Status report on

DNNROI sigproc

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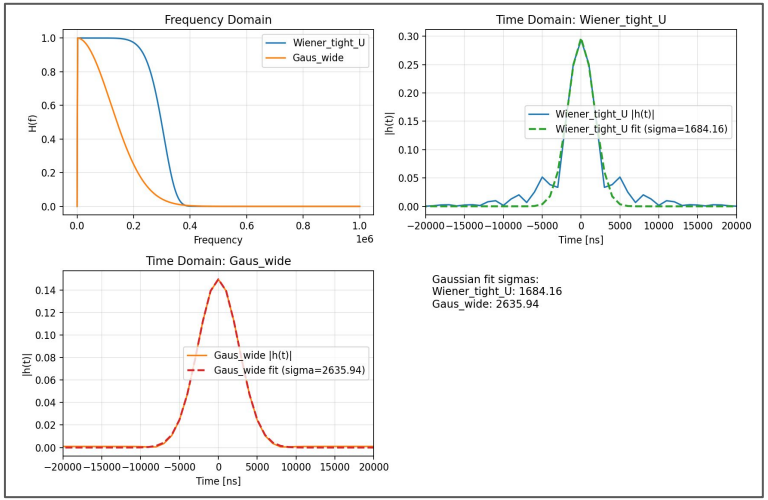
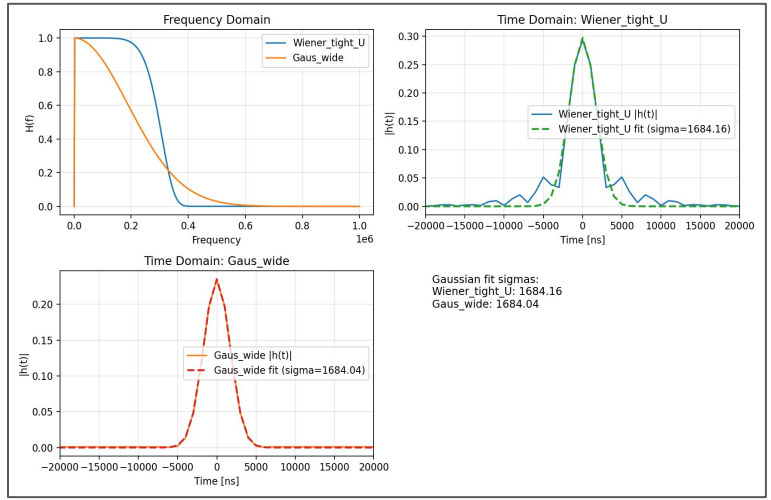
Gaus Filter and Truth Smearing Optimization



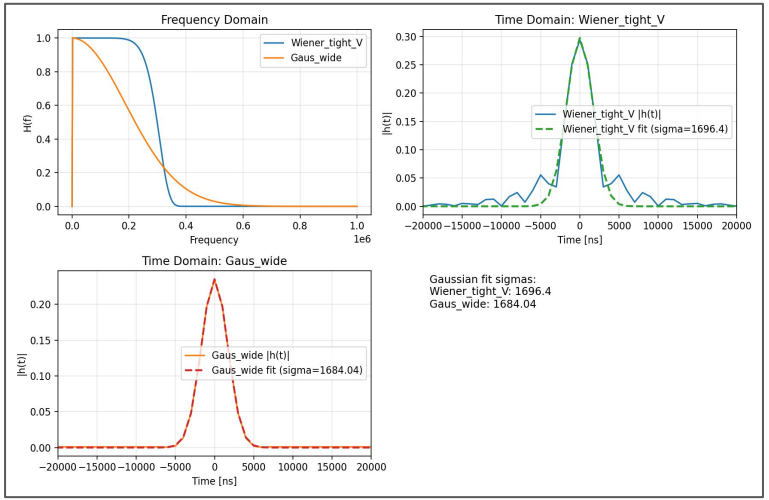
❏ PD-HD's Gaus_wide vs. PD-VD's Wiener U



