Field response check

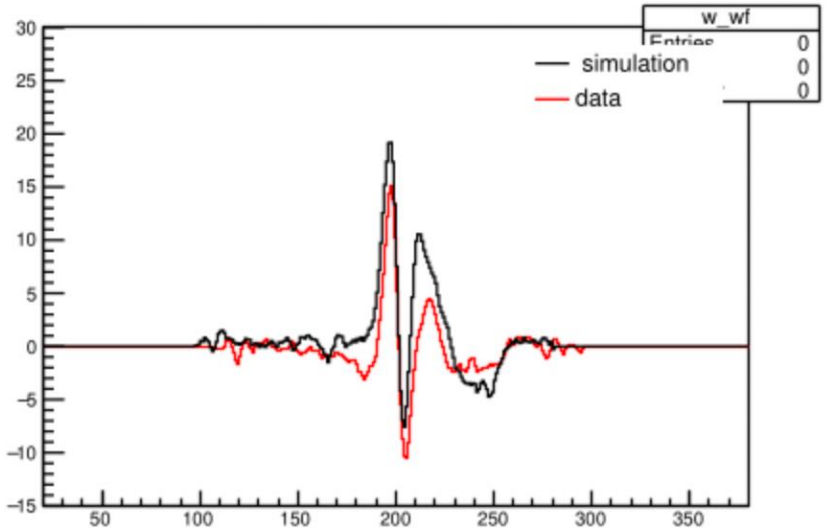
Xuyang Ning & Wenqiang Gu

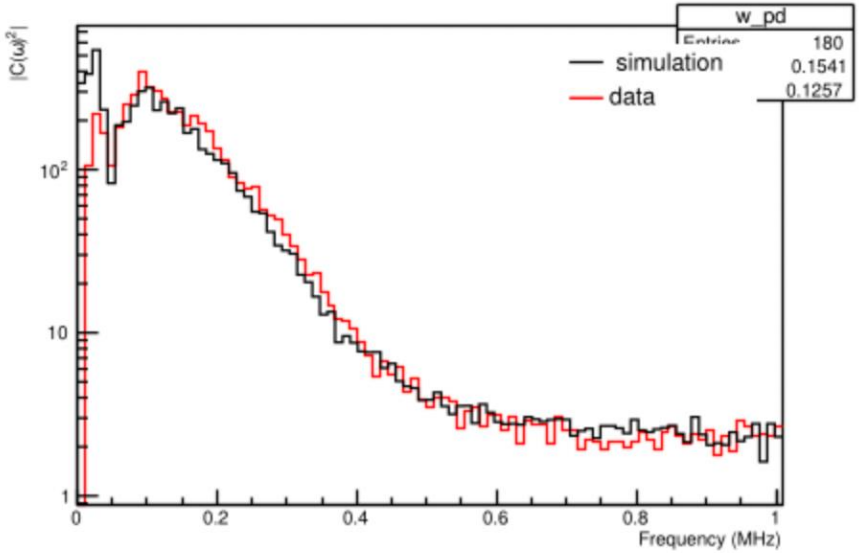
02/12/2025

Brookhaven National Laboratory

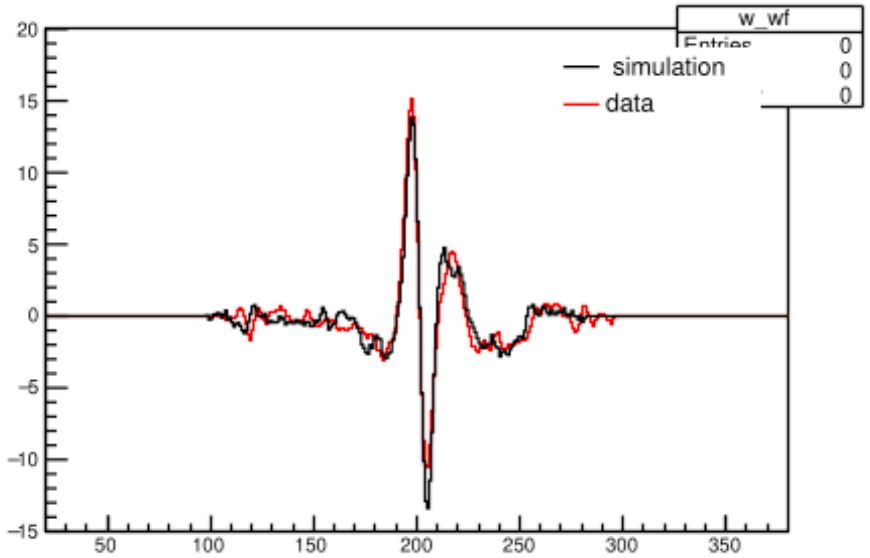
Simulation w/ and w/o CNR

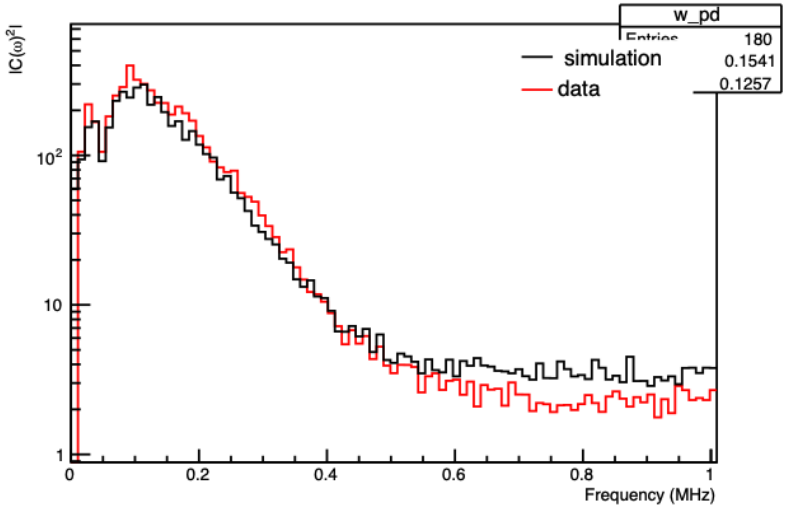
Coherent noise removal not applied





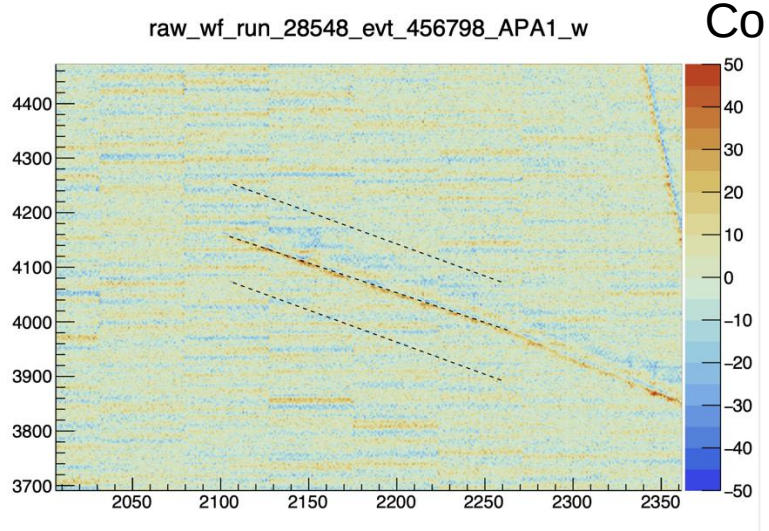
Coherent noise removal applied

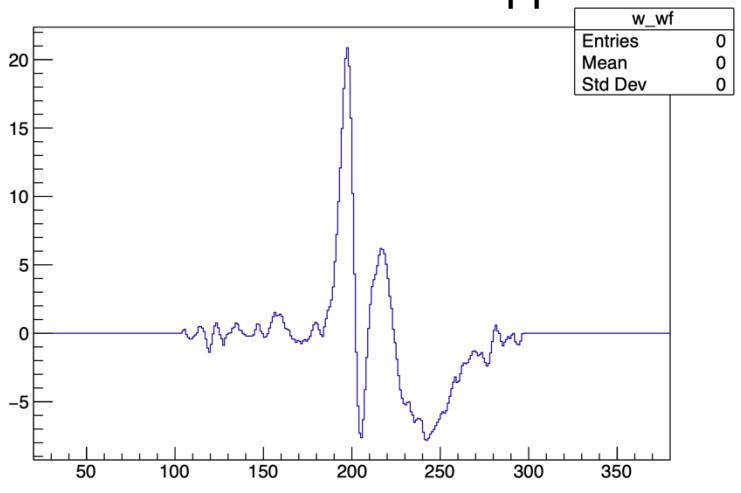


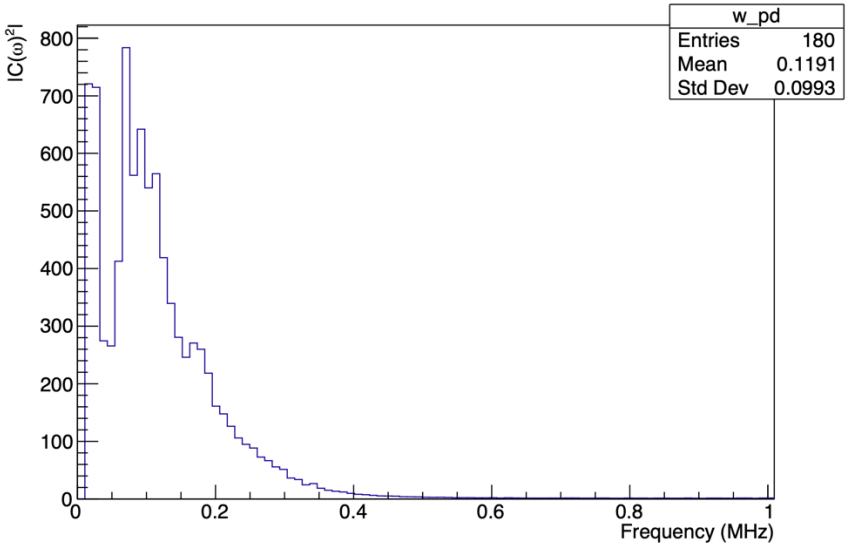


Data w/ and w/o CNR

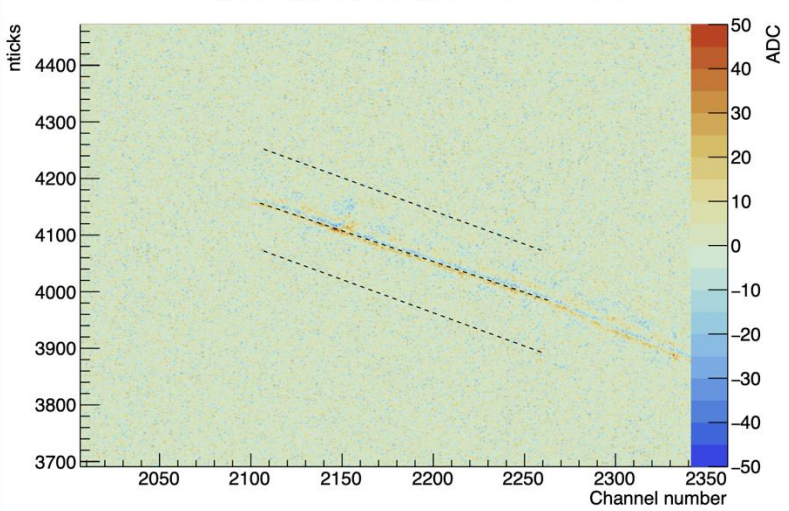
Coherent noise removal not applied

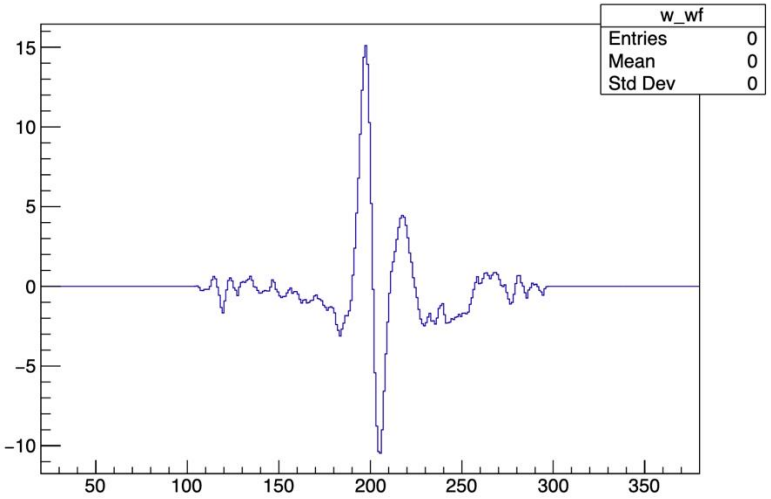


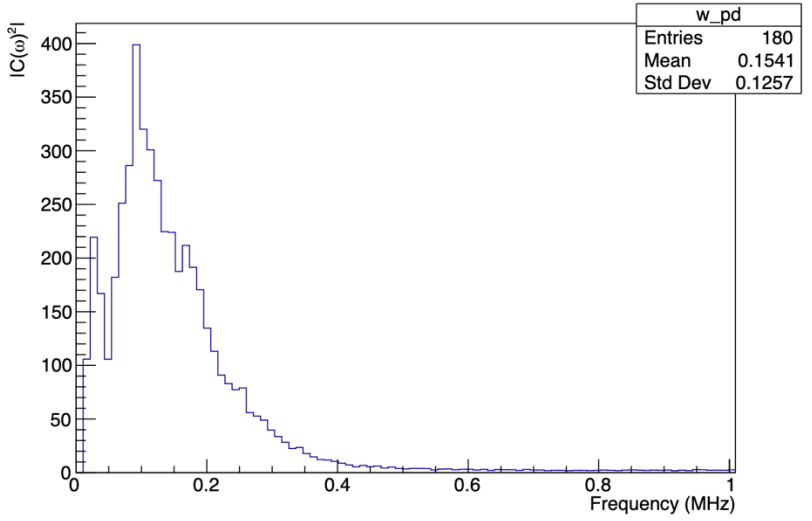




Coherent noise removal applied

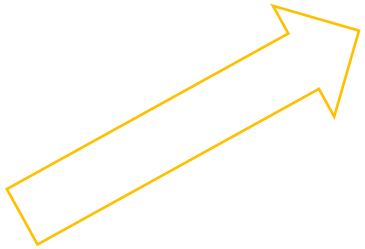






Redo everything with no CNR

- 5 Parameters
  - Different renormalizing factors to 0.4 pitch (f_5) and 0.5 pitch (f_6)
  - One starting point for the 2 electron paths
  - Two time stretch factors for 2 electron paths



- A python script to control everything:
  - Minimize Chi2
  - MCMC

Generate renormalized field response from wire-cell-python

Simulation using a wire-cell-tookit

Compare data with simulation in a root script:

Compute X^2_{total}

Install wire-cell-python on gpvm

- For wire-cell-python:
- Previously I couldn’t install it on gpvm.

