

3D-imaging with 2-views in PD-HD

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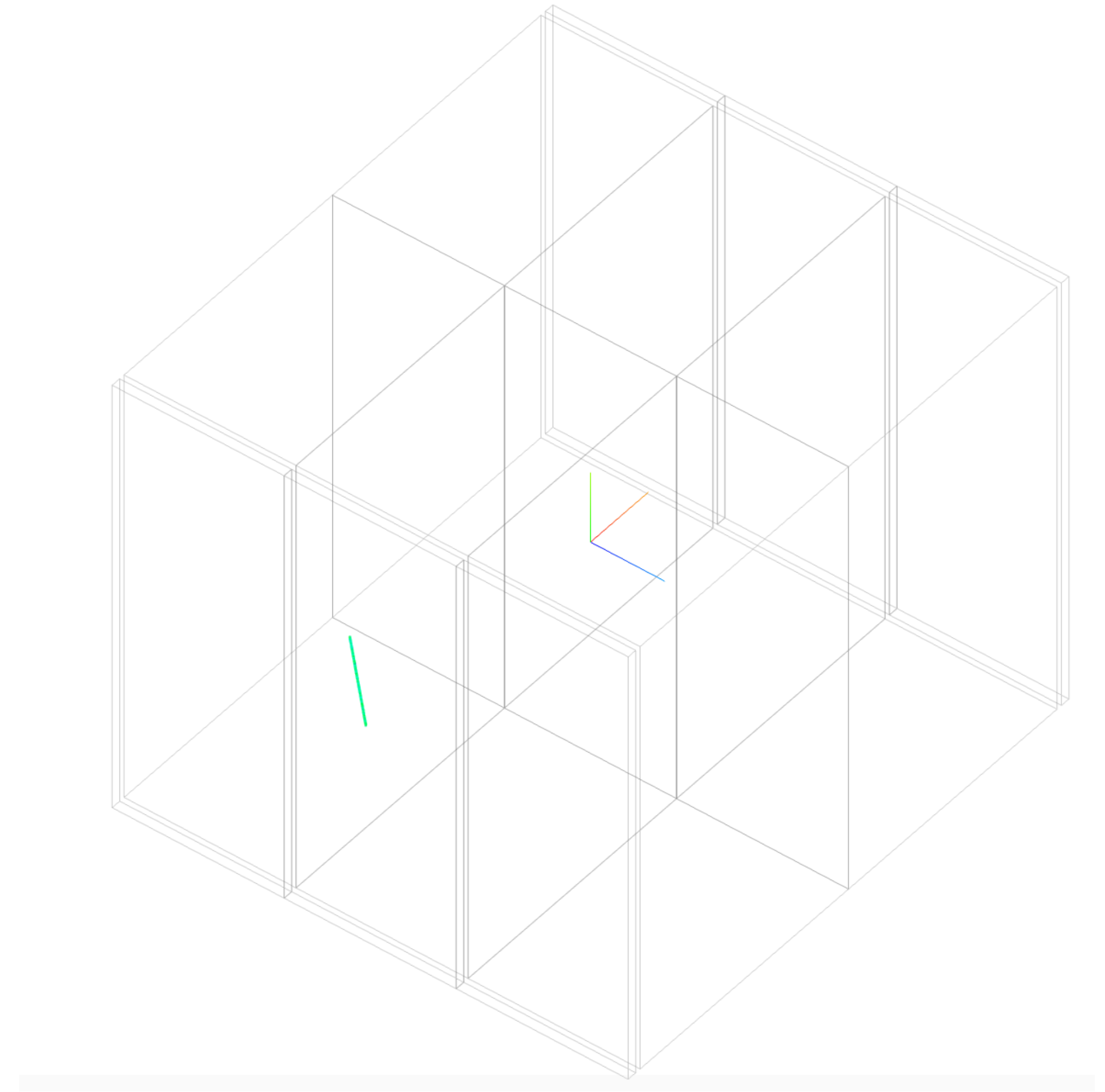
Wire-Cell meeting
June 13, 2024

Quick workflow test with PD-HD

- PD-HD configurations are missing a few WC jsonnet files
- copied over from PD-VD for most parts
- running WC ideal tracks, on APA1 region

3D imaging result

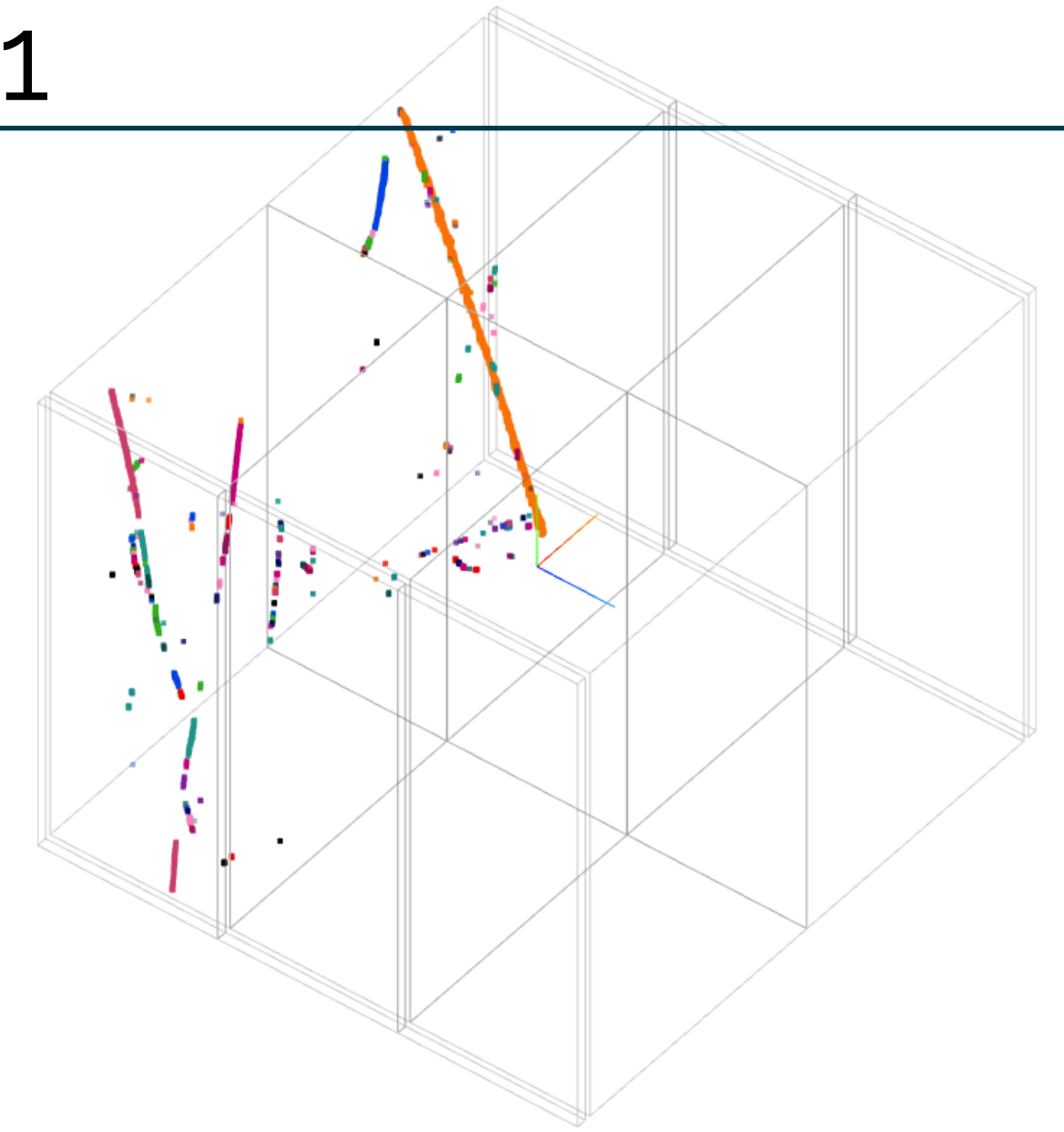
- ideal track, still 3-views
- using PD-SP geometry for BEE display for now
- <https://www.phy.bnl.gov/twister/bee/set/92a3ad2a-3ce3-4495-bef6-2e4c7ccf7e13/event/o/>



