FEMB Noise Scan & DQM update

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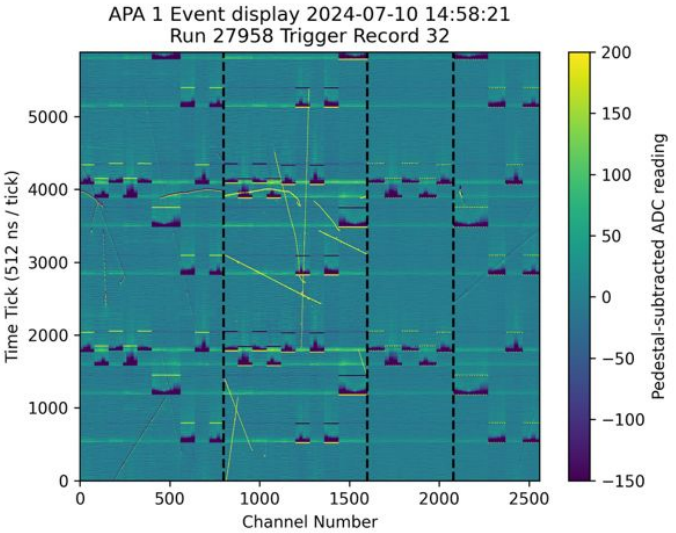
FEMB “Noise” - power rail drop

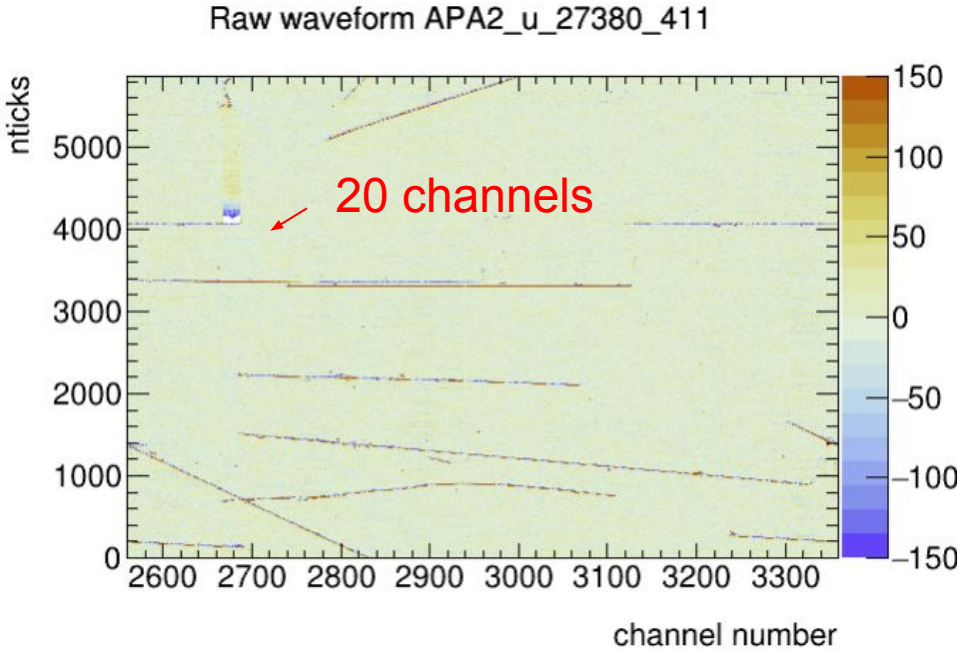
- Observed baseline distortion (undershoot & overshoot) in some U/V/W channels simultaneously
  - Confirmed in pulser data
- The probability of such problem seems better with lower preamplifier gain: 7.8mV/fC
- Shanshan’s explanation:
  - “... multiple FE channels with pulse draw sudden large current that exceed the capability of bypass capacitors for FE power rail, thus voltage of FE power rail frops slightly first and recovers.”
  - “Changing the gain doesn’t reduce input charge, instead it lowers the instant power consumption, and therefore, lowers current draw from bypass capacitors.”

