Full 10kt FD-HD Sim/SigProc

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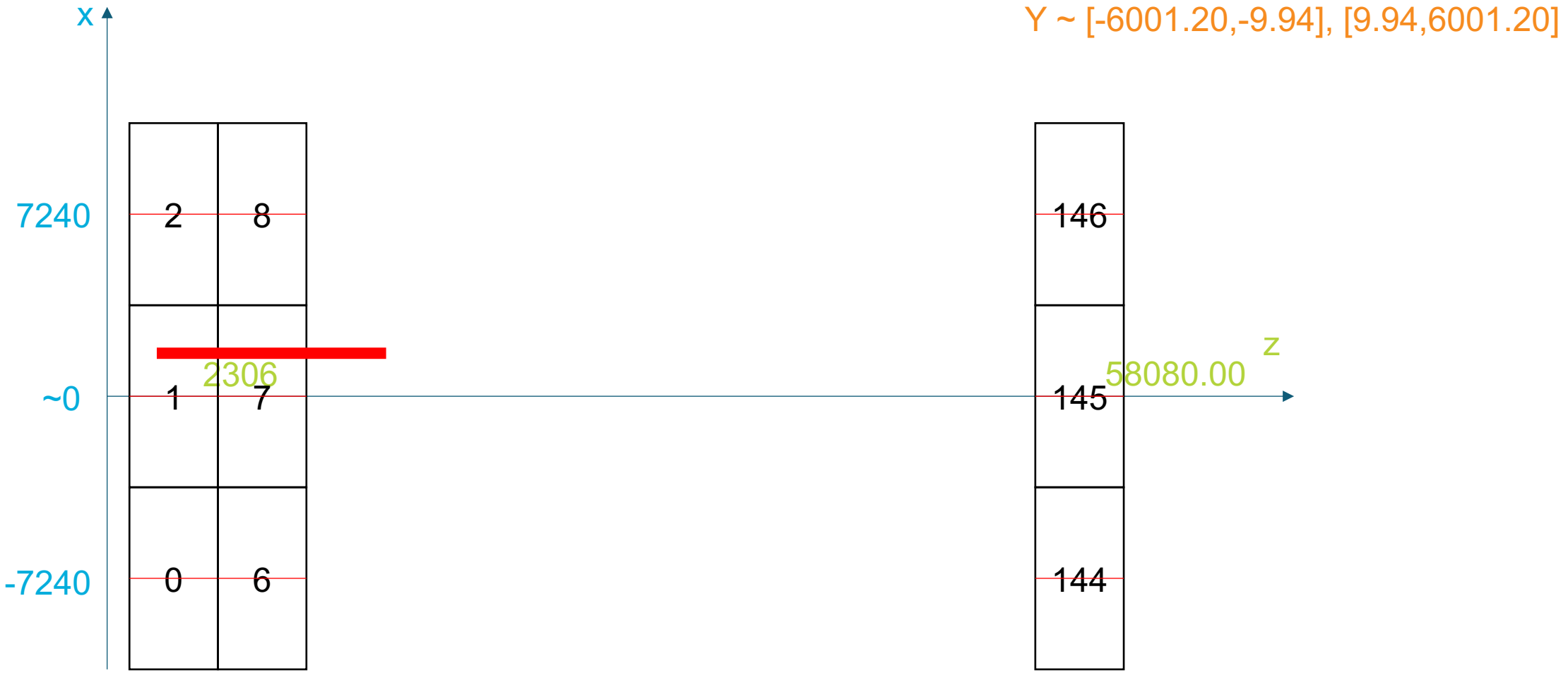
DUNE FD Sim/Reco Meeting

Summary

- Configuration PR: https://github.com/DUNE/dunereco/pull/108
  - **new sub-folder for dune10kt-hd**
- setup: dunesw v09_91_00d00, wirecell v0_27_1
  - hydra available in wirecell v0_27_1
- gen: modified prod_muminus_0.1-5.0GeV_isotropic_dune10kt_1x2x6.fcl
- g4: standard_g4_dune10kt_1x2x6.fcl
- detsim: https://github.com/HaiwangYu/hydra-skip
- Validation:
  - time offset
  - w wire position

