Status report on

DNNROI sigproc & wirecell-dnn

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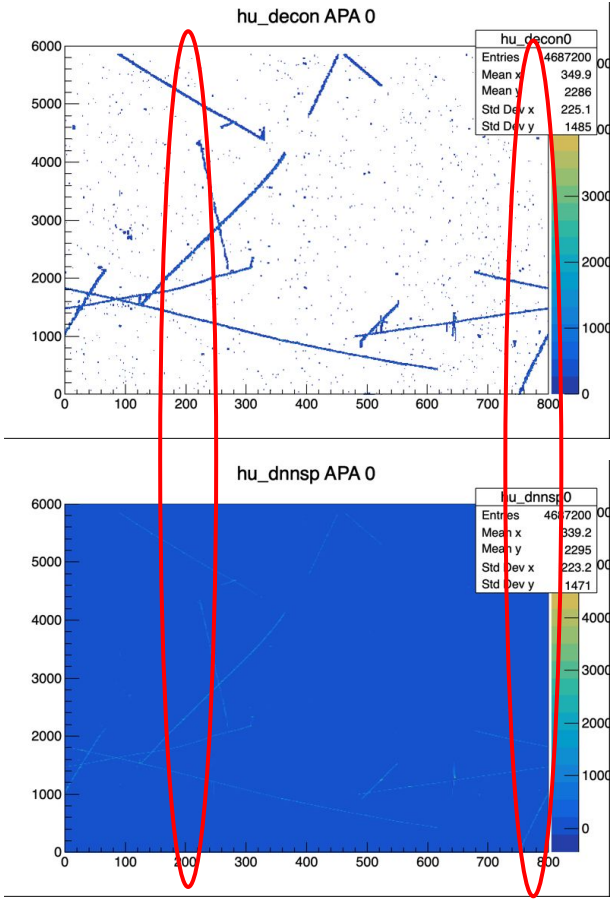
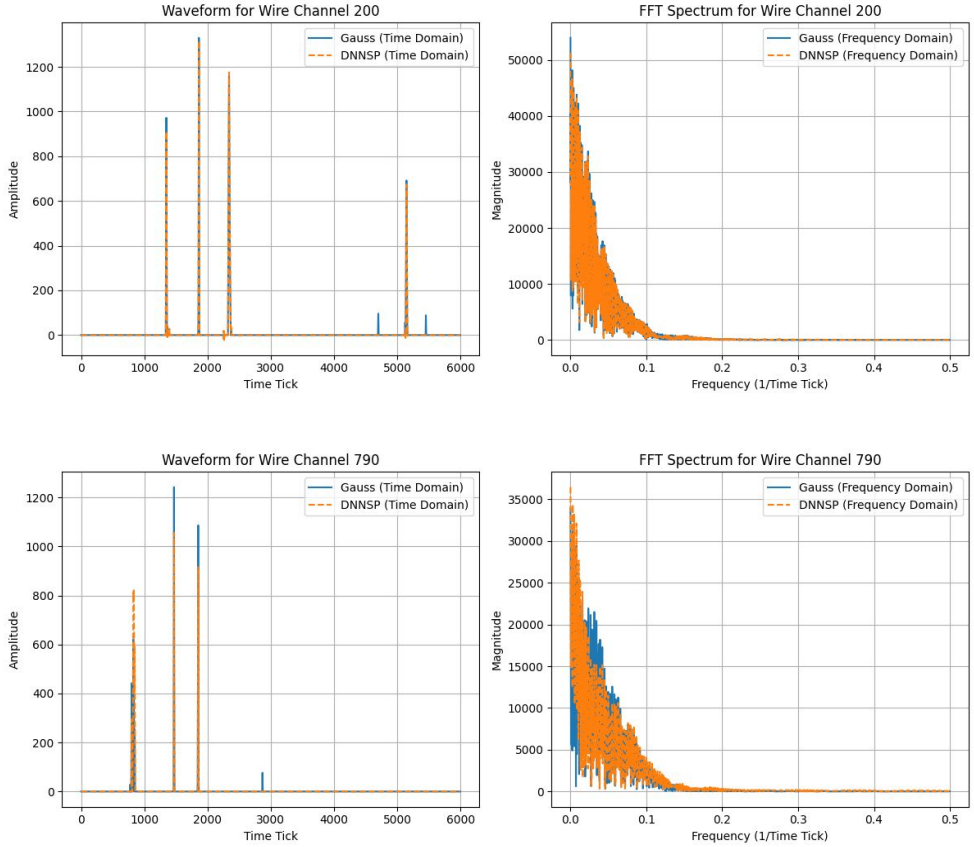
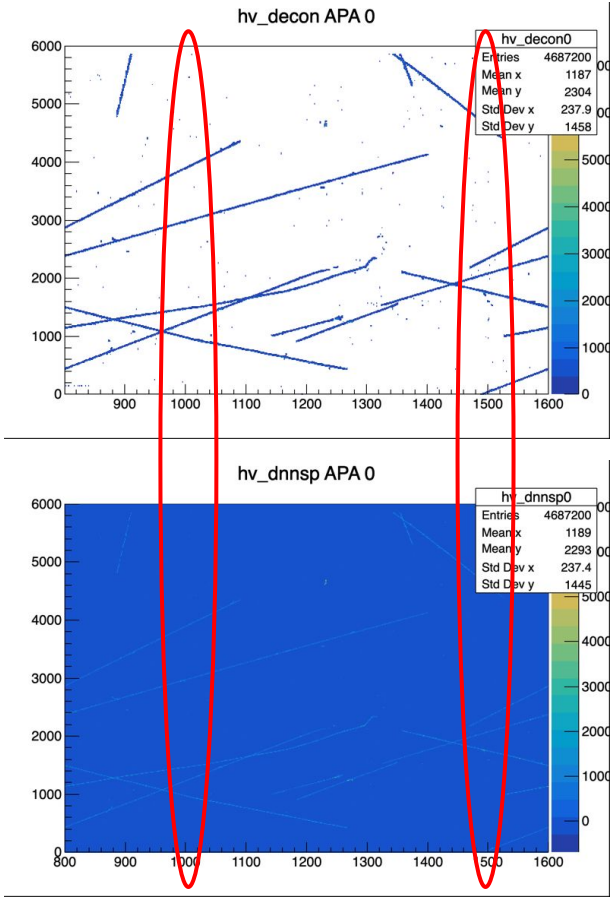
DNNROI SP - PDHD data