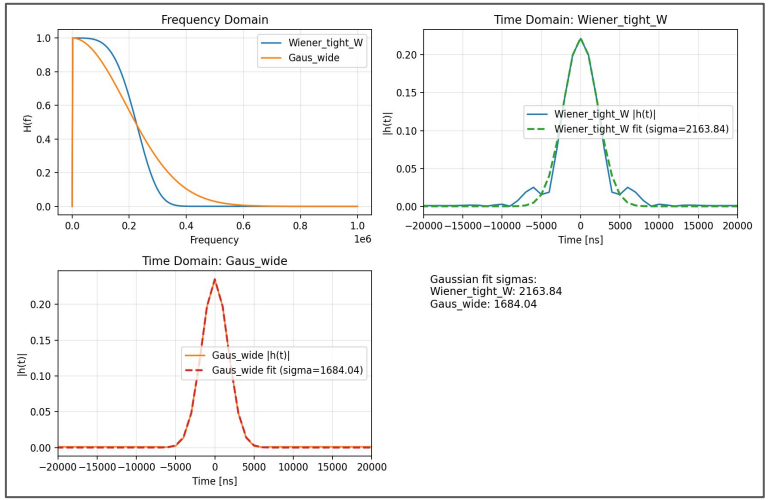
❏ PD-VD's Gaus_wide vs. PD-VD's Wiener U

- Gaussian fit for PD-VD optimized Wiener filter gives a sigma of 1684.16
- The PD-HD's Gaus Filter in time domain is wider (left)
- After updating parameter for Gaus_wide, the fitted sigma is matched
- The fitted sigma for Wiener_tight is used as a parameter for truth smearing (smear_long_U)

Gaus Filter and Truth Smearing Optimization



❑ PD-VD's Gaus_wide vs. PD-VD's Wiener V



❑ PD-VD's Gaus_wide vs. PD-VD's Wiener W

- The single Gaus_wide filter is used for all three wire planes in the current setting
- For U and V planes, the optimized Gaus_wide filter is well aligned in terms of the sigma
- For W plane, Wiener_tight_W is wider than Gauss

Optimized Parameters in Summary

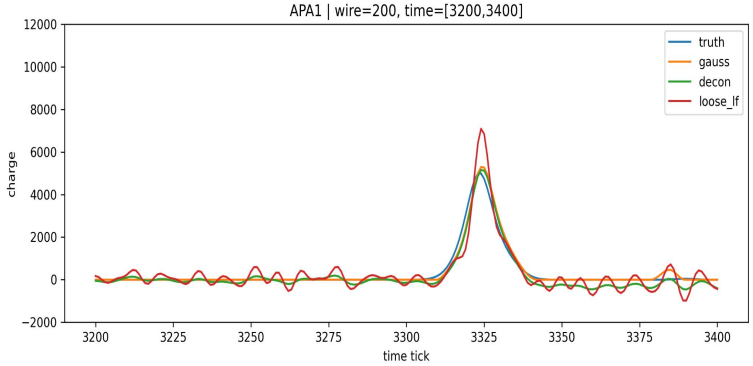
Detector/Filter	Wiener_tight_U	Wiener_tight_V	Wiener_tight_W	Gaus_wide	Wire_ind
PD-SP	Sigma: 0.148788 Power: 3.76194	Sigma: 0.1596568 Power: 4.36125	Sigma: 0.13623 Power: 3.35324	Sigma: 0.12	Sigma: ~* 5.0
PD-HD	Sigma: 0.221933 Power: 6.55413	Sigma: 0.222723 Power: 8.75998	Sigma: 0.225567 Power: 3.47846	Sigma: 0.12	Sigma: ~* 0.75
PD-VD	Sigma: 0.286735 Power: 8.07074	Sigma: 0.289041 Power: 9.94129	Sigma: 0.207127 Power: 4.13956	Sigma: 0.188	Sigma: ~*0.75

❑ Parameters in sp-filters.jsonnet

Detector/Smear	smear_long_U	smear_long_V	smear_long_W	smear_tran_U	smear_tran_V	smear_tran_W
PD-HD	2.691862..	2.675020..	2.713756..	0.737721..	0.715776..	0.139806..
PD-VD	1.68416	1.6964	2.16384	0.737721..	0.715776..	0.139806..

