



Wire-Cell ProtoDUNE Local Meeting

Yujin Park
Chung-Ang University
Apr 22, 2026 (Wed)

Wire-Cell 3D Imaging & Clustering

Blob Depo Fill: Time_offset Tuning

Grid Search using Point Depos

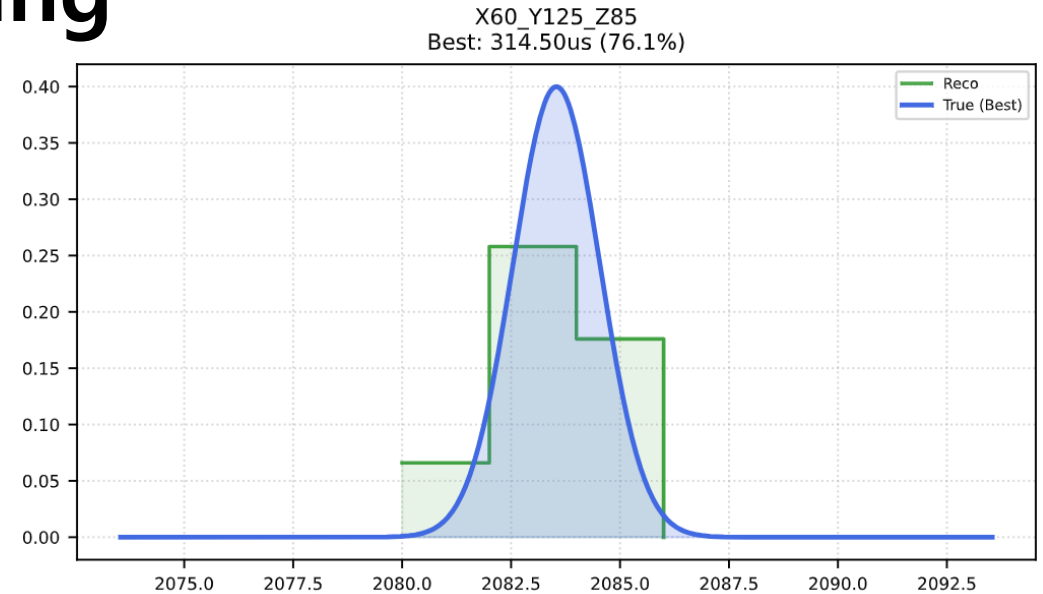
- Instead minimize charge different between depo and blobs, use a simpler method.
- Normalize total charge.
- Maximize the overlap area.

To check position dependence,

- Generate localized point depos at 27 different positions
- Spherical grid generation at each center: 50 cm radius with 25 cm spacing.
- Find the best time offset by maximizing the averaged overlap area within each sphere.

```
X_CENTERS=(60 170 280)  
Y_CENTERS=(100 300 500)  
Z_CENTERS=(60 115 170)
```