- Decouple everything about gojsonnet
- Modify to be suitable for Python version 3.9 (With the help of ChatGPT)

- Successfully install it on gpvm and inside the container.

wire-cell-python/wirecell/sigproc/response/schema.py

2 Modify Code for Python 3.9 Compatibility

If you cannot upgrade Python, you need to **edit** `schema.py`:

1. Open the file:

bash — Copy

```
nano /exp/dune/data/users/xning/git/wire-cell-python/wirecell/sigproc/response/schema.py
```

2. Find the problematic line:

python — Copy

```
paths: List[PathResponse] | None = None
```

3. Change it to:

python — Copy

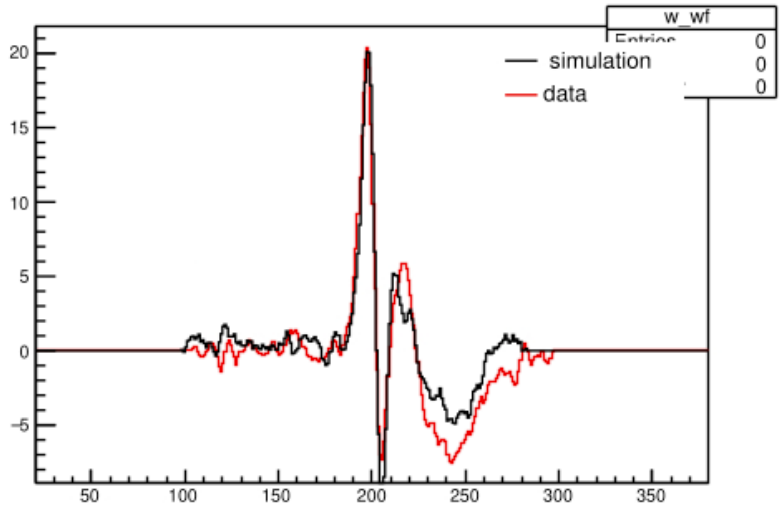
```
from typing import List, Optional
paths: Optional[List[PathResponse]] = None
```

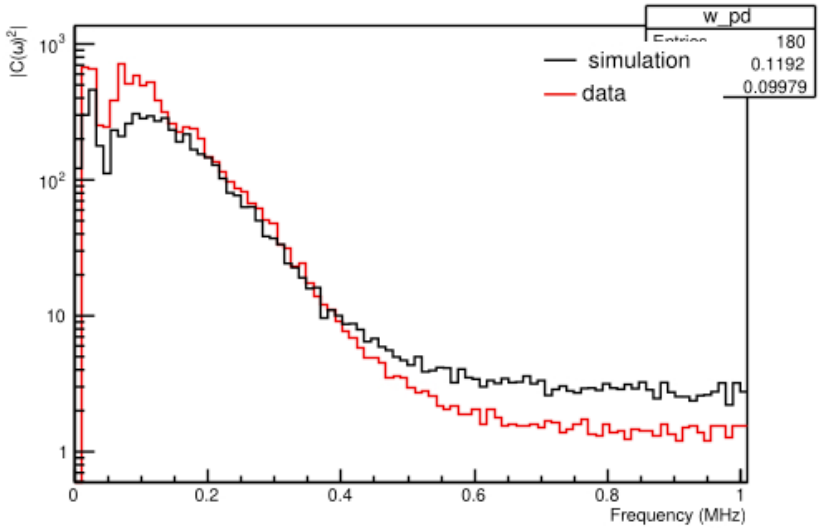
Do fitting using MCMC

- Define X^2_{total} :
  - For w plane, compare waveforms and power density spectra
  - For each plot:

$$X^2 = \sum_{i=1}^{nbins} \frac{(x_i - m_i)^2}{|m_i|} \; /nbins$$

  - X^2_{total}: For different plots in different tracks, multiply all the X^2
    - Only use 7 tracks, because the last one is strange





Do fitting using MCMC

- A very simple MCMC with the help of **OpenAI 4o**:
  - Since the chi2 is dependent on simulation, the same parameters cannot produce same result all the time.
  - MCMC only relies on the result of the last step.
  - It is easy to deal with lots of parameters.

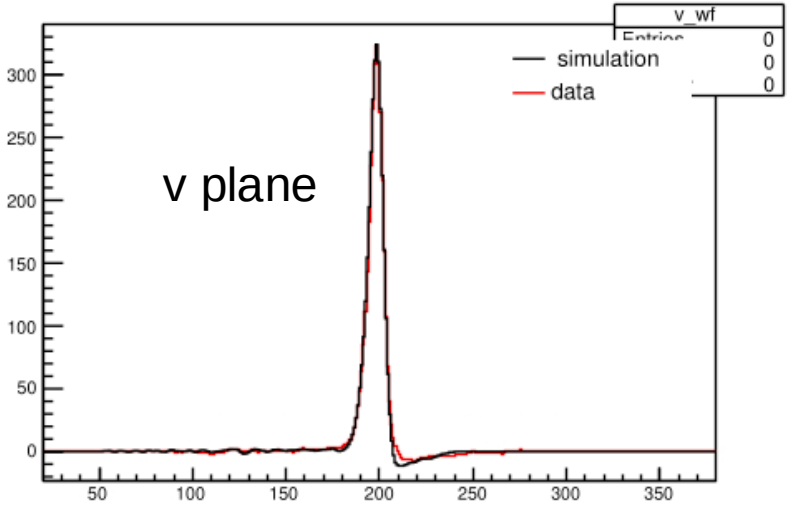
- Random walk: a new parameter set is randomly generated according to the current parameters.
  - The step size is fixed.

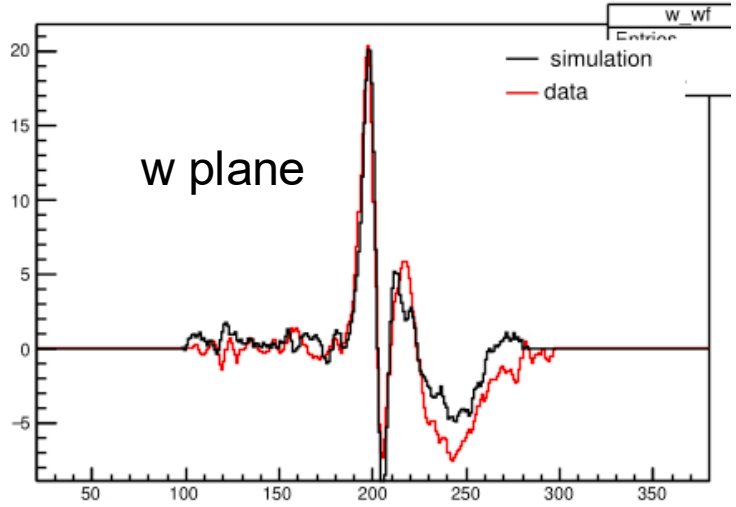
- If $X^2_{total}(current\ parameters) > X^2_{total}(new\ parameters)$
  - Accept new parameters;
- Else
  - $new\ parameters$ still has some chance to be accepted.
    - Metropolis-Hastings acceptance rule.