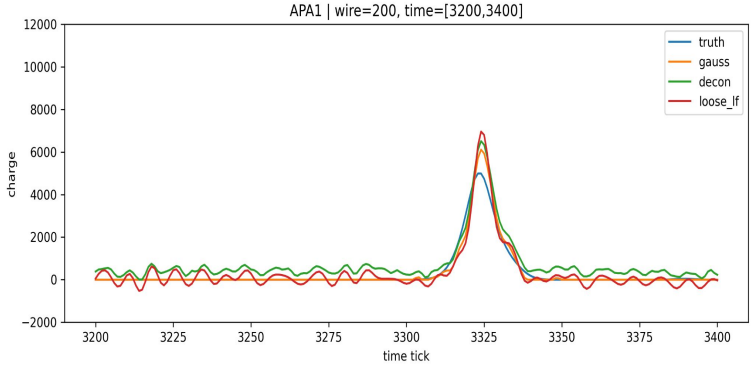
❑ Parameters in funcs.jsonnet

1D Waveform Study



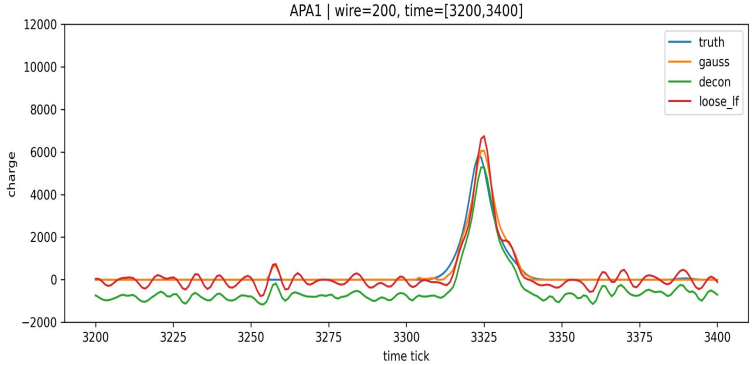
❑ PD-HD's Gaus_wide and truth smearing

update Gaus_wide



❑ PD-HD's truth smearing and PD-VD's Gaus_wide

update smear_long



❑ PD-VD's Gaus_wide and truth smearing

- The PD-VD's Wiener filter is default for this test

Sample Production Test

- Simulation is based on the PD-VD's Bottom Electronics only (CRP 1-2 = CRU 1-4)

- Storage required: ~140 GB
  - File size per single CRU: ~ 70 MB
  - Goal: 2000 CRUs (CRU 1: 500, CRU 2: 500, CRU 3: 500, CRU 4: 500)

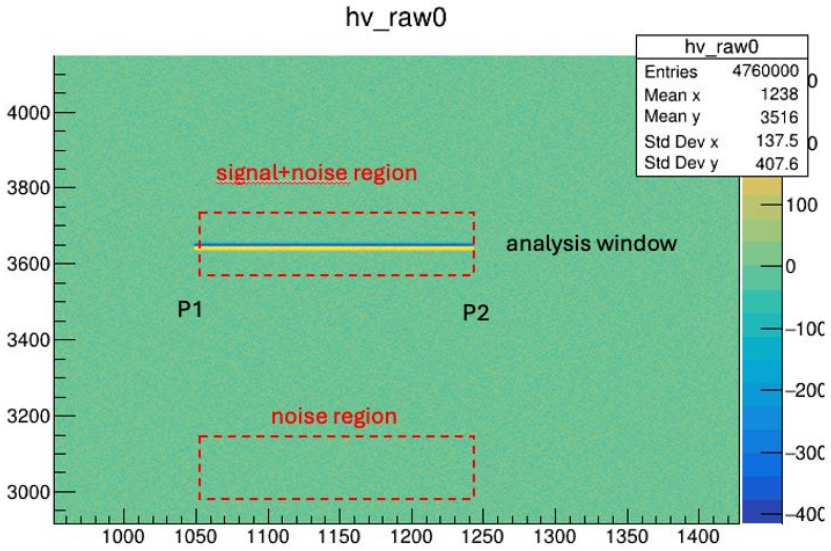
- Test is done on the dunegpvm07:
  - events per file (-n option) are limited to 3 due to the lack of memory
  - took around 10 minutes for single run (12 CRUs = 3 events * 4 CRUs)
  - estimated time for the full production is about 28 hours or more
  - lack of storage forces to use scratch directory: /pnfs/dune/scratch/users/$USER