FD-HD, APA numbering

- dune10kt_v7_refactored.json.bz2, gdml from V. Pec
- XYZ: 3x2x25=150



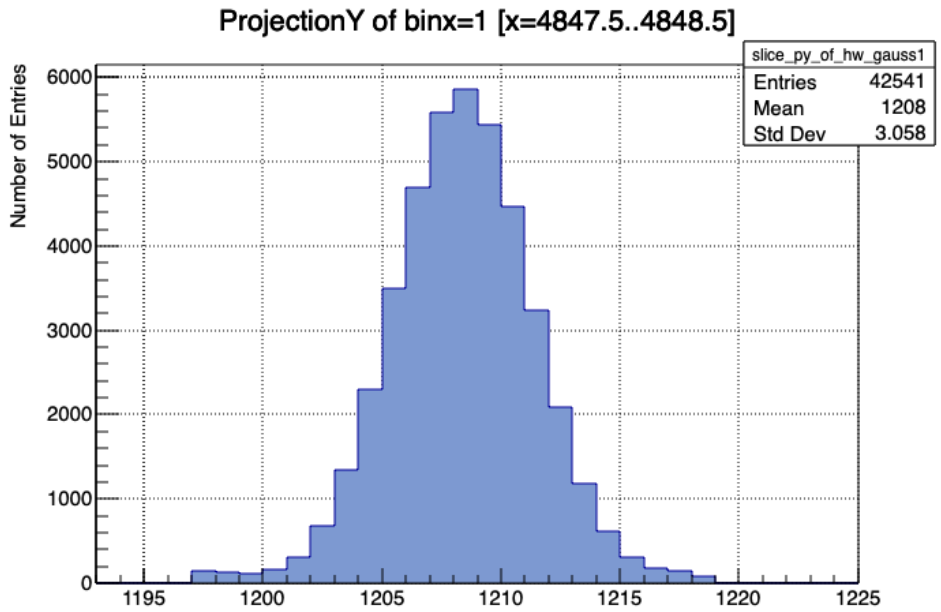
time

X0 = 1000 mm
Y0 = −1000 mm
Z0 = 1000 mm
T0 = 0 ns

G4RefTime = 0
driftSpeed = 1.60563 mm/us

(1000 – 30.02)/1.60563/0.5 = 1208 tick

T0: 0, Peak 1208



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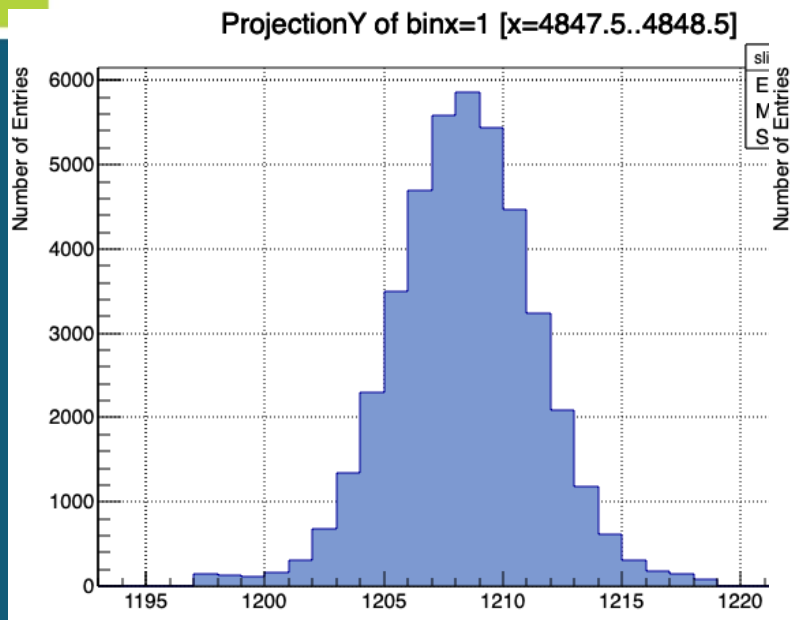
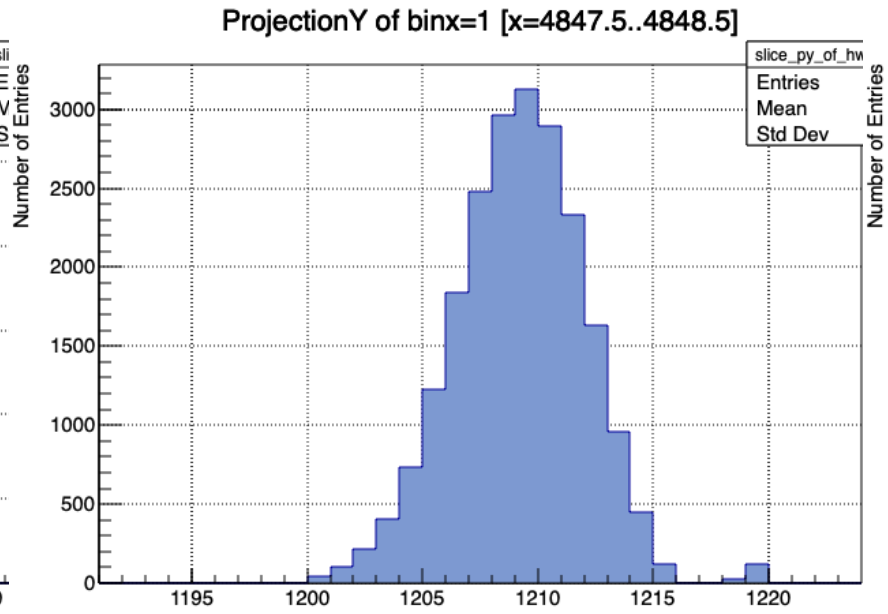
T0 impact