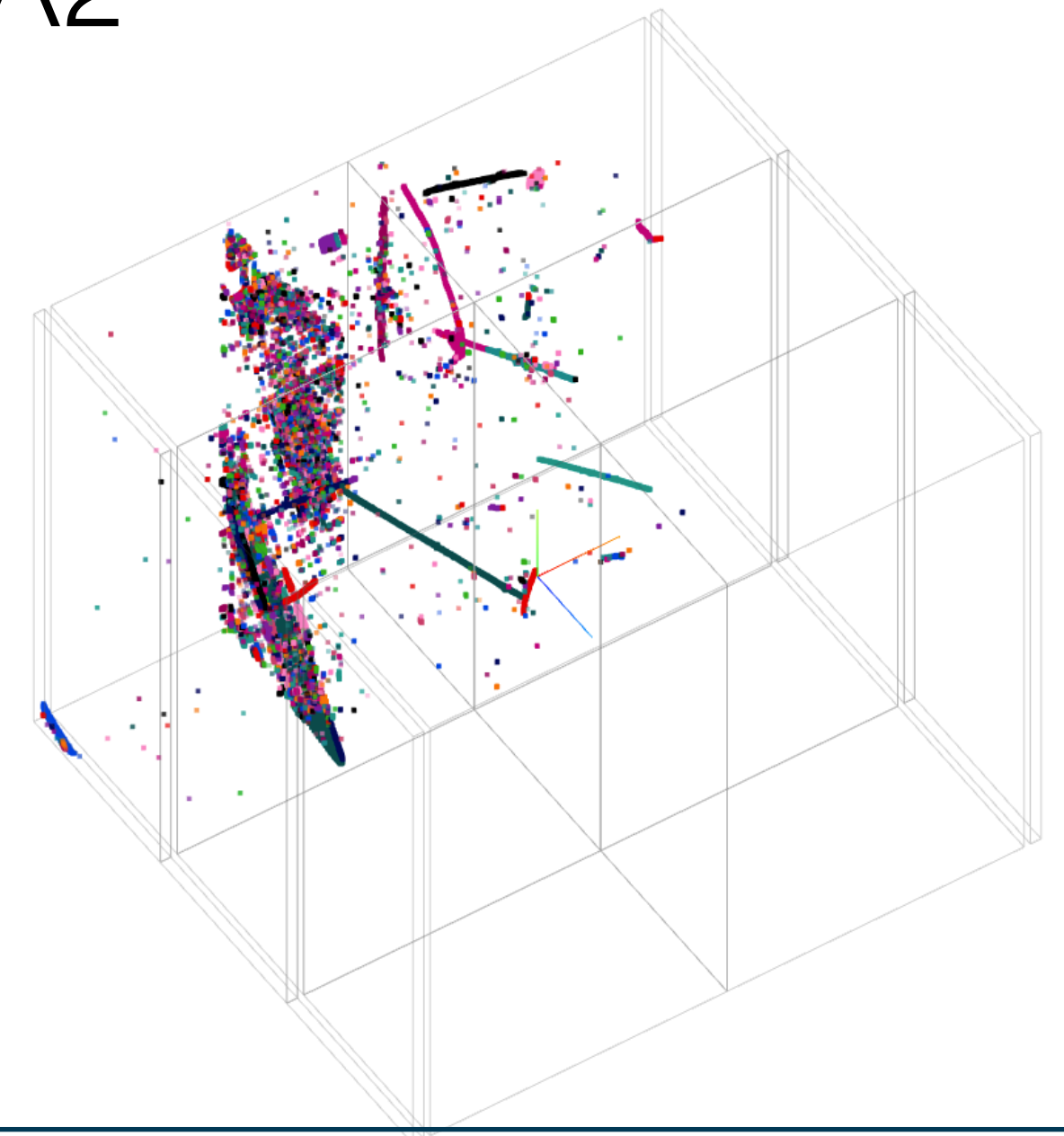
To Do

- practice Haiwang's 2-view tiling with APA1
- test a use of CMM function
- try 3-view imaging with PD-HD cosmic data, where X view still available
 - without NF, only APA1: BEE link
 - without NF, only APA2: BEE link
 - without NF, only APA3: BEE link
 - without NF, only APA4: BEE link
- PD-HD geometry for BEE display

APA1



APA2



3D Imaging with NPO4 cosmic data

- 3-view imaging with PD-HD cosmic data, where X view still available
 - without NF, only APA1: [BEE link](#)
 - without NF, only APA2: [BEE link](#)
 - without NF, only APA3: [BEE link](#)
 - without NF, only APA4: [BEE link](#)