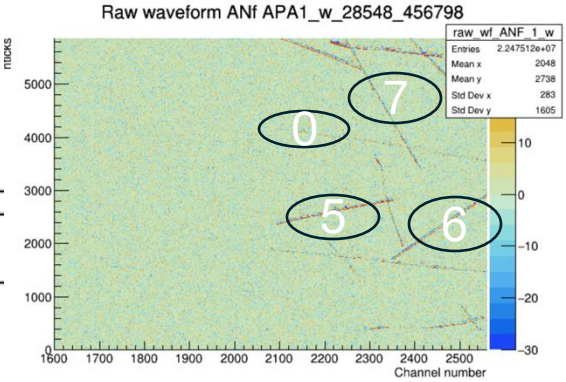
Best one this time

Track0; beam

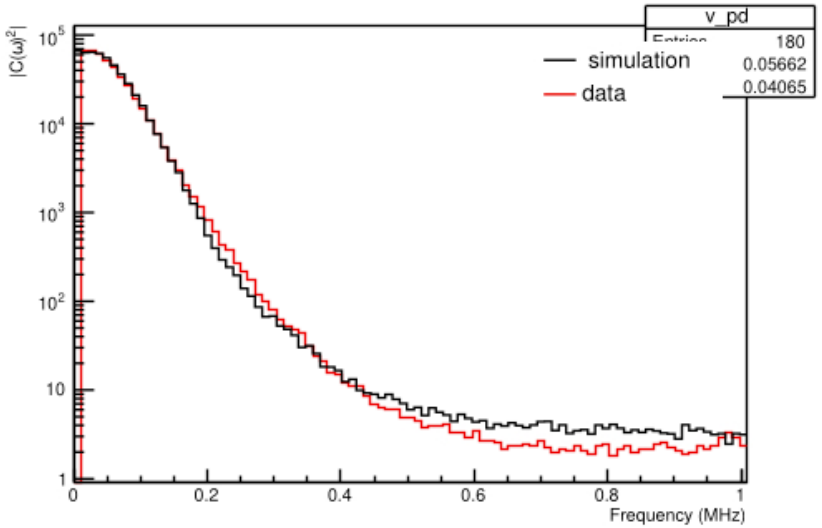
waveform

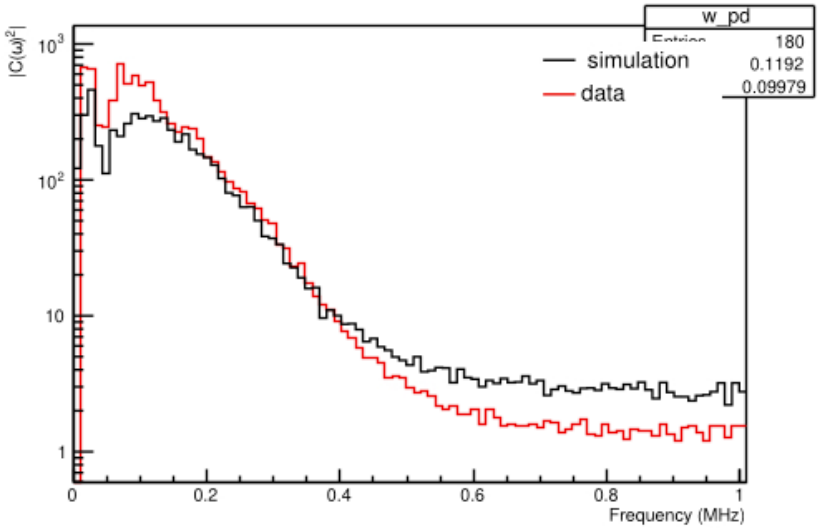






Power spectra

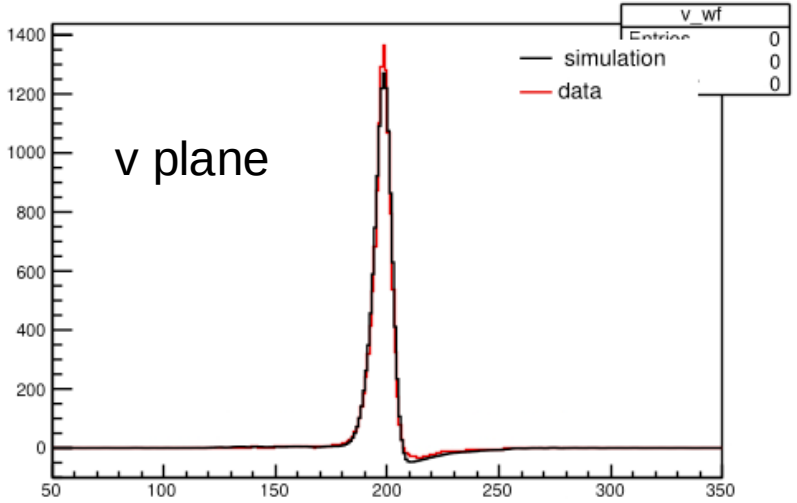


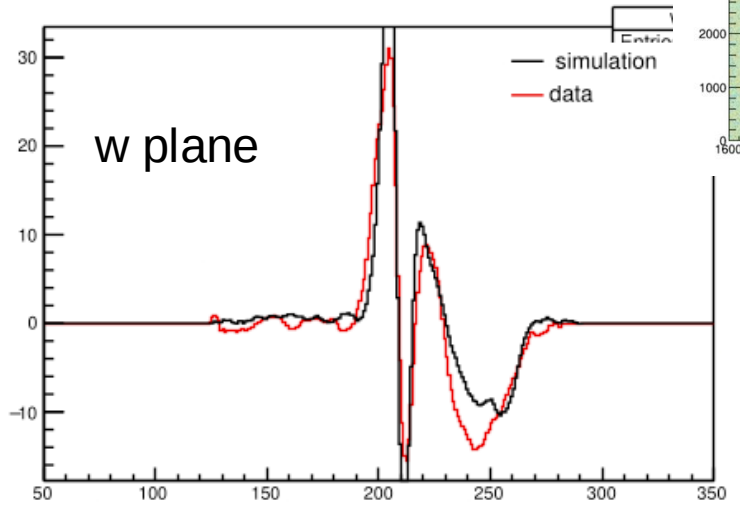


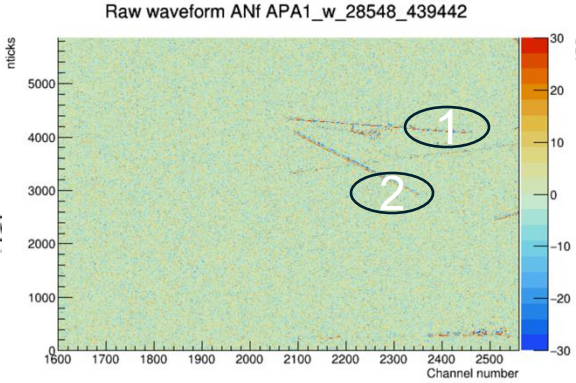
-0.04_2.10_1.00_2.50_650

Best one this time

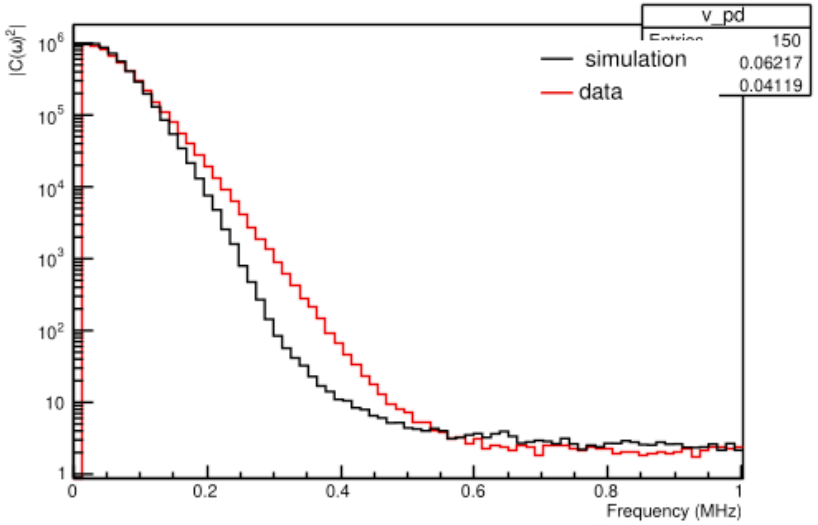
waveform

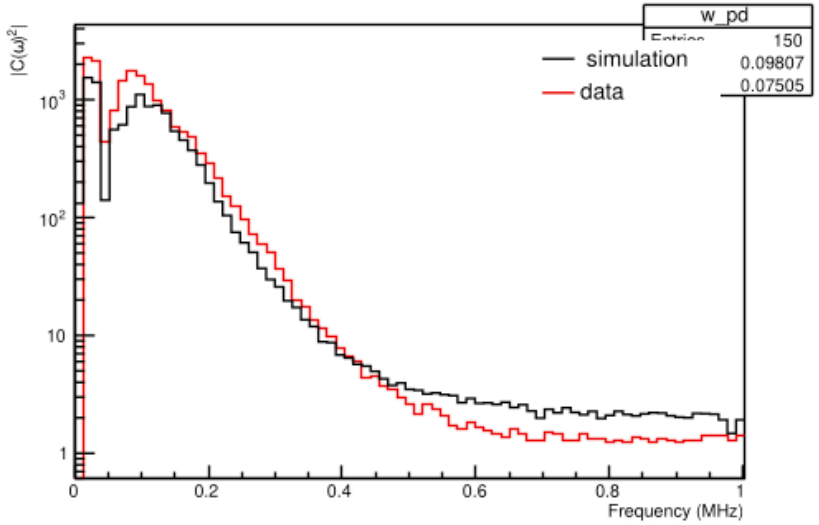






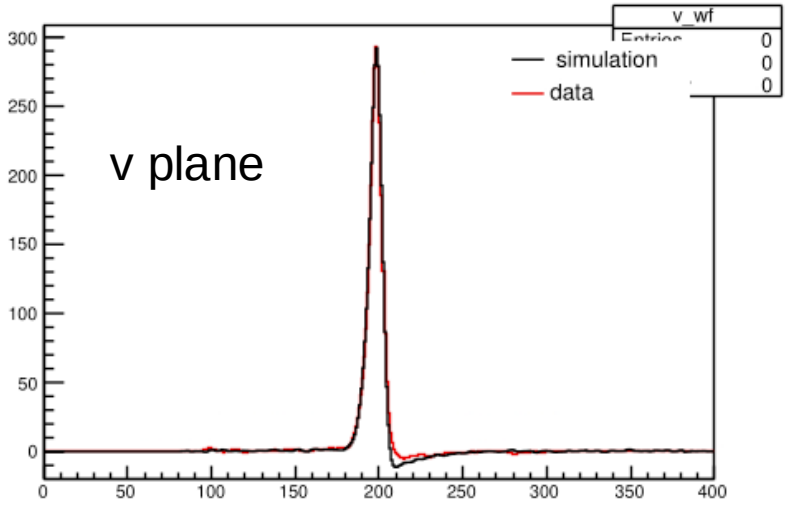