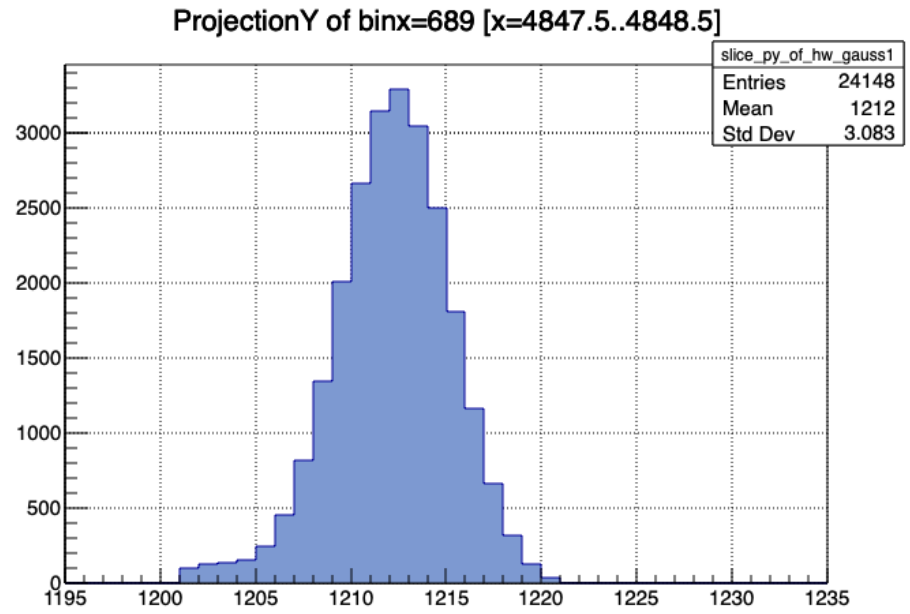
T0: 0, Peak 1208



T0: 500, Peak 1209



T0: 2000, 1212



