Status report on

DNNROI sigproc

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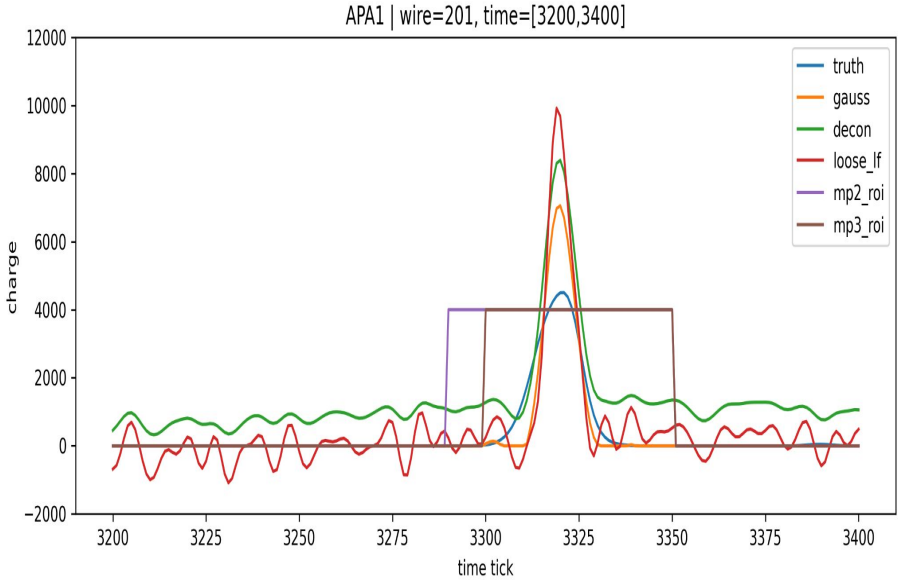
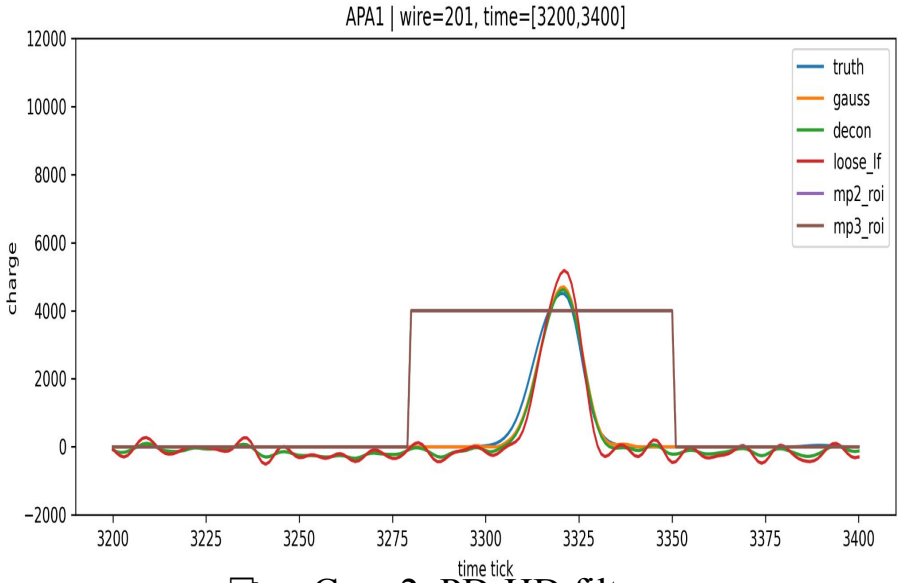
Software Filter Study



