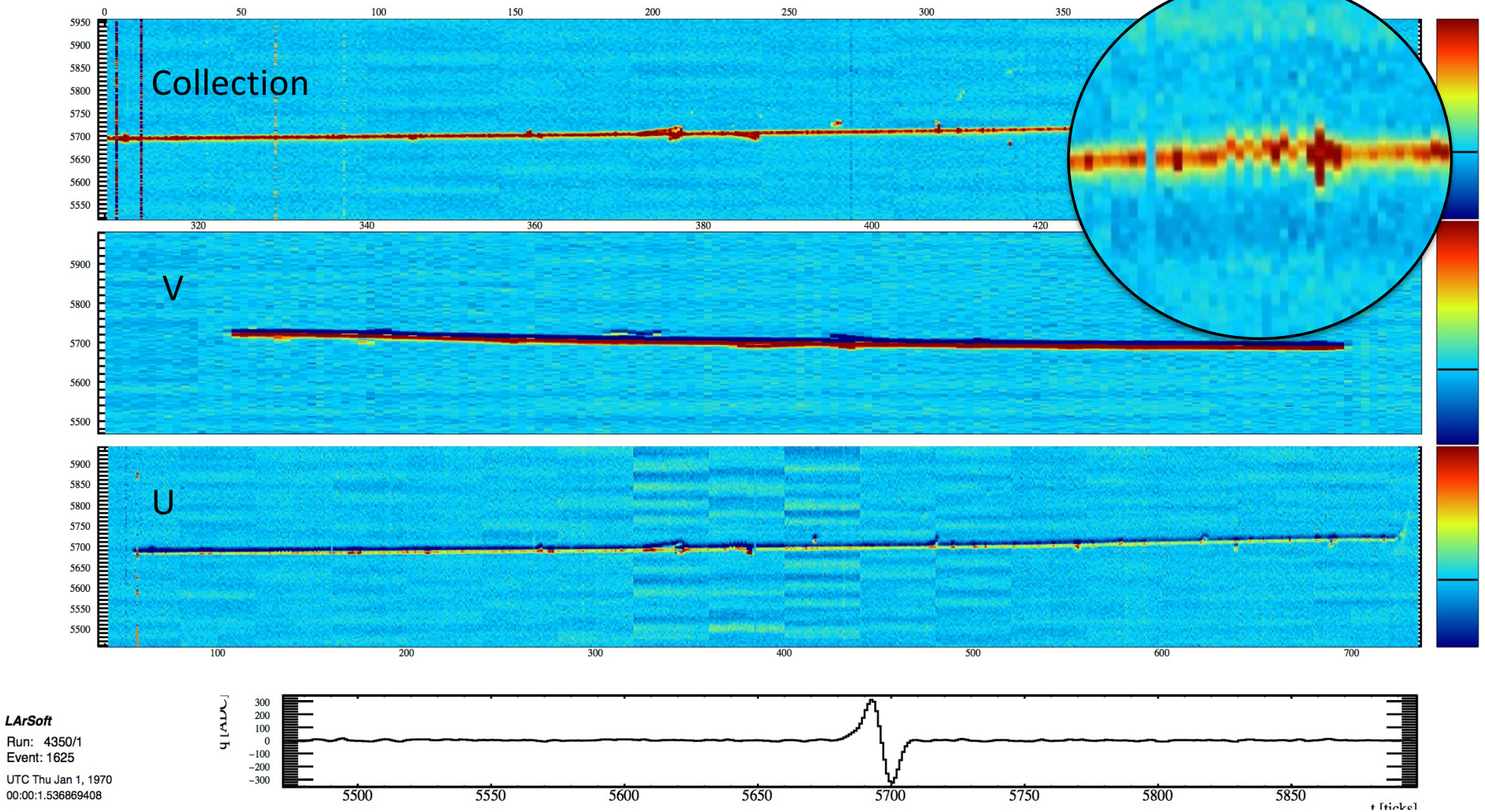


We can fix this if we have full waveforms, or many neighboring ROIs (and some way to tell which time is the "right" time).

Also: FEMB 302 in ProtoDUNE-SP had a disconnected clock line. Substitute clock ran ~0.1% slower than the rest of the detector. Four fewer frames out of 6000. Solvable, but we'd have to come up with something when ROI data are produced. (Trigger primitives?)

ProtoDUNE Press Release Event

Update: Out-of-time channels later died



Fermilab DUNE