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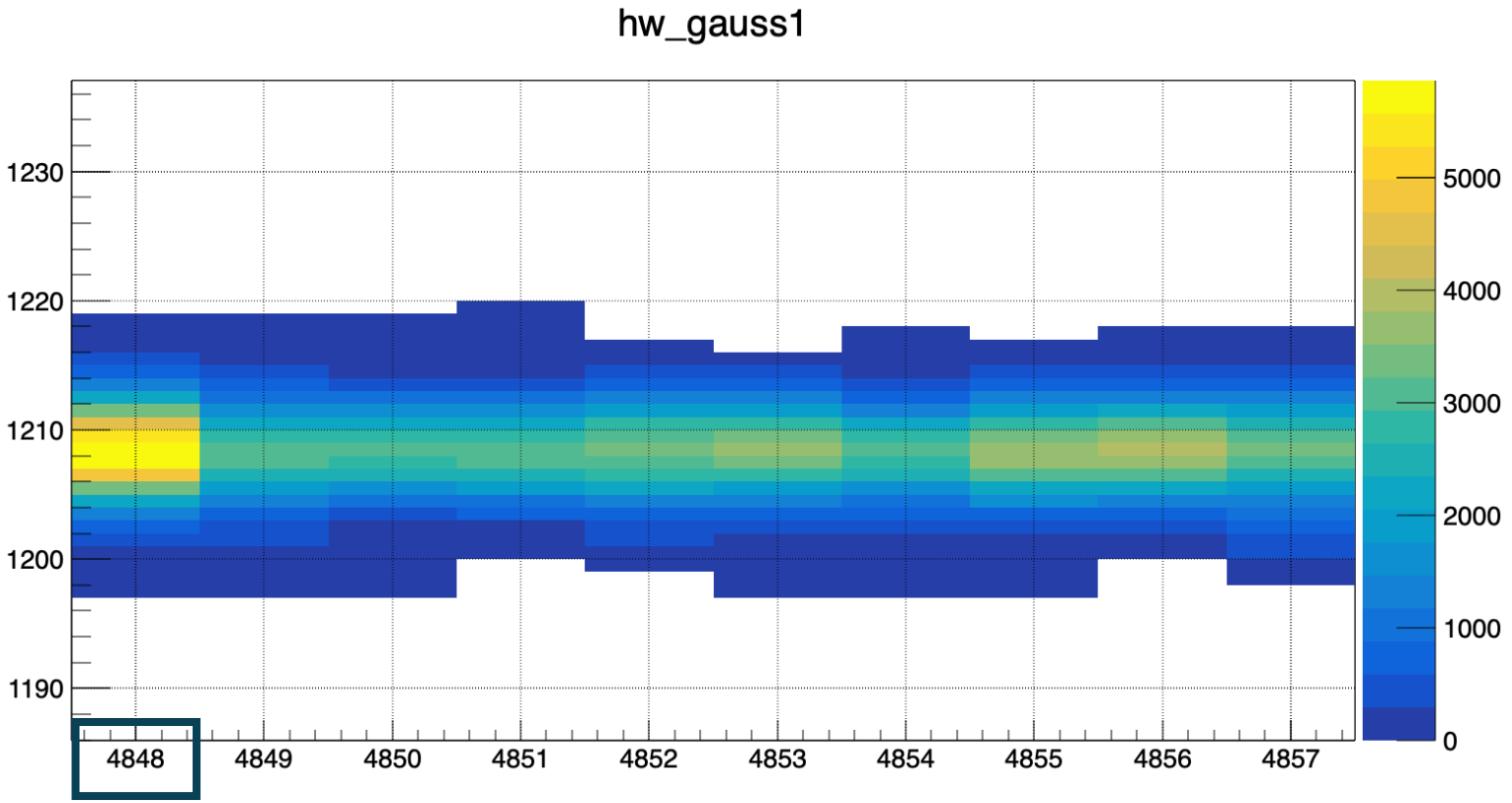
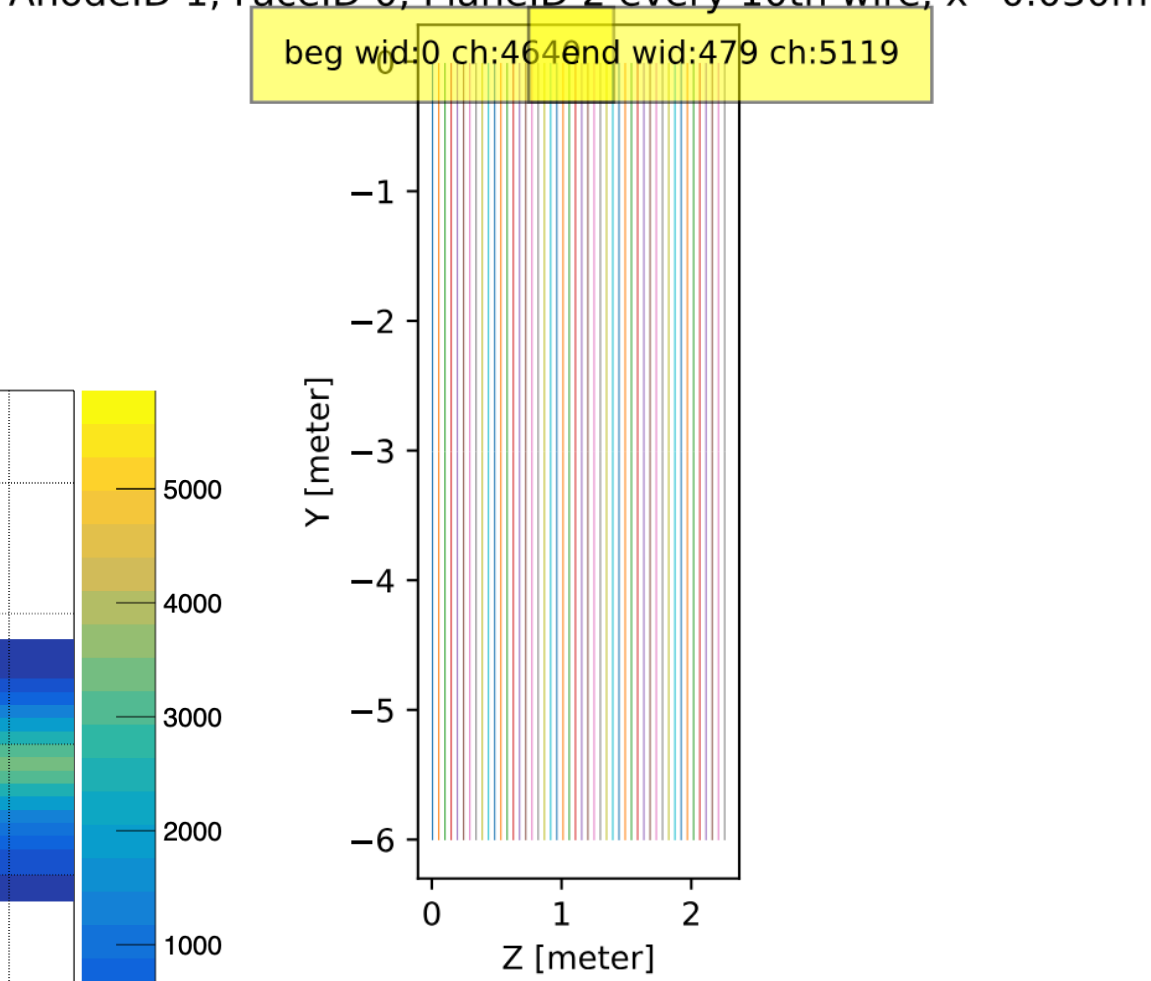
w wire