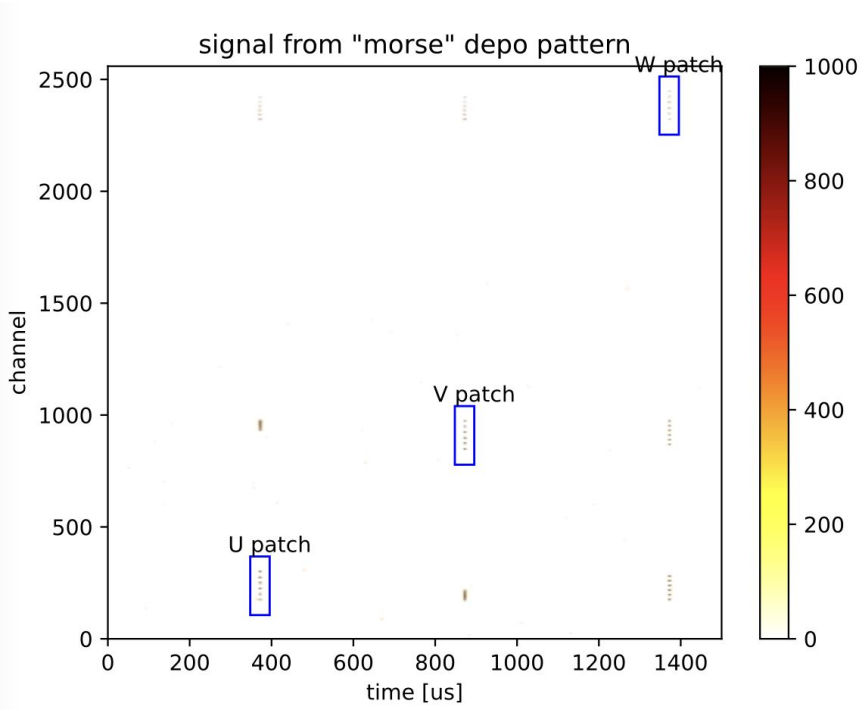
❑ Case 1. PD-VD filter

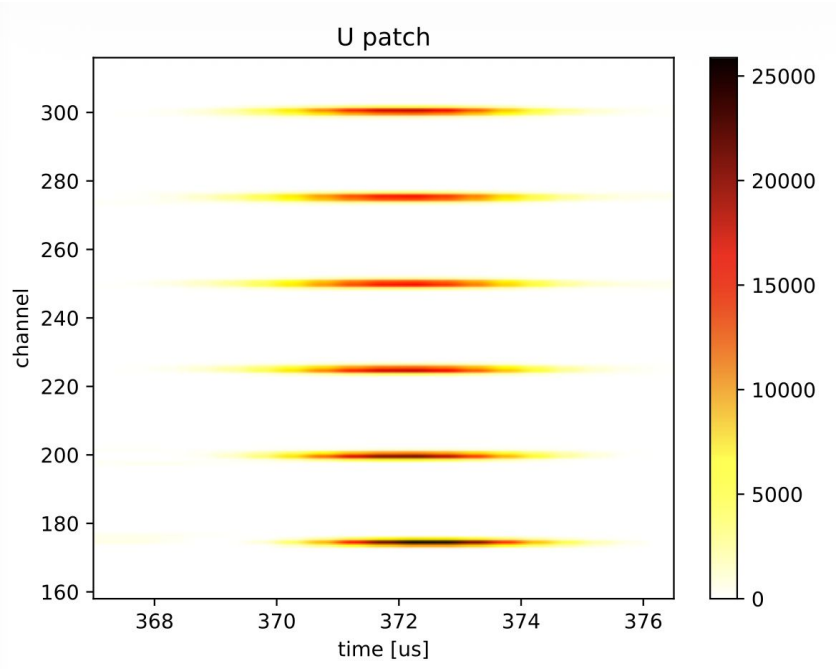


❑ Case 2. PD-HD filter

- Decon waveform seems to be affected by changes of Wiener filter parameters which is weird
- Haiwang and I am investigating this