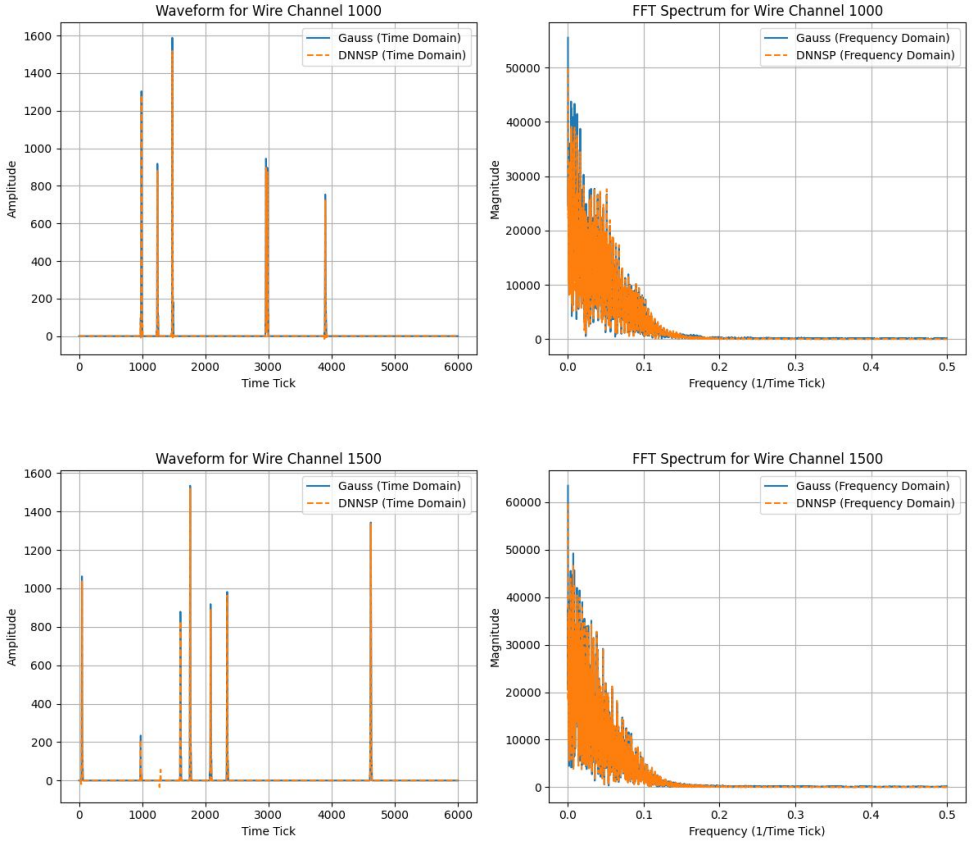




- APA0 - u plane
- 1d wave form in time domain v.s. frequency domain

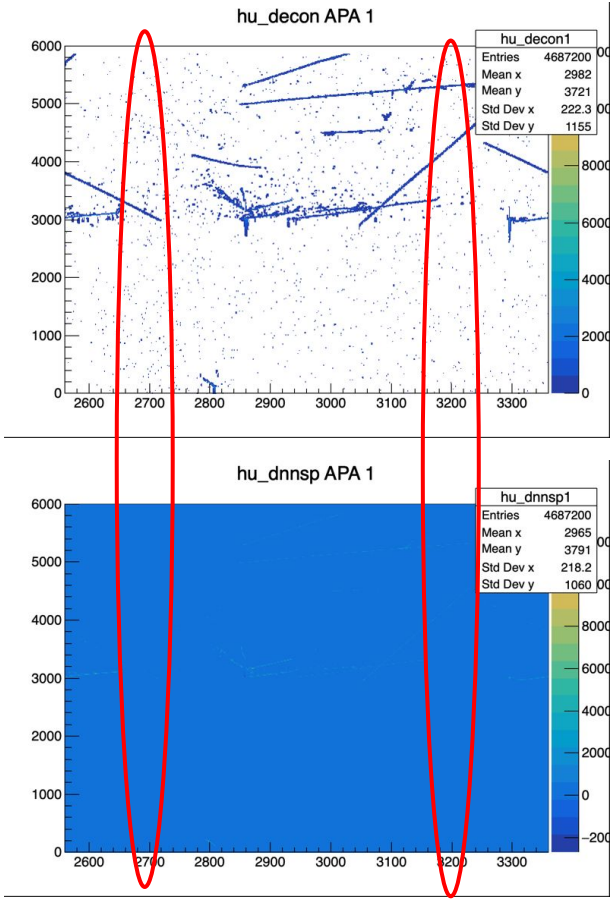
DNNROI SP - PDHD data