Power spectra

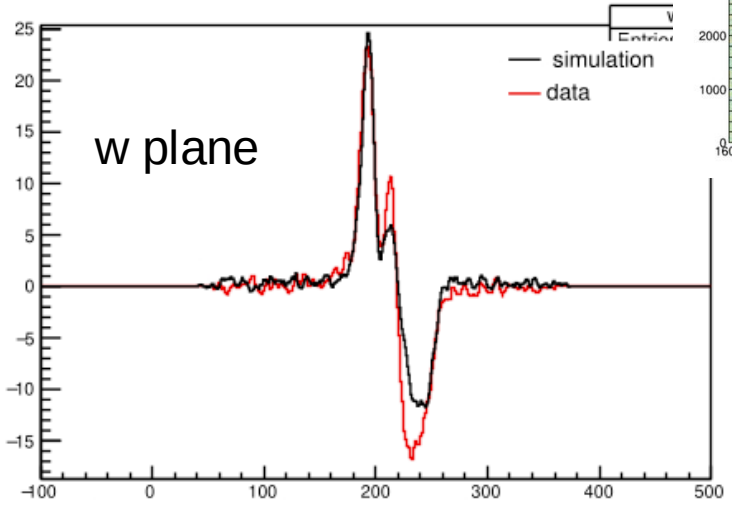


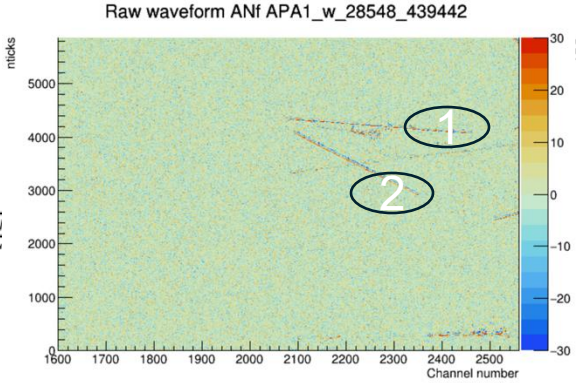


Best one this time

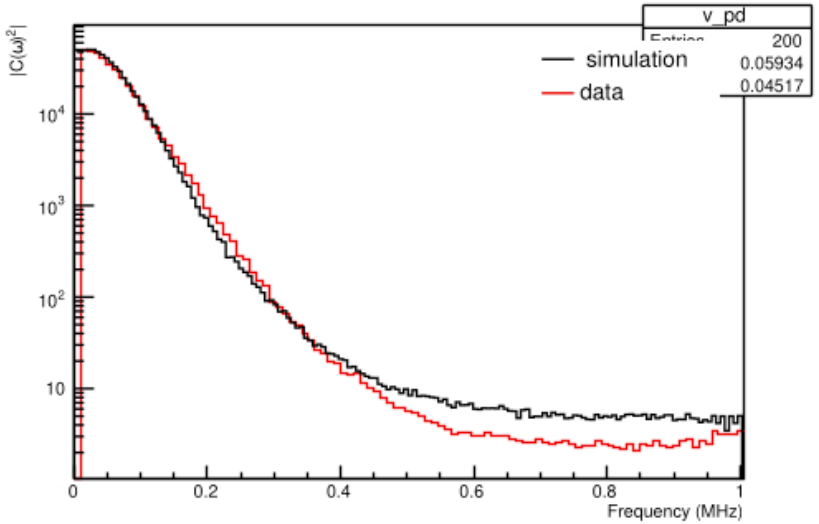
waveform

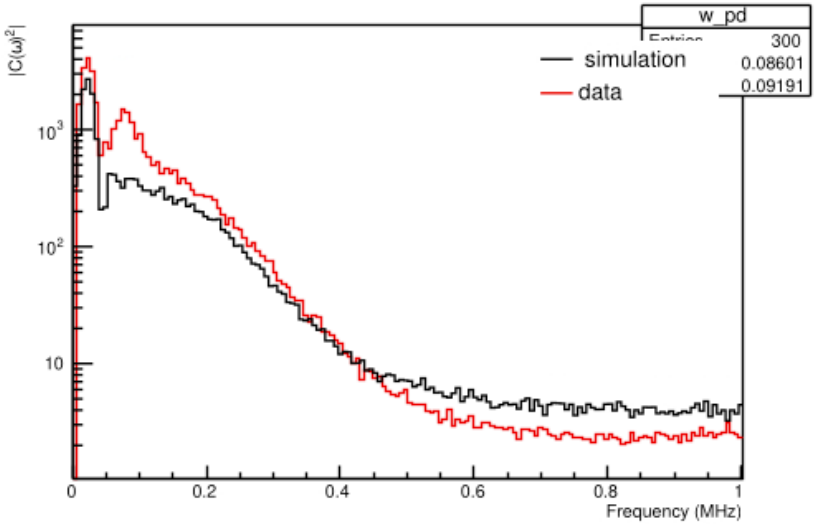






Power spectra





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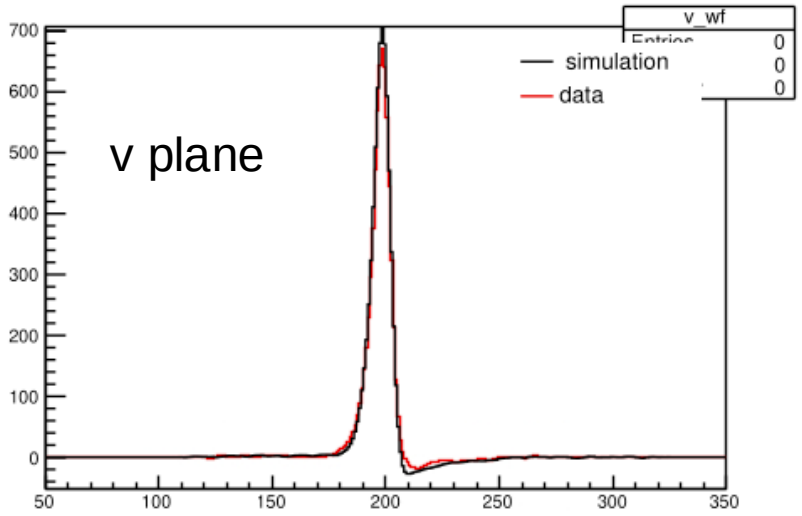
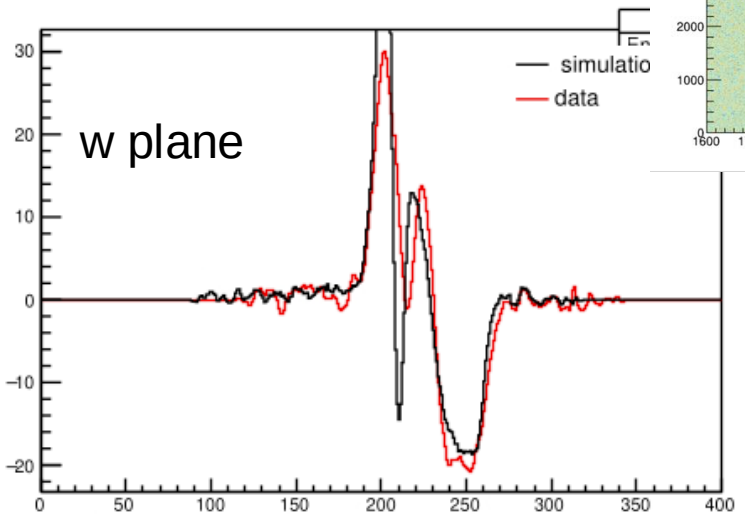
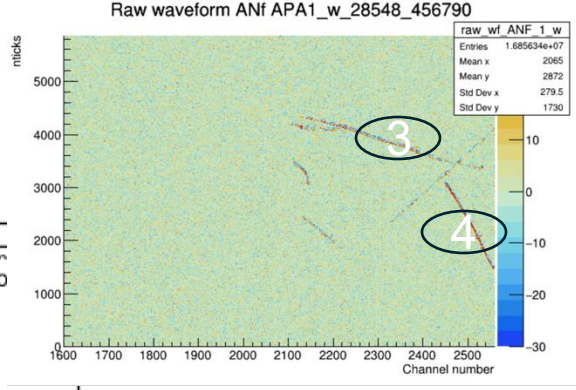
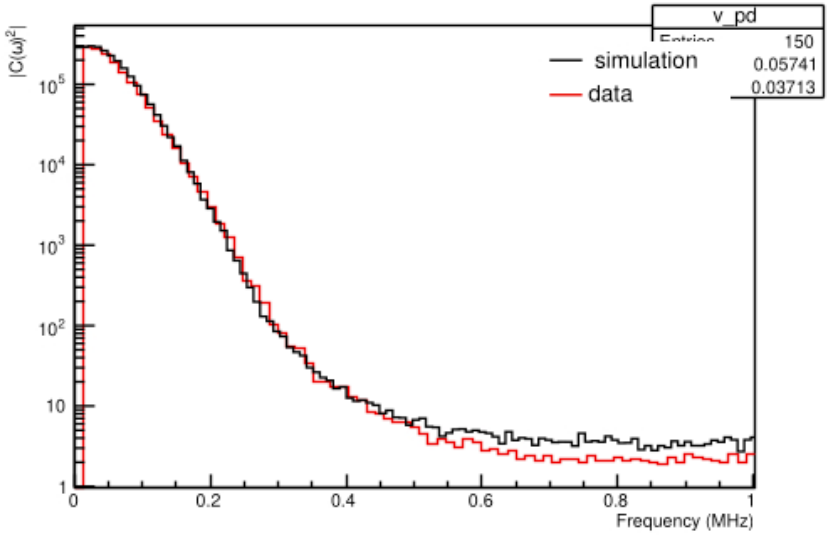
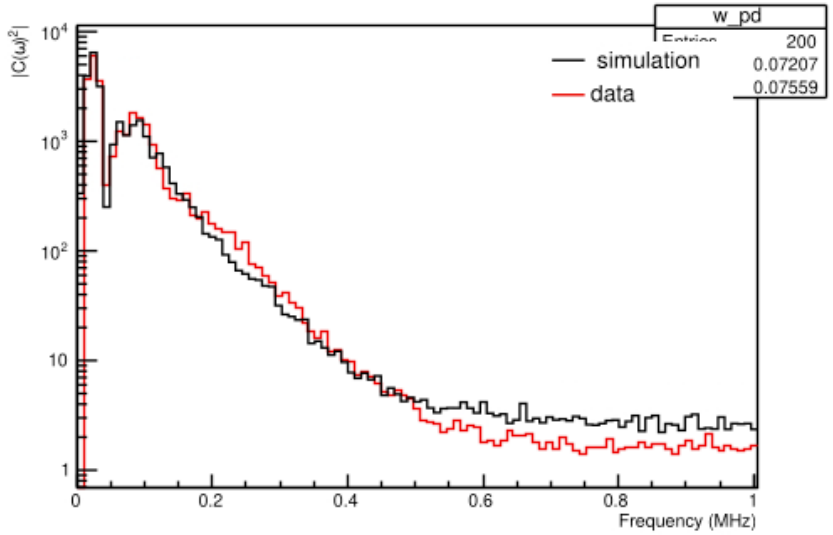