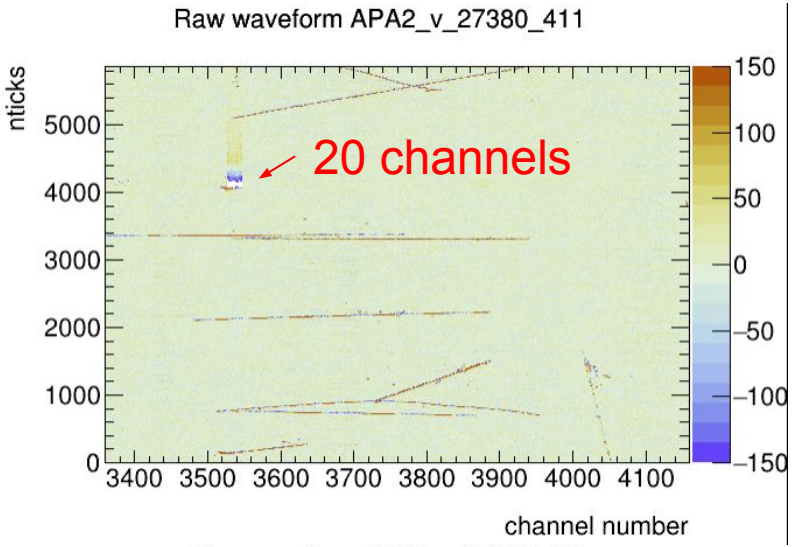
Roger Huang

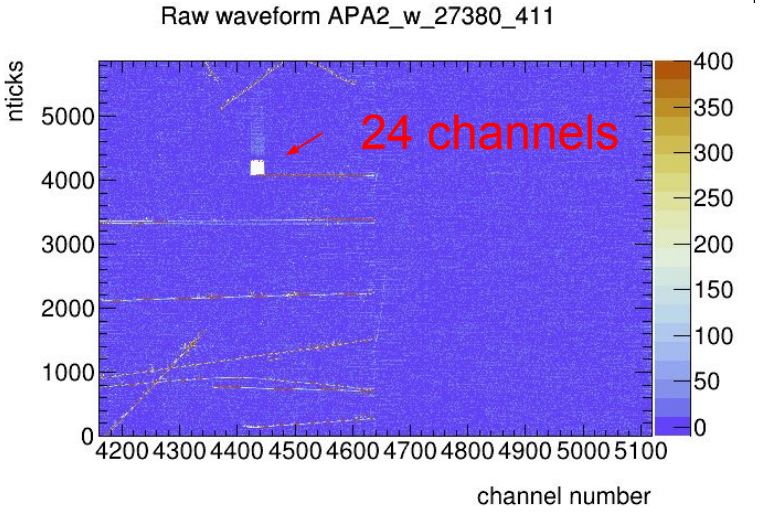


Pulser data

Waveform with the noise

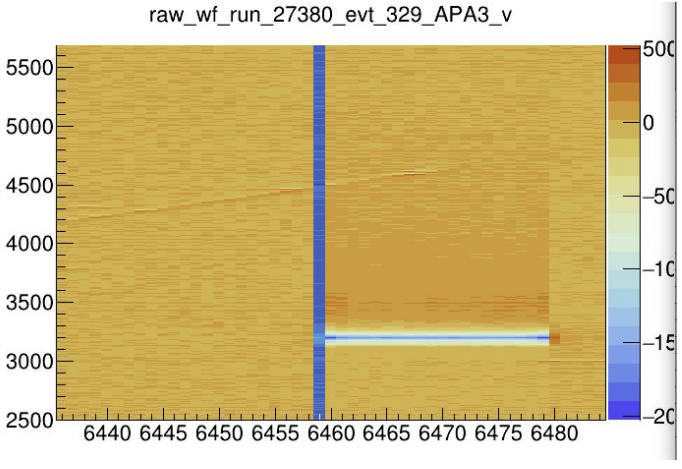


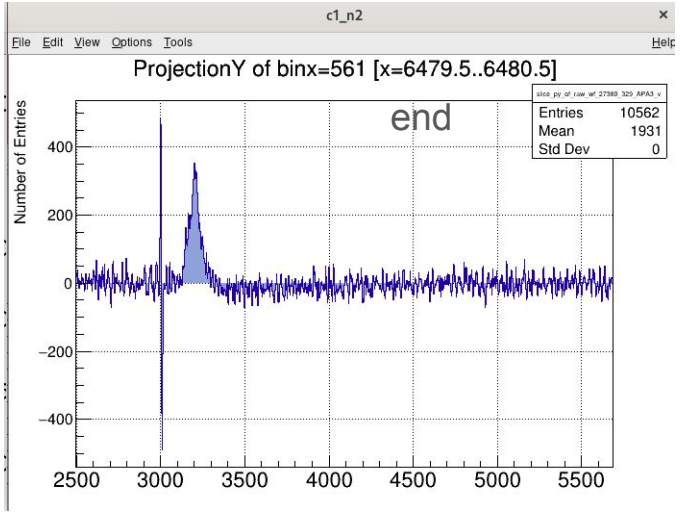


