



Wire-Cell ProtoDUNE Local Meeting

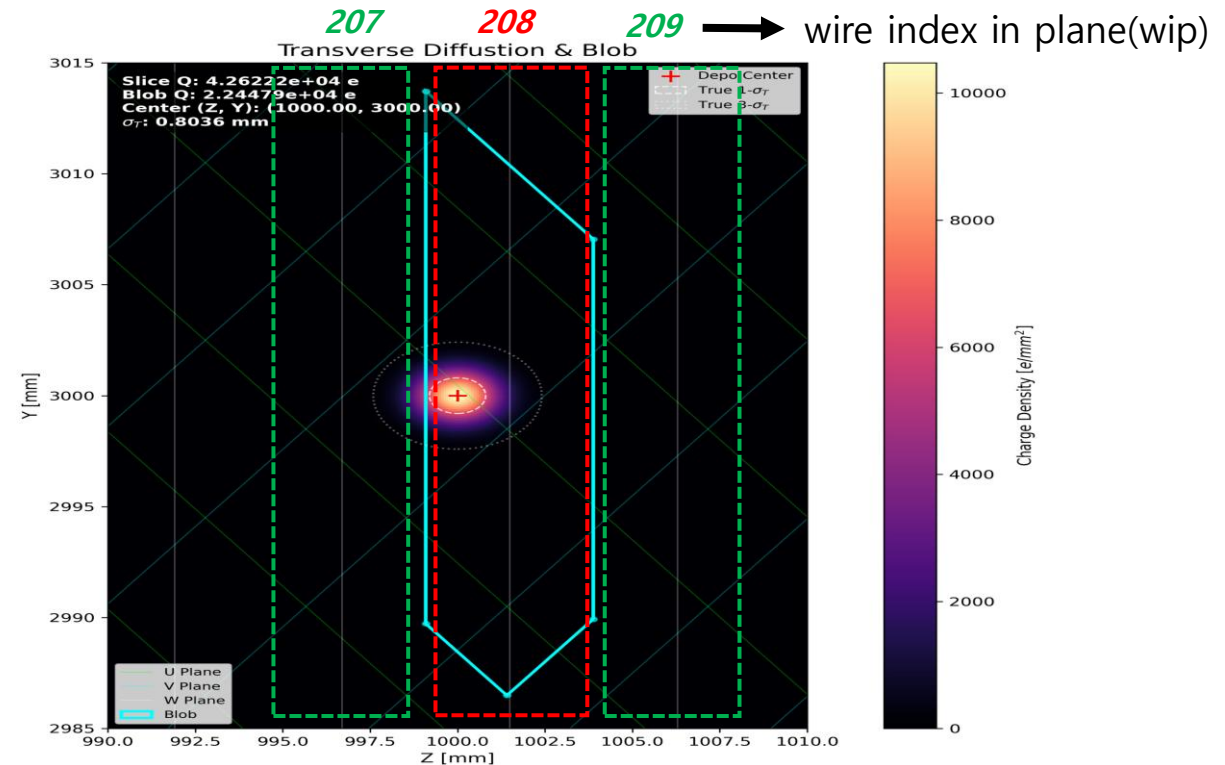
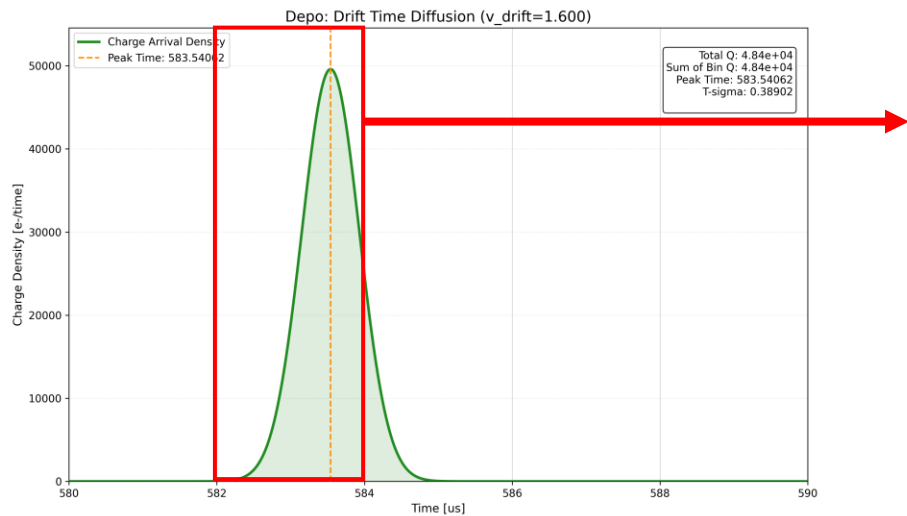
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Chung-Ang University
May 13, 2026 (Wed)