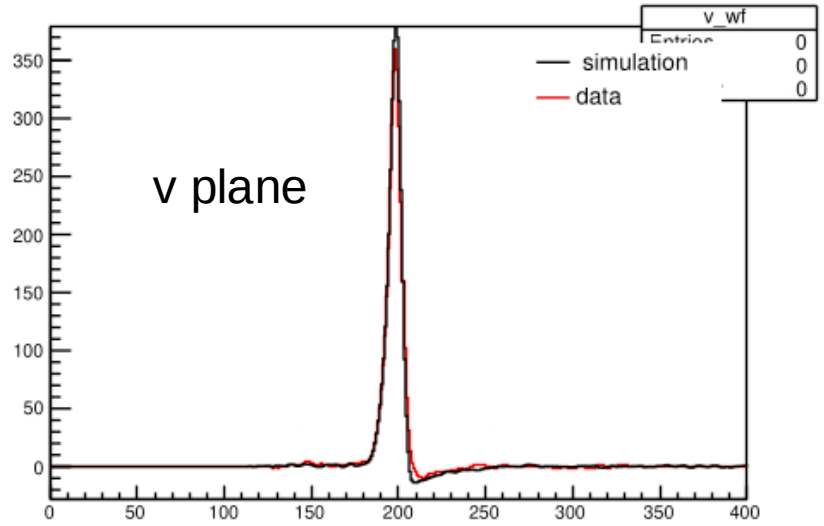
Power spectra

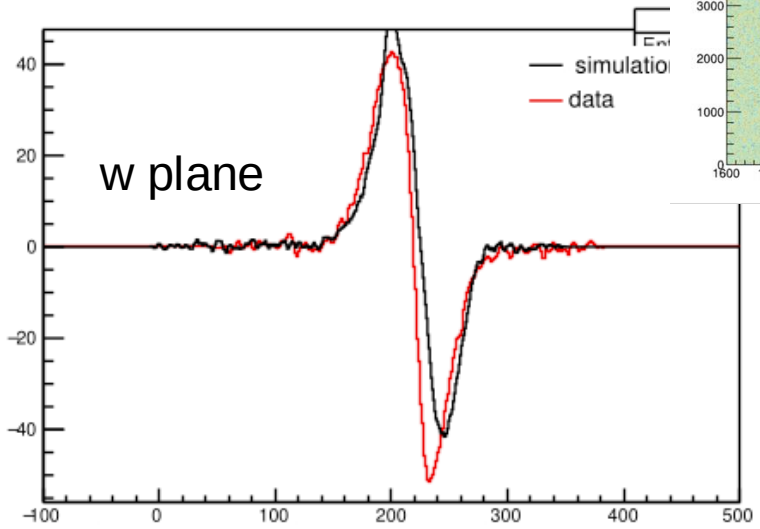


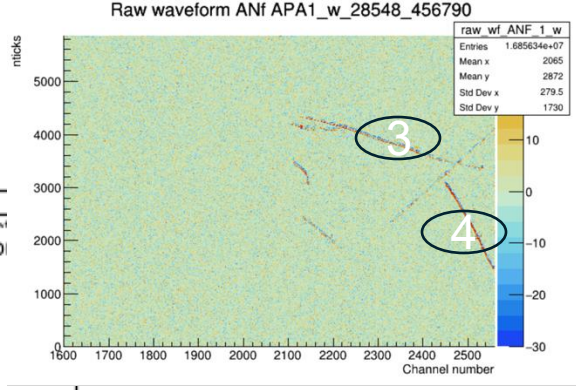


Best one this time

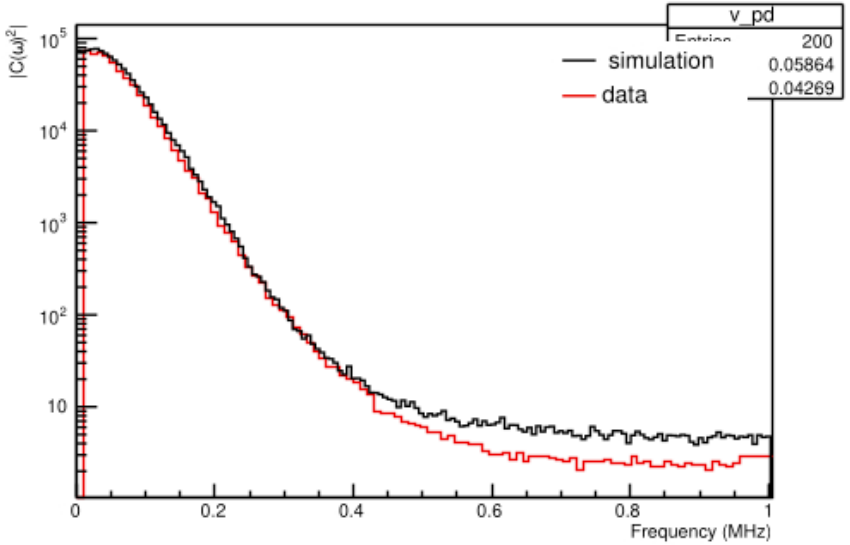
waveform

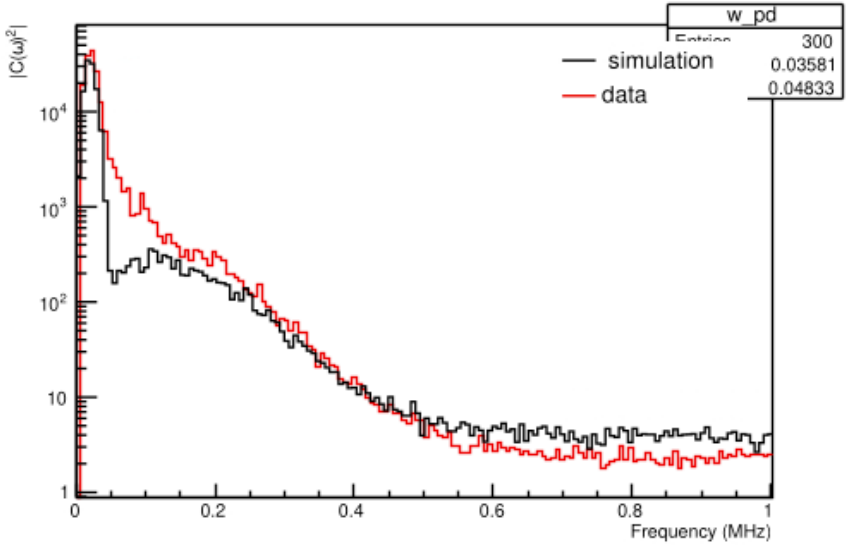






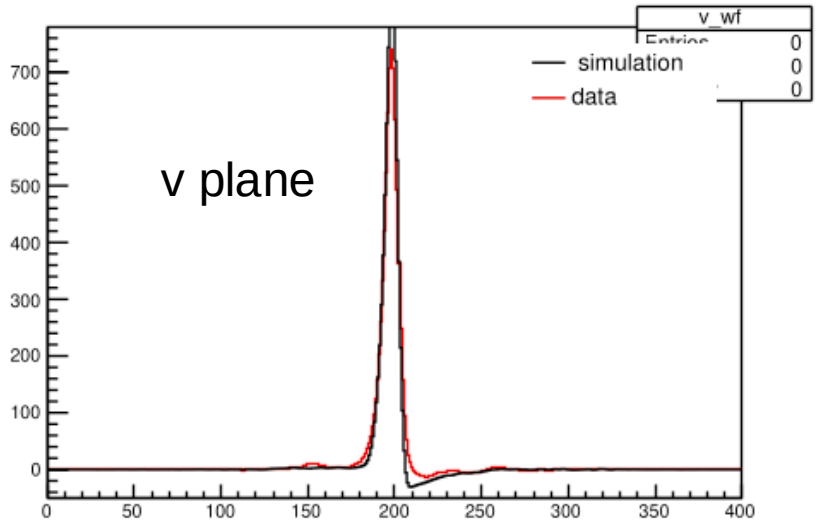
Power spectra

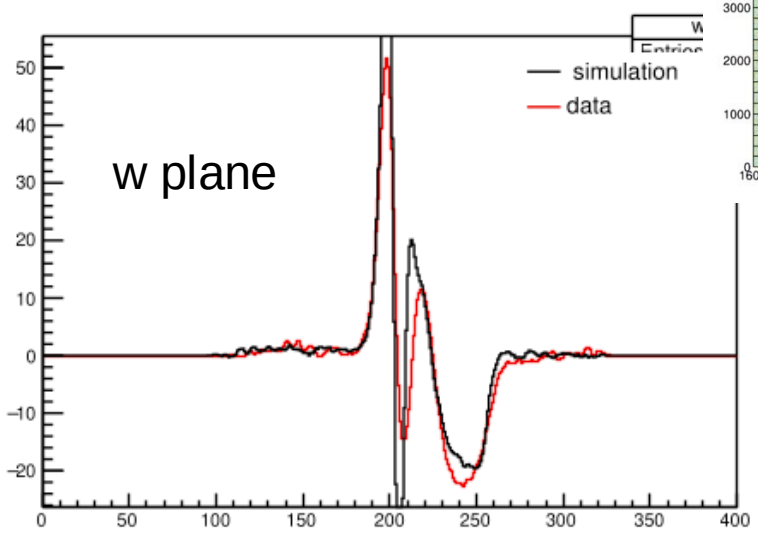


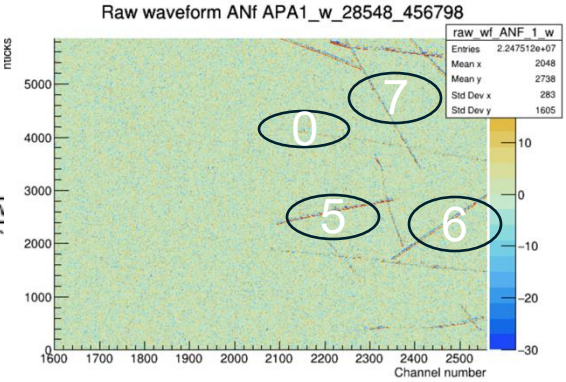


Best one this time

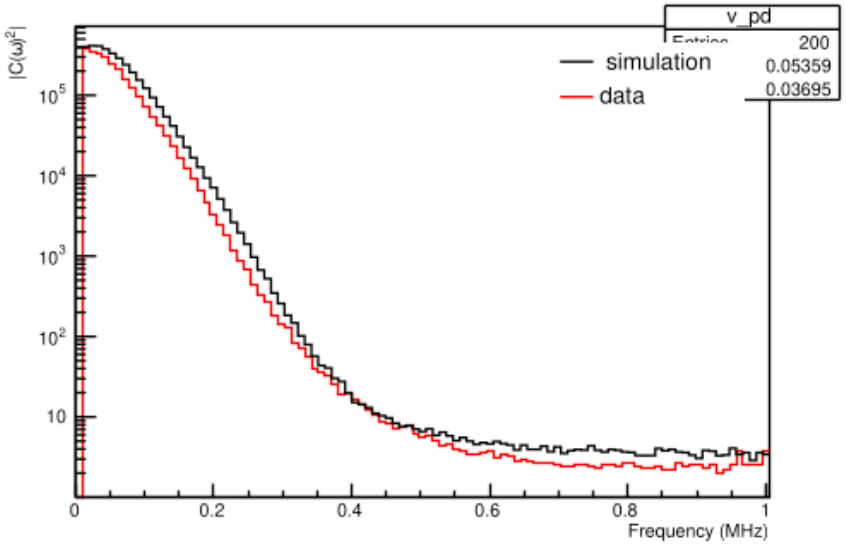
waveform

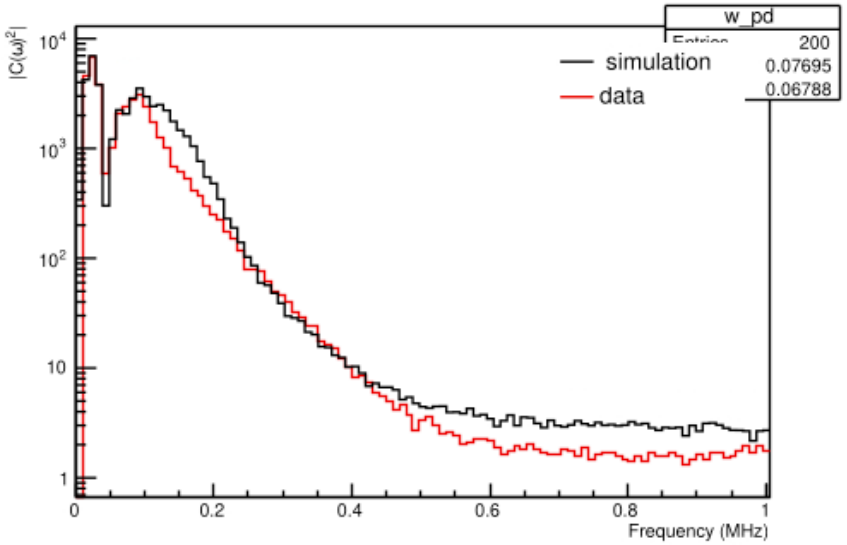






Power spectra