Before & After Wenqiang's F-R and S-P modification (for APA1)

- (unlike the previous ones, these are now with full NF-SP-IMG chain)
- data: np04hd_raw_run027304_0008_dataflow0_datawriter_0_20240619T165307
- APA0 before: <https://www.phy.bnl.gov/twister/bee/set/geafb9f3-da56-46c4-9ec1-017ca96225b4/event/0/>
- APA0 after: <https://www.phy.bnl.gov/twister/bee/set/e5dd9ea9-0746-41a5-aec8-ce4870787f95/event/0/>
- APA1 after: <https://www.phy.bnl.gov/twister/bee/set/bd138734-9179-481e-gd08-8f2309f04d17/event/0/>
- APA2 after: <https://www.phy.bnl.gov/twister/bee/set/cc82876b-8d45-4025-a229-a6b4f8a70b2b/event/0/>
- APA3 after: <https://www.phy.bnl.gov/twister/bee/set/od9fc9d9-7a56-4468-97c3-a2404f39b3e4/event/0/>

How to deal with 2-view in APA1 in the imaging?

- Method 1: mask-off entire APA1 collection plane channels in “CMM” function, run the rest as is
 - careful with the field response!
- Method 2: do not mask any channels, but instead modify tiling/solving/deghosting stage to take care of the 2-view
 - active_planes=[0,1], dummy_planes=[2]

Method2

<https://github.com/HaiwangYu/dunereco/blob/develop/dunereco/DUNEWireCell/pdhd/img.jsonnet#L310-L318>