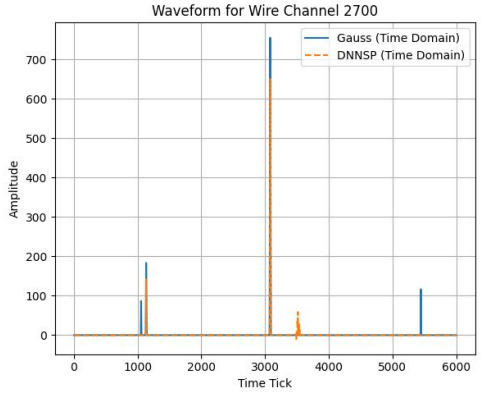


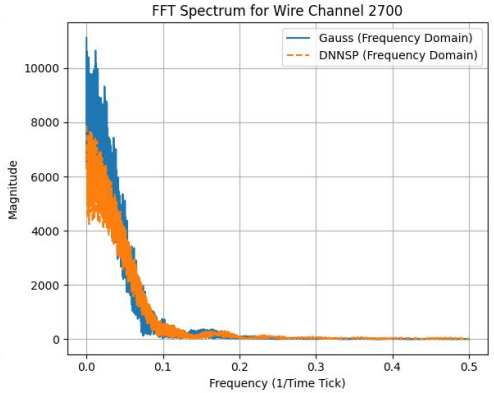


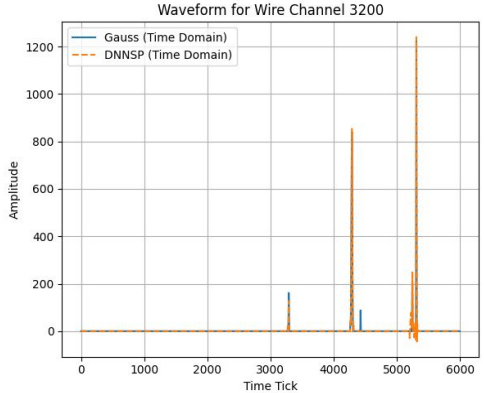
- APA0 - v plane
- 1d wave form in time domain v.s. frequency domain