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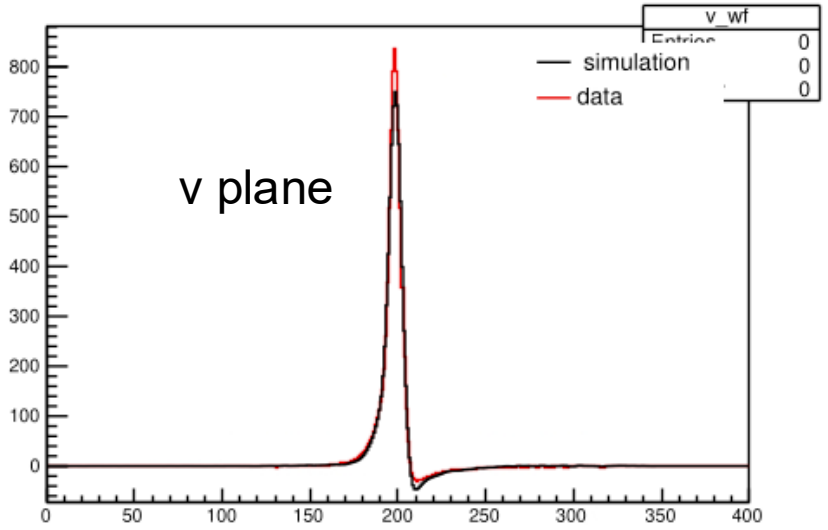
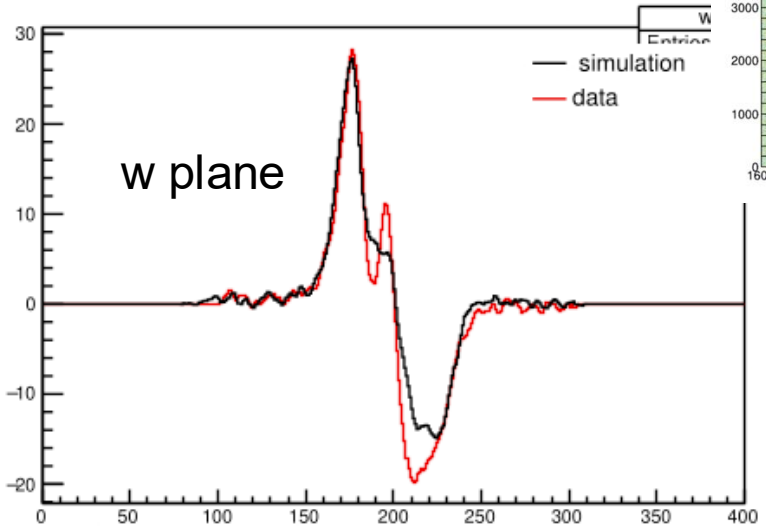
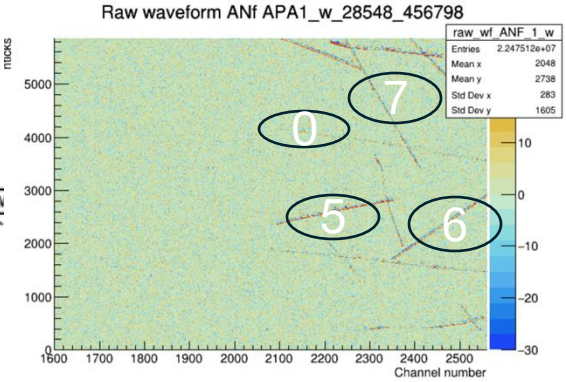
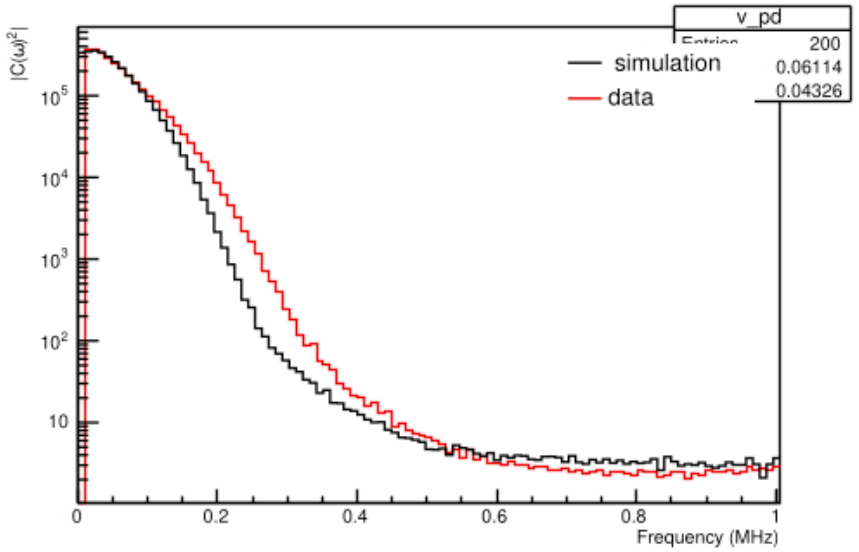
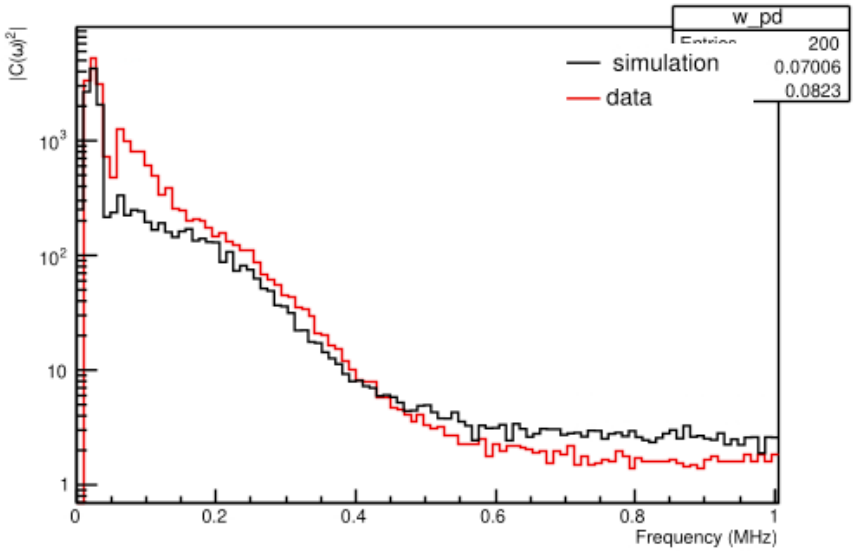






Power spectra





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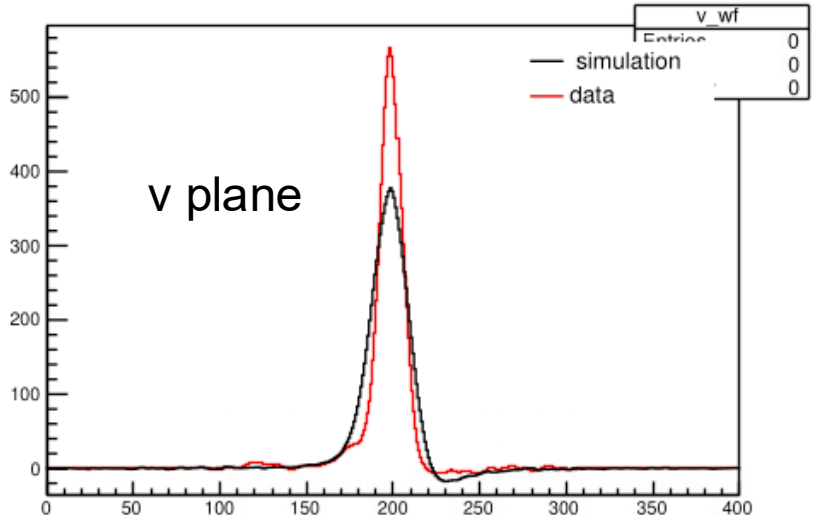
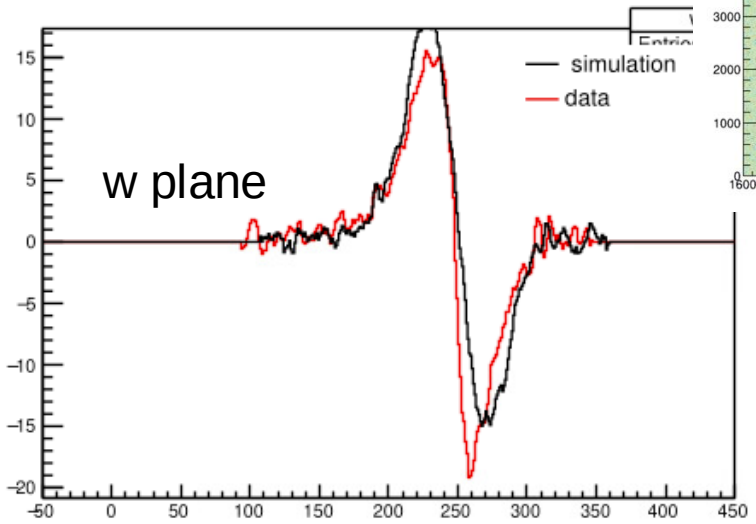
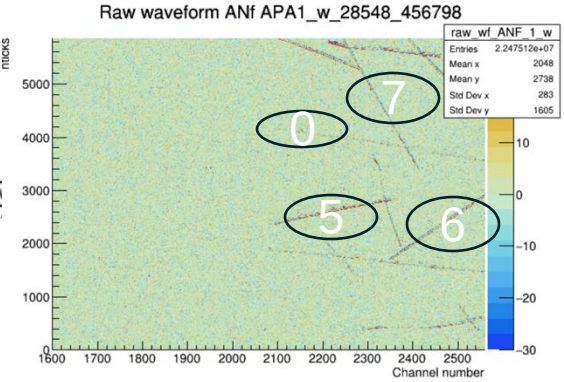
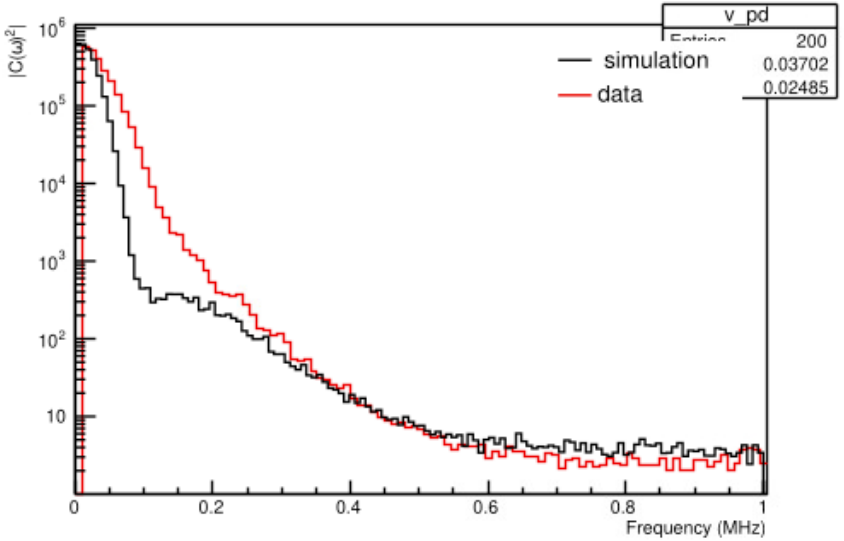
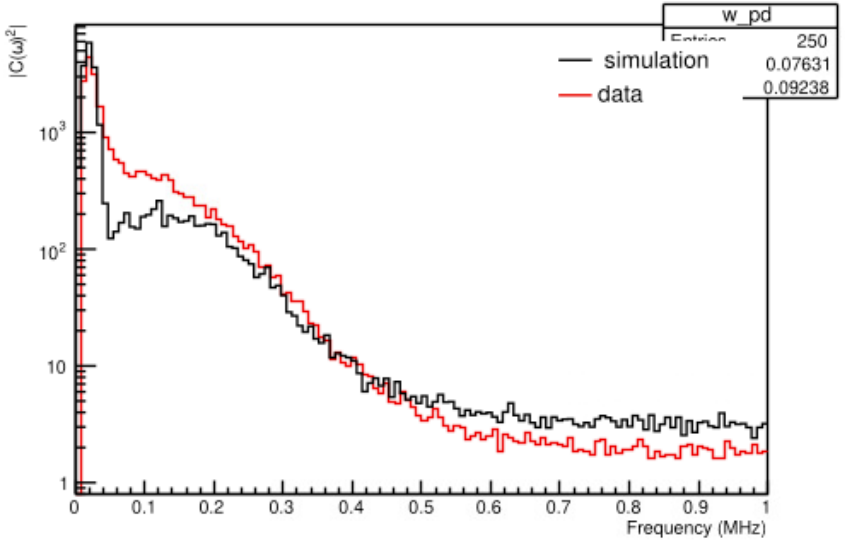