Wire-Cell 3D Imaging & Clustering

BlobDepoFill Debugging

- Bug related to Binning

Point depo at x = 300cm



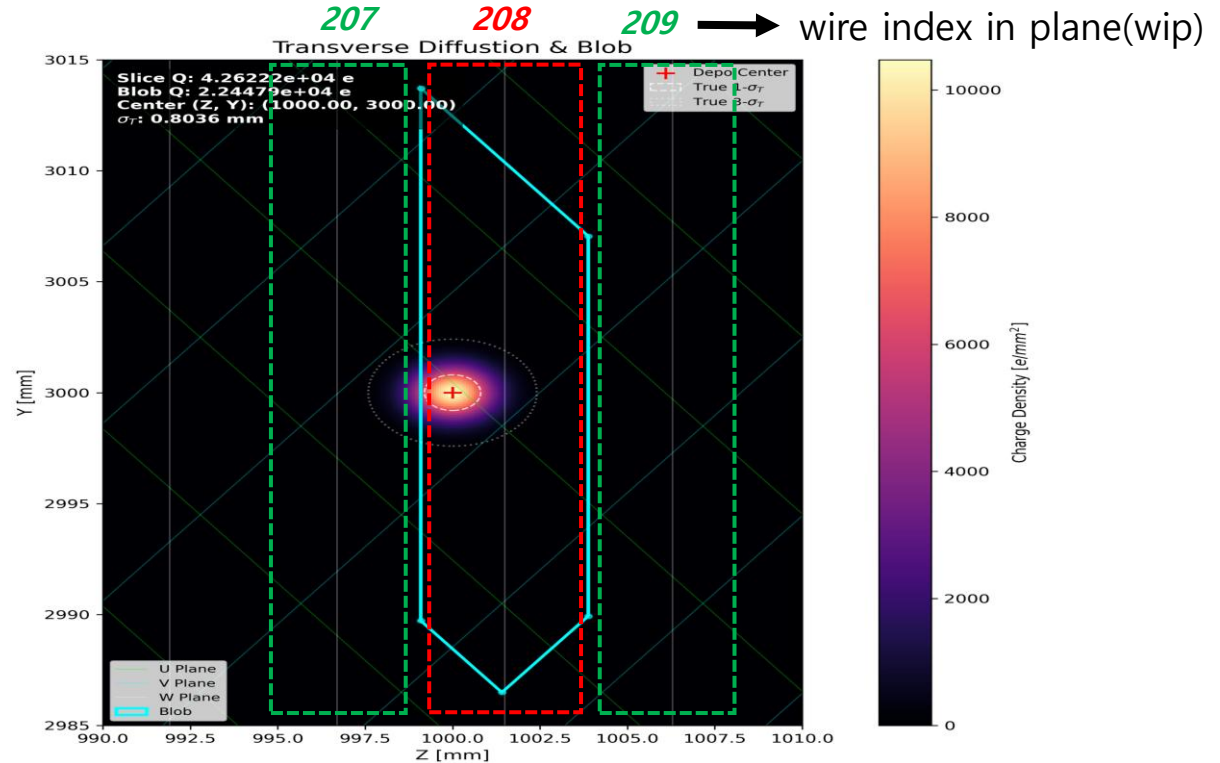
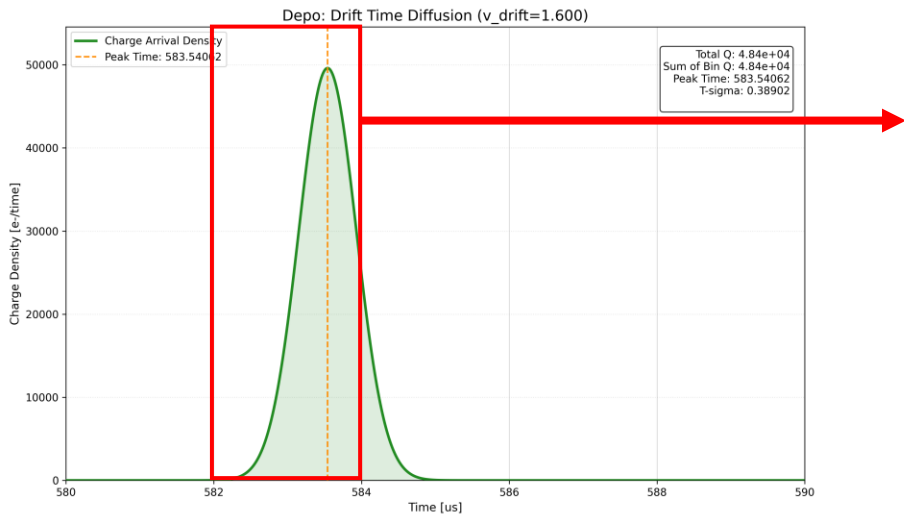
- BlobDepoFill gives true charge existing on the overlapping wire region with both depo and blob.
 - Blob** : existing on wire region with index **208**
 - Depo** : existing on wire region with index **207 (~12.89%) & 208 (~87.13%)**
- So, charge on 208 wire region should be the true charge for this case.