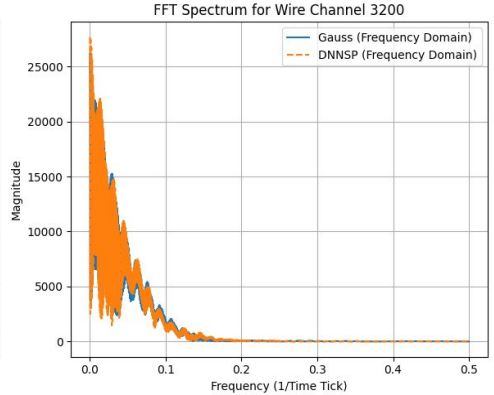
DNNROI SP - PDHD data





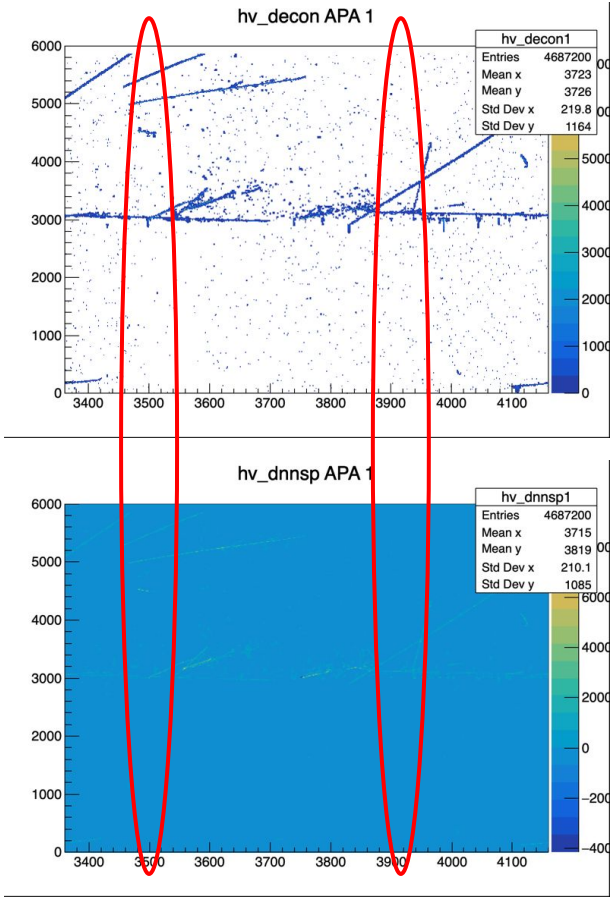


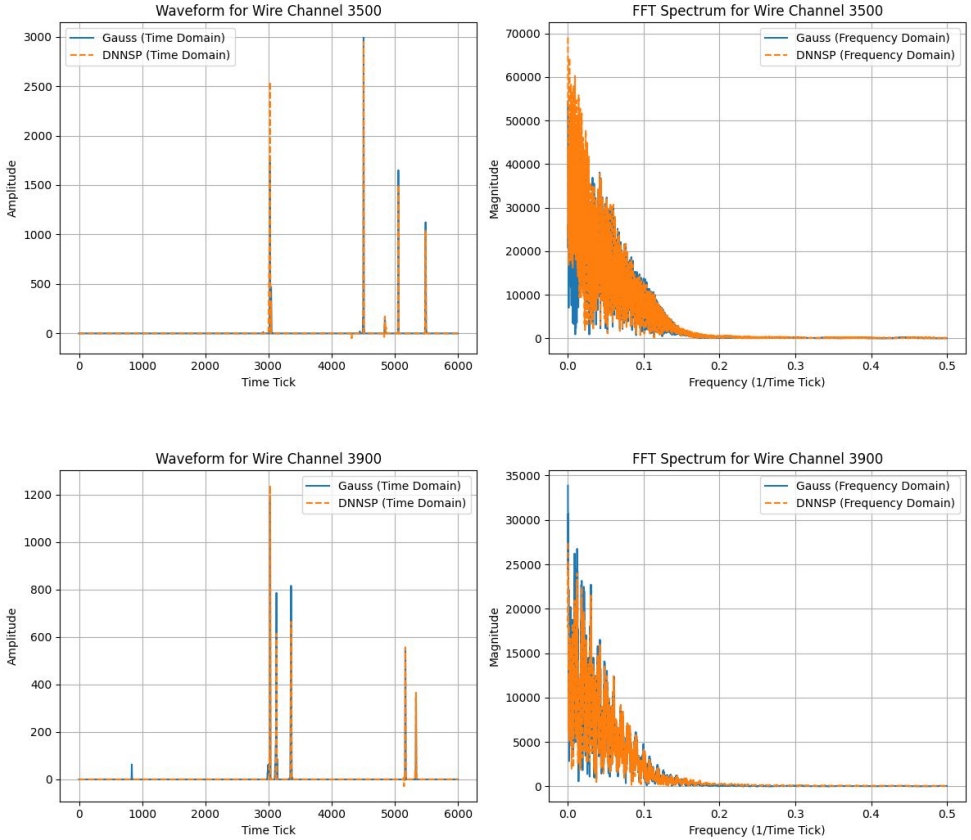




- APA1 - u plane
- 1d wave form in time domain v.s. frequency domain

DNNROI SP - PDHD data





- APA1 - v plane
- 1d wave form in time domain v.s. frequency domain

Summary & Plan

- The remaining issues on WCT standalone simulation w/ dnnroi are in investigating

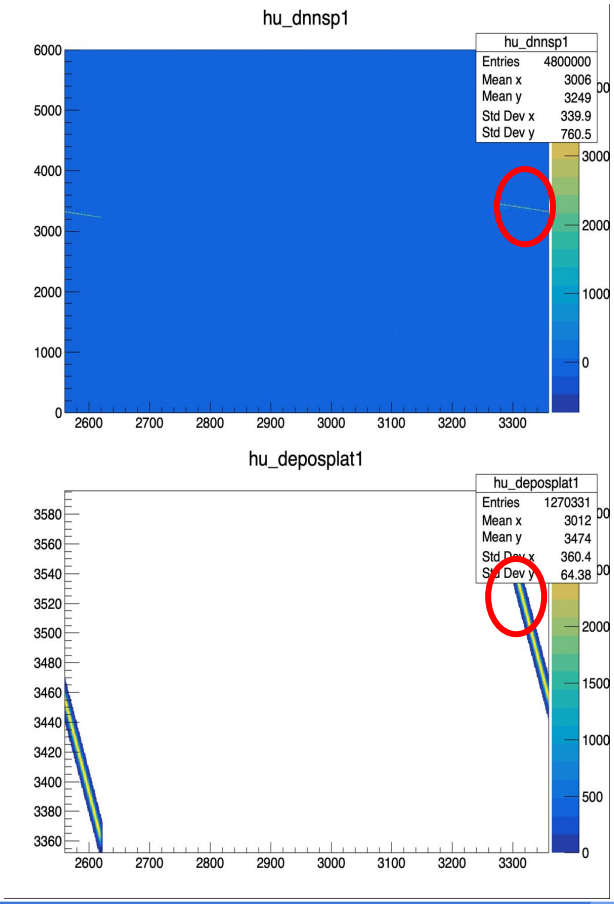