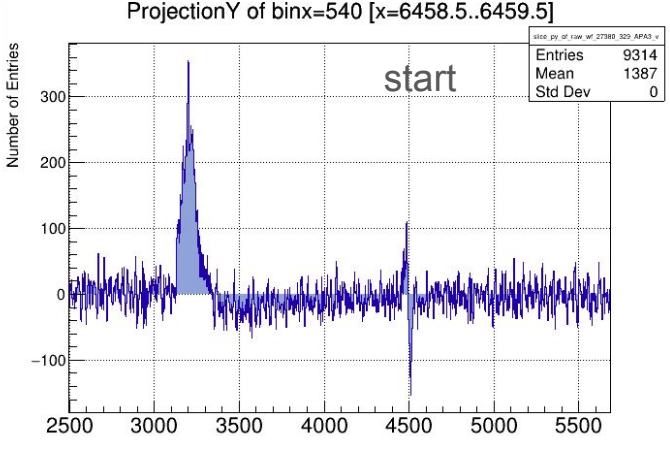


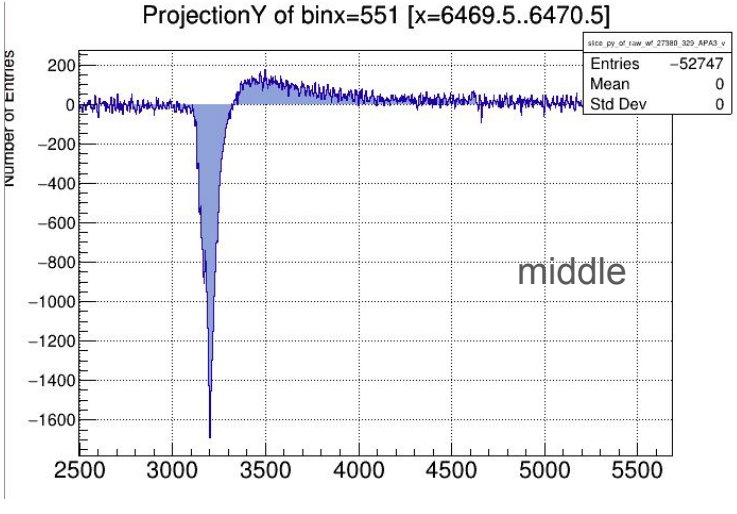
- 20 + 20 + 24 = 64 channels in the same FEMB
  - 128 channels per FEMB
  - Two power rails per FEMB

v plane(similar for u)