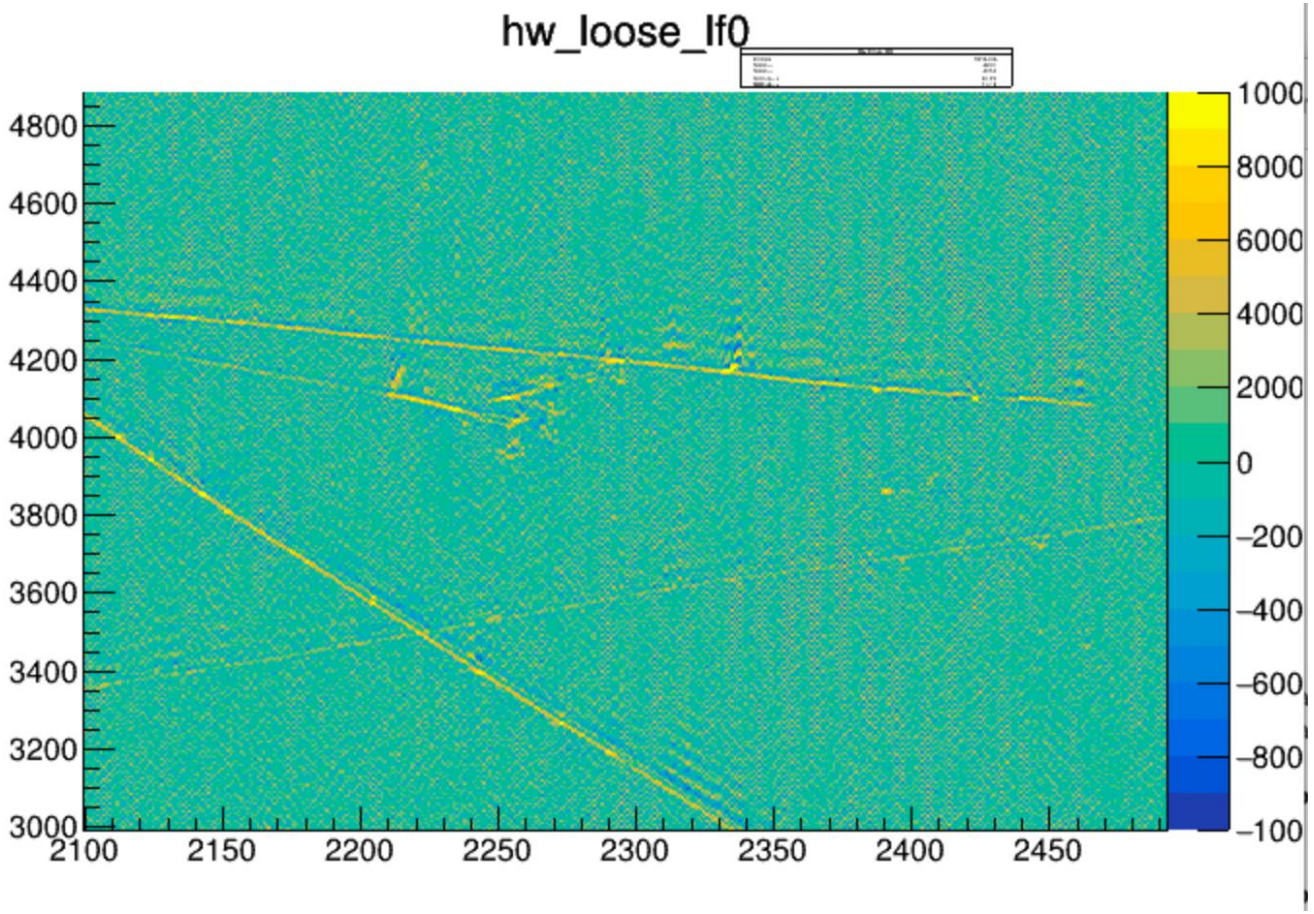


Power spectra

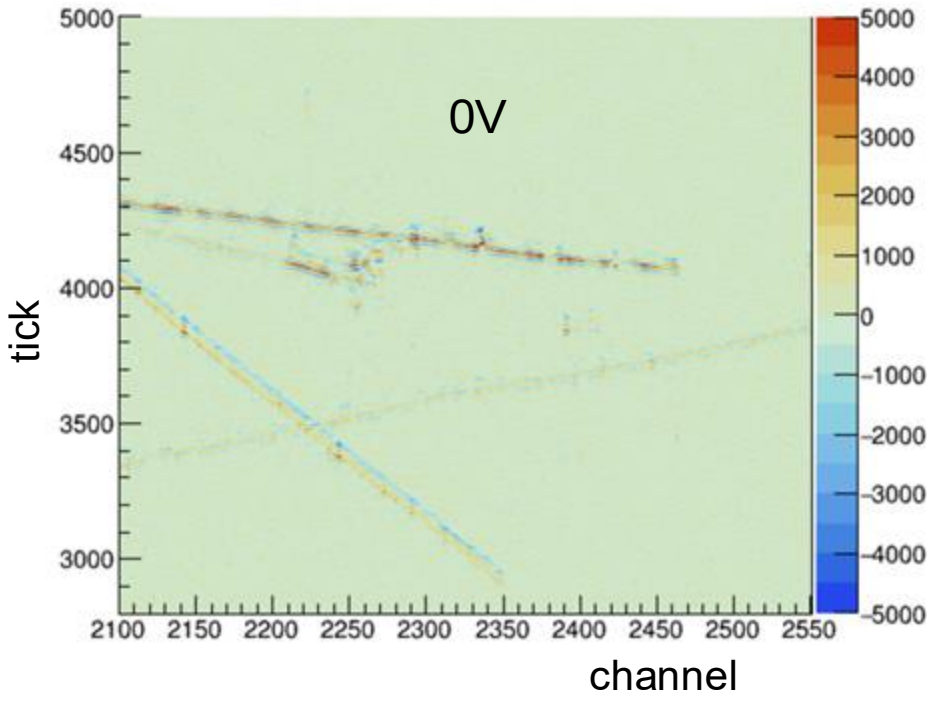


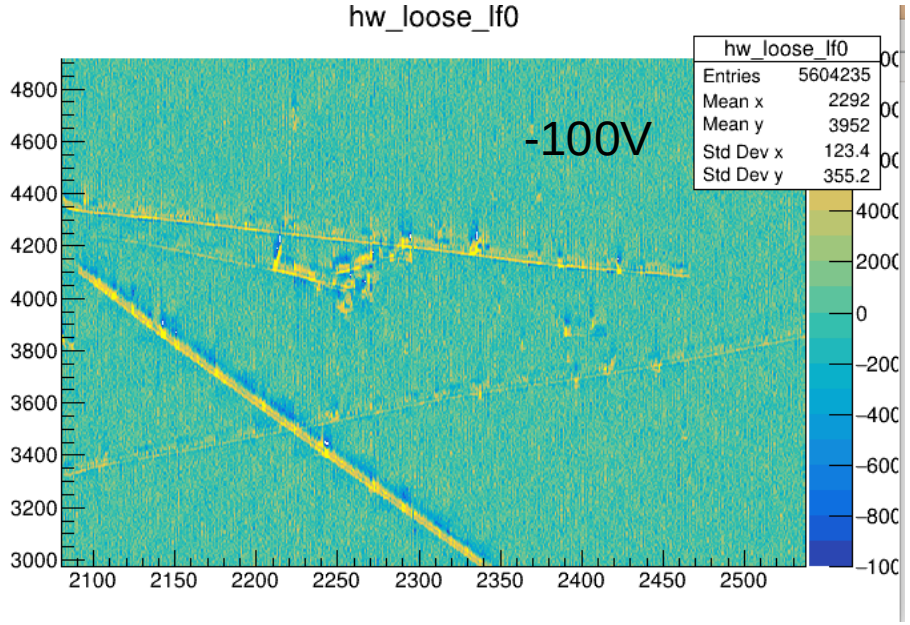


Check decon result

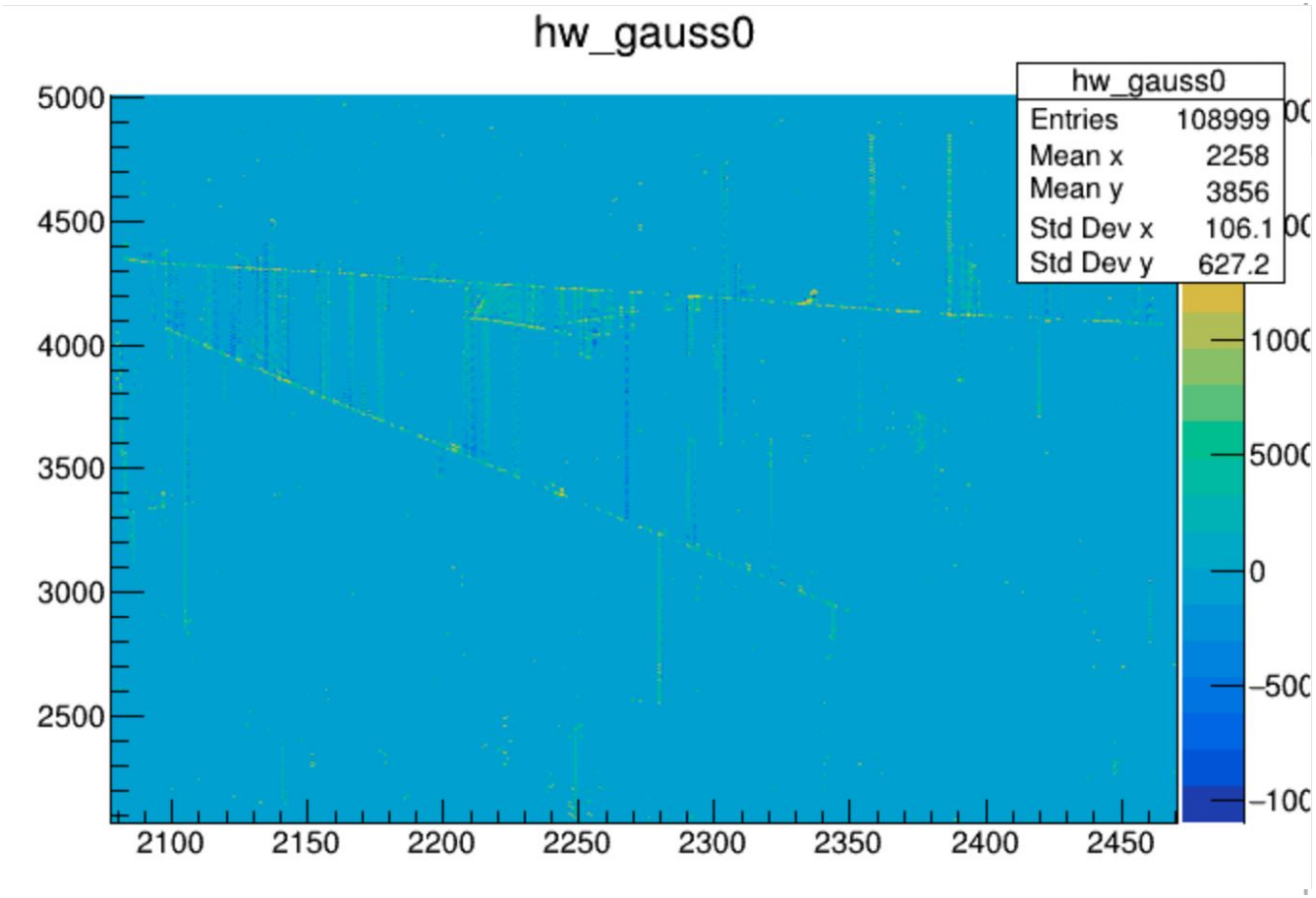


Newly fitted

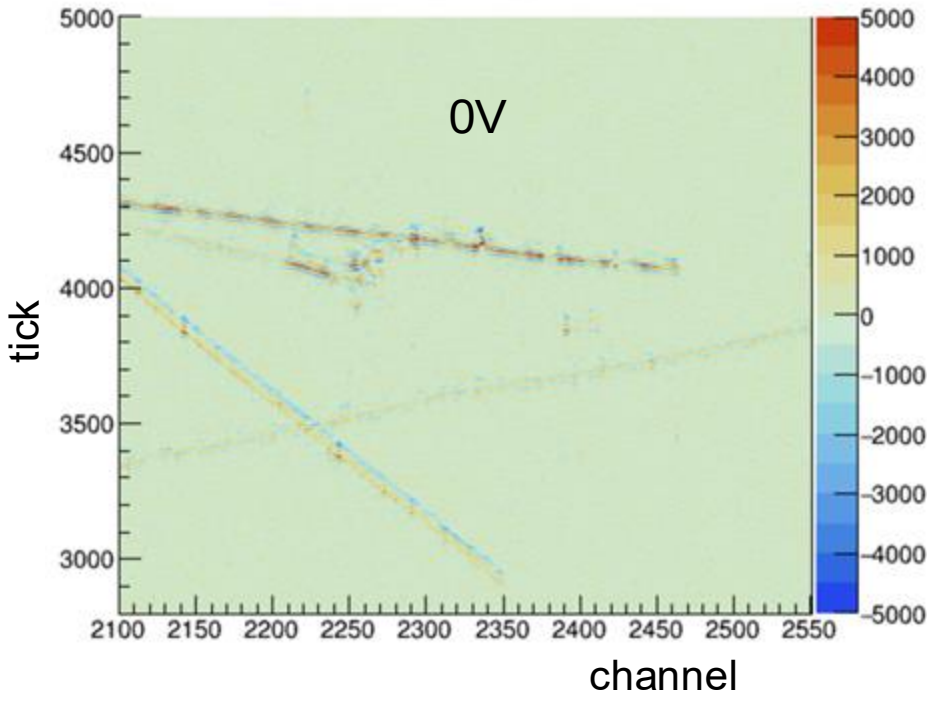


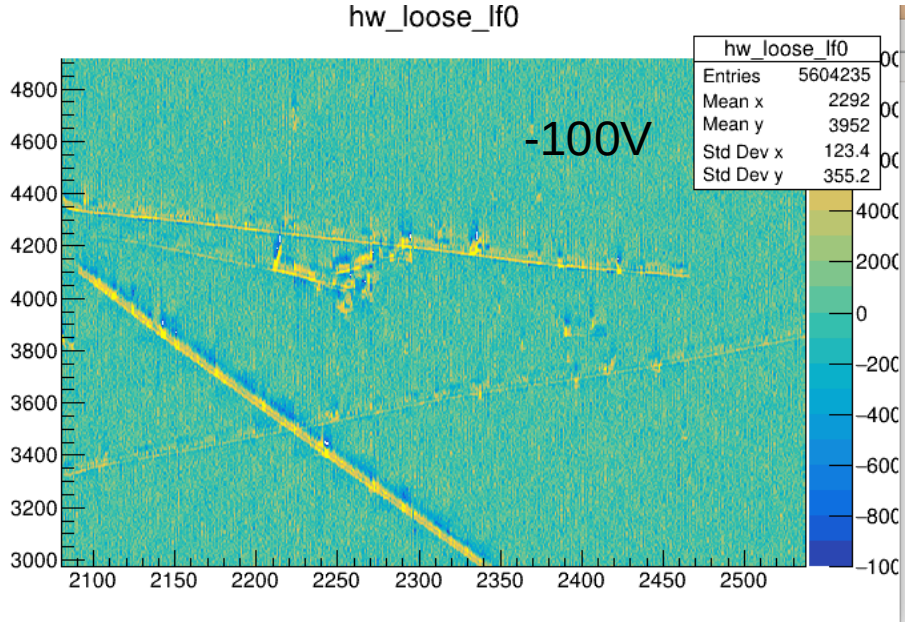


Check decon result



Newly fitted

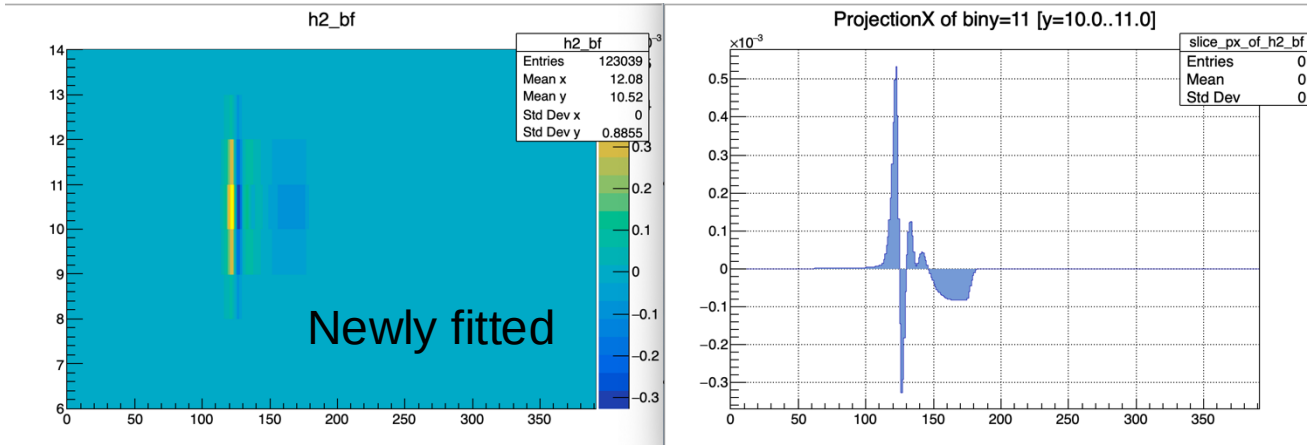


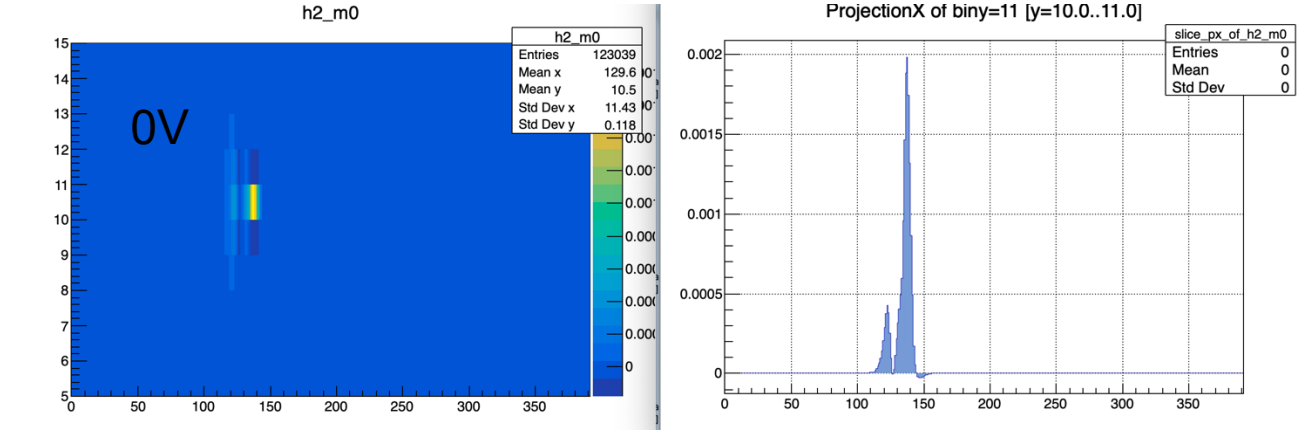


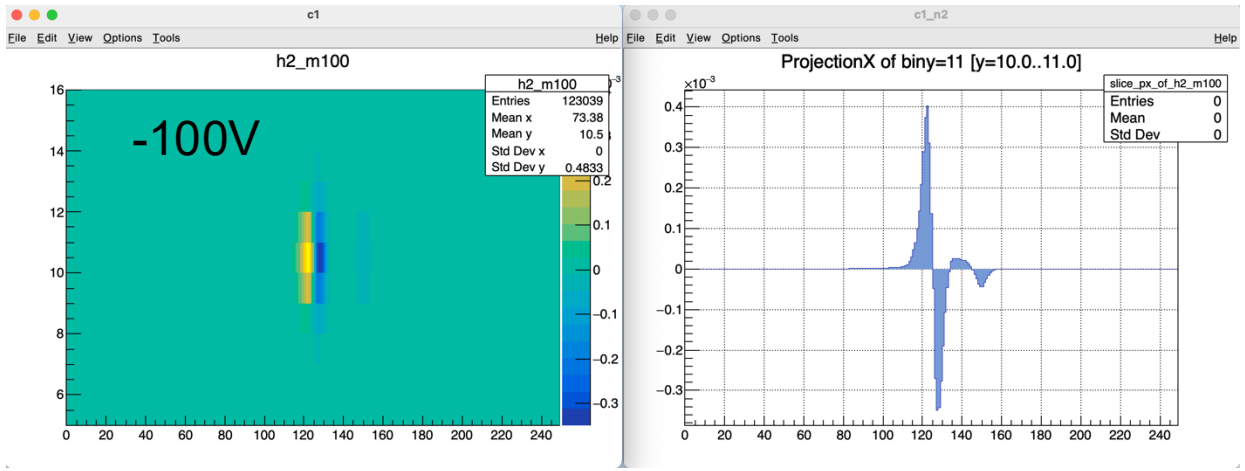
Add a filter to help ROI

- Still ongoing
- **Overall_resp[1]** should be the overall response that combine field response and electronic response.
- A 2D “filter” can be obtained by dividing these 2D response.
- Need more time to understand how to add it through config files.

```
for (size_t i = 0; i != overall_resp[plane].size(); i++) {
    for (int j = 0; j != m_fft_nticks; j++) {
        r_resp(i, j) = overall_resp[plane].at(i).at(j);
        // if(plane==1){
        // std::cout<<r_resp(i, j)<<"\t";
        // }
    }
    //     if(plane==1){
    // std::cout<<std::endl;
    //     }
}
//         if(plane==1){
// exit(0);
//         }
```







