Field response check

Xuyang Ning, Wenqiang Gu

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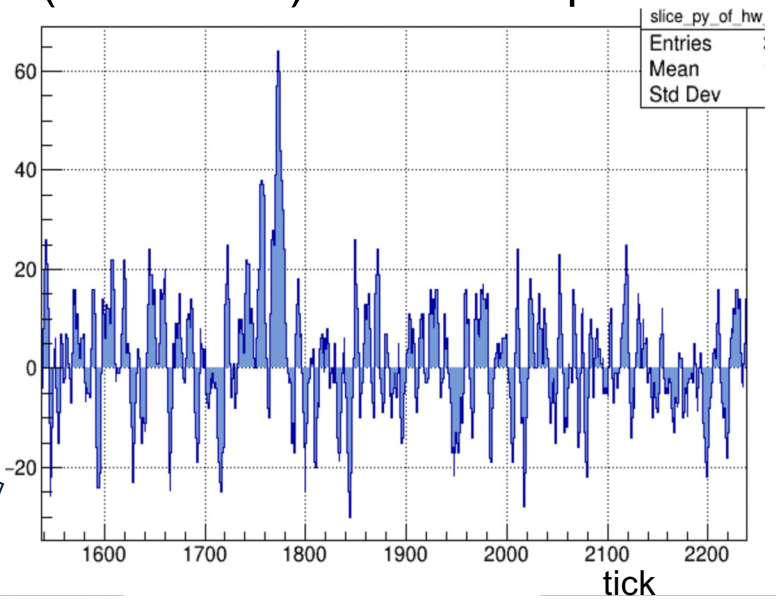
Wiener filter for APA1; w

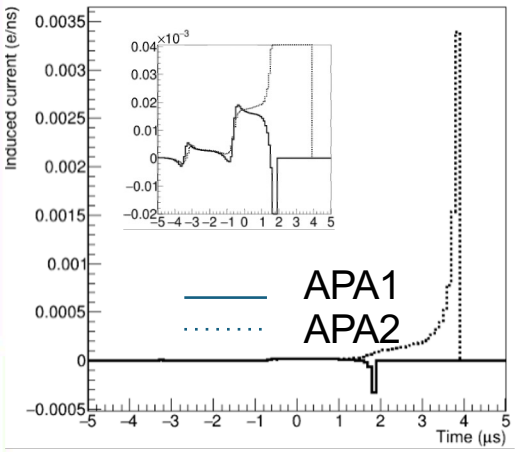
- Updated field response
- S/N is very low in APA1 W plane
- Induction feature introduces a different shape for power spectral density
  - **Need more calibration studies**
- A reasonable choice of Wiener filter would be edging at 0.125 MHz, while we might adjust it in the next round of tuning