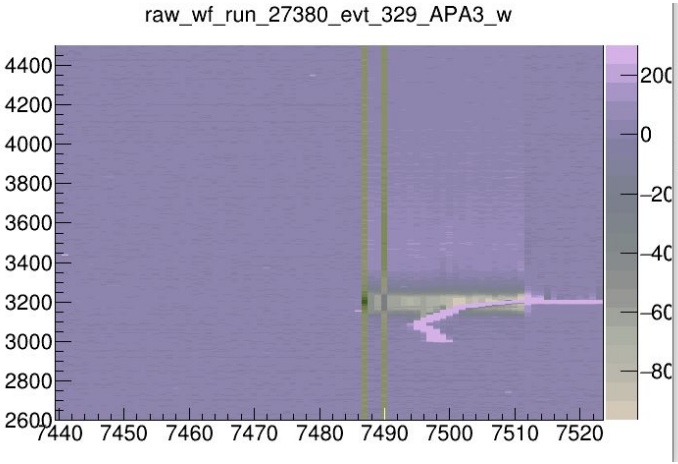


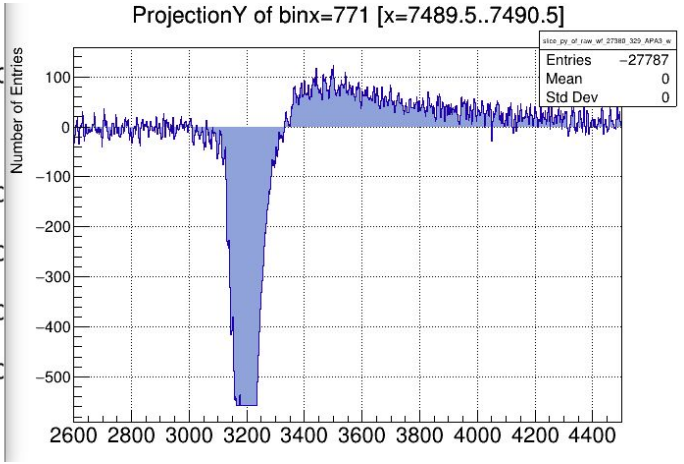


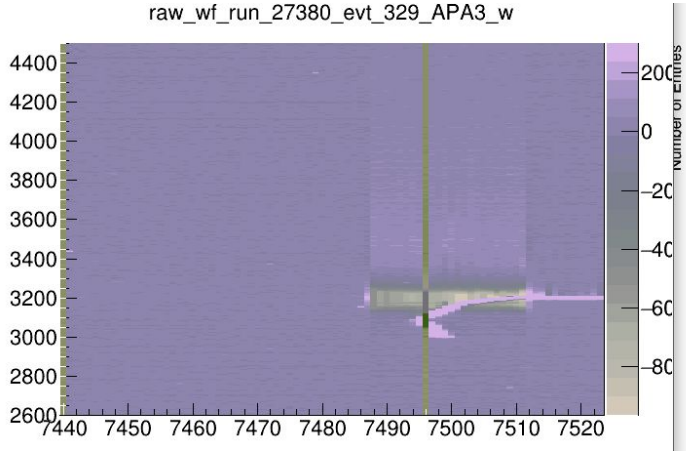


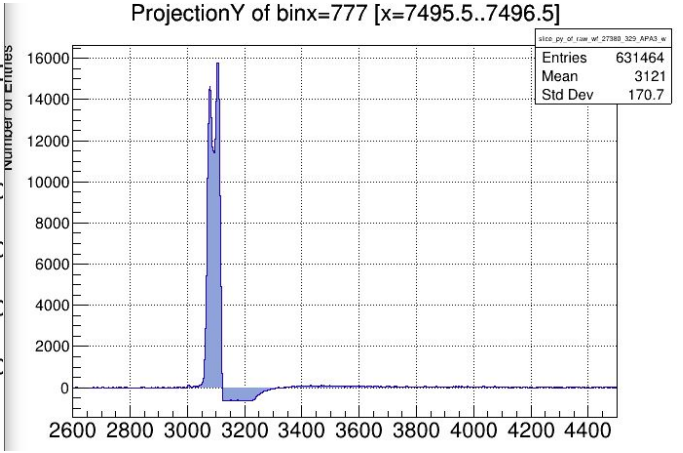


w plane


raw_wf_run_27380_evt_329_APA3_w
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
7440 7450 7460 7470 7480 7490 7500 7510 7520
200
0
−20
−40
−60
−80
Number of Entries