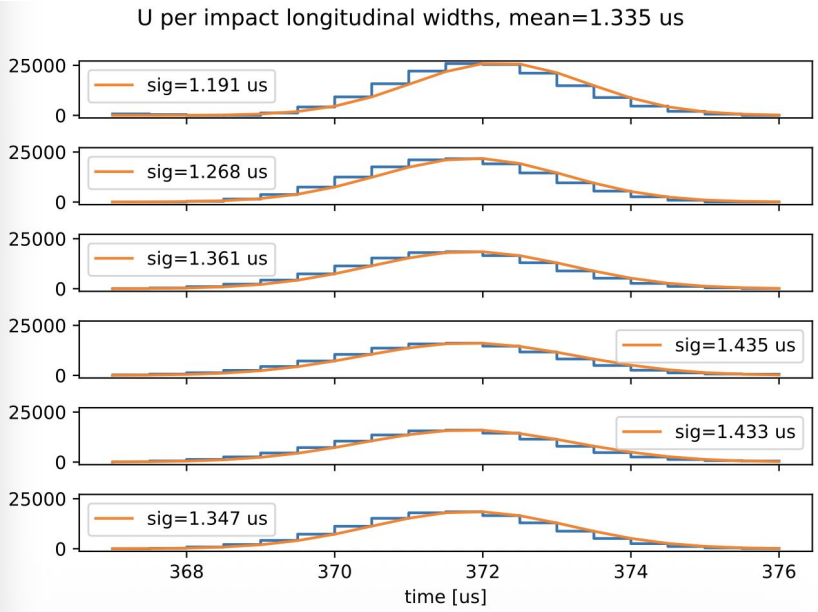
Truth Smearing Study

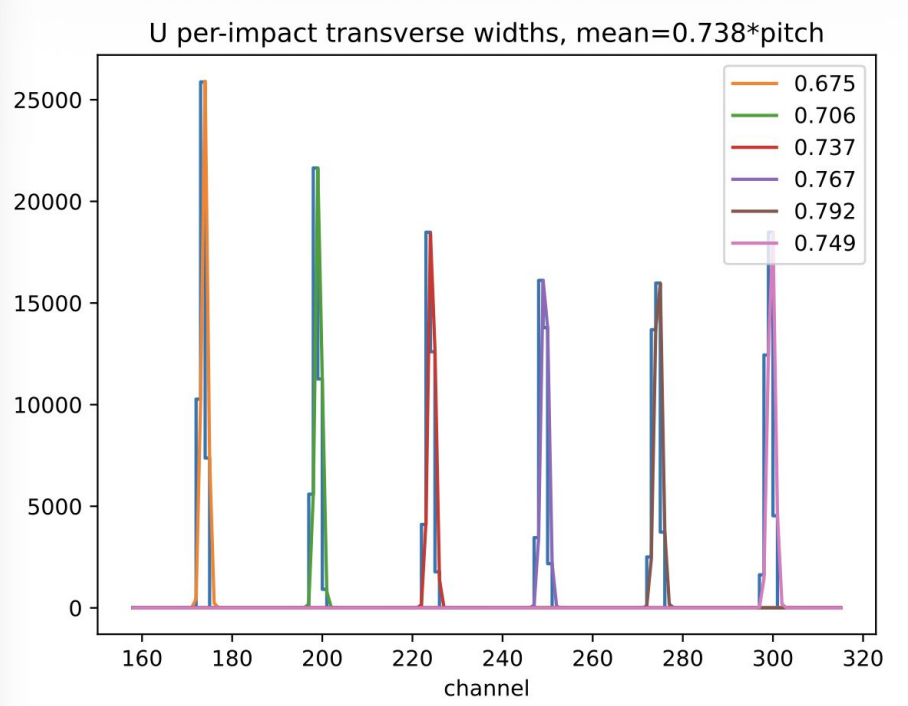




- Reproduced Brett's result on dunegpvms
- Currently, the configuration for PDSP and MicroBooNE is availalbe