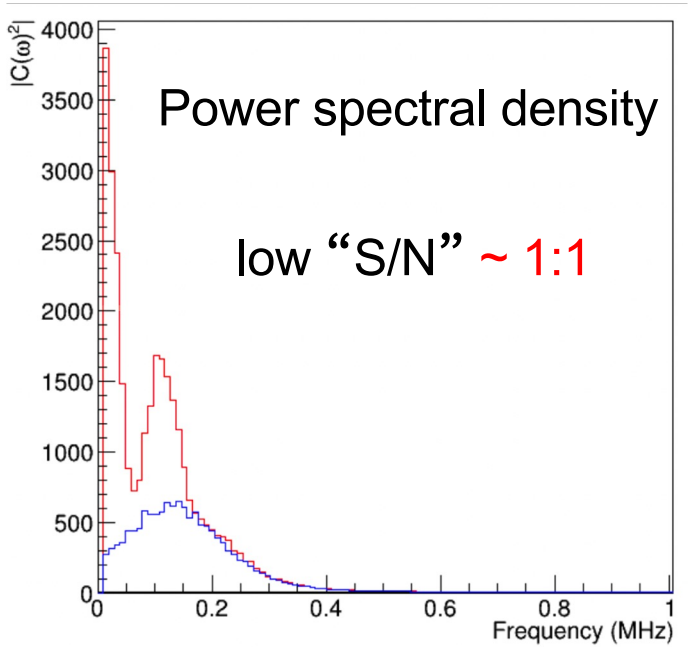
(Simulation) APA 1 – W plane



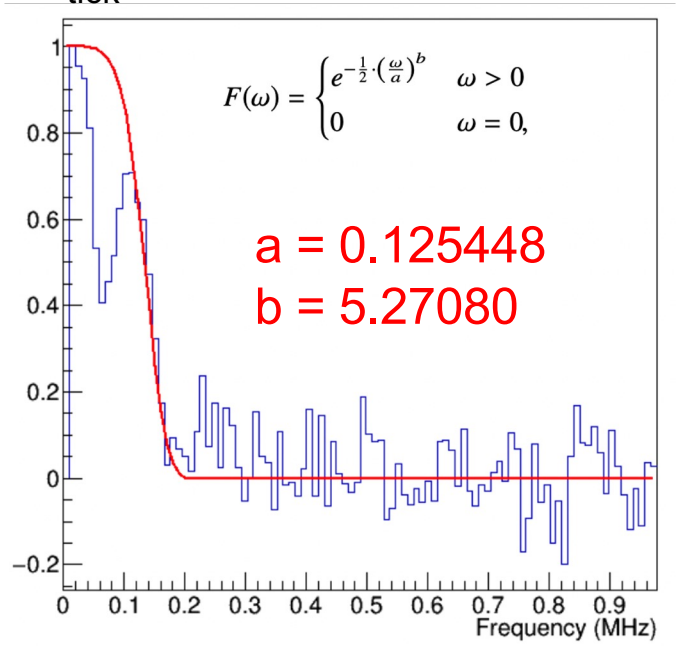
DFT

W plane; field response



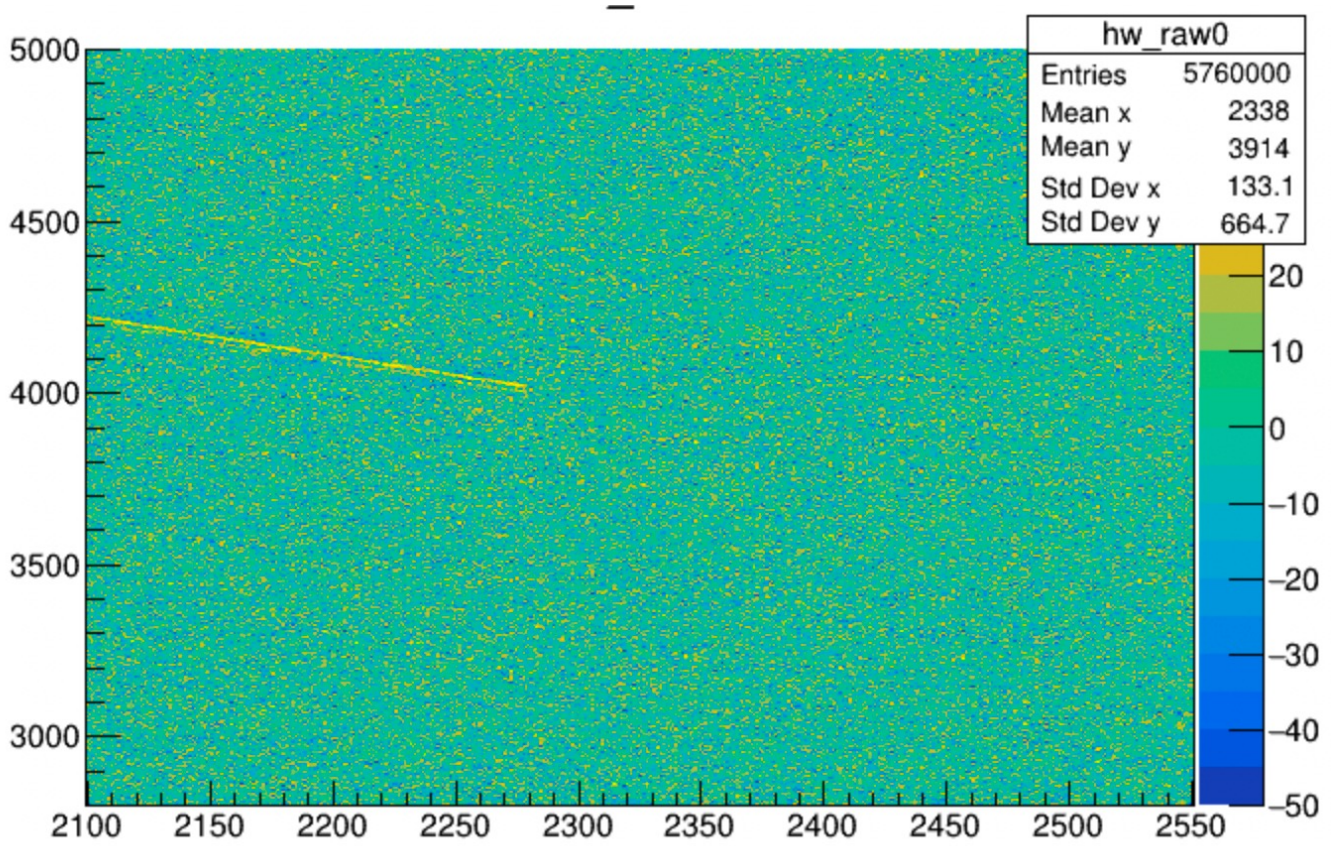


$$\frac{|M(\omega)|^2 - |N(\omega)|^2}{|M(\omega)|^2}$$