Signal processing and imaging validation

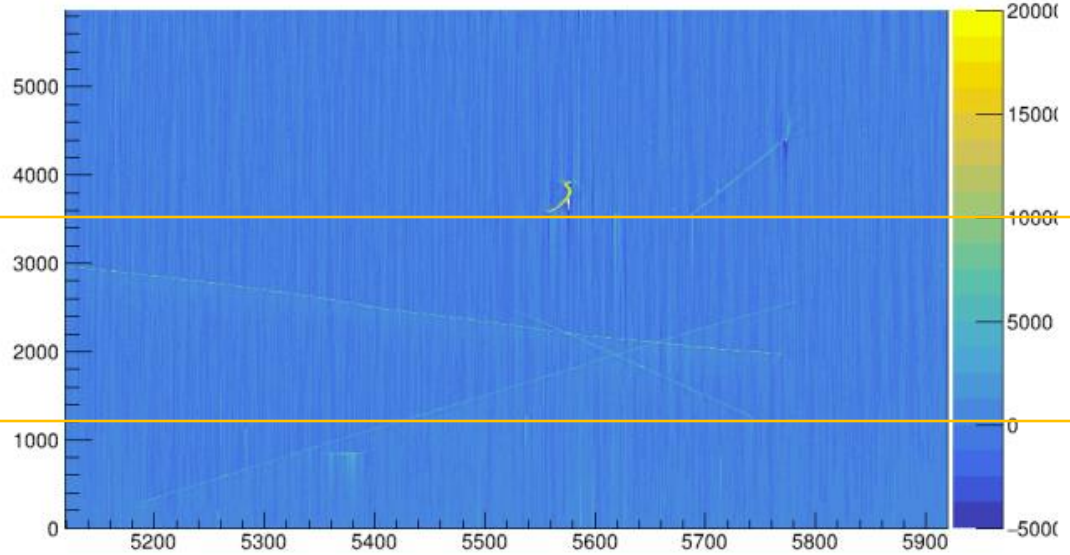
Xuyang Ning

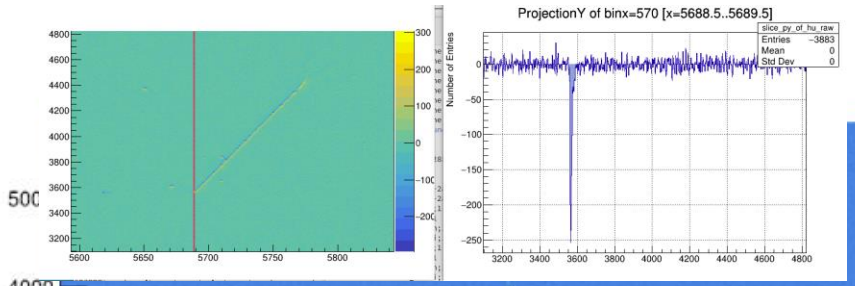
02/12/2025

Brookhaven National Laboratory

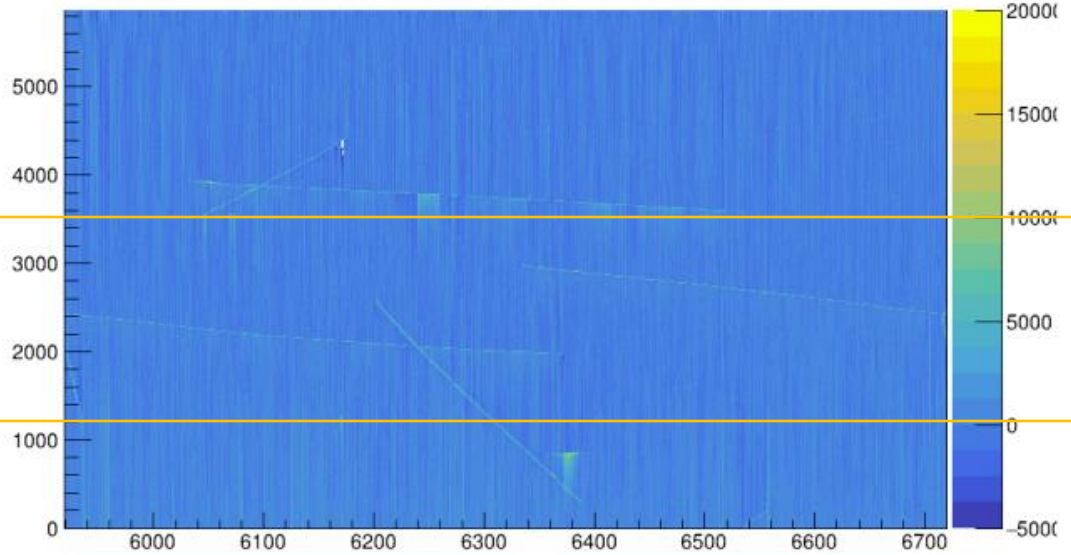
magnify-28548-456814-2.png

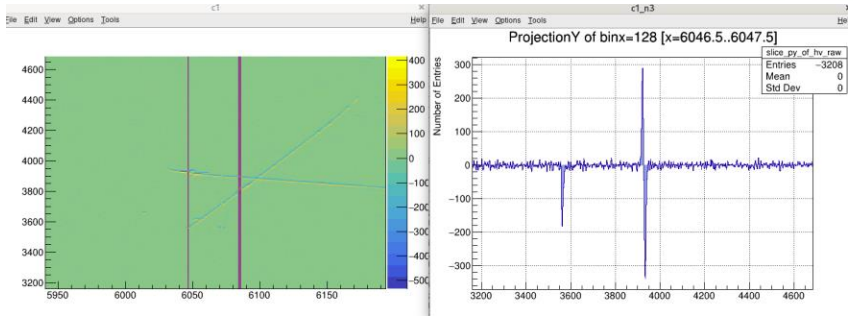
hu_decon_ori2

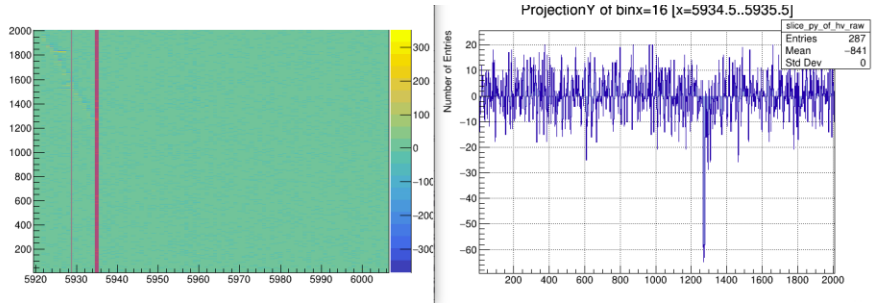




hv_decon_ori2







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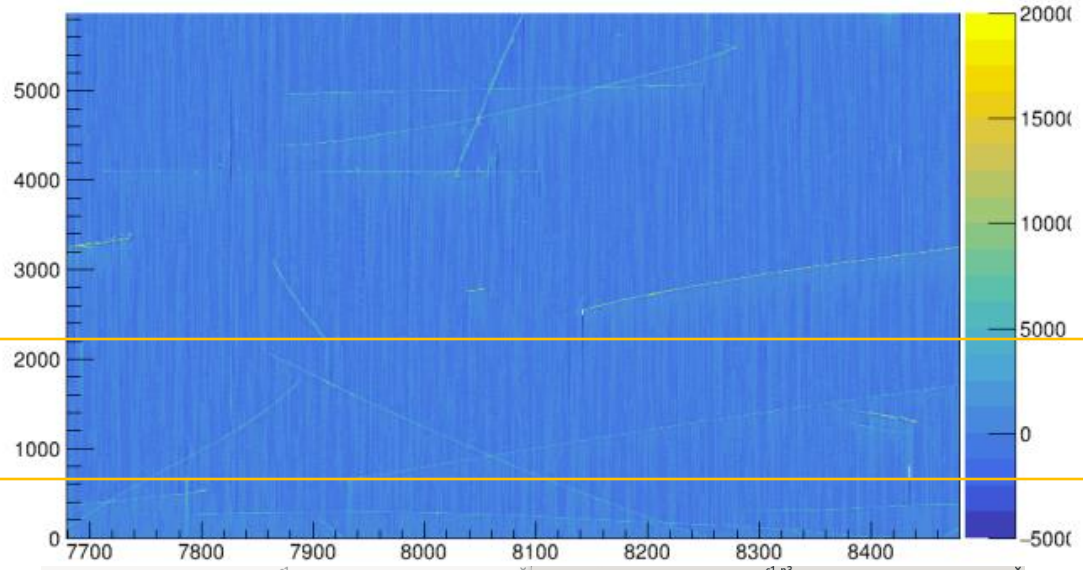
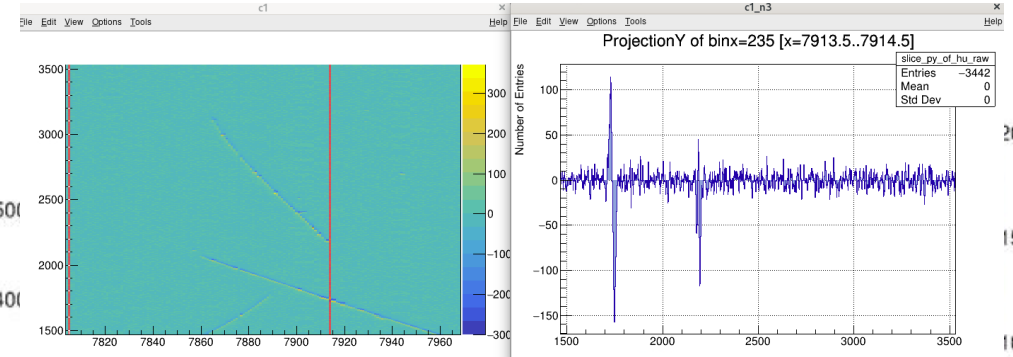
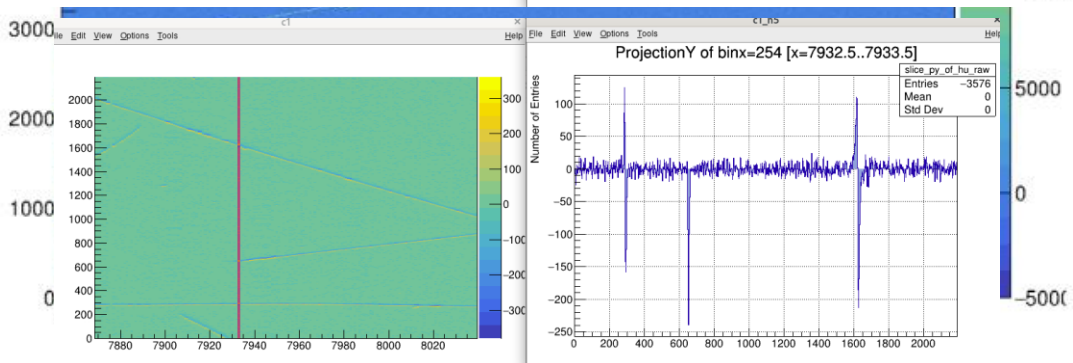
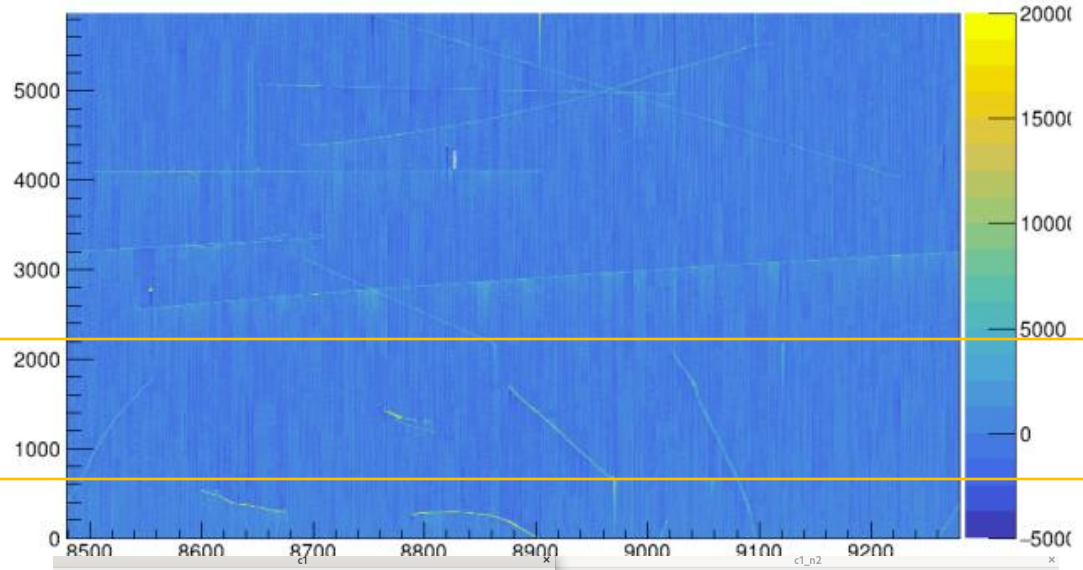
hu_decon_ori3

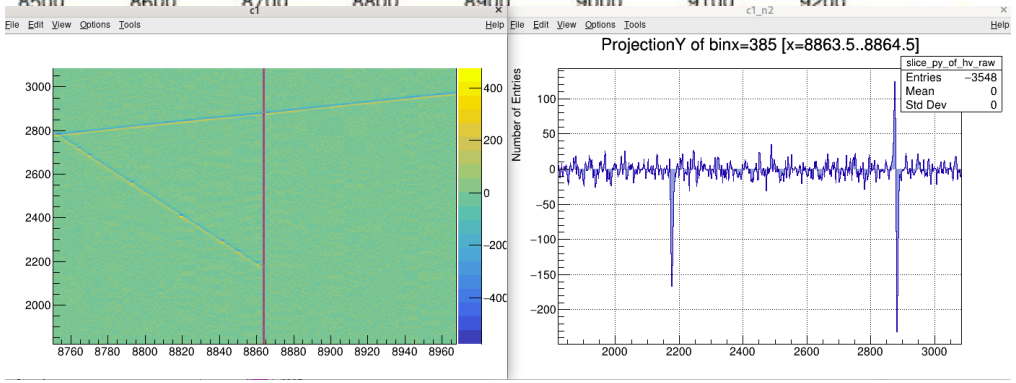


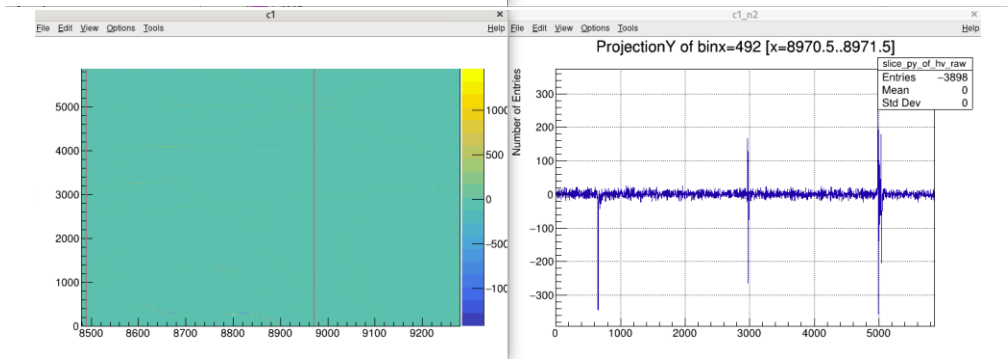




hv_decon_ori3







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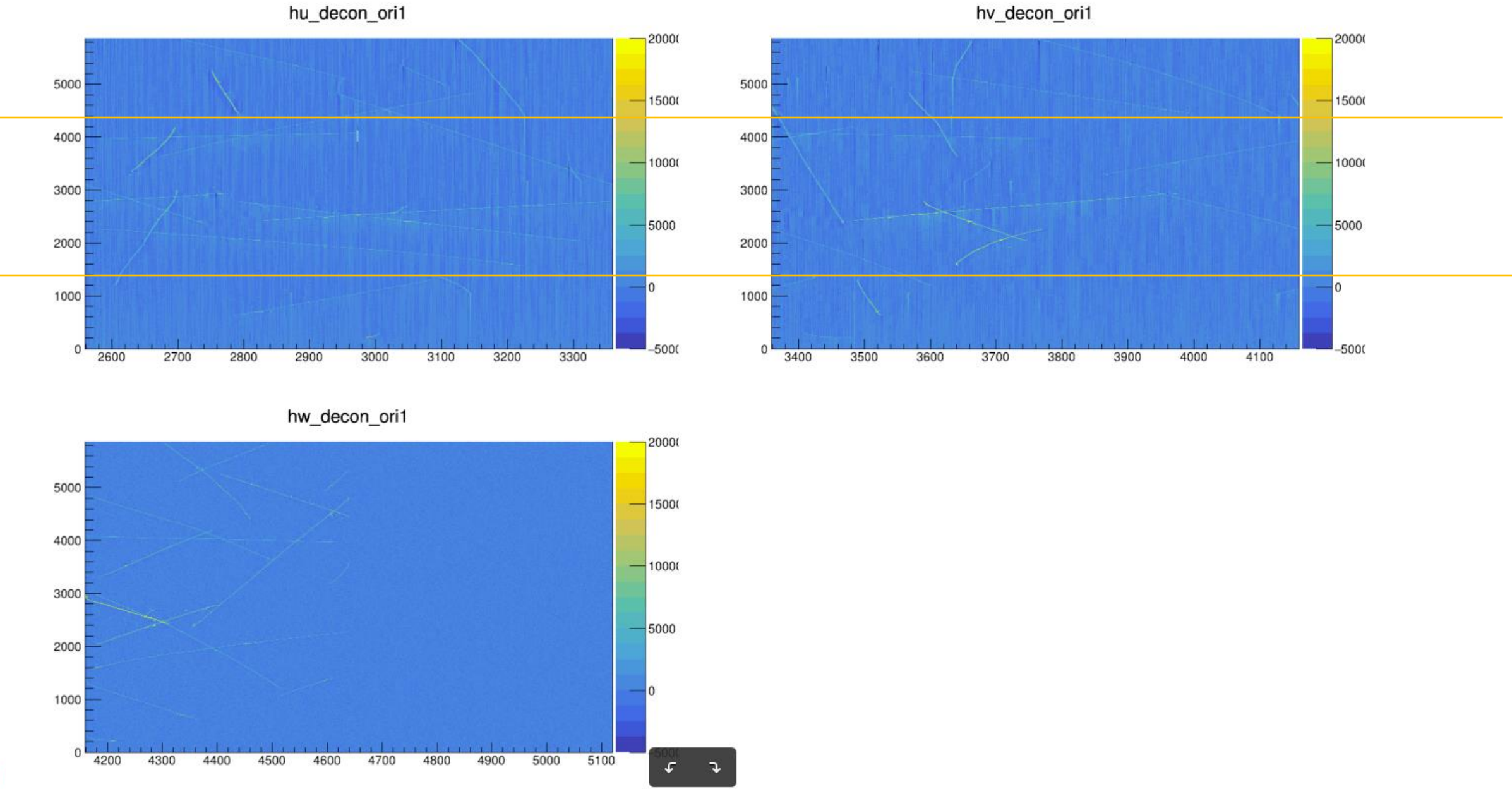

magnify-28548-456822-3.png