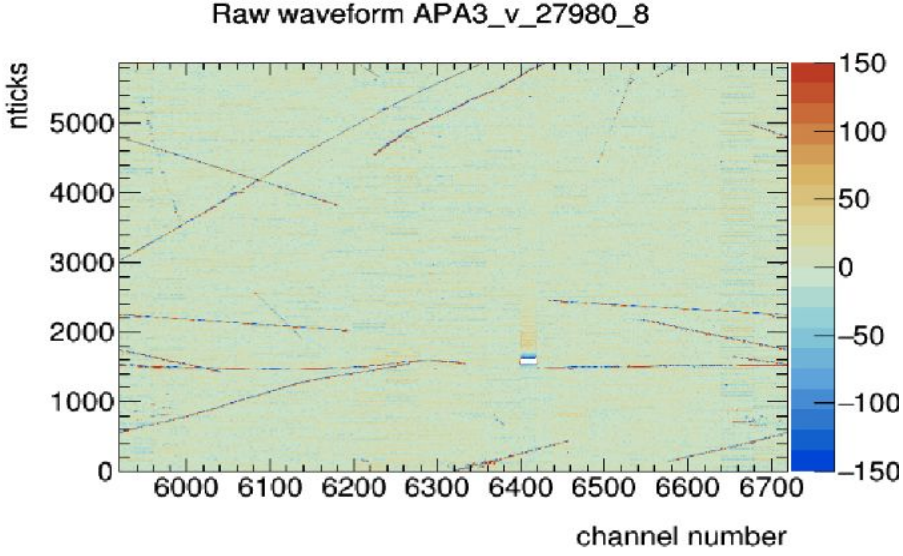

ProjectionY of binx=771 [x=7489.5..7490.5]
Entries −27787
Mean 0
Std Dev 0
100
0
−100
−200
−300
−400
−500
2600 2800 3000 3200 3400 3600 3800 4000 4200 4400

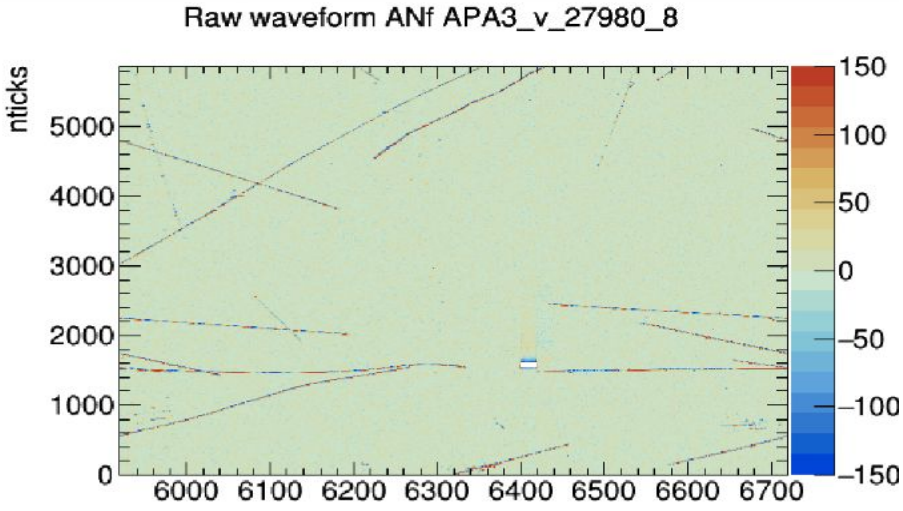

raw_wf_run_27380_evt_329_APA3_w
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
7440 7450 7460 7470 7480 7490 7500 7510 7520
200
0
−20
−40
−60
−80
Number of Entries