- Compared the dnnsp to traditional sp within 1D waveform in time domain v.s. frequency domain
  - PDHD data - DONE
  - WCT standalone simulation data - W.I.P

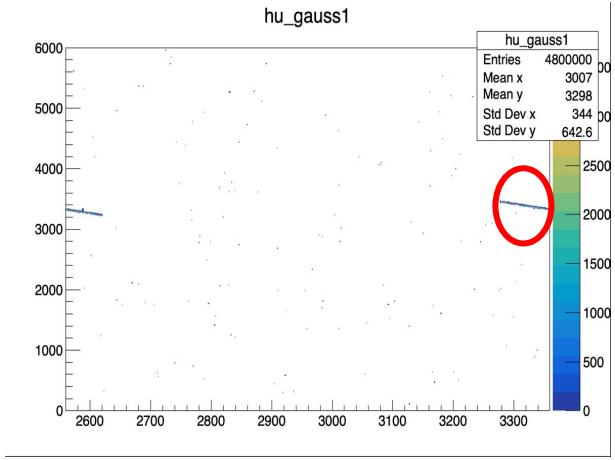
- Next steps for DNNROI SP:
  - Add After NF waveform to the PDHD data plots
  - Evaluate the performance of dnnroi with different angles (theta_XZ)
  - Measure the computing resources and time consumption during the dnnroi more specifically