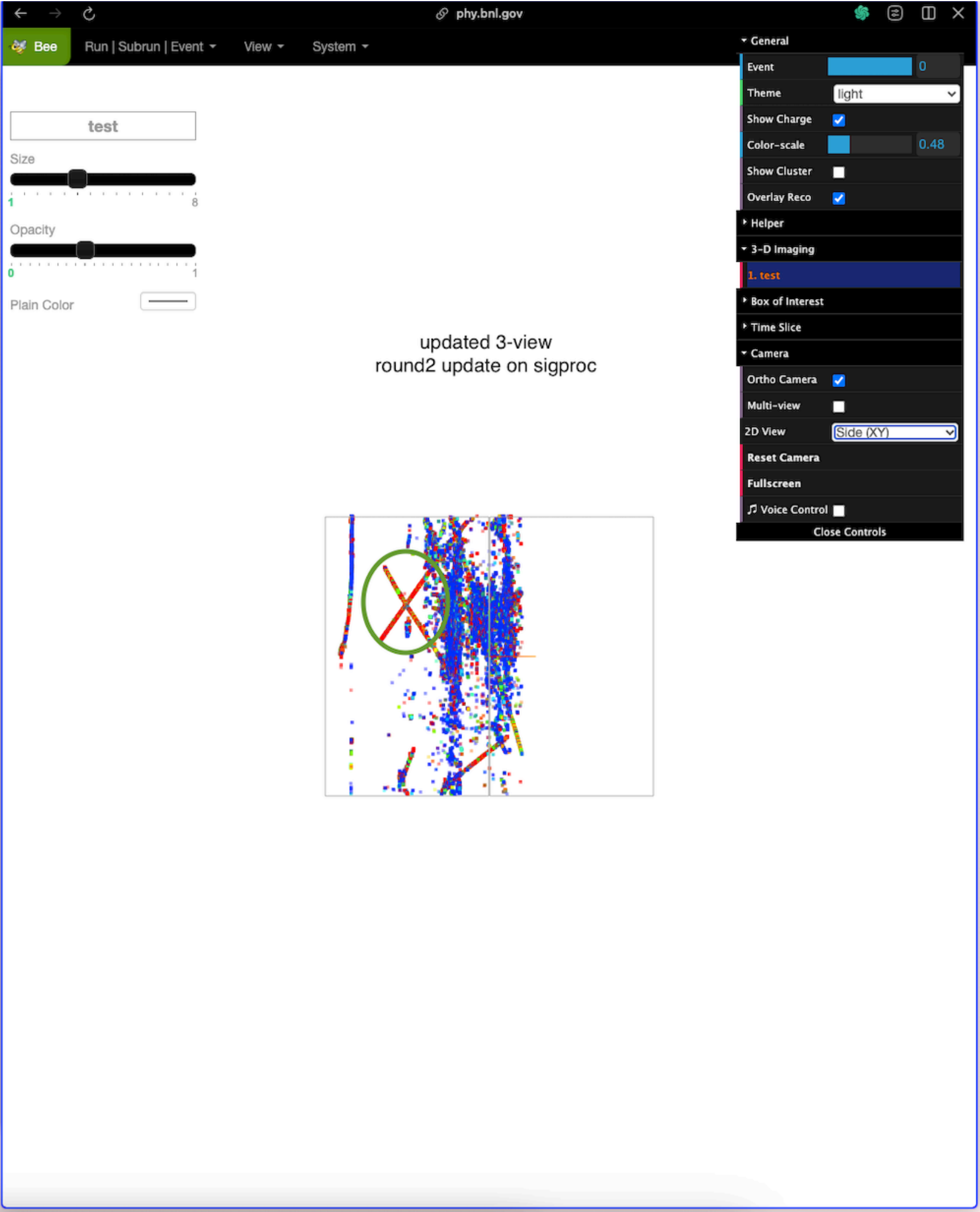
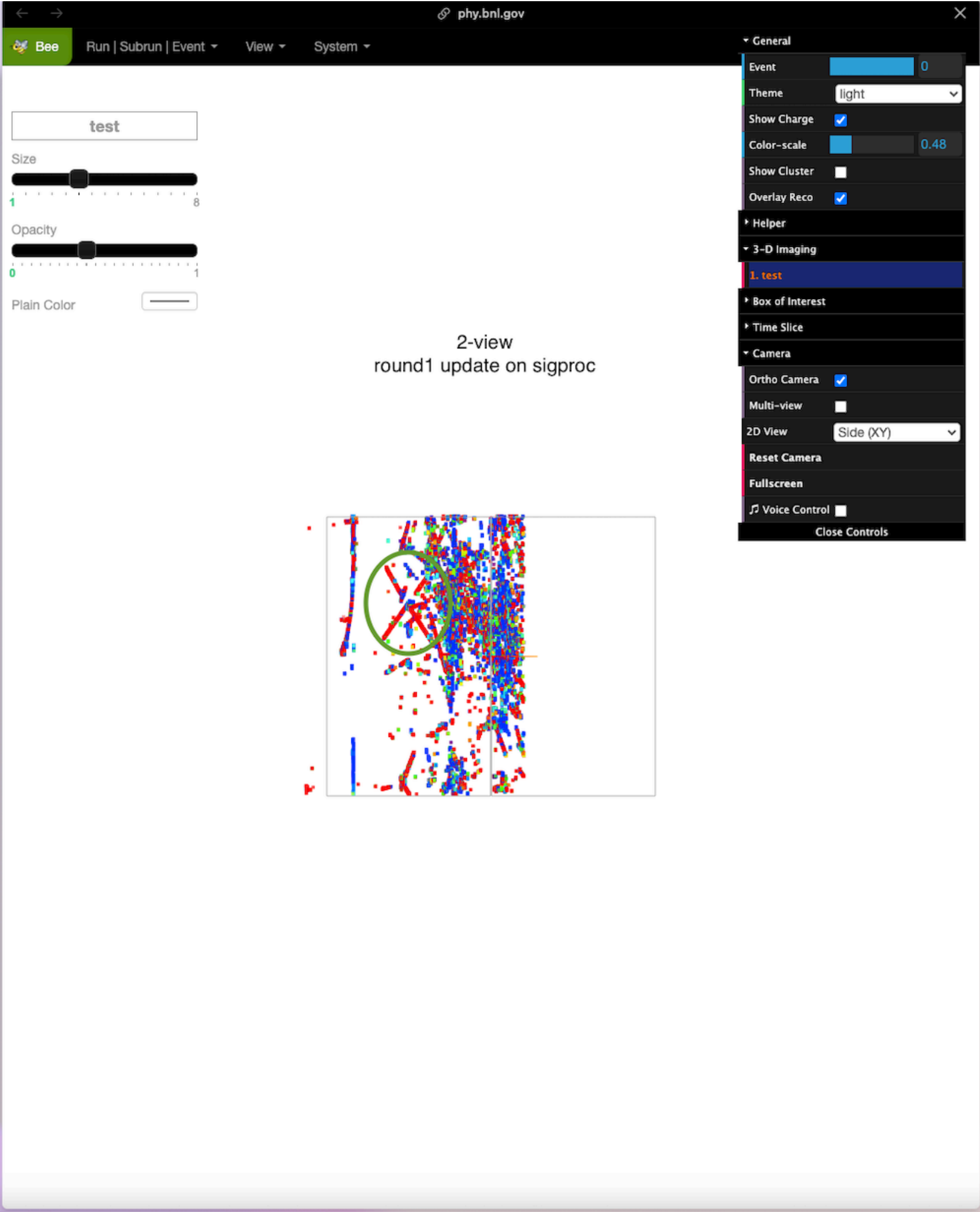
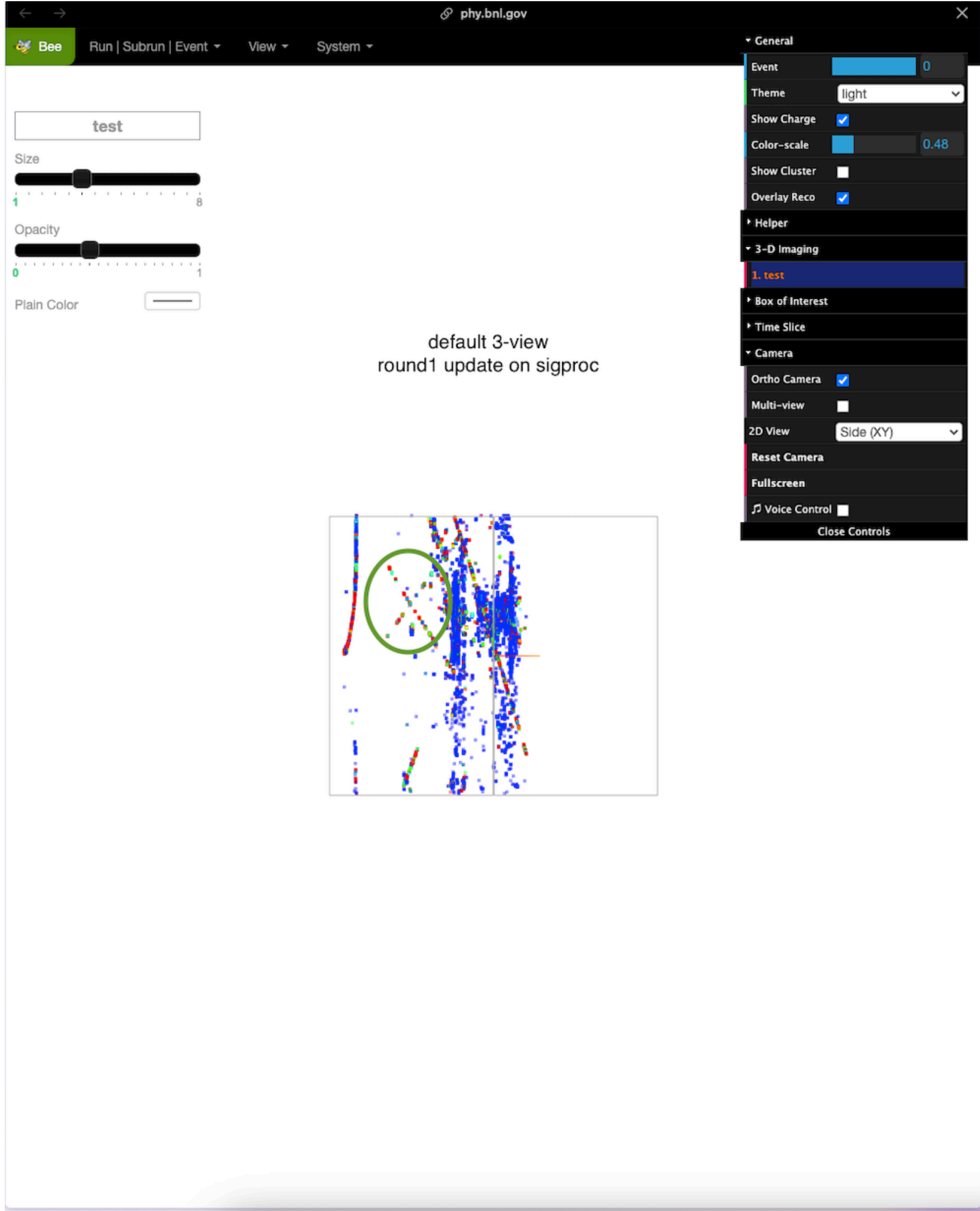
```
else if multi_slicing == "pdhd1"
then g.pipeline([
  // img.slicing(anode, anode.name, 109, active_planes=[0,1,2], masked_planes=[], dummy_planes=[]), // 109*22*4
  // img.slicing(anode, anode.name, 1916, active_planes=[], masked_planes=[0,1], dummy_planes=[2]), // 109*22*4
  img.slicing(anode, anode.name, 4, active_planes=[0,1], masked_planes=[], dummy_planes=[2]), // 109*22*4
  img.tiling(anode, anode.name),
  img.solving(anode, anode.name, "full"),
  // img.clustering(anode, anode.name),
  img.dump(anode, anode.name, params.lar.drift_speed),])
```