- Plan to test on the WCWC cluster

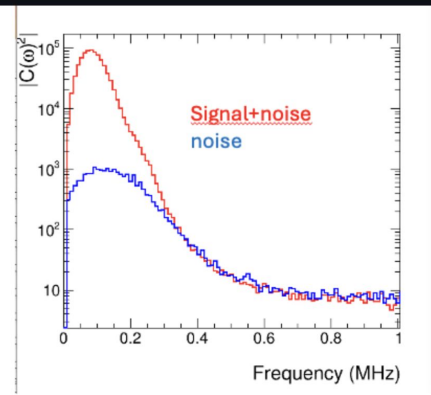
Back Up

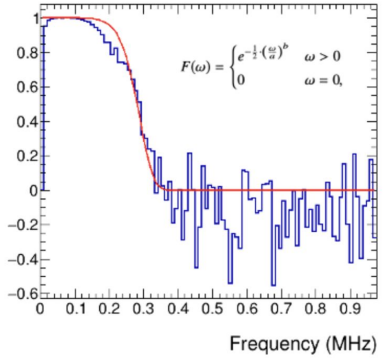
Software Filter Optimization

- 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

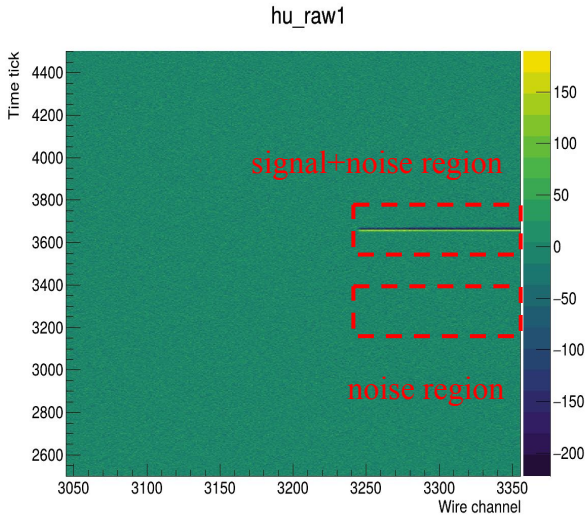




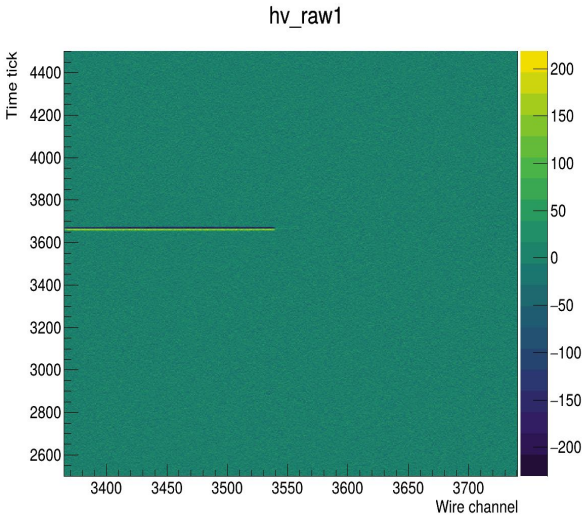
EXT NO.	PARAMETER NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	p0	2.69885e-01	3.74802e-02	2.98269e-05	3.55623e-02
2	p1	8.34938e+00	6.86118e+00	5.42952e-03	-2.51530e-04

Software Filter Study

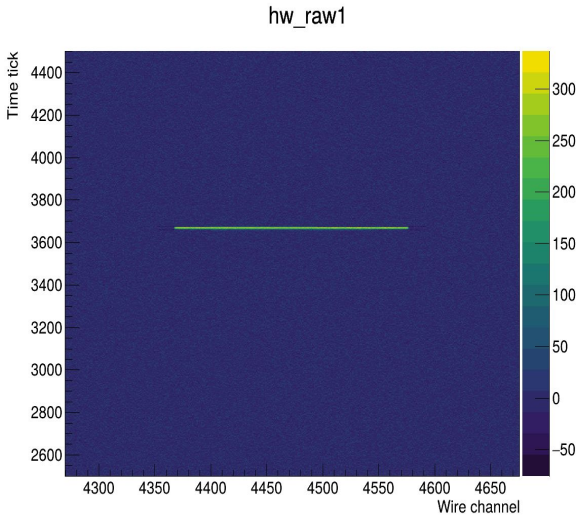
- Confirming the method to get parameters is correct