APA1, face0, [4640, 5120), Z: ~ [0, 2306mm)
1000/2306*480+4640 = 4848 (channel)



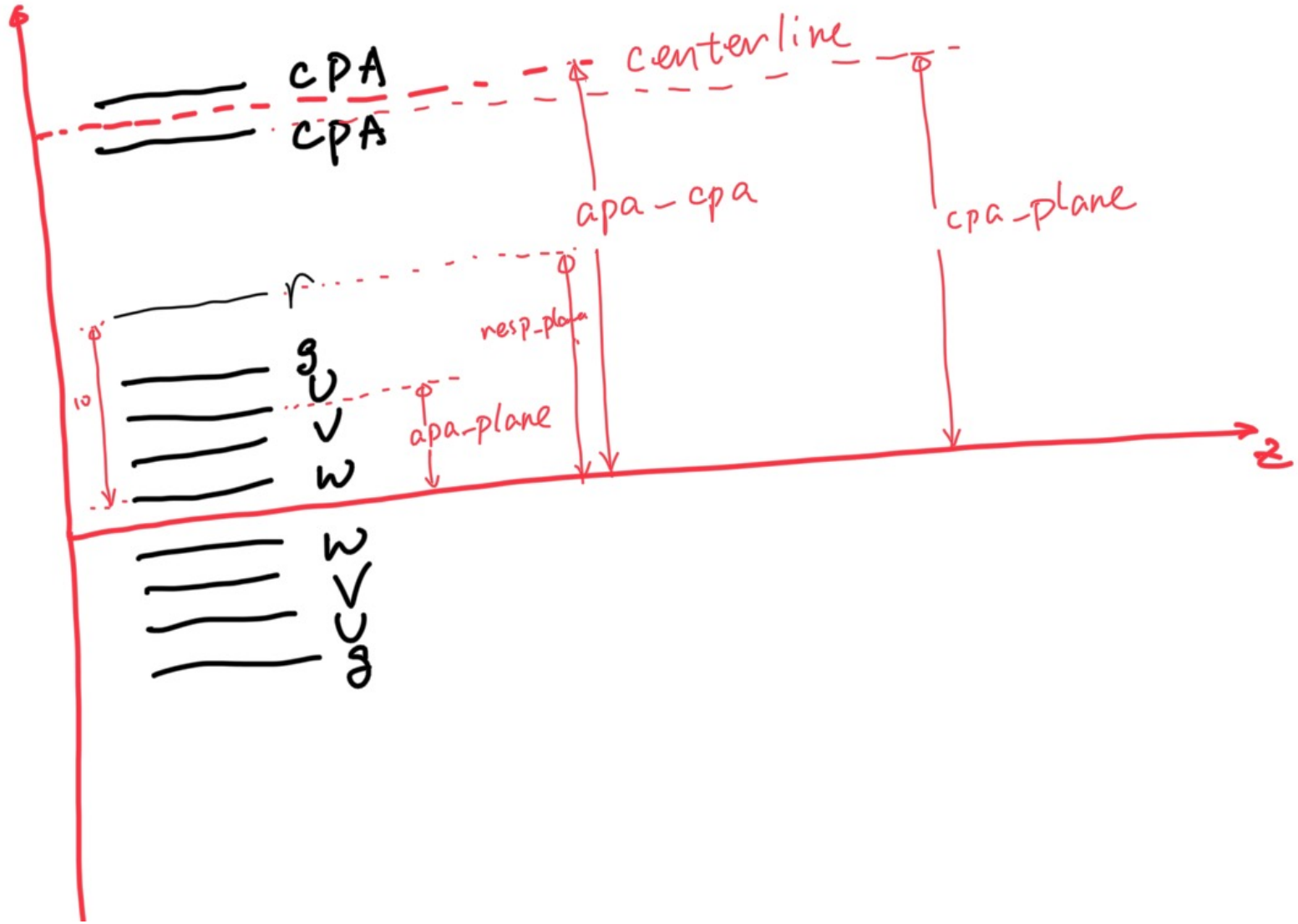


backups

use gdml values

```
38      "volumes": [
39         {
40            "faces": [
41               {
42                  "anode": -7230.9944999999998,
43                  "cathode": -3636.8525,
44                  "response": -7140.5144999999993
45               },
46               {
47                  "anode": -7310.0654999999997,
48                  "cathode": -10904.2075,
49                  "response": -7400.5455000000002
50               }
51            ],
52            "name": "apa0",
53            "wires": 0
54         },
55         {
56            "faces": [
57               {
58                  "anode": 39.535499999999999,
59                  "cathode": 3633.6774999999998,
60                  "response": 130.0155
61               },
62               {
63                  "anode": -39.535499999999999,
64                  "cathode": -3633.6774999999998,
65                  "response": -130.0155
66               }
67            ],
68            "name": "apa1",
69            "wires": 1
70         },
71         {
72            "faces": [
73               {
74                  "anode": 7310.0654999999997,
75                  "cathode": 10904.2075,
76                  "response": 7400.5455000000002
77               },
78               {
79                  "anode": 7230.9944999999998,
80                  "cathode": 3636.8525,
81                  "response": 7140.5144999999993
82               }
83            ],
84            "name": "apa2",
85            "wires": 2
86         },
```

```
1   anode:0 face:0 X=[-7240.51,-7230.99]mm Y=[-6001.20,-9.94]mm Z=[-0.00,2306.38]mm
2       0: x=-7230.99mm dx=9.5200mm n=1149 pitch=(4.6670 +/- 0.000059 [4.6611<4.6732], p0=4.6670)
3       1: x=-7235.75mm dx=4.7600mm n=1148 pitch=(4.6662 +/- 0.000052 [4.6618<4.6692], p0=4.6649)