Wire-Cell 3D Imaging & Clustering

BlobDepoFill Debugging

- **Bug related to Binning**

Point depo at $x = 300\text{cm}$



- In the source code ([BlobDepoFill](#)),
- the wire region of the blob is correctly identified as 208
- But, the wire region of the depo is given by 207 which is mis-identified.

→ No overlapping region is existing, so BlobDepoFill returns zero charge.

Wire-Cell 3D Imaging & Clustering

BlobDepoFill Debugging

<https://github.com/WireCell/wire-cell-toolkit/issues/473>

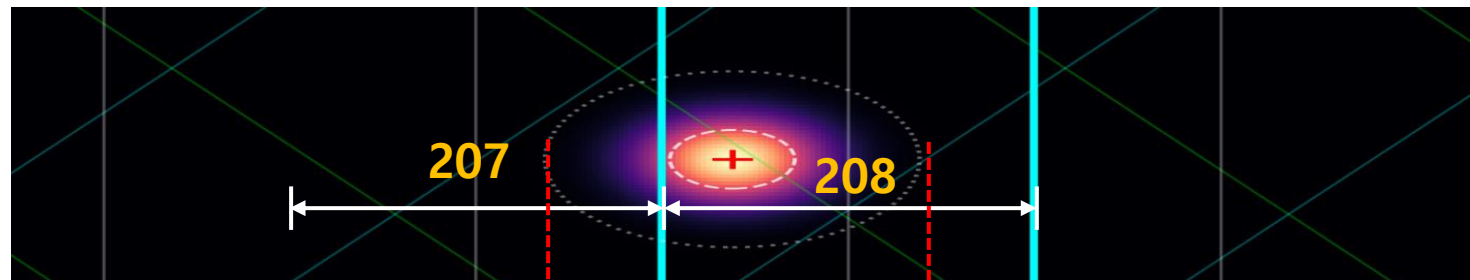
- The problem is due to wrong binning for depo.

#L140-145 of the source code

```
140 // (x,y,z) -> (normal, wire, pitch);
141 const auto wpos = pimpos.transform(idepo->pos());
142 const double wmean = wpos[2]; // pitch
143 const double wsigma = idepo->extent_tran();
144
145 auto wbins = subset(pbins, wmean-wsigma*nsigma, wmean+wsigma*nsigma);
```

#113-122 of Binning.h

```
113 Binning subset(const Binning& bins, double xmin, double xmax) {
114     if (xmin > xmax) std::swap(xmin, xmax);
115     const int lo = std::max(0, bins.bin(xmin)); 207
116     const int hi = std::min(bins.nbins(), bins.bin(xmax)); 208
117     const int n = hi-lo; 1
118     if (n <= 0) {
119         return Binning();
120     }
121     return Binning(hi-lo, bins.edge(lo), bins.edge(hi));
122 }
```



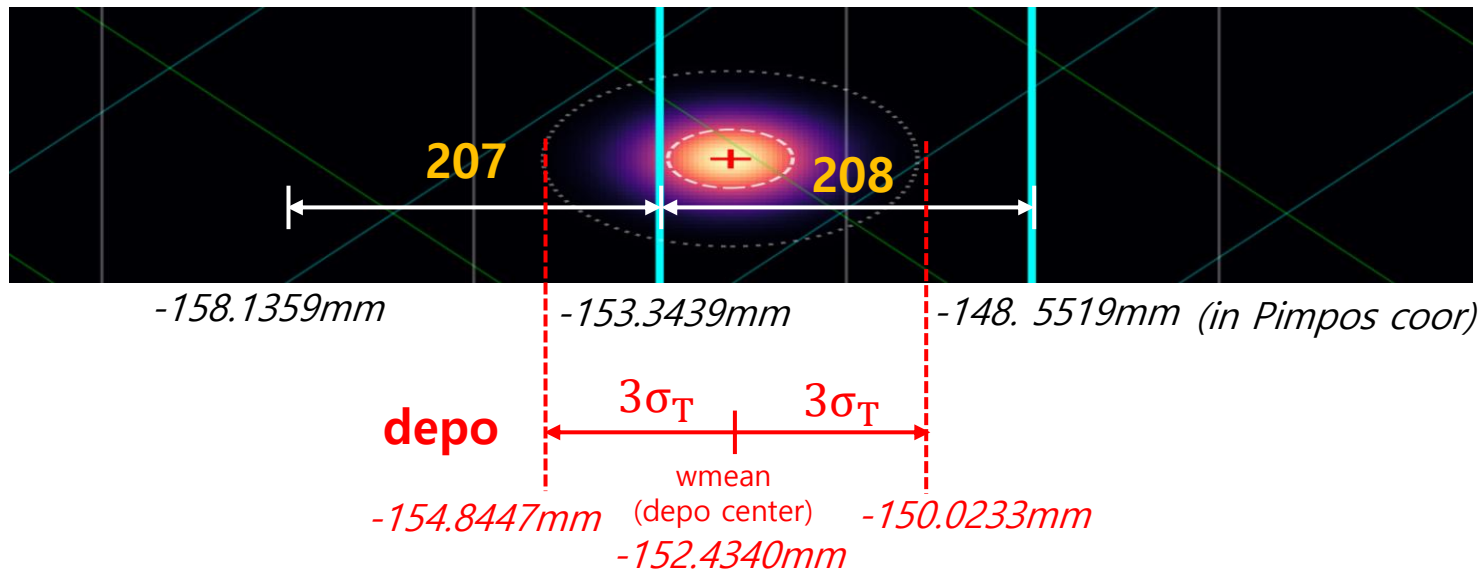
-158.1359mm -153.3439mm -148.5519mm (in Pimpos coord)