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

HDF5 Compression Test

```
=== Analysis by Dataset Name (Grouped) ===
Name                    | Cnt | Type      | Shape           | Logical    | Storage    | Ratio | Comp
------------------------------------------------------------------------------------------------
frame_decon_charge0     | 1   | float32   | (1536, 6400)    | 37.50 MB   | 37.50 MB   | 1.0   | None
frame_gauss0            | 1   | float32   | (1536, 6400)    | 37.50 MB   | 37.50 MB   | 1.0   | None
frame_loose_lf0         | 1   | float32   | (1536, 6400)    | 37.50 MB   | 37.50 MB   | 1.0   | None
frame_mp2_roi0          | 1   | float32   | (1536, 6400)    | 37.50 MB   | 37.50 MB   | 1.0   | None
frame_mp3_roi0          | 1   | float32   | (1536, 6400)    | 37.50 MB   | 37.50 MB   | 1.0   | None
channels_decon_charge0  | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
channels_gauss0         | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
channels_loose_lf0      | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
channels_mp2_roi0       | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
channels_mp3_roi0       | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
tickinfo_decon_charge0  | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
tickinfo_gauss0         | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
tickinfo_loose_lf0      | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
tickinfo_mp2_roi0       | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
tickinfo_mp3_roi0       | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
------------------------------------------------------------------------------------------------
TOTAL                   | 15  | -         | -               | 187.53 MB  | 187.53 MB  | 1.0   | -
```

❑ gzip = 0

```
=== Analysis by Dataset Name (Grouped) ===
Name                    | Cnt | Type      | Shape           | Logical    | Storage    | Ratio | Comp
------------------------------------------------------------------------------------------------
frame_loose_lf0         | 1   | float32   | (1536, 6400)    | 37.50 MB   | 34.84 MB   | 1.1   | gzip
frame_decon_charge0     | 1   | float32   | (1536, 6400)    | 37.50 MB   | 34.77 MB   | 1.1   | gzip
frame_gauss0            | 1   | float32   | (1536, 6400)    | 37.50 MB   | 462.11 KB  | 83.1  | gzip
frame_mp2_roi0          | 1   | float32   | (1536, 6400)    | 37.50 MB   | 192.14 KB  | 199.9 | gzip
frame_mp3_roi0          | 1   | float32   | (1536, 6400)    | 37.50 MB   | 175.06 KB  | 219.4 | gzip
channels_decon_charge0  | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
channels_gauss0         | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
channels_loose_lf0      | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
channels_mp2_roi0       | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
channels_mp3_roi0       | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
tickinfo_decon_charge0  | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
tickinfo_gauss0         | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
tickinfo_loose_lf0      | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
tickinfo_mp2_roi0       | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
tickinfo_mp3_roi0       | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
------------------------------------------------------------------------------------------------
TOTAL                   | 15  | -         | -               | 187.53 MB  | 70.45 MB   | 2.7   | -
```

❑ gzip = 2

```
=== Analysis by Dataset Name (Grouped) ===
Name                    | Cnt | Type      | Shape           | Logical    | Storage    | Ratio | Comp
------------------------------------------------------------------------------------------------
frame_loose_lf0         | 1   | float32   | (1536, 6400)    | 37.50 MB   | 34.74 MB   | 1.1   | gzip
frame_decon_charge0     | 1   | float32   | (1536, 6400)    | 37.50 MB   | 34.67 MB   | 1.1   | gzip
frame_gauss0            | 1   | float32   | (1536, 6400)    | 37.50 MB   | 309.53 KB  | 124.1 | gzip
frame_mp2_roi0          | 1   | float32   | (1536, 6400)    | 37.50 MB   | 50.13 KB   | 766.1 | gzip
frame_mp3_roi0          | 1   | float32   | (1536, 6400)    | 37.50 MB   | 42.13 KB   | 911.4 | gzip
channels_decon_charge0  | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
channels_gauss0         | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
channels_loose_lf0      | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
channels_mp2_roi0       | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
channels_mp3_roi0       | 1   | int32     | (1536,)         | 6.00 KB    | 6.00 KB    | 1.0   | None
tickinfo_decon_charge0  | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
tickinfo_gauss0         | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
tickinfo_loose_lf0      | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
tickinfo_mp2_roi0       | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
tickinfo_mp3_roi0       | 1   | float64   | (3,)            | 24 B       | 24 B       | 1.0   | None
------------------------------------------------------------------------------------------------
TOTAL                   | 15  | -         | -               | 187.53 MB  | 69.83 MB   | 2.7   | -
```