4       2: x=-7240.51mm dx=0.0000mm n=480 pitch=(4.7900 +/- 0.000006 [4.7870<4.7905], p0=4.7900)
5   anode:0 face:1 X=[-7310.06,-7300.54]mm Y=[-6001.20,-9.94]mm Z=[-0.00,2306.38]mm
6       0: x=-7310.06mm dx=-9.5200mm n=1149 pitch=(4.6686 +/- 0.000068 [4.6630<4.6729], p0=4.6691)
7       1: x=-7305.30mm dx=-4.7600mm n=1148 pitch=(4.6672 +/- 0.000049 [4.6623<4.6702], p0=4.6671)
8       2: x=-7300.54mm dx=0.0000mm n=480 pitch=(4.7900 +/- 0.000006 [4.7870<4.7905], p0=4.7900)
9   anode:1 face:0 X=[30.02,39.54]mm Y=[-6001.20,-9.94]mm Z=[-0.00,2306.38]mm
10      0: x=39.54mm dx=9.5200mm n=1149 pitch=(4.6670 +/- 0.000059 [4.6611<4.6732], p0=4.6670)
11      1: x=34.78mm dx=4.7600mm n=1148 pitch=(4.6662 +/- 0.000052 [4.6618<4.6692], p0=4.6649)
12      2: x=30.02mm dx=0.0000mm n=480 pitch=(4.7900 +/- 0.000006 [4.7870<4.7905], p0=4.7900)
13  anode:1 face:1 X=[-39.54,-30.02]mm Y=[-6001.20,-9.94]mm Z=[-0.00,2306.38]mm
14      0: x=-39.54mm dx=-9.5200mm n=1149 pitch=(4.6686 +/- 0.000068 [4.6630<4.6729], p0=4.6691)
15      1: x=-34.78mm dx=-4.7600mm n=1148 pitch=(4.6672 +/- 0.000049 [4.6623<4.6702], p0=4.6671)
16      2: x=-30.02mm dx=0.0000mm n=480 pitch=(4.7900 +/- 0.000006 [4.7870<4.7905], p0=4.7900)
17  anode:2 face:0 X=[7300.54,7310.06]mm Y=[-6001.20,-9.94]mm Z=[-0.00,2306.38]mm
18      0: x=7310.06mm dx=9.5200mm n=1149 pitch=(4.6670 +/- 0.000059 [4.6611<4.6732], p0=4.6670)
19      1: x=7305.30mm dx=4.7600mm n=1148 pitch=(4.6662 +/- 0.000052 [4.6618<4.6692], p0=4.6649)
20      2: x=7300.54mm dx=0.0000mm n=480 pitch=(4.7900 +/- 0.000006 [4.7870<4.7905], p0=4.7900)
21  anode:2 face:1 X=[7230.99,7240.51]mm Y=[-6001.20,-9.94]mm Z=[-0.00,2306.38]mm
22      0: x=7230.99mm dx=-9.5200mm n=1149 pitch=(4.6686 +/- 0.000068 [4.6630<4.6729], p0=4.6691)
23      1: x=7235.75mm dx=-4.7600mm n=1148 pitch=(4.6672 +/- 0.000049 [4.6623<4.6702], p0=4.6671)
24      2: x=7240.51mm dx=0.0000mm n=480 pitch=(4.7900 +/- 0.000006 [4.7870<4.7905], p0=4.7900)
```