depo
 $3\sigma_T$ $3\sigma_T$
 wmean
 (depo center)
 -154.8447mm -150.0233mm
 -152.4340mm

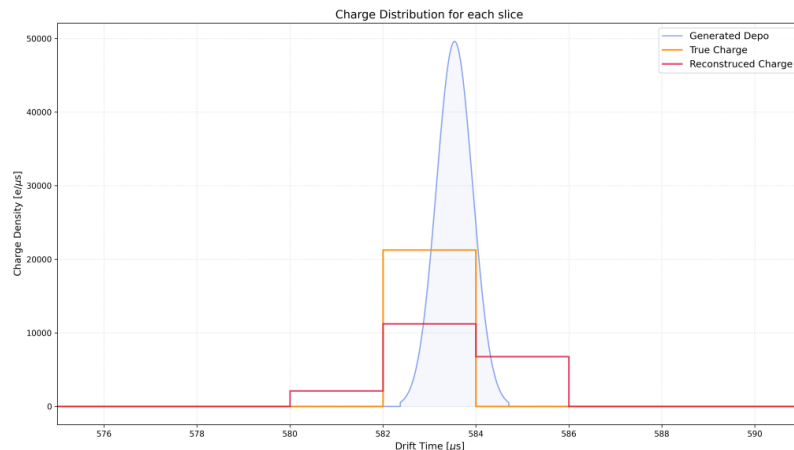
→ Give a bin range (-158,1359mm, 153.3439) which is the 207 wire region

Wire-Cell 3D Imaging & Clustering

BlobDepoFill Debugging



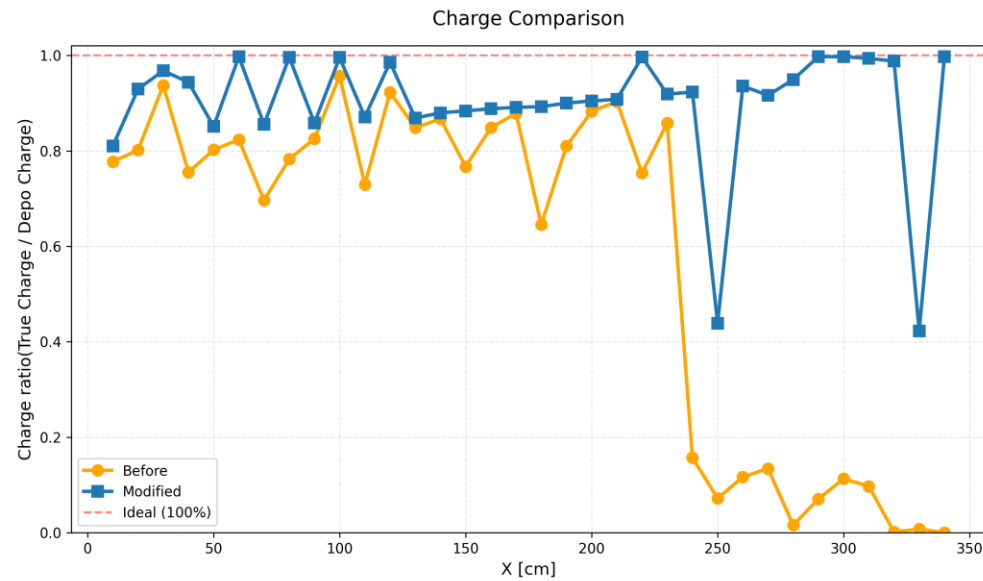
- For $6\sigma_T \sim \text{binsize}$ (4.72mm), this unintended bin drop occurs.
- ➔ Use $2n\sigma_T$ range with $n > 3$ OR Modify the binning algorithm to find depo range properly