Truth Smearing Study





- Obtained truth smearing parameters, (For U plane, Transverse: 0.738, Longitudinal: 1.335)

Truth Smearing Study

```
local wc = import 'wirecell.jsonnet';
{

    wires_file: 'protodune-wires-larsoft-v4.json.bz2',

    // distance between collection wire plane and a plane.
    xplanes: {
        danode: 10.0 * wc.mm,
        dresponse: 100.0 * wc.mm,
        dcathode: 1000.0 * wc.mm,
    },
    local xplanes = self.xplanes,  // to make available below

    volumes: [

        {
            wires: 0,
            xcenter: -3636.9 * wc.mm,  // absolute center of APA
            local xcenter = self.xcenter,  // to make available below.
            faces: [

                {
                    local dcollection = 52.3 * wc.mm,
                    anode: xcenter + (xplanes.danode + dcollection),
                    response: xcenter + (xplanes.dresponse + dcollection),
                    cathode: xcenter + (xplanes.dcathode + dcollection),
                },

                {
                    local dcollection = 52.3 * wc.mm,
                    anode: xcenter - (xplanes.danode + dcollection),
                    response: xcenter - (xplanes.dresponse + dcollection),
                    cathode: xcenter - (xplanes.dcathode + dcollection),
                },

            ],
        },
```

❑ geometry.jsonnet for PDSP

- cfg files for the morse test is in wire-cell-toolkit/cfg/layers
- Working on converting cfg files for PDVD
- Switched wires_file to protodunevd-wires-larsoft-v3.json.bz2

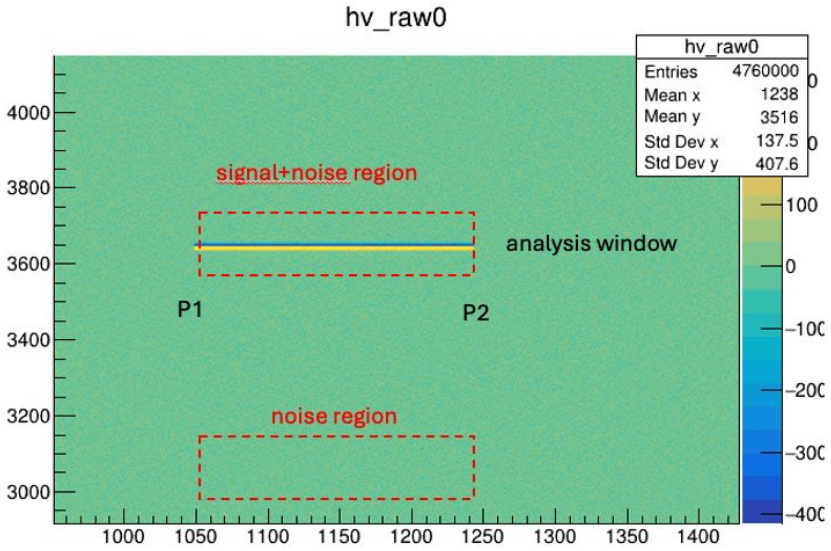
```
"xregions": [
    {
        "anode": -3358.3499999999999,
        "cathode": -25.400000000000091,
        "response": -3191.6374999999998
    },
    {
        "anode": 3358.3499999999999,
        "cathode": 25.400000000000091,
        "response": 3191.6374999999998
    }
```