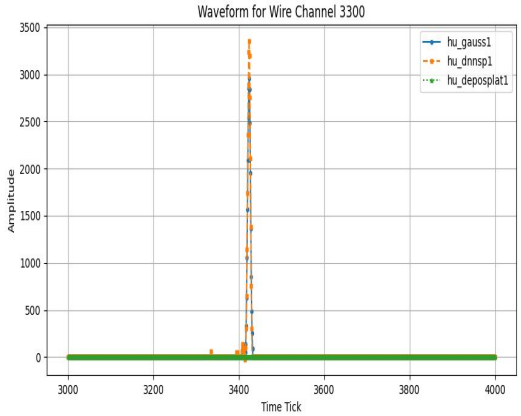
- Next steps for wirecell-dnn validation:
  - Check model structures and loss between Pytorch-UNet & wirecell-dnn

Back Up

DNNROI SP - WCT standalone simulation

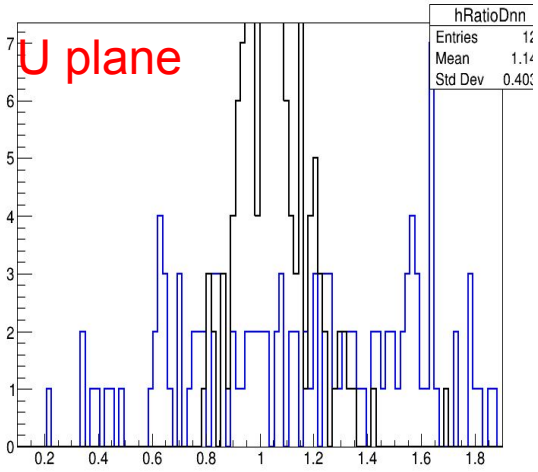


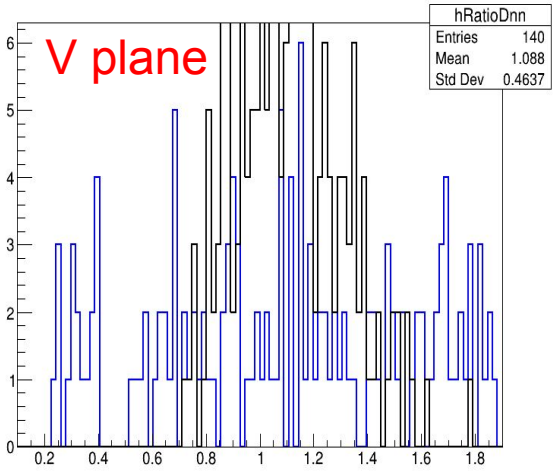




- We can access truth information (deposplat)
- Some errors in 1D waveform plotting code

DNNROI SP - WCT standalone simulation - evaluation






```
=== Bias
Gau bias (%): 5.50951
Dnn bias (%): 14.9479
=== Resolution
Gau RMS (%): 12.4873
Dnn RMS (%): 35.1132
=== Inefficiency
ntru: 143, bad ndnn: 19, bad ngau: 0
```

U plane

```
=== Bias
Gau bias (%): 11.2275
Dnn bias (%): 8.77239
=== Resolution
Gau RMS (%): 17.5455
Dnn RMS (%): 42.6279
=== Inefficiency
ntru: 192, bad ndnn: 52, bad ngau: 0
```

V plane

❖ Charge ratio

$$\text{Bias}_{\text{method}} = 100 \times (\text{Mean}(Charge_{\text{method}}/Charge_{\text{truth}}) - 1.0)$$

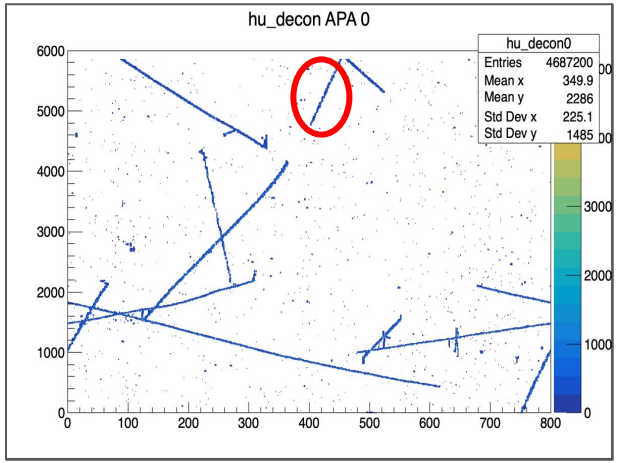
$$\text{Resolution} = 100 \times \frac{\text{RMS}(Charge_{method}/Charge_{truth})}{\text{Mean}(Charge_{method}/Charge_{truth})}$$