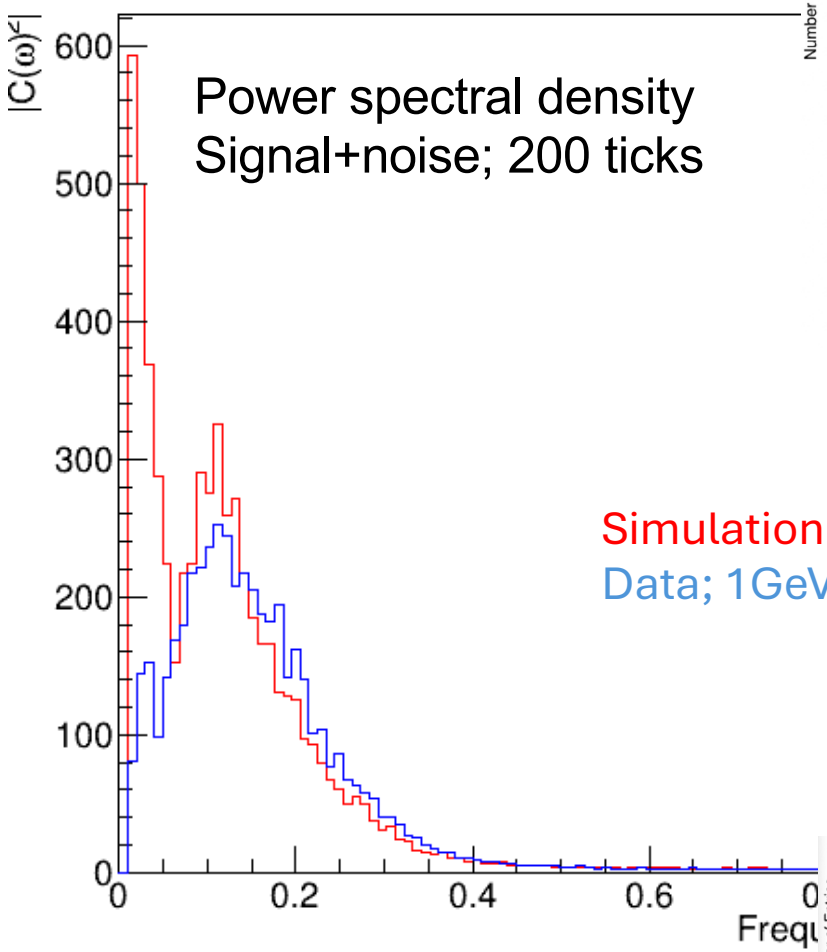


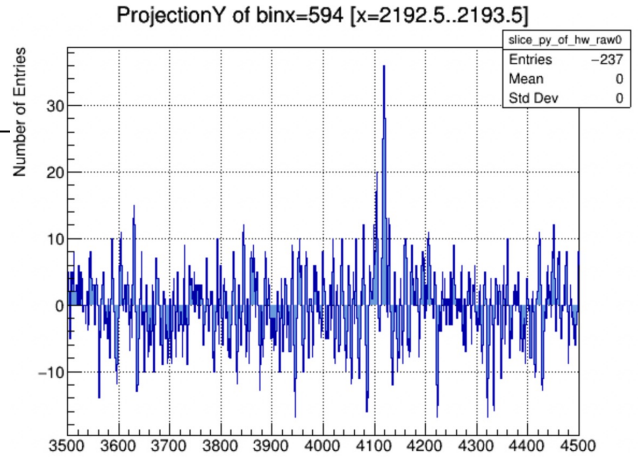
Beam simulation

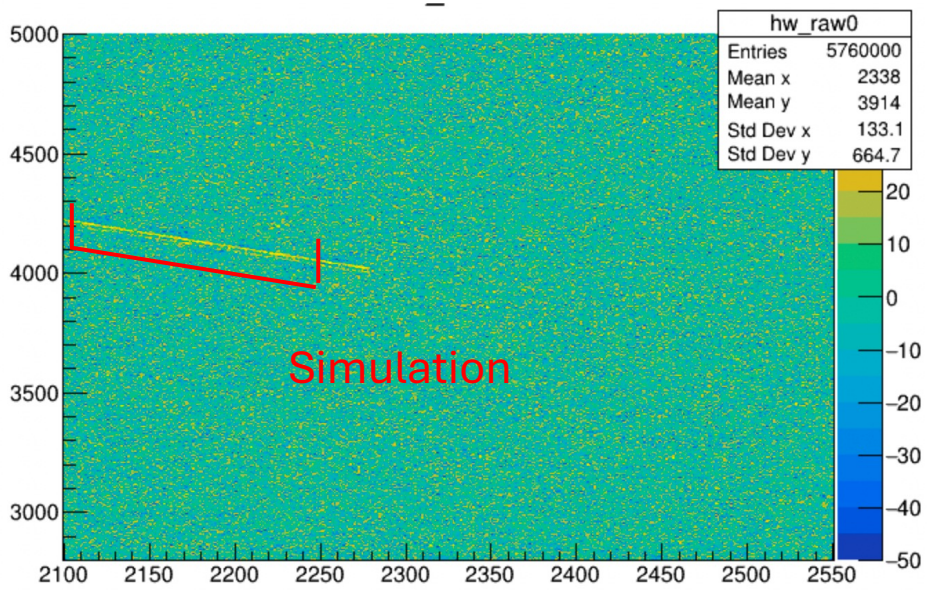
- Gain: 7.8mV/fC
- Noise: "protodunehd-noise-spectra-7d8mVfC-v1.json.bz2
- Field response: from simulation.