ProjectionY of binx=777 [x=7495.5..7496.5]
Entries 631464
Mean 3121
Std Dev 170.7
16000
14000
12000
10000
8000
6000
4000
2000
0
2600 2800 3000 3200 3400 3600 3800 4000 4200 4400

Current Noise filter

- Can’t remove it
  - Head will be regarded as signal, and protected.
  - Tails will be regarded as part of the coherent noise.
  - Because coherent noise is evaluated in a group of 40 channels, this noise is in 20 channels, it will affect the other adjacent channels.

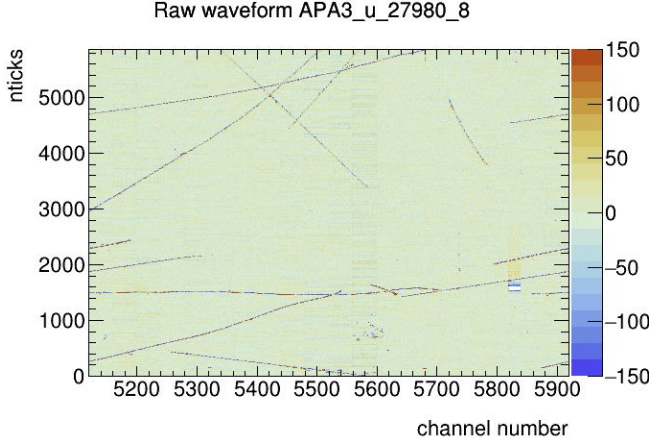


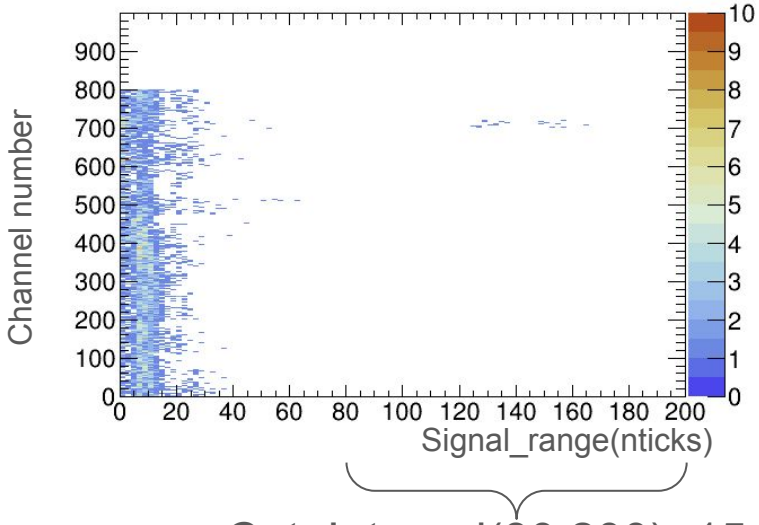


Scan datafiles to find more

- Features:
  - Width is wider.(in u and v)
  - Appears in 20 consecutive channels at same time
  - Can be seen in all 3 planes.
  - Negative pulse