33x27 = 891 point depos for tuning



Wire-Cell 3D Imaging & Clustering

Blob Depo Fill: Time_offset Tuning

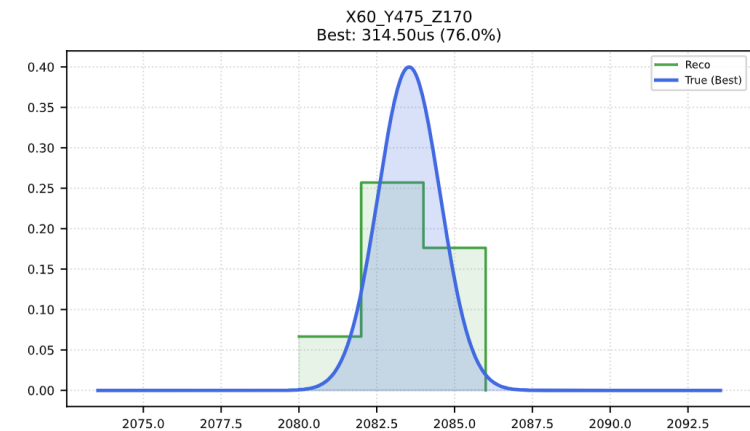
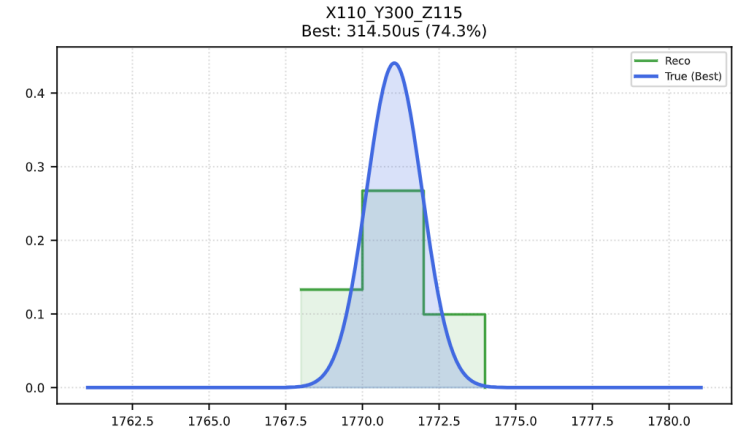
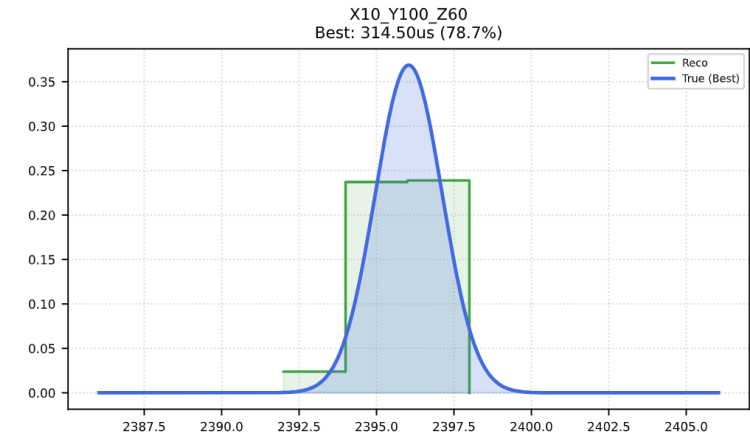
FINAL SUMMARY

- 314.0 us Group : 1 Centers
- 314.5 us Group : 26 Centers

- Far from the anode: ~75% overlap

[Group: Best Offset = 314.5 us]
 - Total Centers in this group: 26

- center_X60_Y100_Z60	Avg Overlap: 75.37%
- center_X60_Y100_Z115	Avg Overlap: 75.69%
- center_X60_Y100_Z170	Avg Overlap: 75.50%
- center_X60_Y300_Z60	Avg Overlap: 75.35%
- center_X60_Y300_Z115	Avg Overlap: 75.53%
- center_X60_Y300_Z170	Avg Overlap: 75.55%
- center_X60_Y500_Z60	Avg Overlap: 75.34%
- center_X60_Y500_Z115	Avg Overlap: 75.48%
- center_X60_Y500_Z170	Avg Overlap: 75.68%