wcls-nf-sp-img.jsonnet, wct-sim-fans.jsonnet

```
//local img_pipes = [img_maker.per_anode(a) for a in tools.anodes]; // original
local img_pipes = [
  // Haiwang's fix for 2view tiling
  if a.data.ident == 1
  then img_maker.per_anode(a, "pdhd1") // 2view tiling, full solving
  else img_maker.per_anode(a, "single") // 3view tiling, simple solving
  for a in tools.anodes];
```

2-view tiling test with Method2 (full NF/SP/IMG chain)

- cosmic data (after Wenqiang's new FR/SP tune dunesw 09_g1_03d00)
 - 2view: <https://www.phy.bnl.gov/twister/bee/set/ba4adb57-47df-4548-a05d-c9d9deb67d61/event/0/>
 - 3view (round1): <https://www.phy.bnl.gov/twister/bee/set/4b4f3f57-8472-40d3-b5d7-f131c4ccfcda/event/0/>
 - 3view (round2): <https://www.phy.bnl.gov/twister/bee/set/241fe82f-a08f-455c-bbbf-f4cfad0fb949/event/0/>
 - 3view (round3):
- round1: new FR and SP tune
- round2: round1 + tightened Wiener filter
- round3: round2 + further adjustment in ROI thresholds

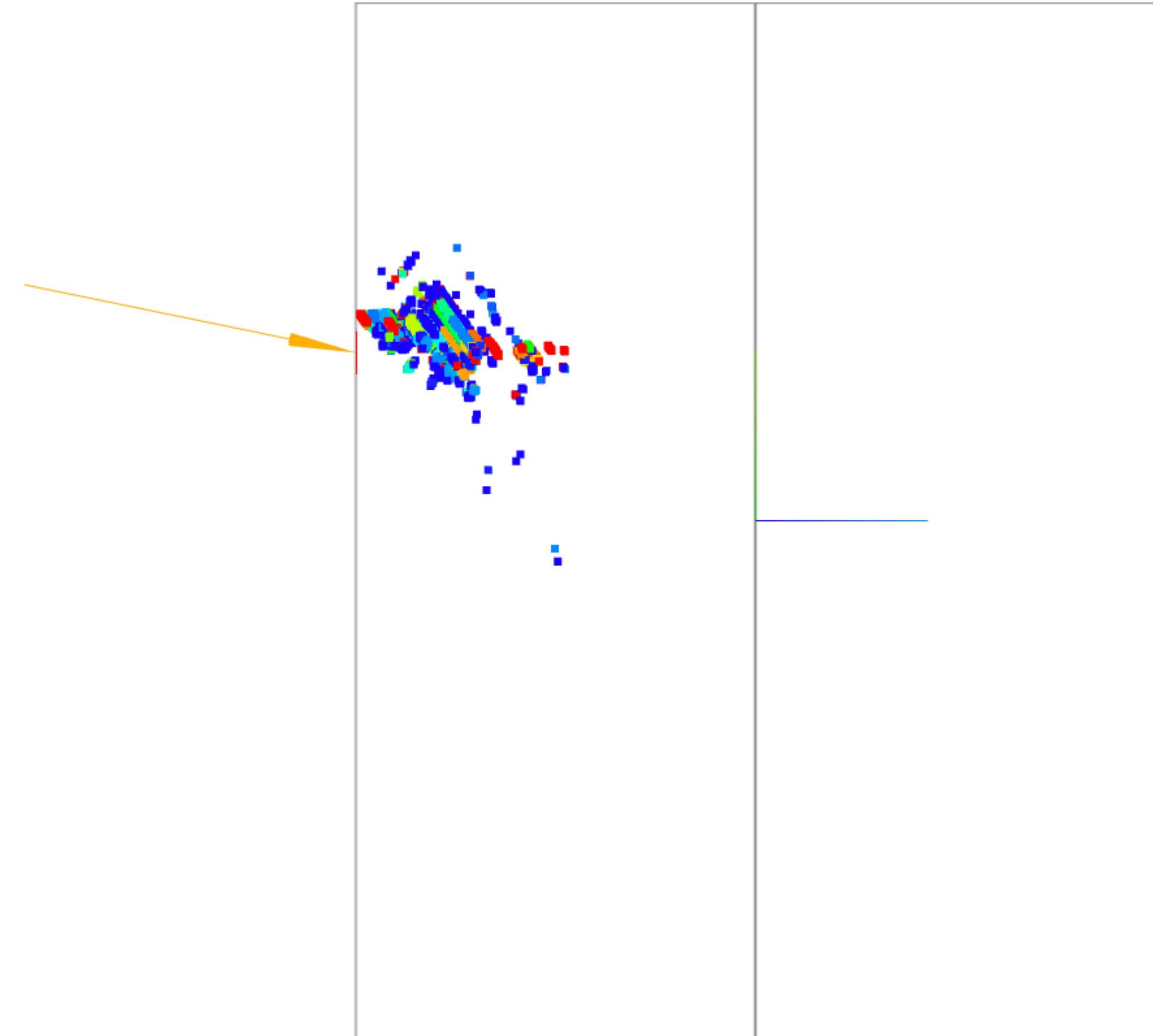


3D imaging for showers?