❑ gzip = 6

- gzip option works now (chunk should not be zero)
- File sizes per event (1 CRU)
  - gzip = 0, reco 188 MB, truth 38 MB
  - gzip = 2, reco 70 MB, truth 744 KB
  - gzip = 6, reco 70 MB, truth 600 KB
- gzip=2 gives enough suppression rate
- For 1000 events, estimated required storage ~ 70.7 GB

Memory Study

- I was using the fcl file dumped out using old dunesw (v10_04_07d01)
- When dumping out the fcl, some parameters differ from which dunesw is set
- Tested how each parameter affects
- The problem was difference “clock_speed” is given depending on dunesw version
  - in wirecell-dune.jsonnet → clock_speed: @local:protodunehd_services.DetectorClocksService.ClockSpeedTPC
  - /cvmfs/dune.opensciencegrid.org/products/dune/dunecore/**v10_20_01d01**/fcl/detectorclocks_dune.fcl

```
66 # This is 2MHz rather than 1.953125 (1./512ns) because we are resampling from
67 # 512ns tick period to 500ns within wirecell
68 protodunehd_detectorclocks.ClockSpeedTPC: 2.0
```

  - /cvmfs/dune.opensciencegrid.org/products/dune/dunecore/**v10_04_07d01**/fcl/detectorclocks_dune.fcl

```
64 protodunehd_detectorclocks: @local::protodune_detectorclocks
65 protodunehd_detectorclocks.ClockSpeedTPC: 1.953125
```

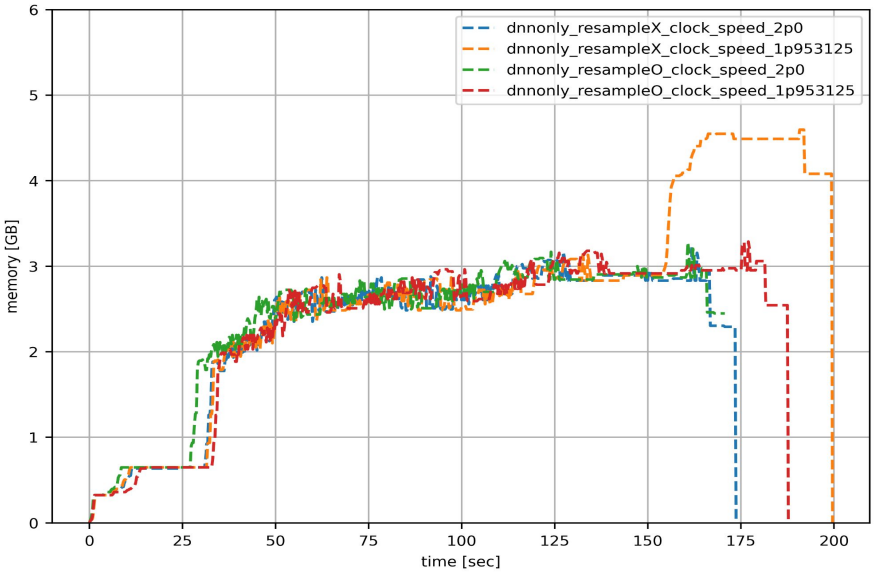
- Extracted clock_speed goes to tick in params.jsonnet

```
39          tick: 1.0/std.extVar('clock_speed') * wc.us,
```

- That tick fed into the wclsRawFrameSource

```
62    local wcls_input = {
63      adc_digits: g.pnode({
64        type: 'wclsRawFrameSource',
65        name: '',
66        data: {
67          art_tag: raw_input_label,
68          frame_tags: ['orig'],  // this is a WCT designator
69          //nticks: params.daq.nticks,
70          // nticks: nsample,
71          tick: params.daq.tick,
72        },
73      }, nin=0, nout=1),
74
75    };
```

Memory Study



- Regardless of which version of WC and dunesw used, the peak appears when the clock_speed is set to 1.953125
- However, resampler is able to suppress the peak
- Yujin will report the results of the Valgrind heap profiling on this issue
- I opened a PR to merge the TagSelector (https://github.com/WireCell/wire-cell-toolkit/pull/458)