Charge in depo : 48372 e-
 Reco charge : 22448 e- (~46%)
 True charge : 42507.08 e- (~87%)

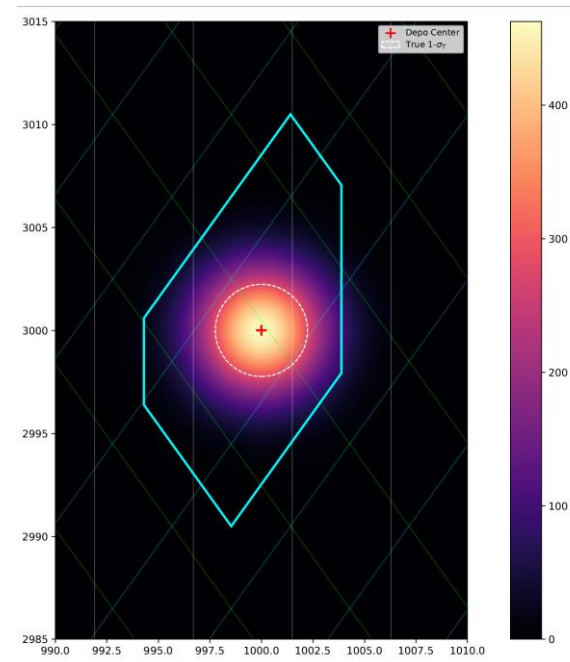
Wire-Cell 3D Imaging & Clustering

BlobDepoFill Debugging



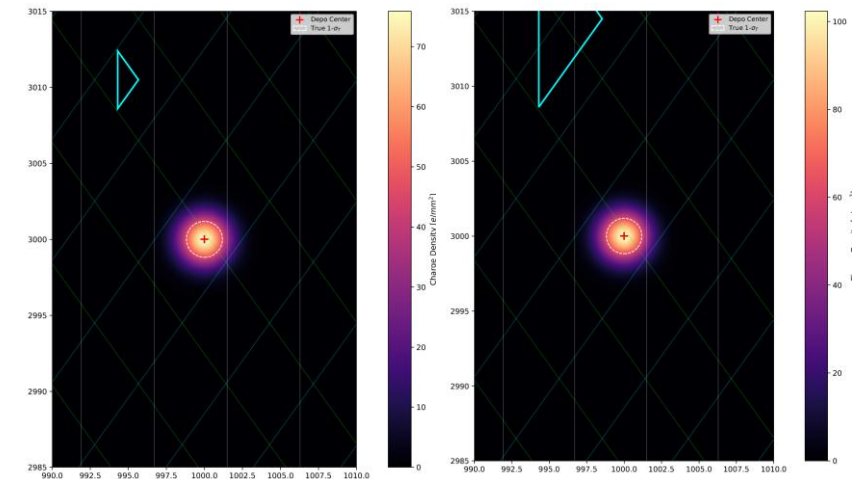
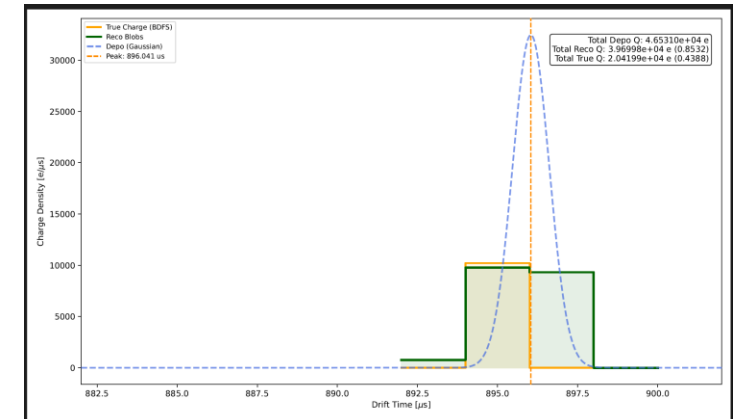
- Improvement is observed in the region near the anode.
- Some cases like:

e.g. 10cm



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e.g. 250cm

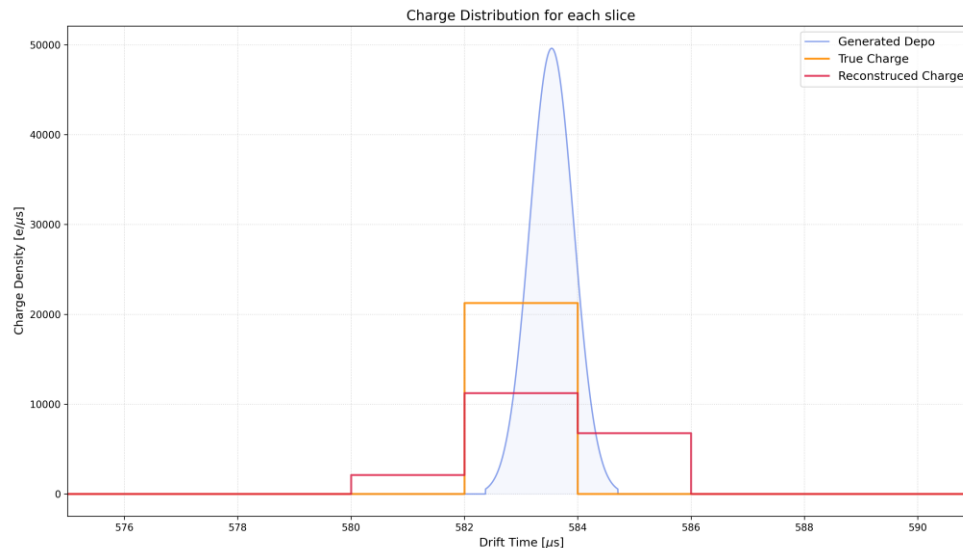
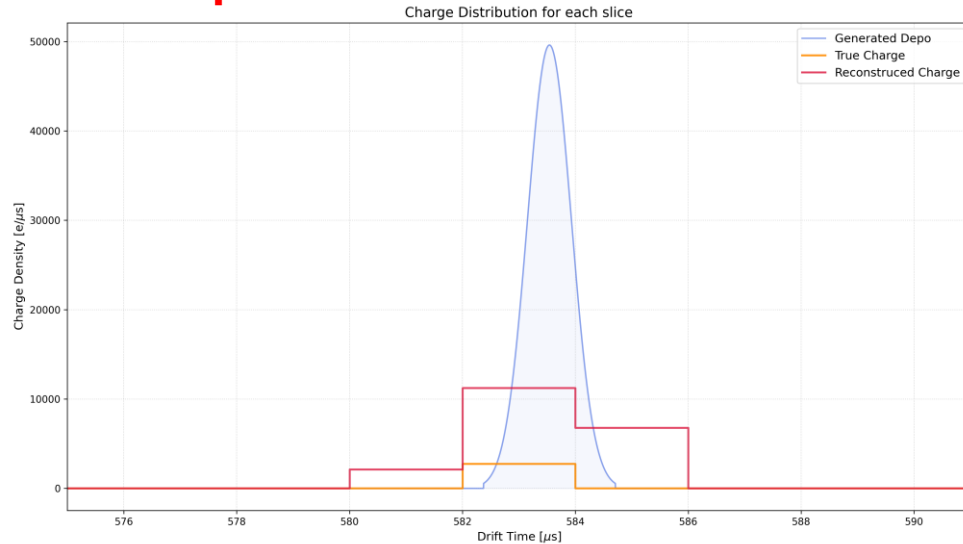


Backup

Wire-Cell 3D Imaging & Clustering

BlobDepoFill Debugging

Point depo at x = 300mm



$$Q_{true} = (1. "sd weight") \times (2. "dw weight") \times (3. "w weight") \times Q_{depo}$$

- $\sigma_T = 0.8036$ nsigma = 3
 - only one wire was included for charge calculation.
 - $dw weight = 0.12874402336693608$

Charge in depo : 48372 e-

True charge : 5472.533 e- (11%)

- $\sigma_T = 0.8036$ nsigma = 50 (extreme case),
 - 17 wires were included for charge calculation.
 - $dw weight = 0.8712552979400132$
 - $dw weight = 0.12874402336693608$
 - Other wire contributions are negligible

Charge in depo : 48372 e-

True charge : 42507.08 e- (87%)

Wire-Cell 3D Imaging & Clustering

BlobDepoFill Debugging

<https://github.com/WireCell/wire-cell-toolkit/blob/41e4b7ec9d06bfc195b18c8d4db7f016f202061b/img/docs/talks/blob-depo-fill.org>

The true charge from BlobDepoFill is came from 3D integration of:

1. drift direction (for one chosen time slice),
2. pitch direction (for one chosen plane),
3. wire direction (bound by each blob).

For each sensing wire,

$$Q_{true} = (1. "sd weight") \times (2. "dw weight") \times (3. "w weight") \times Q_{depo}$$



- How slices divided the charge in the **longitudinal direction**.
- Considering slices in $[t_{mean} - 3\sigma_L, t_{mean} + 3\sigma_L]$
 - t_{mean} : center time of depo + time offset
 - σ_L : Longitudinal extent of a depo at anode
 - nsigma= 3 : The number of sigma of depo Gaussian to consider

```
// first we slice
{
    const double tmean = idepo->time() + time_offset;
    const double tsigma = idepo->extent_long()/speed;
    const double tmin = tmean - tsigma*nsigma;
    const double tmax = tmean + tsigma*nsigma;
    const Binning tbins = subset(sbins, tmin, tmax);
    const auto ntbins = tbins.nbins();
    if (ntbins) {
        std::vector<double> weights(ntbins);
        gaussian(weights.begin(), tbins, tmean, tsigma);

        for (int it=0; it<ntbins; ++it) {
            const idweight::vdesc_t sdesc = sbins.bin(tbins.center(it));
            boost::add_edge(sdesc, ddesc, {weights[it]}, gr);
        }
    }
}
```