Wire-Cell 3D Imaging & Clustering

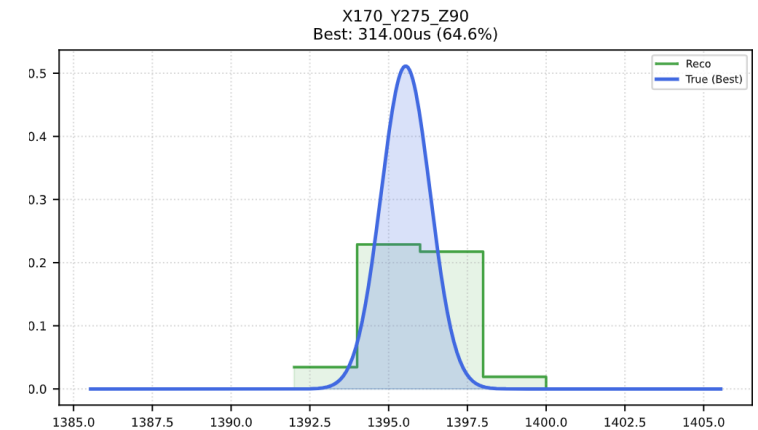
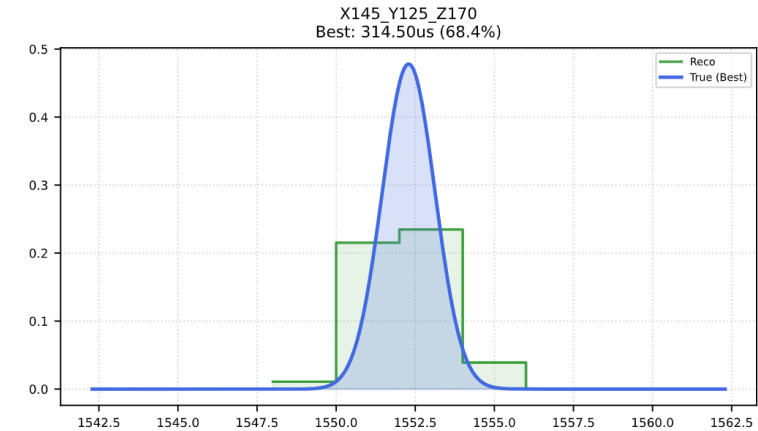
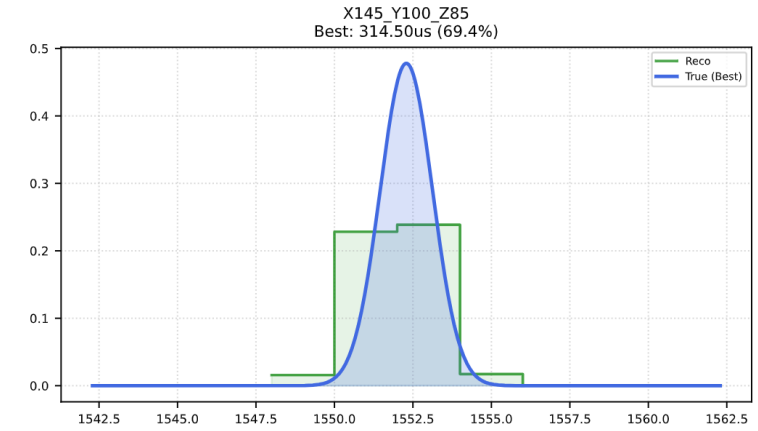
Blob Depo Fill: Time_offset Tuning

FINAL SUMMARY

- 314.0 us Group : 1 Centers
- 314.5 us Group : 26 Centers

- Center of the drift volume: ~66% overlap

- center_X170_Y100_Z60	Avg Overlap: 66.33%
- center_X170_Y100_Z115	Avg Overlap: 65.98%
- center_X170_Y100_Z170	Avg Overlap: 66.31%