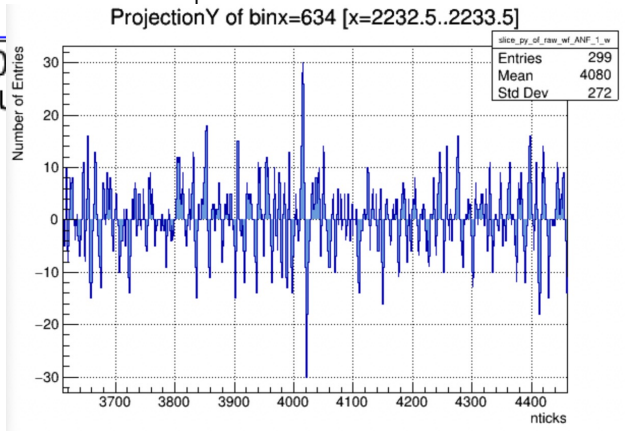


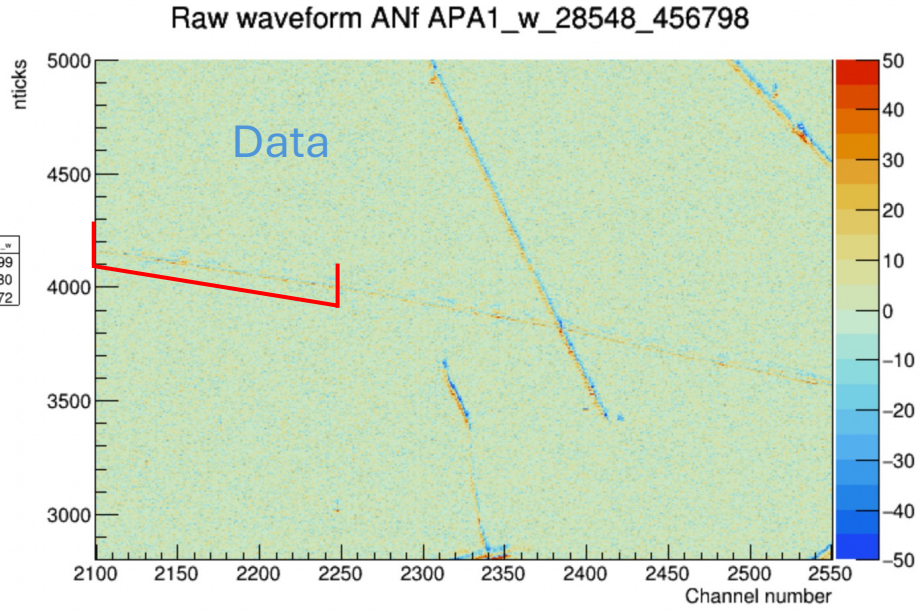

```
local beam_dir = [-0.178177, -0.196387, 0.959408];
local beam_center = [-27.173, 421.445, 0];

local track0 = {
  head: wc.point(beam_center[0], beam_center[1], beam_center[2], wc.cm),
  tail: wc.point(beam_center[0] + 100*beam_dir[0], beam_center[1] + 100*beam_dir[1], beam_center[2] + 100*beam_dir[2], wc.cm),
};
```

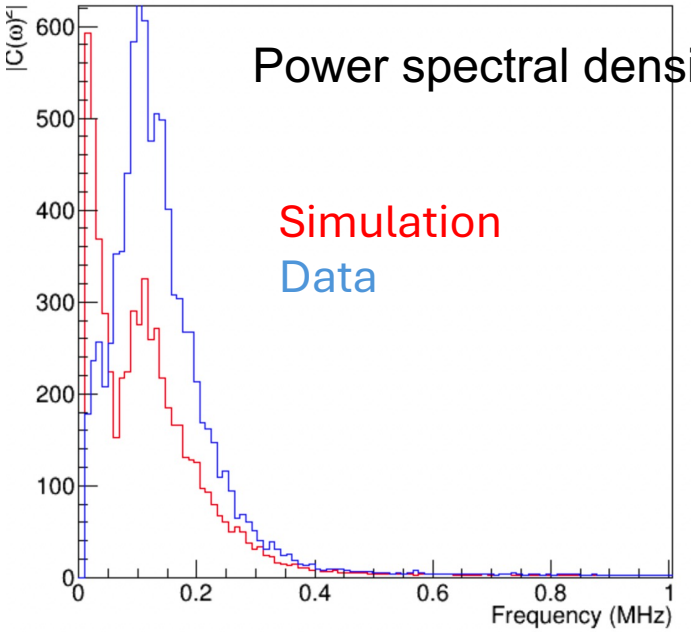

Power spectral density
Signal+noise; 200 ticks
Simulation
Data; 1GeV beam
|C(ω)²|
Freq

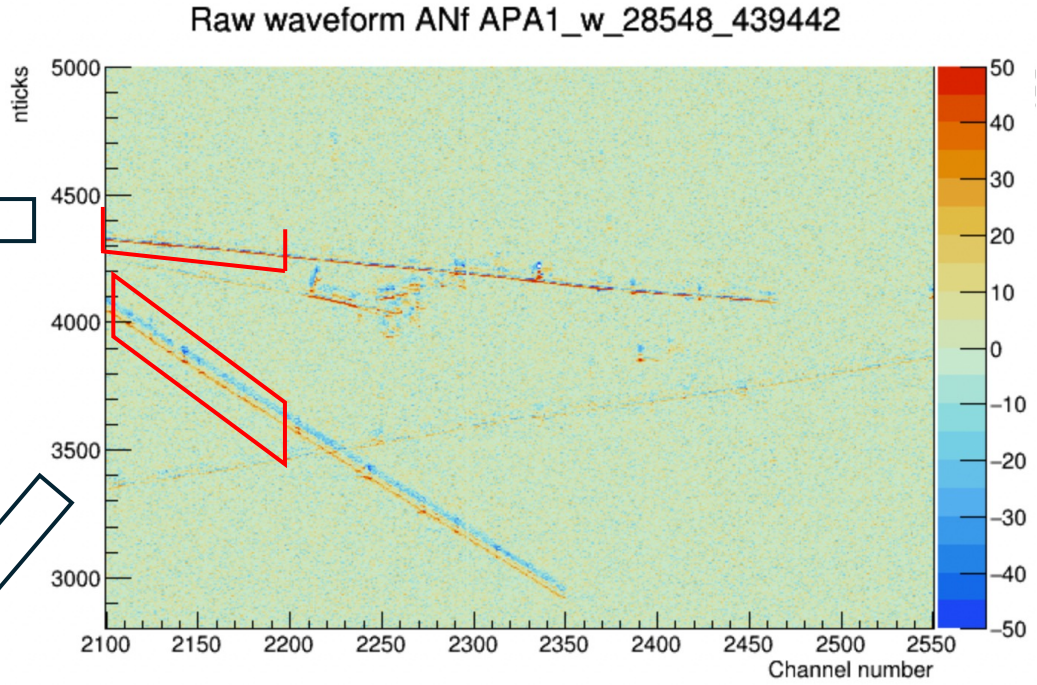

ProjectionY of binx=594 [x=2192.5..2193.5]
slice_py_of_hw_raw0
Entries −237
Mean 0
Std Dev 0
Number of Entries