Wire-Cell 3D Imaging & Clustering

BlobDepoFill Debugging

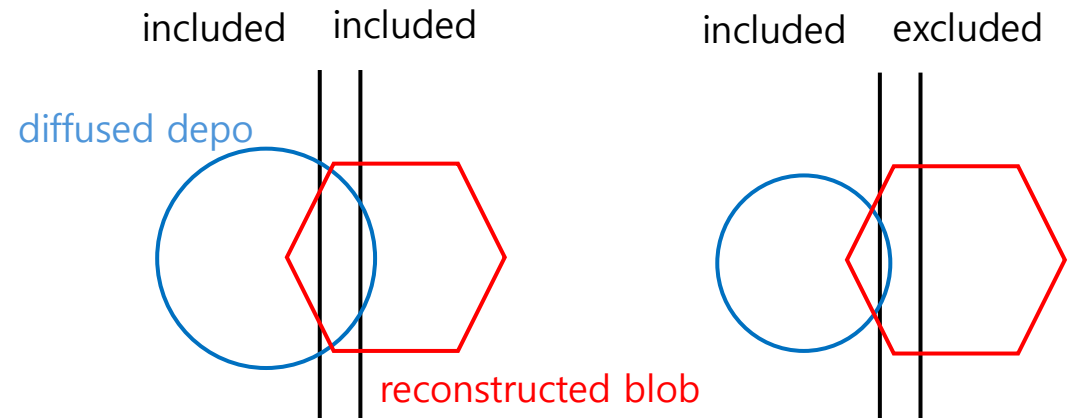
$$Q_{true} = (1. "sd\ weight") \times (2. "dw\ weight") \times (3. "w\ weight") \times Q_{depo}$$



- How wires divided the charge in the **transverse direction**.
- Considering wires in $[w_{mean} - 3\sigma_T, w_{mean} + 3\sigma_T]$ and in blob range
- σ_T : transvers extent of a depo at anode
- nsigma= 3 (share with slice part)

-> If nsigma is too small, wires carrying significant charge could be excluded.

```
// (x,y,z) -> (normal, wire, pitch);  
const auto wpos = pimpos.transform(idepo->pos());  
const double wmean = wpos[2]; // pitch  
const double wsigma = idepo->extent_tran();  
  
auto wbins = subset(pbins, wmean-wsigma*nsigma, wmean+wsigma*nsigma);  
const auto nwbins = wbins.nbins();  
if (nwbins) {  
    std::vector<double> weights(wbins.nbins(), 0);  
    gaussian(weights.begin(), wbins, wmean, wsigma);  
}
```



Wire-Cell 3D Imaging & Clustering

BlobDepoFill Debugging

Point depo at x = 150mm

$$Q_{true} = (1. "sd weight") \times (2. "dw weight") \times (3. "w weight") \times Q_{depo}$$

- $\sigma_T = 1.7017$ nsigma = 3

Charge in depo : 43050 e-

True charge : 33030 e- (76%)

- $\sigma_T = 1.7017$ nsigma = 50 (extreme case),

Charge in depo : 43050 e-

True charge : 33420 e- (77%)

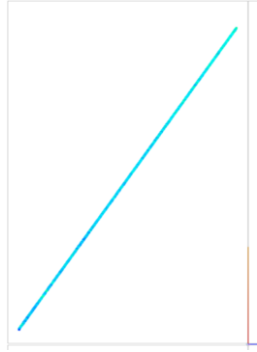
- Changing nsigma for this case doesn't impact much

Wire-Cell 3D Imaging & Clustering

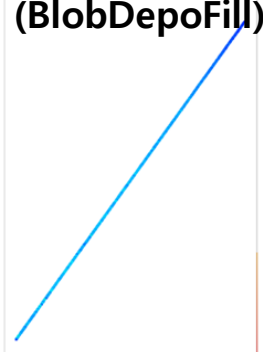
Performance Evaluation with a simple track

For a single long track (x : 10cm – 320cm)