- Extracted parameters from current PDVD configurations

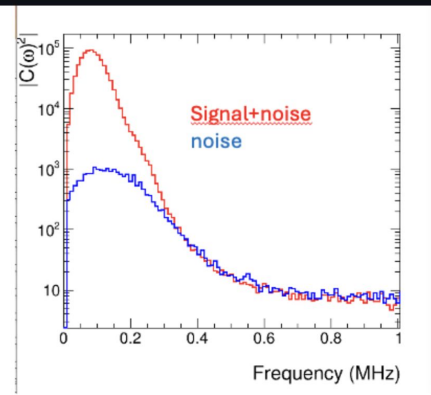
Back Up

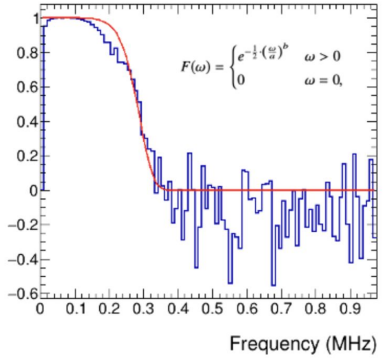
Software Filter Optimization

- There is a tool to get the optimized sigma and power for the HfFilter
  - https://github.com/WireCell/wire-cell-toolkit/blob/feature/xn_WF_fitter_script/root/test/calcFilter.C
  - https://github.com/WireCell/wire-cell-toolkit/blob/feature/xn_WF_fitter_script/root/docs/calcFilter.org
- Isochronous track sample is needed



1. **c1**: Power spectral density comparison
   - Red: Signal + noise power density
   - Blue: Noise-only power density
2. **c2**: Wiener filter response
   - Normalized to maximum value of 1
   - Fitted with function: `exp(-0.5*(x/p0)^p1)`
   - Fit parameters printed to console

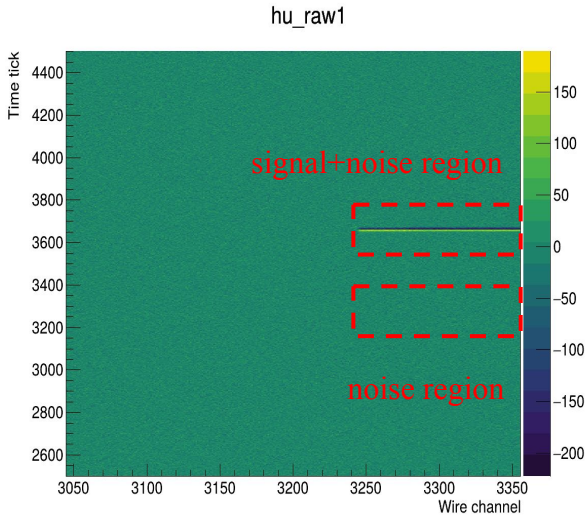




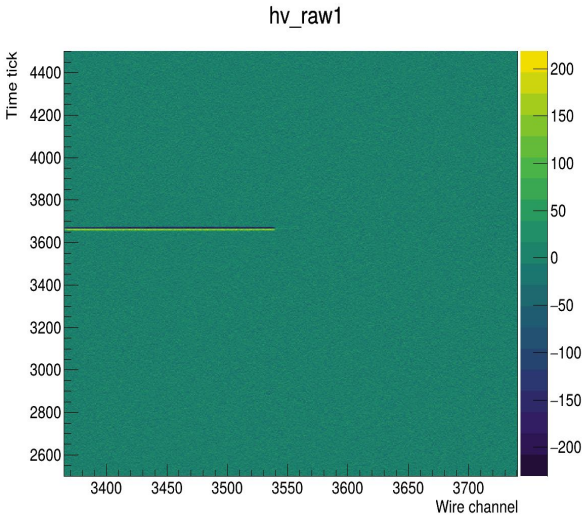

```
EXT PARAMETER                                   STEP         FIRST
NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
 1  p0           2.69885e-01   3.74802e-02   2.98269e-05   3.55623e-02
 2  p1           8.34938e+00   6.86118e+00   5.42952e-03  -2.51530e-04
```