- after Wenqiang's latest SP tune (stringent Wiener filter), 3-view
- APA1: <https://www.phy.bnl.gov/twister/bee/set/3bbe60ee-545f-4f03-8cf9-ca7857ac1fe3/event/0/>
- APA2: <https://www.phy.bnl.gov/twister/bee/set/a246dca7-3fe1-41a9-bf5f-8198b8091e02/event/0/>
- APA3: <https://www.phy.bnl.gov/twister/bee/set/g1f8f803-076e-4ad4-8035-552f65144c28/event/0/>
- APA4: <https://www.phy.bnl.gov/twister/bee/set/8512c5fa-5413-4bc2-baa7-445842bddge2/event/0/>

Electron particle gun, APA1

- With 'normal' field response (not the modified one that reflects 0-field W plane)
- 1 electron shower, same direction as the beam
 - isochronous-like
- BEE: <https://www.phy.bnl.gov/twister/bee/set/ea613fe4-27ed-4ff0-93d7-855a976becae/event/0/>

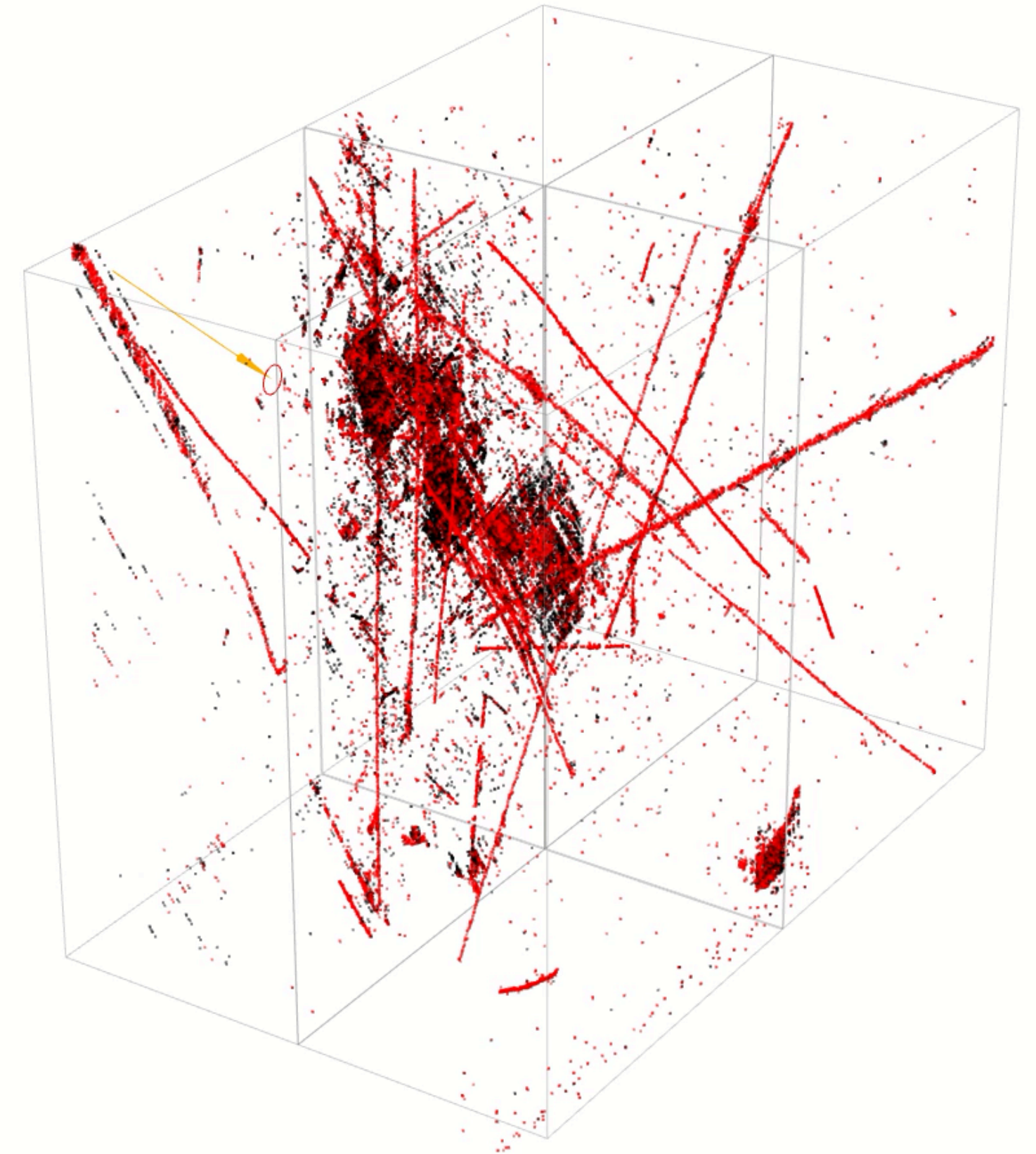


PD-HD beam data imaging (Run 27380)

- Default (after APA1 S-P tune from Wenqiang/Xuyang): <https://www.phy.bnl.gov/twister/bee/set/4c9cf187-9101-433e-935b-bab98f441a0c/event/0/>
- ROI further tuned (2.5 instead of 5): <https://www.phy.bnl.gov/twister/bee/set/01622157-bf40-43e3-9dee-4b5e34434a77/event/0/>