CPA
CPA
centerline
apa_cpa
cpa_plane
resp_plane
apa_plane
10
r
g
U
V
W
W
V
U
g
z

Outline

- gdml → wire geom in WC format
  - gdml (from V. Pec): https://github.com/vpec0/dunecore/blob/feature/vpec_add_fd_full_geom_gdml/dunecore/Geometry/gdml/dune10kt_v7_refactored.gdml
  - dump → txt: https://github.com/HaiwangYu/dunefd-geom
  - txt → json.bz2: wire-cell-python
    - 57a0ac5ede5234bd738905a46d7539eb10f12d52 (this commit works)
- new configuration sub-folder “dune10kt-hd”
  - params forked from dune10kt-1x2x6
    - https://github.com/WireCell/wire-cell-toolkit/tree/master/cfg/pgrapher/experiment/dune10kt-1x2x6
  - dev area: https://github.com/HaiwangYu/hydra-skip/tree/main/cfg/pgrapher/experiment/dune10kt-hd
- run 1-event

To-do

- Validations:
  - volume
    - Which apa-cpa dist. to use?
  - wire/channel numbering
  - time offsets
  - interface to LArSoft

- Optimizations: total time vs. CPU time?
  - loading cfg time
  - loading geom time

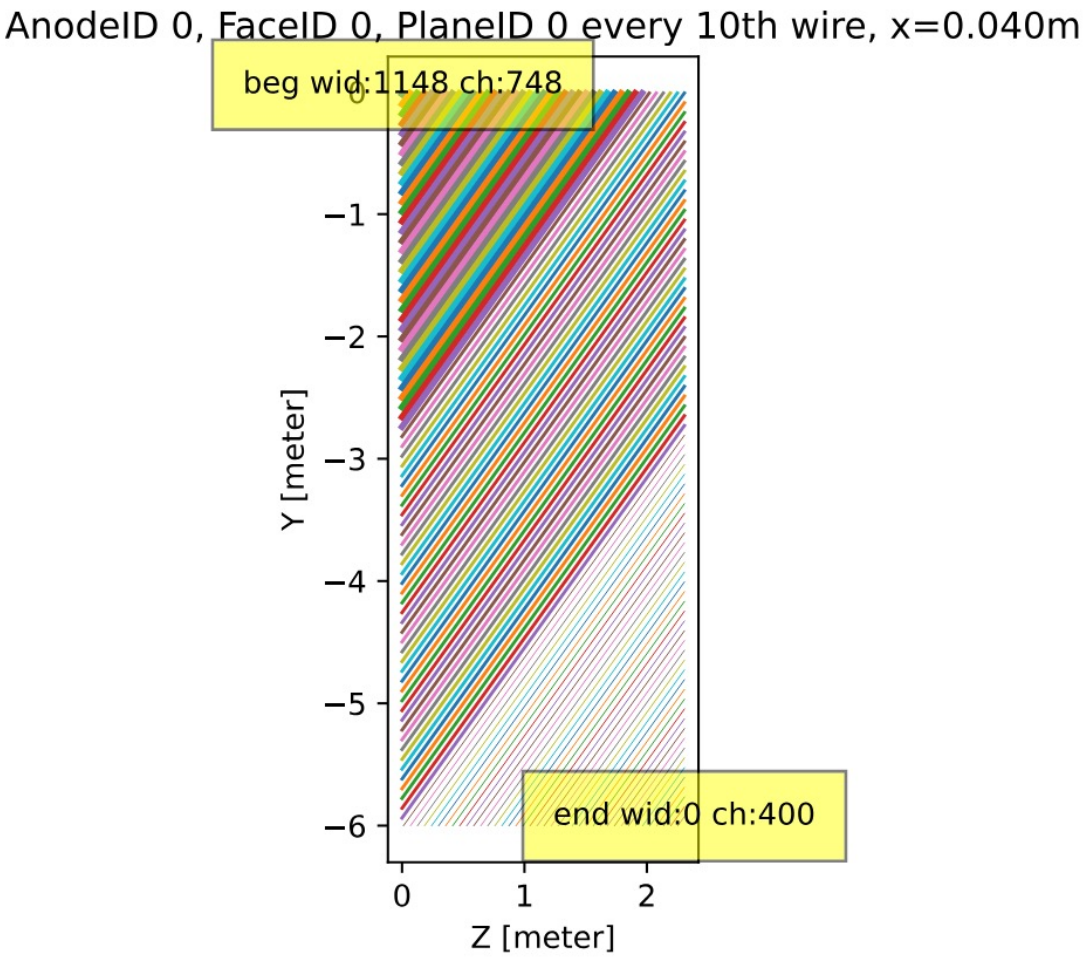
- Option to save out raw ADC?