Software Filter Study

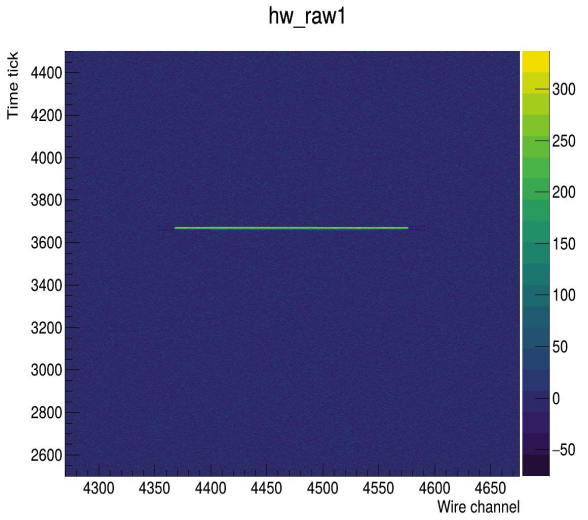
- Confirming the method to get parameters is correct



p0 = 0.168801
p1 = 3.11267



p0 = 0.18197
p1 = 5.35323

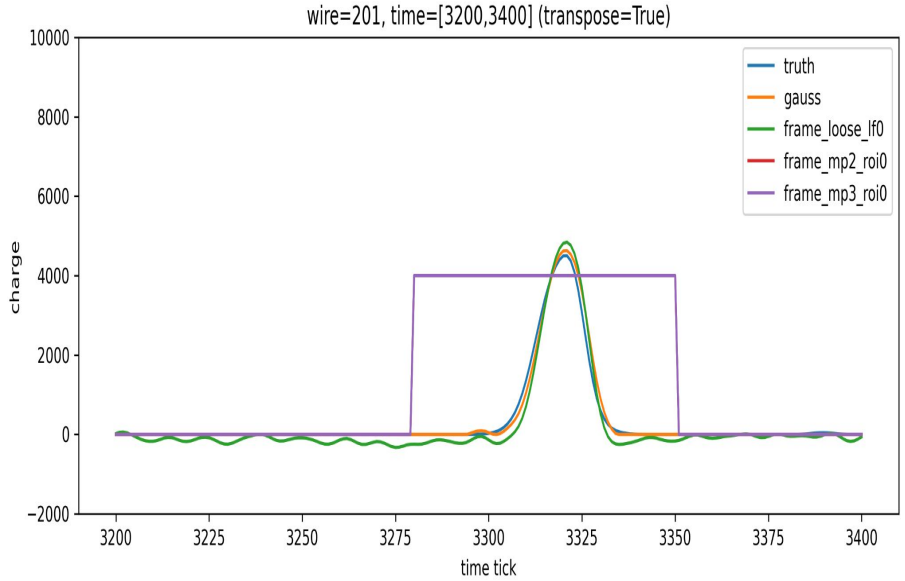


p0 = 0.155818
p1 = 2.73558

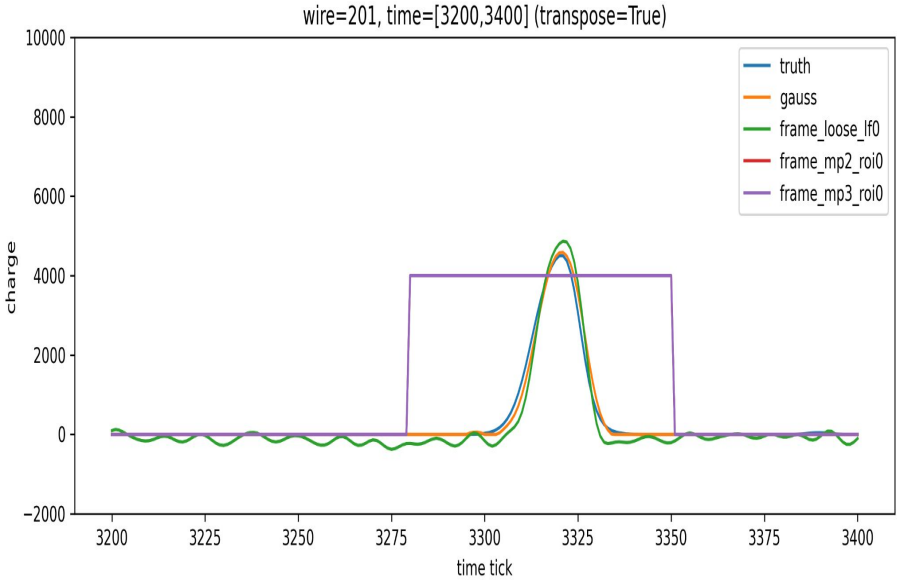
- The fitted parameters are different from PD-HD HfFilter we used