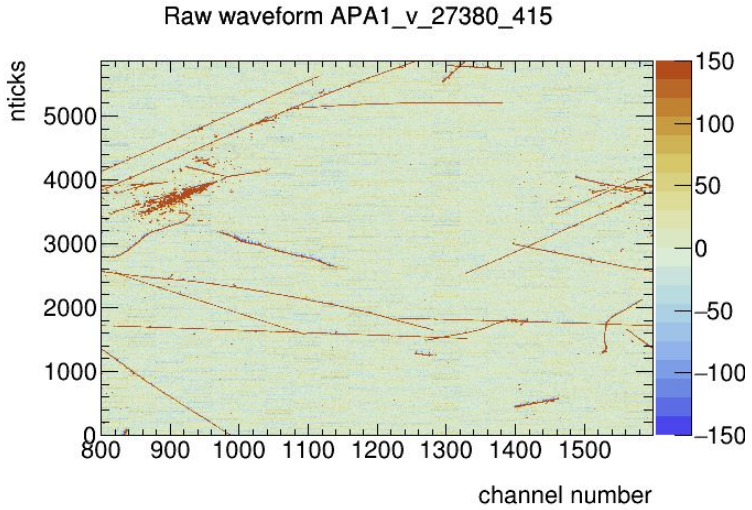
- An easy and quick way to do scan
  - Find all signal ROIs in a plane:
    - (if ADC-baseline >3.5 rms)
  - Add a cut on the number of signals with wide width.

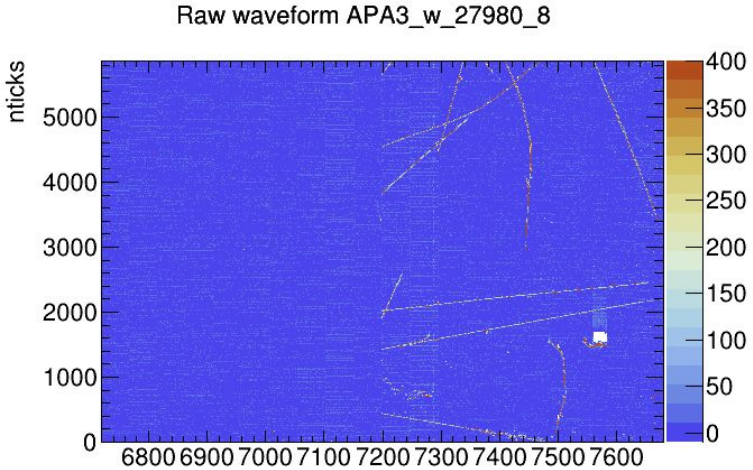


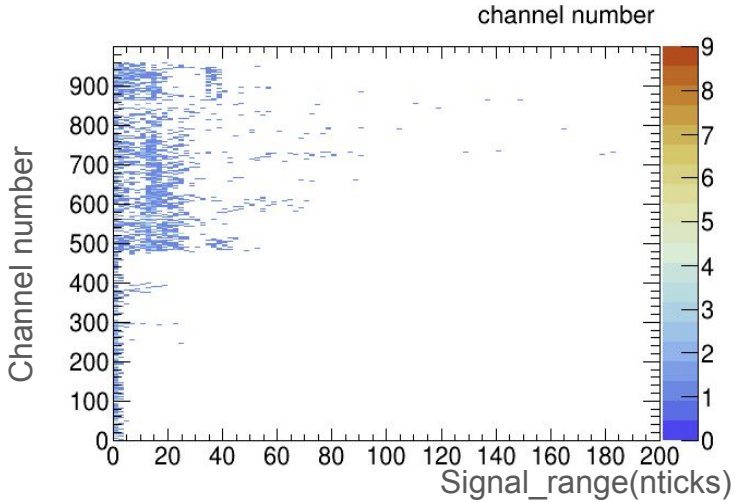


Cut: Integral(80,200)>15

Some failure situation:







- Addtional requirement:
  - Apply this cut on U and V plane
  - U and V should found this simultaneously

Scan result:

- Run:27380
- Date: 06/22/2024
- Gain: 14mV/fC

- Scanl event: 565
- Noise event: 37
  - APA1:3
  - APA2:10
  - APA3:13
  - APA4:11