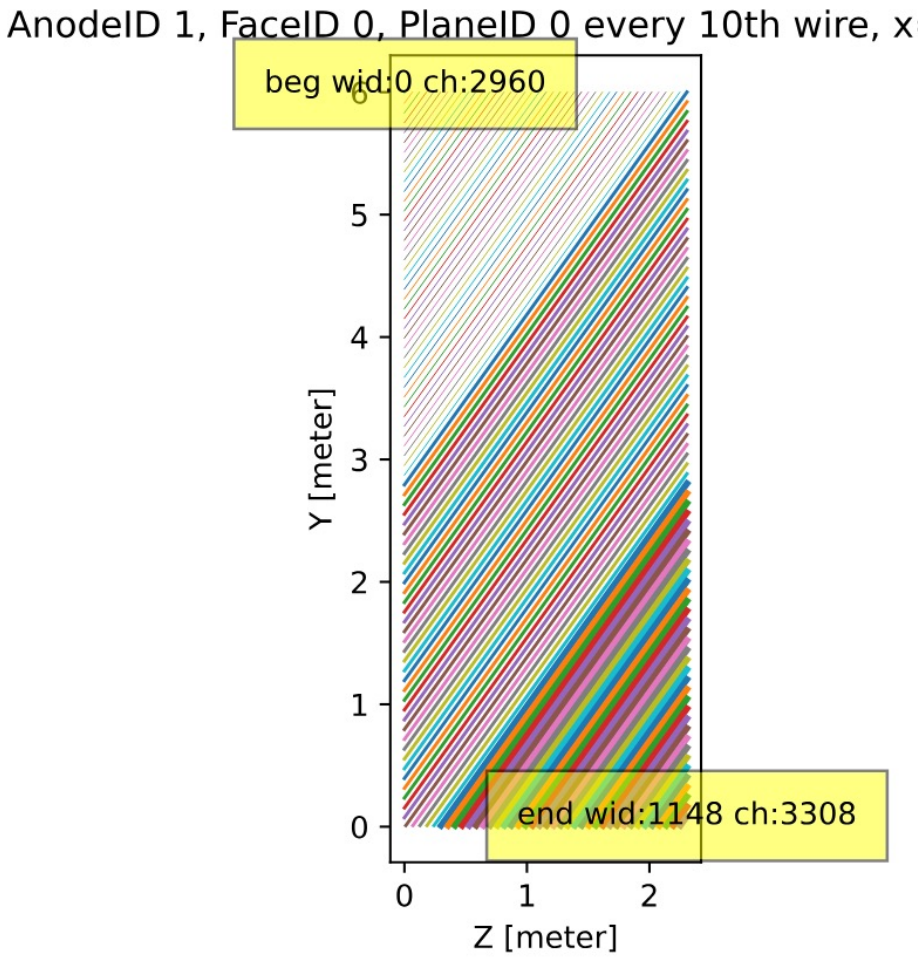
- Cleanup and update repos
  - Coordination with others (e.g., V. Pec, L. Paulucci and D. Brailsford)

```
31571 TimeReport ---------- Time summary [sec] -------
31572 TimeReport CPU = 109.475846 Real = 112.544419
31573
31574 MemReport  ---------- Memory summary [base-10 MB] ------
31575 MemReport  VmPeak = 6357.48 VmHWM = 4962.07
31576
31577 Art has completed and will exit with status 0.
31578
31579 real    7m4.012s
31580 user    7m42.090s
31581 sys     0m5.243s
```

dune10kt-vd

dune10kt-1x2x6





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wire numbering

- https://www.phy.bnl.gov/~hyu/wire-cell-data/dev/protodune-wires-larsoft-v4.pdf
- https://www.phy.bnl.gov/~hyu/wire-cell-data/dev/dune10kt-1x2x6-wires-larsoft-v1.pdf
- https://www.phy.bnl.gov/~hyu/wire-cell-data/dev/dune10kt_v7_refactored.pdf