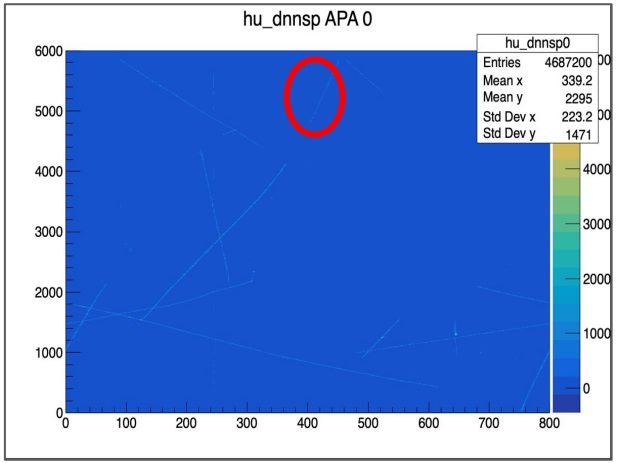
❖ Evaluation

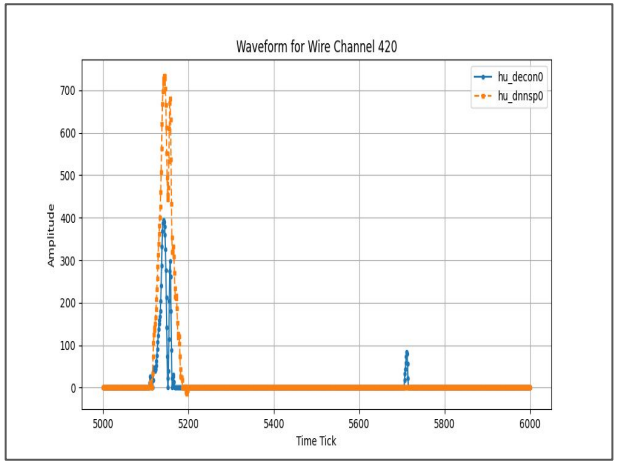
$$\text{hRatioGau} = \frac{\text{Charge}_{\text{Gaussian}}}{\text{Charge}_{\text{Truth}}}$$

$$\text{hRatioDnn} = \frac{\text{Charge}_{\text{DNN}}}{\text{Charge}_{\text{Truth}}}$$

DNNROI SP - PDHD data

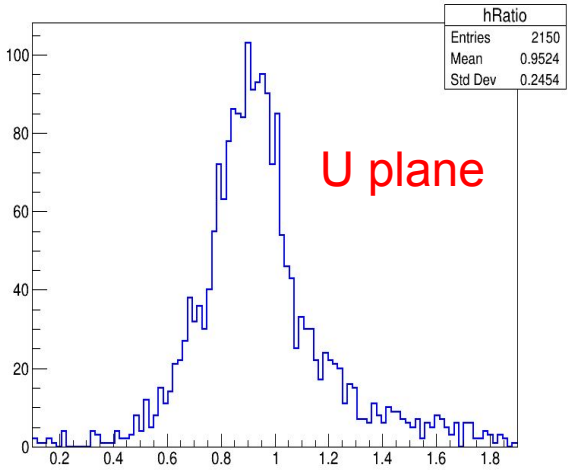


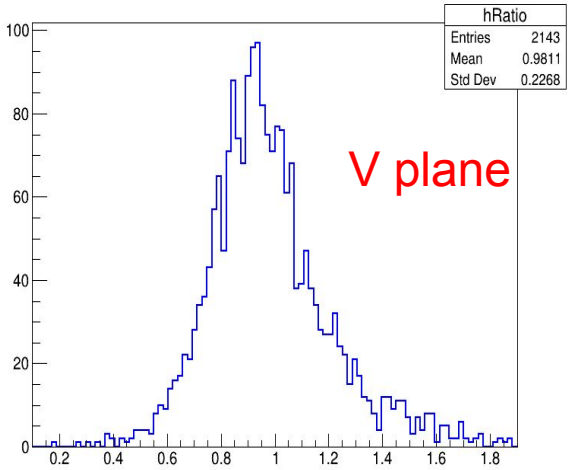




- PDHD data: /exp/dune/app/users/jjo/pdhd_imaging/np04_data/np04hd_raw_run026763_0008_dataflow0_datawriter_0_20240607T071013.hdf5