- center_X170_Y300_Z115	Avg Overlap: 66.08%
- center_X170_Y300_Z170	Avg Overlap: 66.48%
- center_X170_Y500_Z60	Avg Overlap: 66.43%
- center_X170_Y500_Z115	Avg Overlap: 66.12%
- center_X170_Y500_Z170	Avg Overlap: 66.63%



Wire-Cell 3D Imaging & Clustering

Blob Depo Fill: Time_offset Tuning

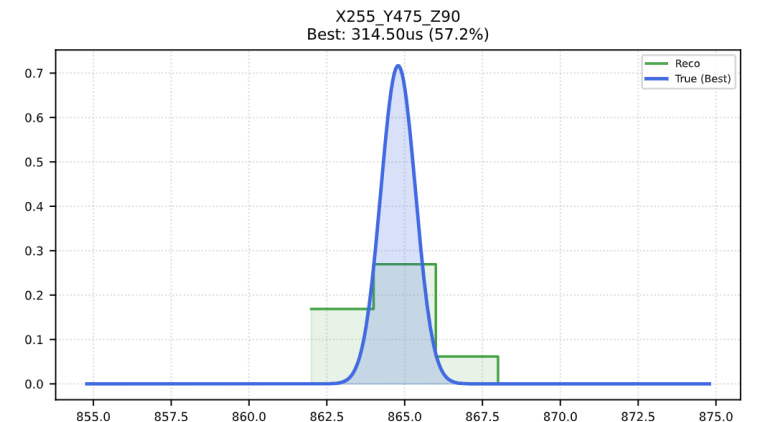
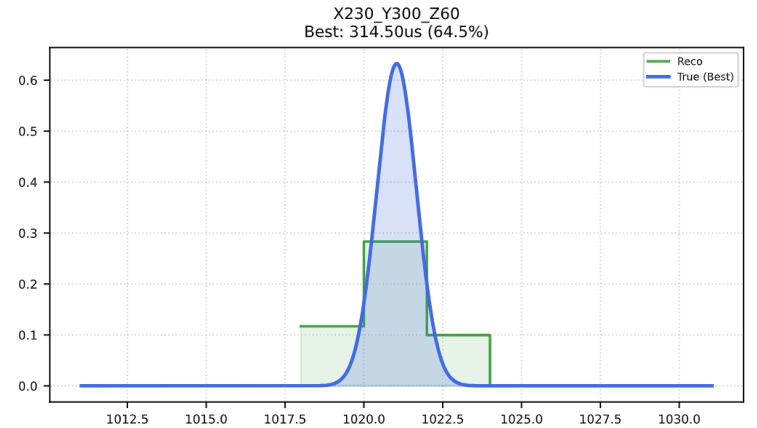
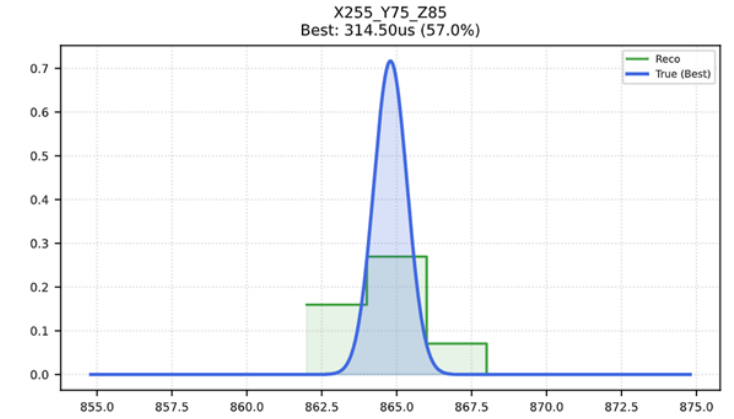
FINAL SUMMARY