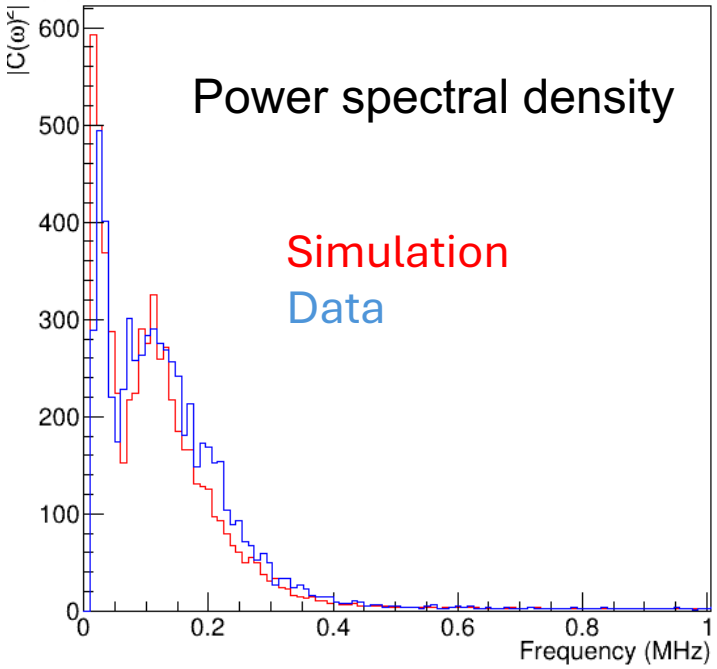

hw_raw0
Entries 5760000
Mean x 2338
Mean y 3914
Std Dev x 133.1
Std Dev y 664.7
Simulation

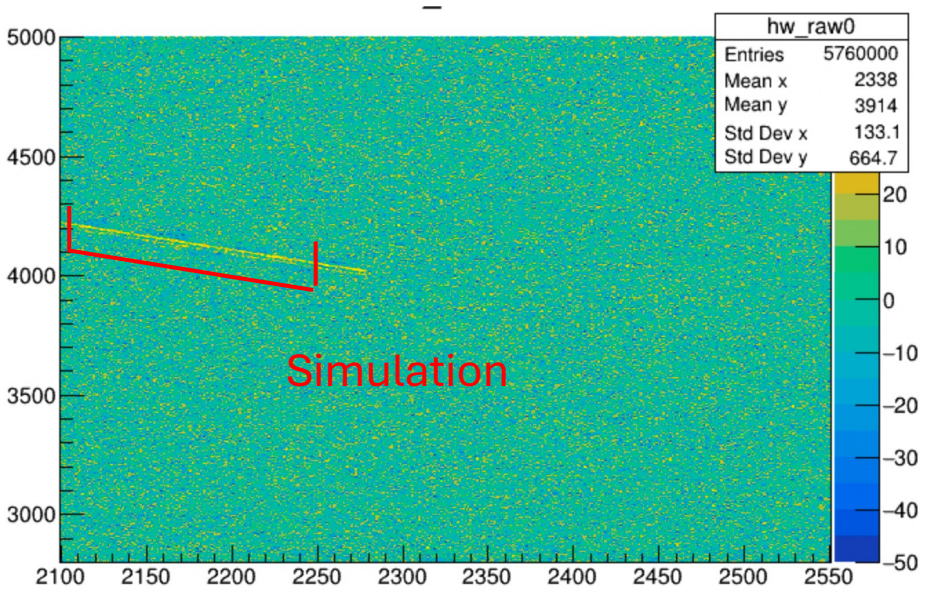

ProjectionY of binx=634 [x=2232.5..2233.5]
Entries 299
Mean 4080
Std Dev 272
Number of Entries
nticks


Raw waveform ANf APA1_w_28548_456798
Data
nticks
Channel number

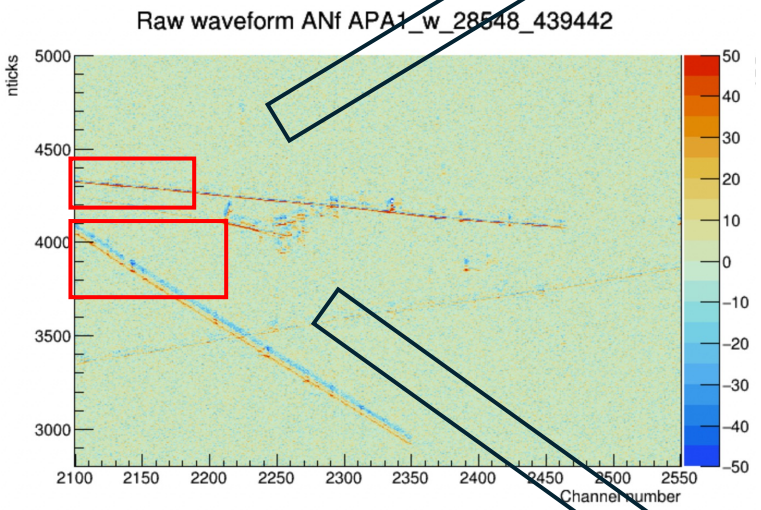

Power spectral density
Simulation
Data
|C(ω)²|
Frequency (MHz)