DNNROI SP - PDHD data - evaluation






```
=== Bias ===
DNN bias (%): -4.75702
=== Resolution ===
DNN RMS (%): 25.7666
=== Inefficiency ===
Total comparisons: 2311, Bad DNN: 161
DNN inefficiency (%): 6.96668 +/- 0.529581
```

U plane

```
=== Bias ===
DNN bias (%): -1.89038
=== Resolution ===
DNN RMS (%): 23.1194
=== Inefficiency ===
Total comparisons: 2353, Bad DNN: 210
DNN inefficiency (%): 8.92478 +/- 0.587744
```

V plane

❖ Charge ratio

$$\text{Bias}_{\text{DNN}} = 100 \times (\text{Mean}(Charge_{\text{DNN}}/Charge_{\text{Gaussian}}) - 1.0)$$

$$\text{Resolution} = 100 \times \frac{\text{RMS}(Charge_{DNN}/Charge_{Gaussian})}{\text{Mean}(Charge_{DNN}/Charge_{Gaussian})}$$

❖ Evaluation

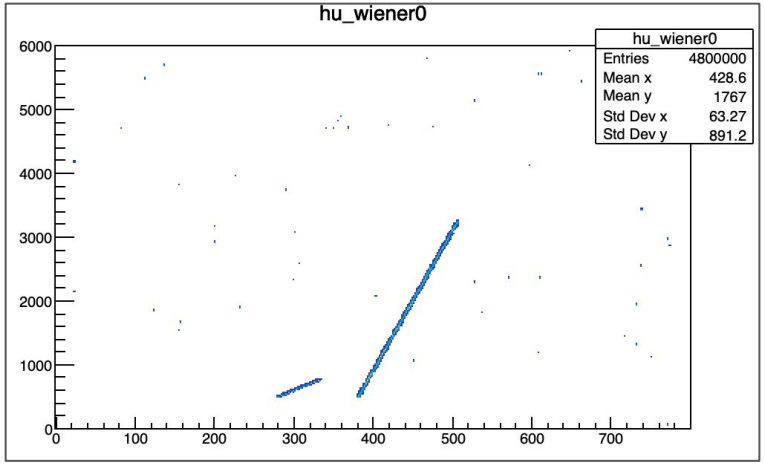
$$\text{Inefficiency} = 100 \times \frac{\text{Bad Count}}{\text{Total Count}}$$

$$\text{hRatio} = \frac{\text{Charge}_{\text{DNN}}}{\text{Charge}_{\text{Gaussian}}}$$

DNNROI SP - WCT standalone simulation - issues

```
local sp = g.pnode({
    type: 'DepoFluxSplat',
    name: sufix,
    data: {
        anode: wc.tn(anode),
        field_response: wc.tn(tools.field), // for speed and origin
        sparse: true,
        tick: params.daq.tick,
        window_start: params.sim.ductor.start_time,
        window_duration: params.sim.ductor.readout_time,
        reference_time: 0.0,
        process_planes: [0,1,2],
        // Run wirecell-gen morse-* to find these numbers that match the extra
        // spread the sigproc induces.
        "smear_long": [
            2.691862363980221,
            2.6750200122535057,
            2.7137567141154055
        ],
        "smear_tran": [
            0.7377218875719689,
            0.7157764520393882,
            0.13980698710556544
        ]
    },
}, nin=1, nout=1, uses=[anode, tools.field]),
```

❖ Edited funcs.jsonnet



❖ Two tracks on u plane

- Running WCT with “wct-sim-drift-deposplat.jsonnet” had solved issues as follows:
  - Out Of Memory (on gpvm) → Solved (unique trace problem)
  - Missing truth information → Partially solved (add sparse, process_planes on funcs.jsonnet)
- Remaining issues
  - Wrong channels and time ticks in truth hdf5 files →
  - Track cfg → One track is set at cfg file, but generates 2 tracks

```
❯ h5ls g4-tru-1.h5/0
channels_deposplat1      Dataset {156035}
frame_deposplat1         Dataset {156035, 244}
tickinfo_deposplat1      Dataset {3}
```

❖ Wrong channels & ticks