Software Filter Study

- Even though the fitted parameters are different, the waveform is well aligned



❑ Case 1. My parameters

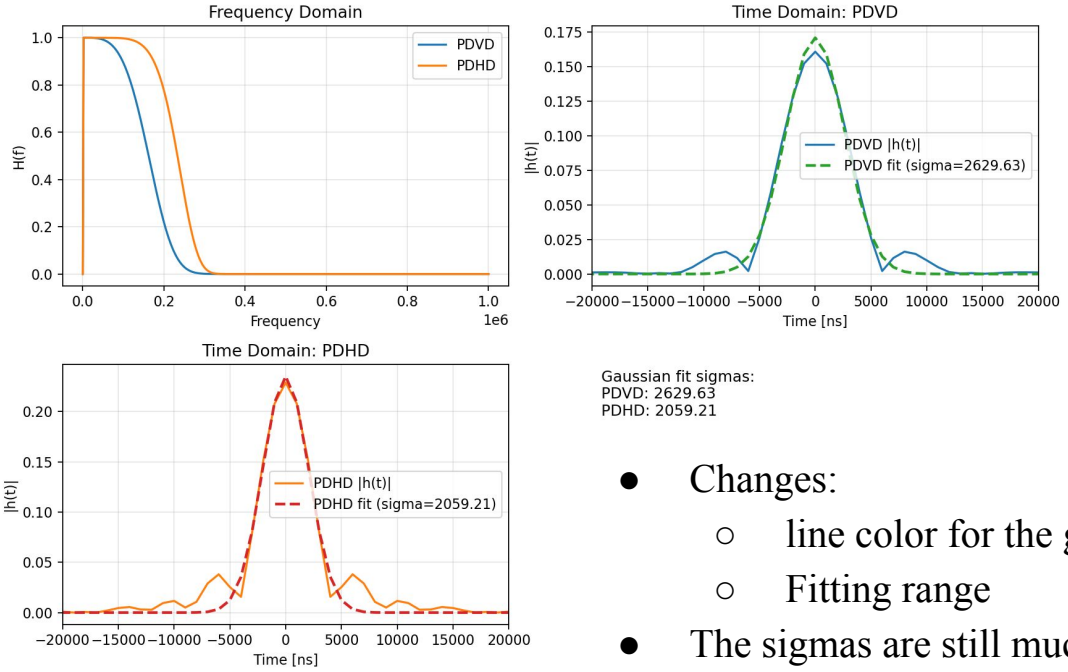


❑ Case 2. Wenqiang's parameters

```
[OmnibusSigProc][filter-params] stage=runtime_hf filter=Wiener_tight_U sigma=0.000168801 power=3.11267 flag=1 max_freq=0.001
```