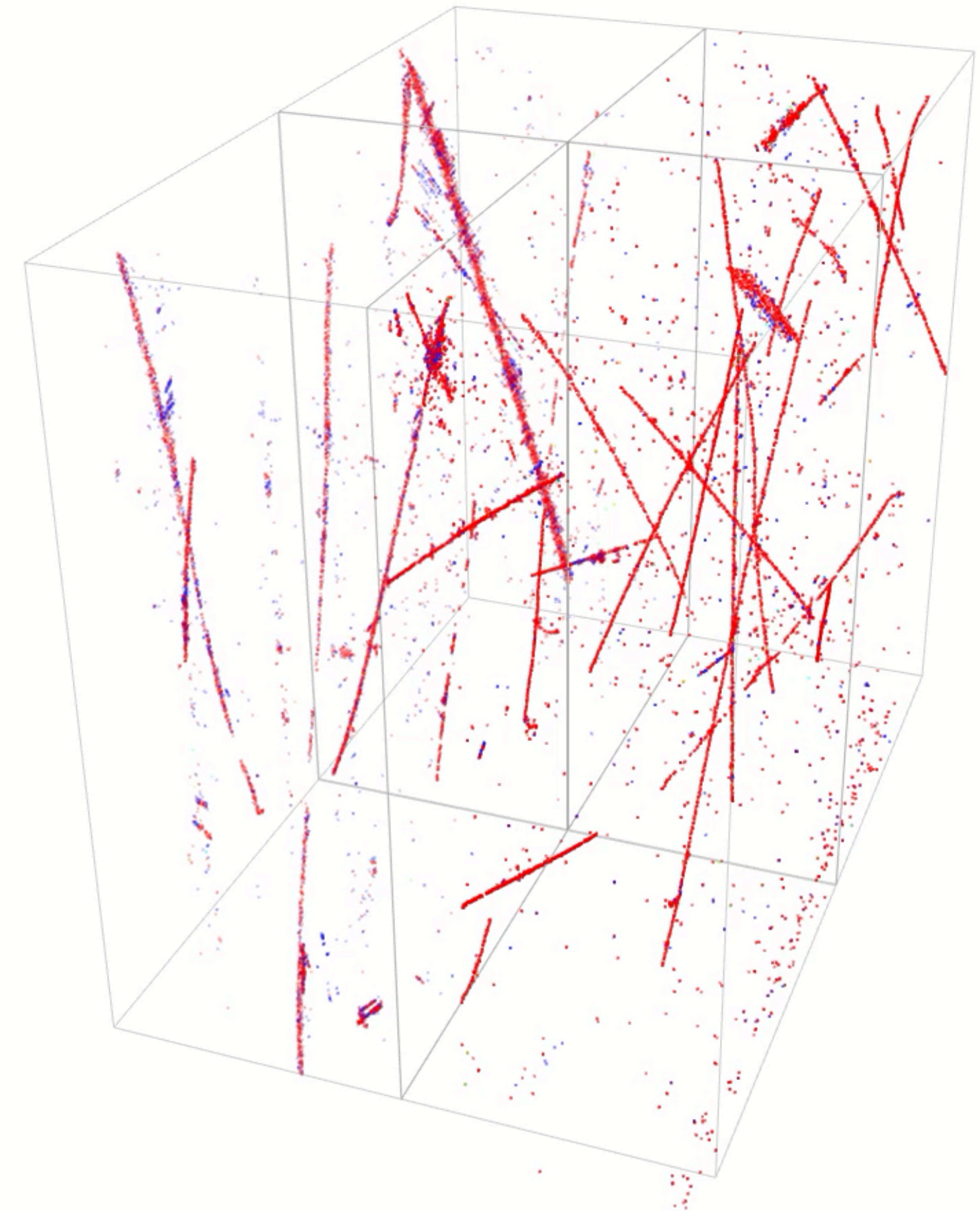
PD-HD beam data (Run 27304)

- <https://www.phy.bnl.gov/twister/bee/set/obb42699-c2b7-4cb5-b1a0-338951595564/event/0/>



PD-HD cosmic data (run26763)

- <https://www.phy.bnl.gov/twister/bee/set/5c7cf291-abb9-4baa-86d7-55d6738578be/event/o/>



PD-HD Neutrino candidate events

- Based on Dario's hand-scan: <https://indico.fnal.gov/event/66567/#preview:250664>
- With modified PDHD APA1 field response (np04hd-garfield-6paths.json.bz2)
- With Wenqiang/Xuyang's latests? APA1 sigproc tune
- Run 29425 Subrun 887 Event 67538:
<https://www.phy.bnl.gov/twister/bee/set/34b9b126-237e-4803-a6f9-cb1054df0071/event/o/>
- Run 29425 Subrun 1125 Event 73066:
<https://www.phy.bnl.gov/twister/bee/set/g790067c-bc10-4d8c-gbb0-48e2fc91f7e1/event/o/>
- Run 29425 Subrun 1140 Event 74064:
<https://www.phy.bnl.gov/twister/bee/set/bb09e275-90ed-44ae-8b8a-c63acd809c5e/event/o/>

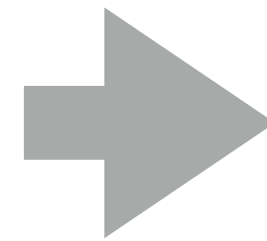
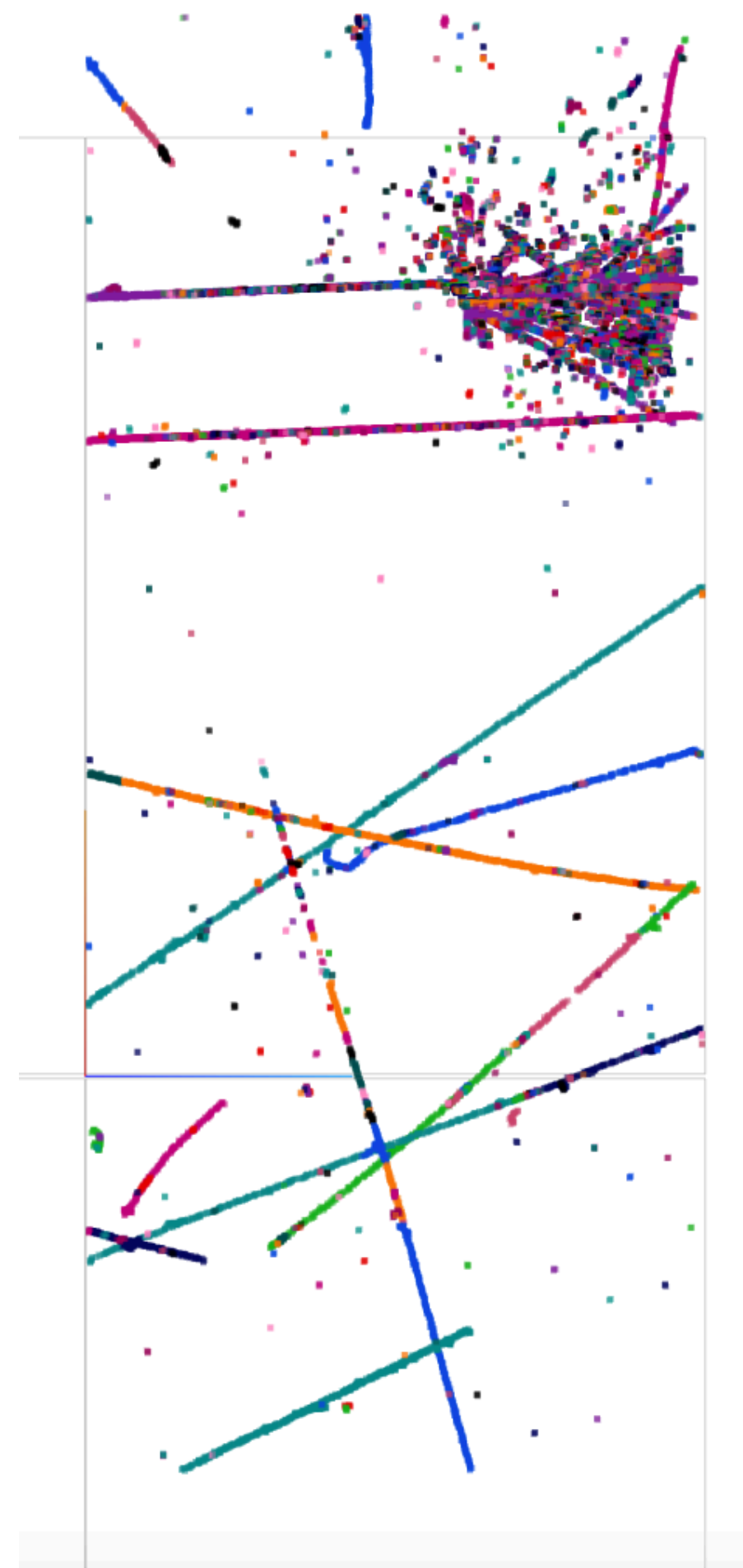
PD-HD Neutrino candidate events