- Run:28052
- Date: 07/18/2024
- Gain: 7.8mV/fC

- Scan event: 413
- Noise event: 8
  - APA1:1
  - APA2:4
  - APA3:2
  - APA4:1

Not all related to beam activities

- Consistent with Roger and Shanshan's explanation

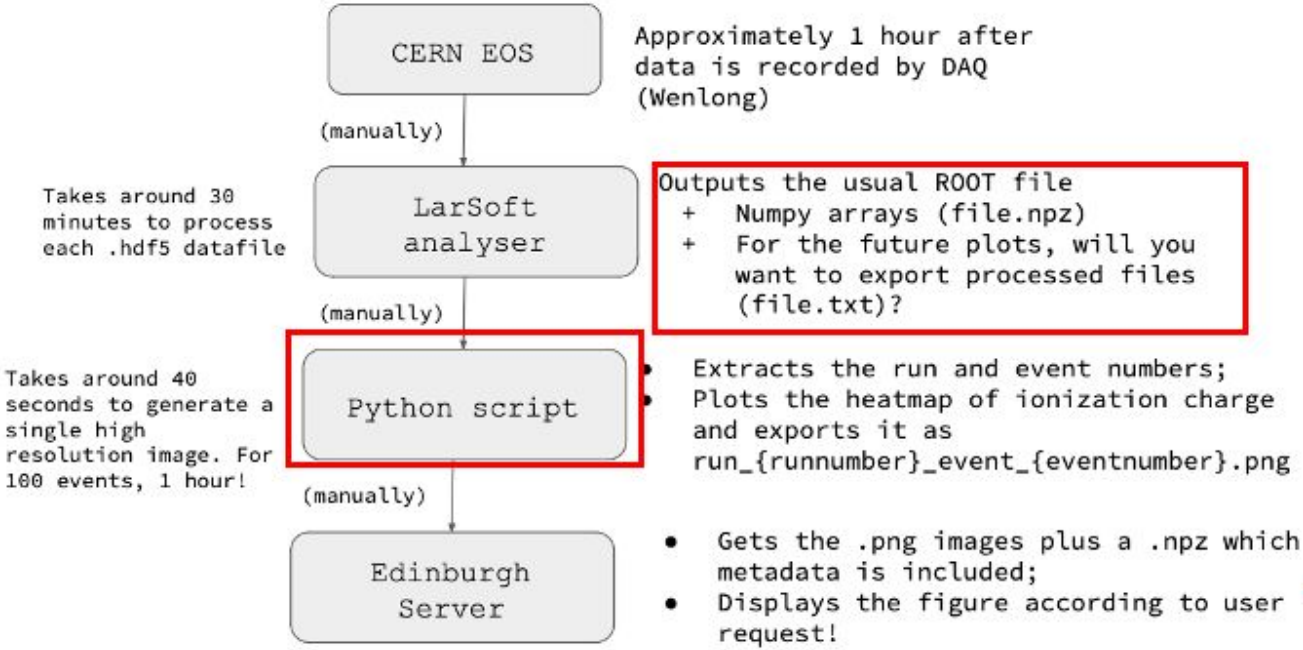
Lower gain relieve the problem

- **Next step:**
  - Find it explicitly. For now only for the quick scan.
    - Normal signals are bipolar(positive) for induction(collection) plane, this noise is negative.
  - Quantify it: amplitude, shaping;
  - Correct it (or blind the region) ;

DQM Update

DQM

Path of the Data



Outputs Art rootfile

Gallery root script
Add some plots

For us, I run it on dunegpvm11

Demo

Plots available now:

- Baseline
- Waveform; before&after noise filter
- RMS; before&after noise filter
- Spectra vs frequency; before&after noise filter
- Channel-to-channel correlation; before&after noise filter

Demo available here: https://github.com/Ningclover/protodune_DQM_v_BNL

On your local terminal:

```
ssh -N -f -L localhost:8050:localhost:8050 <username>@dunegpvm11.fnal.gov
```

http://127.0.0.1:8050/

Next Plan

- More plots:(Xuyang)
  - Hit finding information
  - Summary plots of different runs
  - ...
- Improve the interface.(Gabriela)
  - Move to Django
  - interface Django app with s3 and elasticsearch services.