- 314.0 us Group : 1 Centers
- 314.5 us Group : 26 Centers

- Near the anode: ~48% overlap

- center_X280_Y100_Z60	Avg Overlap: 48.55%
- center_X280_Y100_Z115	Avg Overlap: 48.66%
- center_X280_Y100_Z170	Avg Overlap: 48.68%
- center_X280_Y300_Z60	Avg Overlap: 48.62%
- center_X280_Y300_Z115	Avg Overlap: 48.67%
- center_X280_Y300_Z170	Avg Overlap: 48.83%
- center_X280_Y500_Z60	Avg Overlap: 48.66%
- center_X280_Y500_Z115	Avg Overlap: 48.65%
- center_X280_Y500_Z170	Avg Overlap: 48.74%

- ✓ Average overlap area depends on only drift time.
- ✓ Less overlap areas are due to small longitudinal diffusion.
- ✓ The peak positions of the depo and blobs are well-matched



Wire-Cell 3D Imaging & Clustering

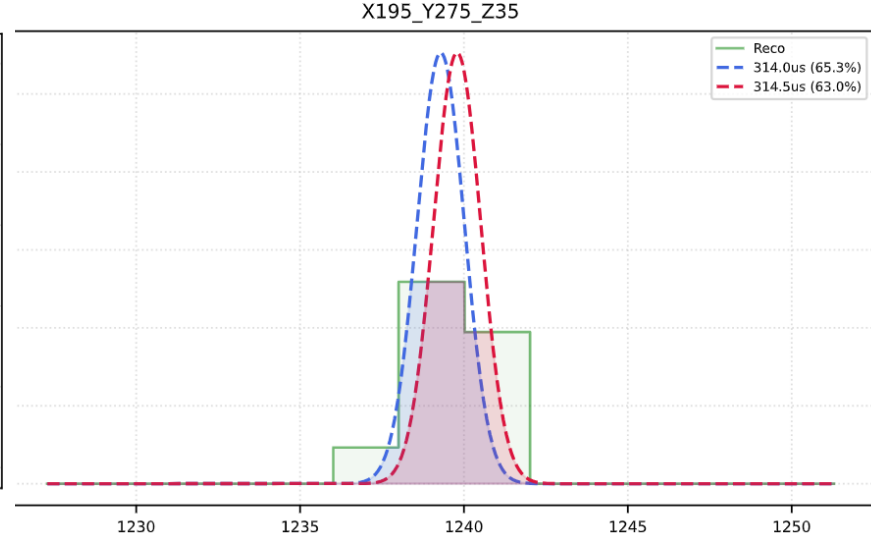
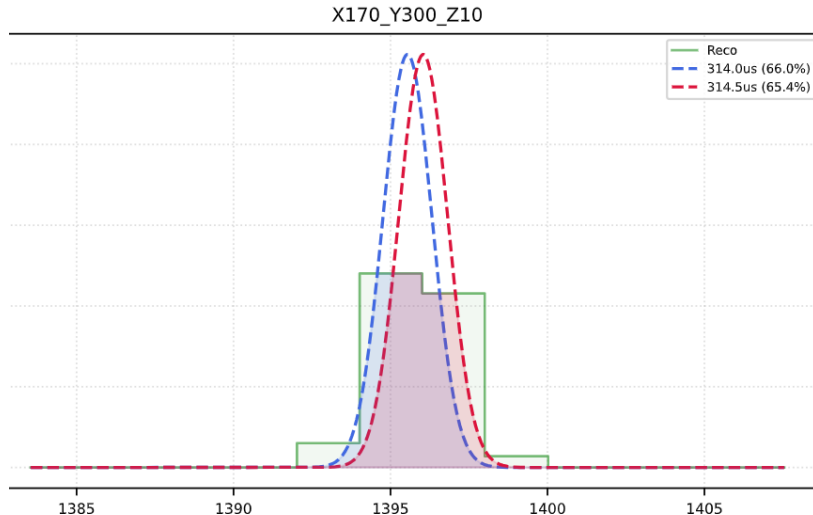
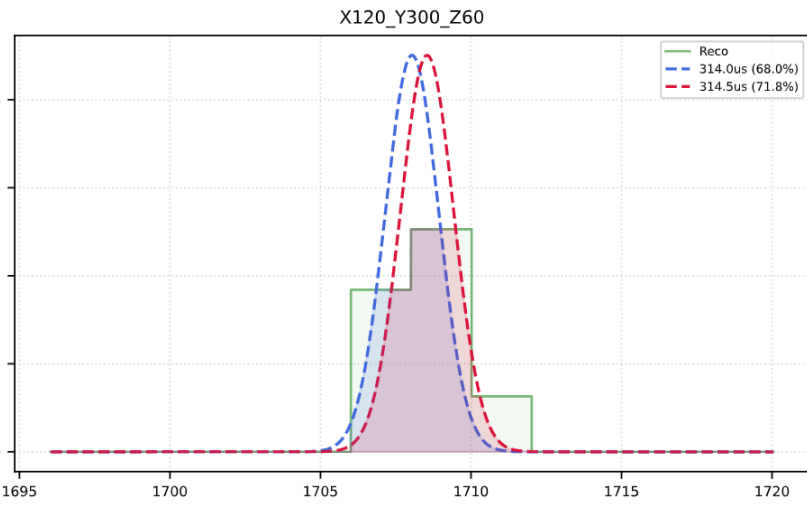
Blob Depo Fill: Time_offset Tuning

- One case with 314.0 us

```
[ Group: Best Offset = 314.0 us ]  
- Total Centers in this group: 1  
-----  
- center_X170_Y300_Z60 | Avg Overlap: 66.37%
```

```
=====   
FINAL AGGREGATION FOR center_X170_Y300_Z60   
=====   
- Center Mean Overlap at 314.0 us : 66.3713%   
- Center Mean Overlap at 314.5 us : 66.3611%
```

✓ The averaged overlap areas for 314us & 314.5us are similar.



Backup

Wire-Cell 3D Imaging & Clustering

Blob Depo Fill: Adding true info in the conventional pipeline

Metrics

- Two metrics for 3D Imaging performance evaluations in the **Blob level**

blob size -> charge smearing
ghost evaluation
de-ghosting algorithm performance

$$\text{Purity} = \frac{\text{Number of blobs with non-zero true charge}}{\text{Total number of reconstructed blobs}}$$

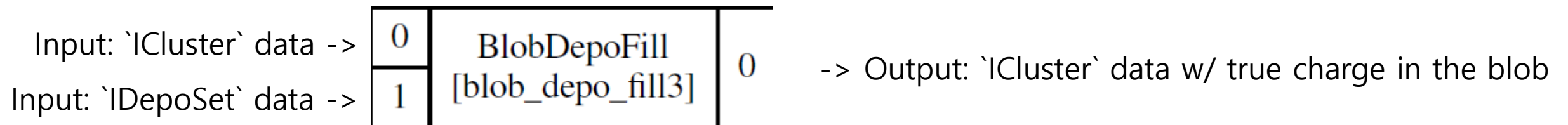
$$\text{Efficiency} = \frac{\text{Total true charge in blob}}{\text{Total true charge}}$$