Raw waveform ANf APA1_w_28548_439442
nticks
Channel number

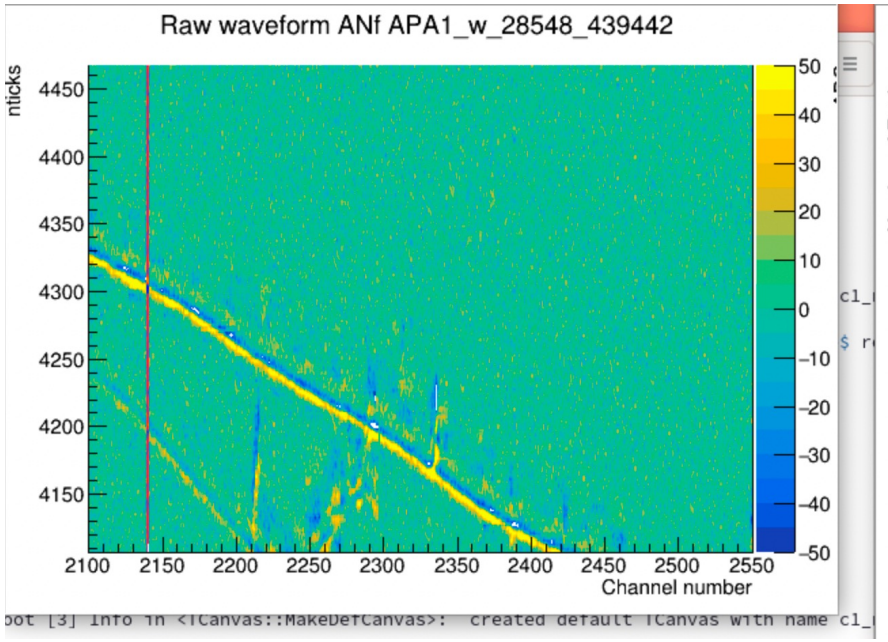

Power spectral density
Simulation
Data
|C(ω)²|
Frequency (MHz)

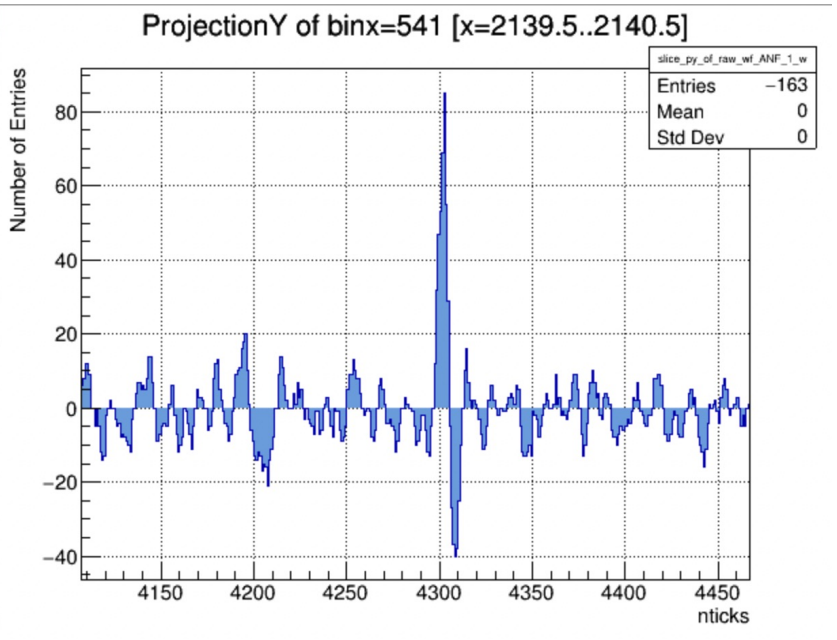

hw_raw0
Entries 5760000
Mean x 2338
Mean y 3914
Std Dev x 133.1
Std Dev y 664.7
Simulation