Reco blobs



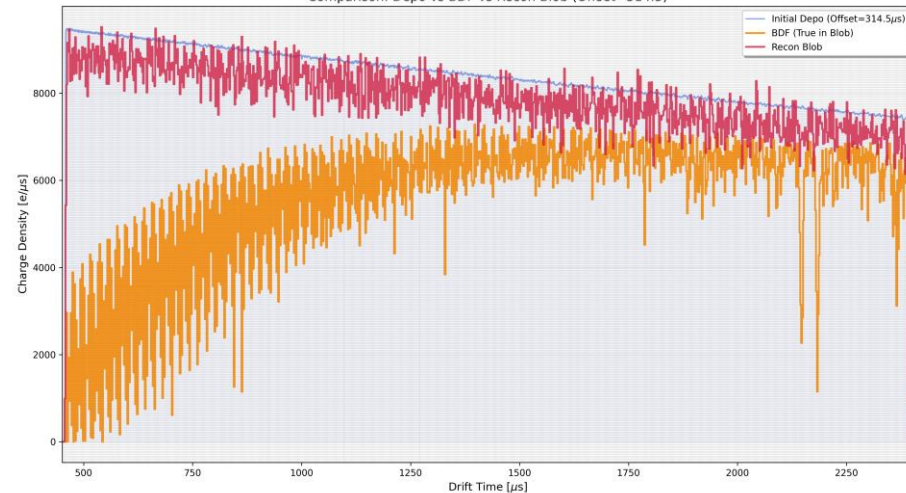
True Charge
(BlobDepoFill)



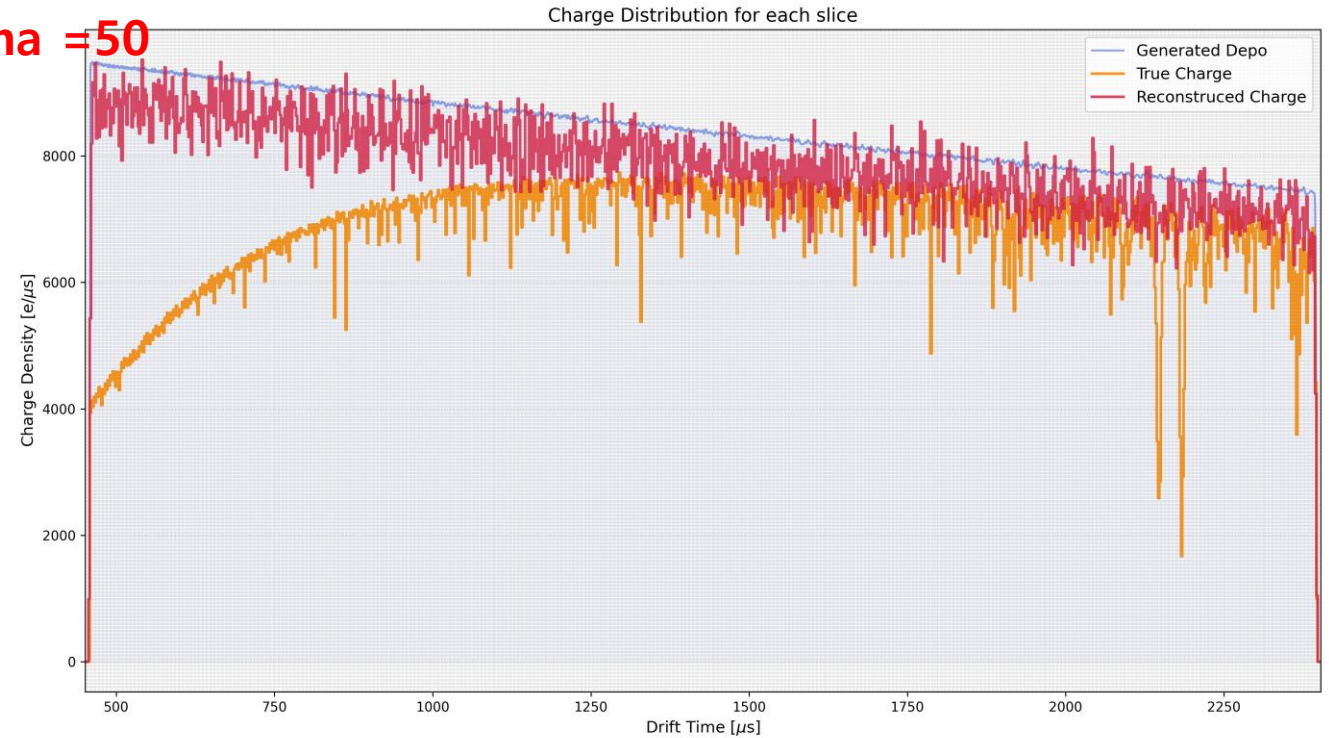
Drift

nsigma = 3 (plot from last meeting)

Comparison: Depo vs BDF vs Recon Blob (Offset=314.5)



nsigma = 50



- The discrepancy at near anode is still considerable.
- Possible point?
 - Too large nsigma?
 - With many depos, charge from several depos accumulated at a one wire -> w weight can impact?

$$Q_{true} = (1. "sd weight") \times (2. "dw weight") \times (3. "w weight") \times Q_{depo}$$