BlobDepoFill

(<https://github.com/WireCell/wire-cell-toolkit/blob/18a8a5c06c8f8001e8dea5e3a577570ee473b79b/img/src/BlobDepoFill.cxx#L2>)

- Replace charges of reco blob with true charges in the blobs
- This node only replace the charge info, not position info, giving the position of reco blob

→ BlobDeopFill approach can be used for only evaluating about charge

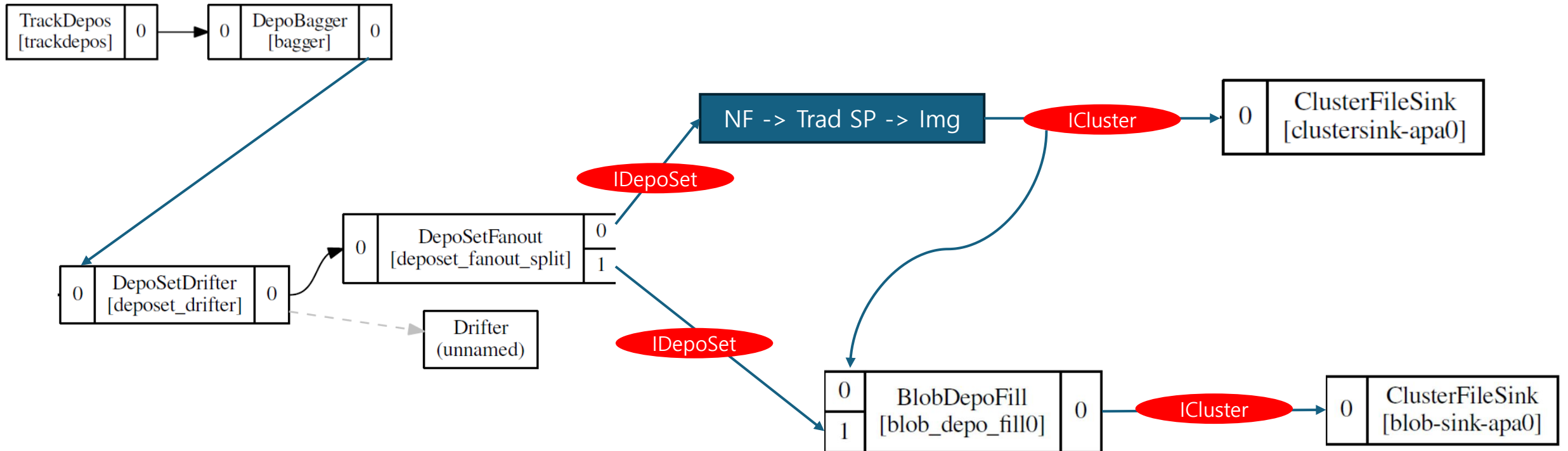


Wire-Cell 3D Imaging & Clustering

Blob Depo Fill: Adding true info in the conventional pipeline

New PDHD configuration including BlobDepoFill nodes

- Wire-Cell standalone simulation: NF -> Trad SP -> Img
- Add BlobDepoFill nodes to the conventional img pipeline



Wire-Cell 3D Imaging & Clustering

Blob Depo Fill: Adding true info in the conventional pipeline

✓ Zero charge in BlobDepoFill is due to the time offset value

PDHD : Single track sim(apa2, thetaXZ=45 deg)

```
blob_depo_fill(anode, name, drift_speed=params.lar.drift_speed) :: g.pnode({
  type: "BlobDepoFill",
  name: "blobdepo-filler-%s"%name,
  data: {
    // fixme, breaks detector independence
    speed: drift_speed, //1.56*wc.mm/wc.us,
    time_offset: 312.5*wc.us, //314*wc.us,
```

- **drift_speed: 1.6 mm/us**
- **time_offset: 0 -> 312.5 us**

The values came from `'sim.ducto.start_time'` in PDHD `'params.jsonnet'`

```
ducto : {
  nticks: $.daq.nticks + response_nticks,
  readout_time: self.nticks * $.daq.tick,
  start_time: tick0_time - response_time_offset,
},

local response_time_offset = $.det.response_plane / $.lar.drift_speed,
```

- tick0_time = -250 us (the absolute time of the first tick)
- response_plane = 10cm (where the field response functions start)
- response_time_offset = 62.5us
- **start_time = - 312.5 us**