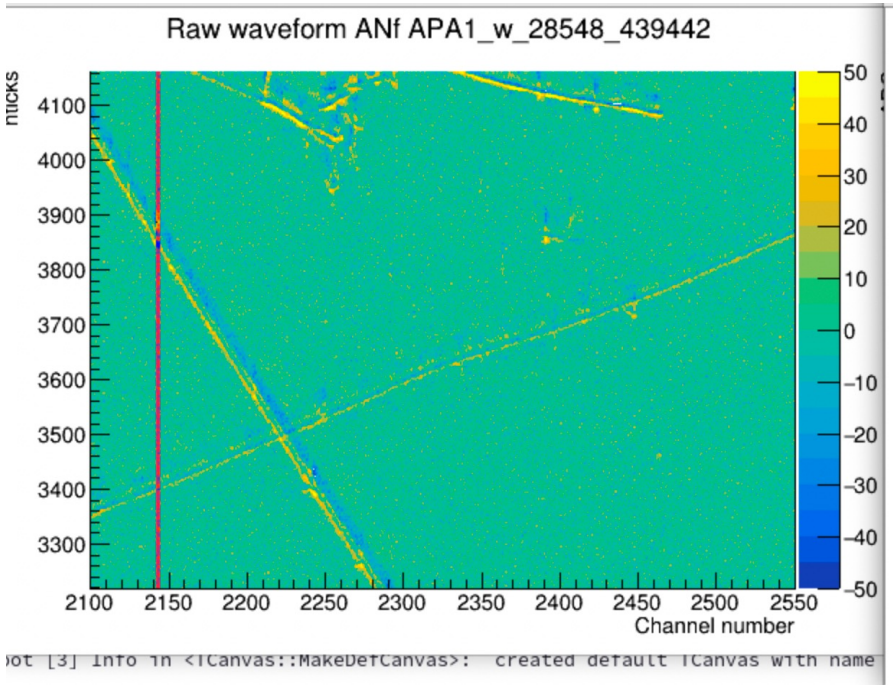
Zoom in

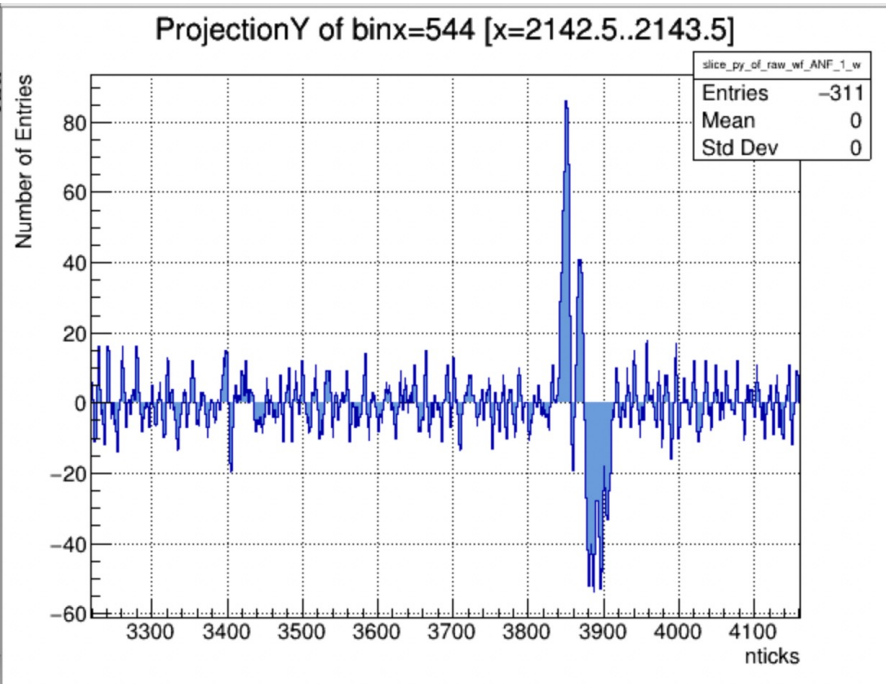


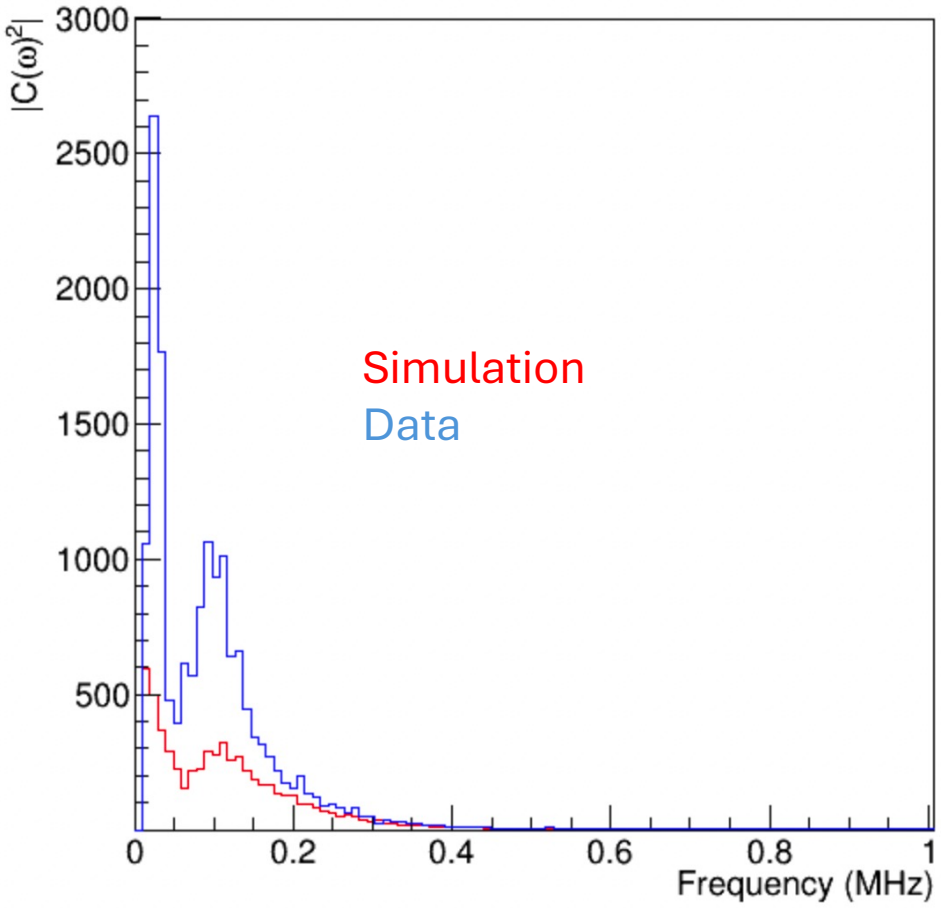
Zoom in

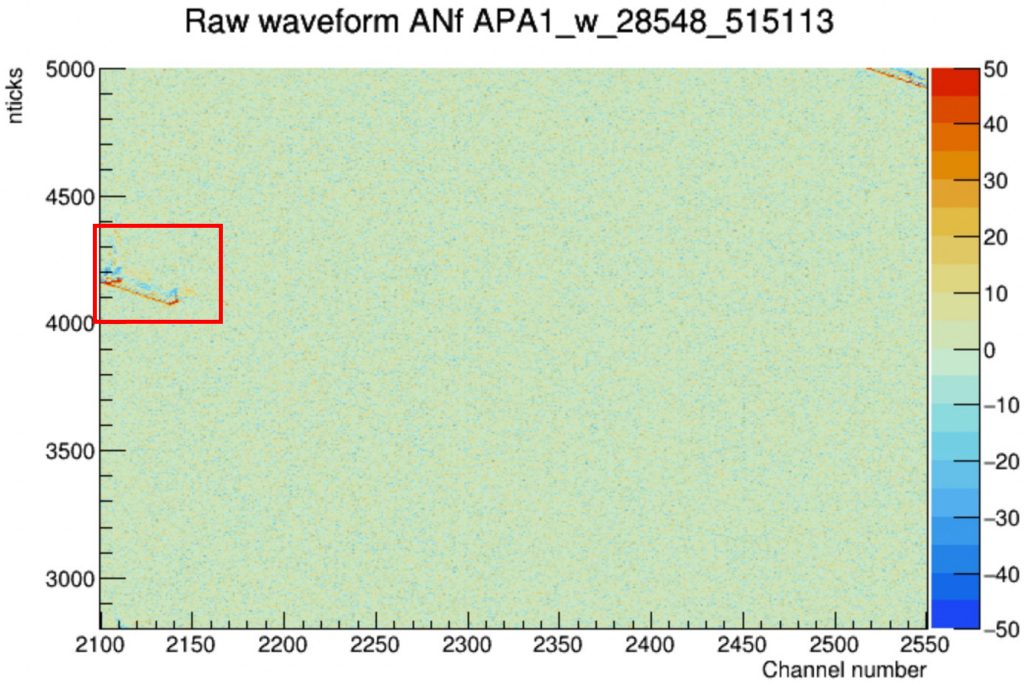


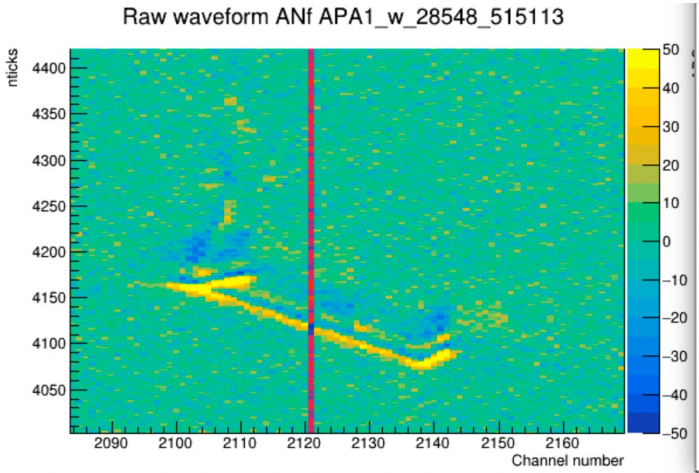


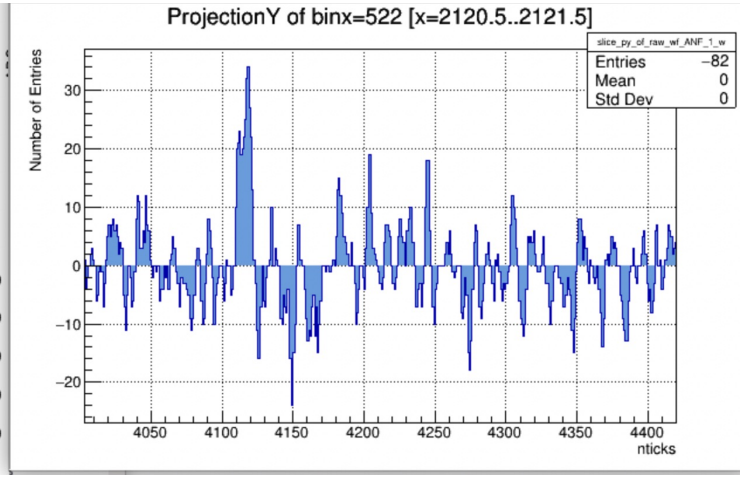





$|C(\omega)^2|$
3000
2500
2000
1500
1000
500
0
0.2
0.4
0.6
0.8
1
Frequency (MHz)
Simulation
Data


Raw waveform ANf APA1_w_28548_515113
nticks
5000
4500
4000
3500
3000
2100
2150
2200
2250
2300
2350
2400
2450
2500
2550
Channel number
50
40
30
20
10
0
−10
−20
−30
−40
−50


Raw waveform ANf APA1_w_28548_515113
nticks
4400
4350
4300
4250
4200
4150
4100
4050
2090
2100
2110
2120
2130
2140
2150
2160
Channel number
50
40
30
20
10
0
−10
−20
−30
−40
−50


ProjectionY of binx=522 [x=2120.5..2121.5]
slice_py_of_raw_wf_ANF_1_w
Entries −82
Mean 0
Std Dev 0
Number of Entries
30
20
10
0
−10
−20
4050
4100
4150
4200
4250
4300
4350
4400
nticks