Truth Smearing Study

- Frequency domain Wiener filter → IFFT → Time domain signals → Gaussian fit

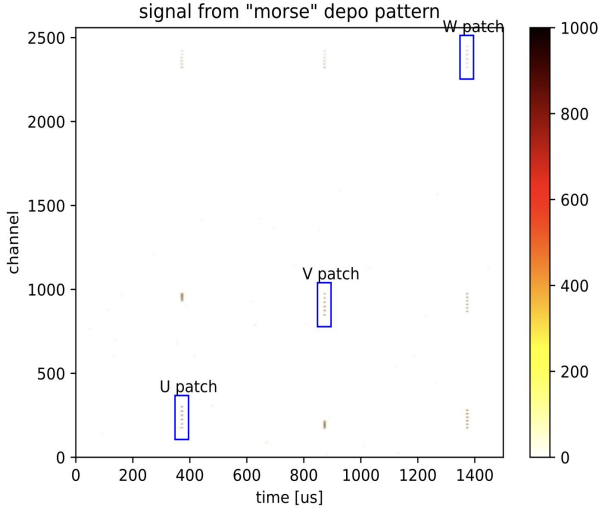


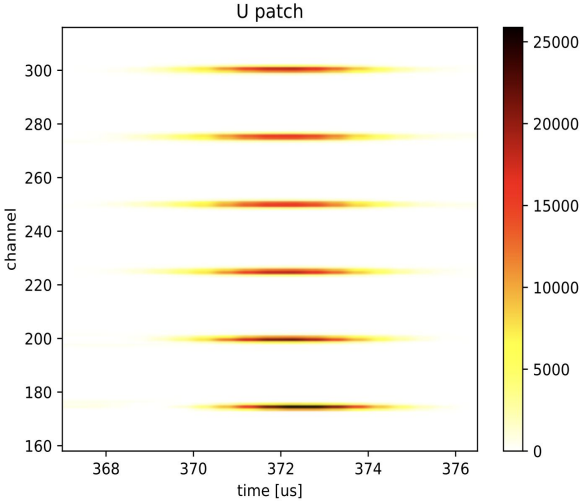
Gaussian fit sigmas:
PDVD: 2629.63
PDHD: 2059.21

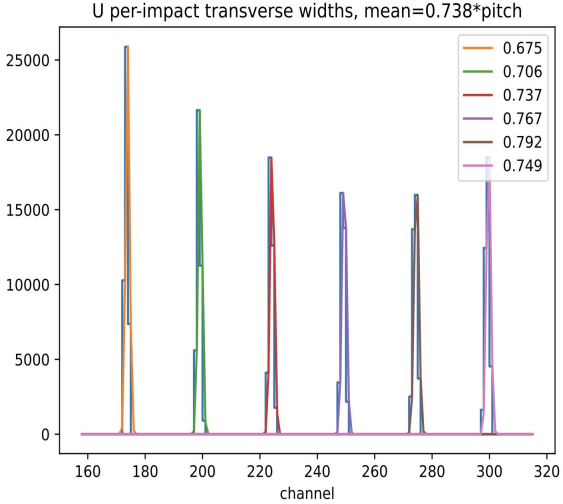
- Changes:
  - line color for the gauss fit to prevent misreading
  - Fitting range
- The sigmas are still much larger than the parameter used in the cfg
- Currently studying Brett's morse test tool to make it work for PD-VD

Truth Smearing - Approach 1

- Morse test tool provided by Brett
  - https://github.com/WireCell/wire-cell-toolkit/blob/master/test/scripts/bats-debug
  - https://github.com/WireCell/wire-cell-toolkit/blob/master/test/test/test-morse-pdsp.bats







- The tool is not fully ready for PD-VD
- Would be precise, but need to understand how to use

Future tasks

- Memory check
  - Is the high peak at the last really due to the APA1?
  - Tag Selector test and validation
  - Remove the unneeded datasets from the HDF5 and check the file size
- Comments from the 2026 DUNE CM @ CERN
  - Jake: noise level (PDHD vs PDVD)
  - Xin: generalize the model, train the model with loose_lf only → performance

- PD-VD sample production
  - PD-HD wiener filter optimization -> check consistency
  - Add decon waveform and remove mp2_roi, improve visibility
  - cout lines added to OmnibusSigProc.cc and results to ensure the filter params are set correctly
  - Current sim is only using Bottom? Top? electronics response
  - HDF5 compression issue.., needed to be tested with recent version? or check params..
  - Pick up a similar track from the real data and see the noise level and waveform