- Based on Dario's hand-scan: <https://indico.fnal.gov/event/66567/#preview:250664>
- With modified PDHD APA1 field response (np04hd-garfield-6paths.json.bz2)
- With Wenqiang/Xuyang's latests? APA1 sigproc tune
- **deghosting turned on**
- Run 29425 Subrun 887 Event 67538:
<https://www.phy.bnl.gov/twister/bee/set/0gbaebd0-b43d-4379-b2b5-c0fcf6ae2f0f/event/0/>

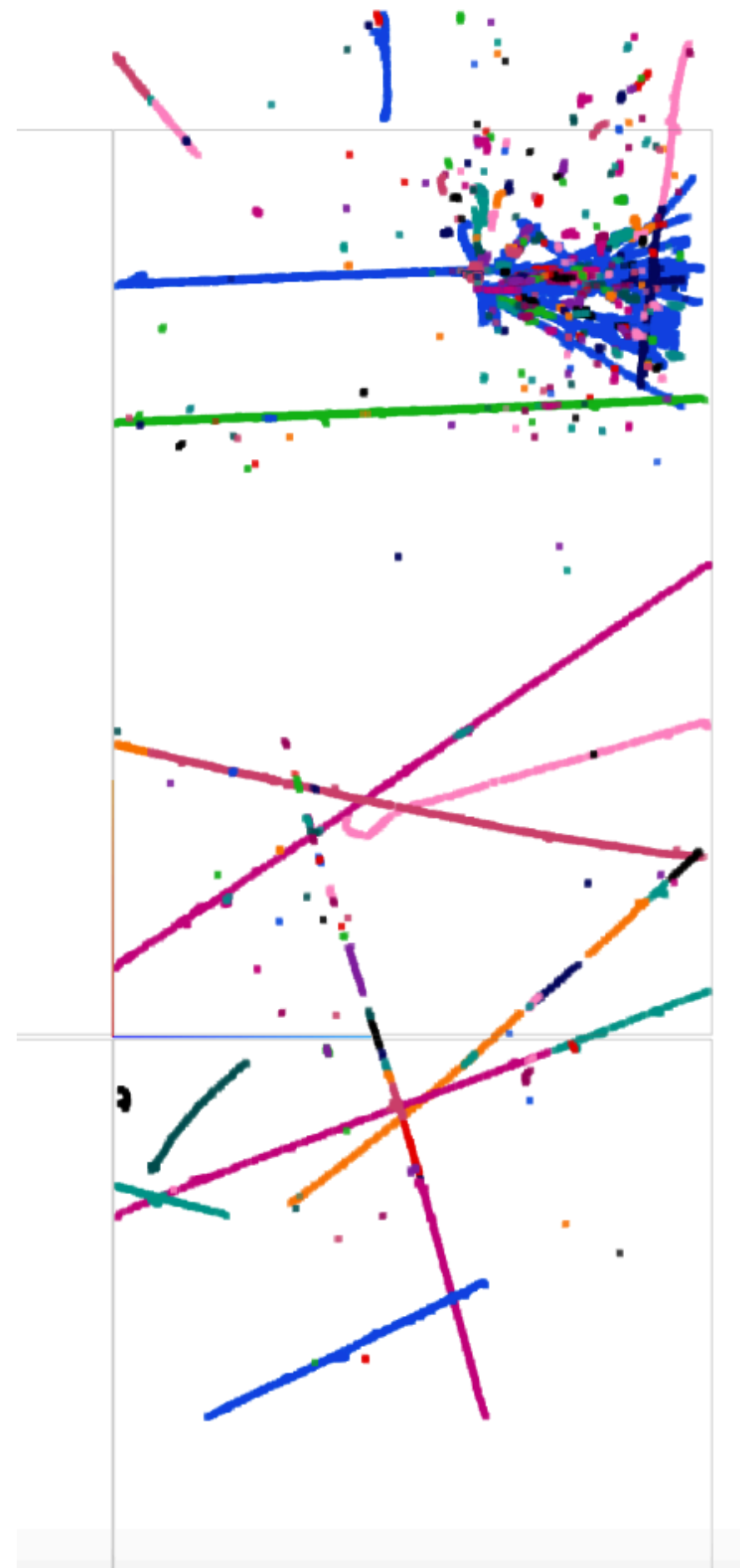
PD-HD Neutrino candidate events

- Run 29425 Subrun 887 Event 67538:
<https://www.phy.bnl.gov/twister/bee/set/ogbaebd0-b43d-4379-b2b5-c0fcf6ae2f0f/event/0/>

without deghosting



with deghosting



Plan for imaging performance check

- before Imaging
 - inefficiency in high angle track: due to Signal processing?
 - DNN ROI will help
- during imaging
 - list/check tunable parameters in tiling, solving, deghosting
 - optimize: will be needing evaluation tool
- after imaging
 - clustering getting ready for PD: check performance after