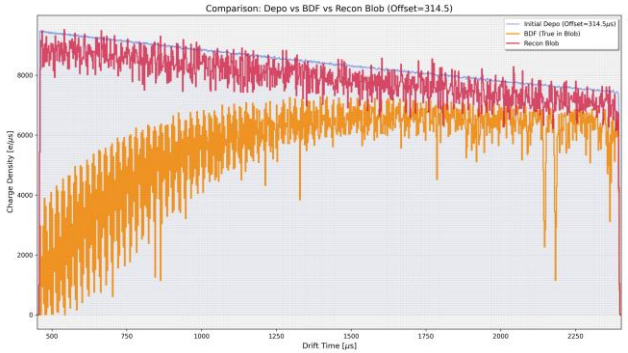
Wire-Cell ProtoDUNE Local Meeting

Yujin Park
Chung-Ang University
May 13, 2026 (Wed)

Wire-Cell 3D Imaging & Clustering
Performance Evaluation

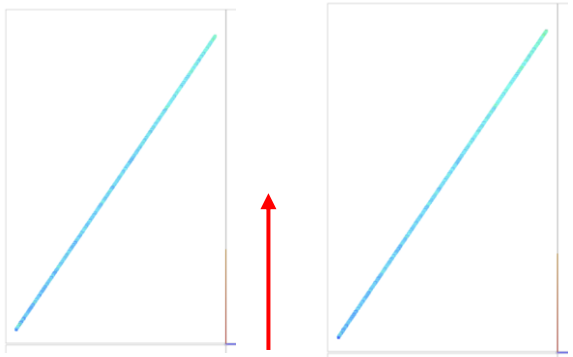
ref) wrong ver



Current Status

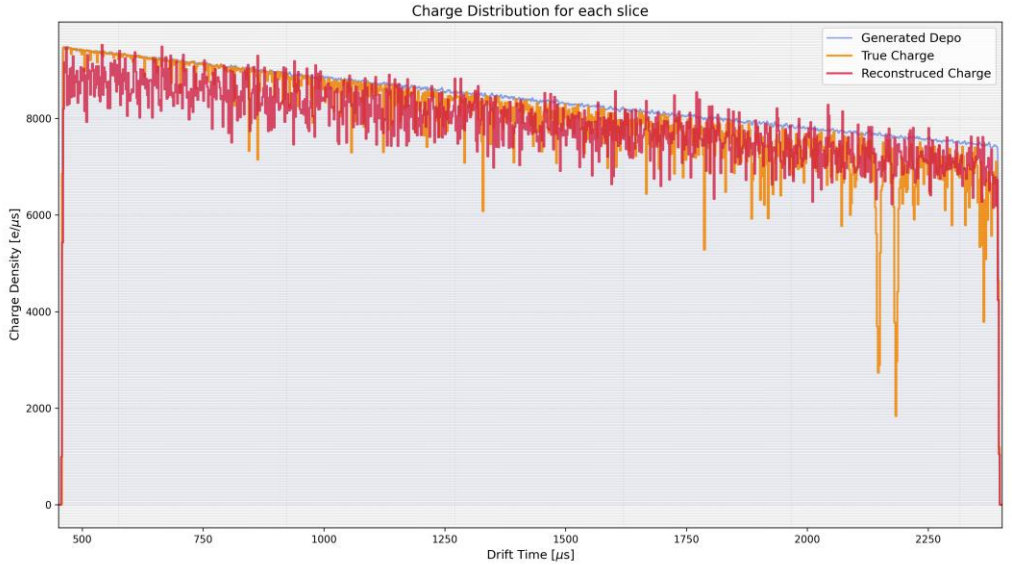
- BlobDepoFill node -> Can extract true charges information in blobs

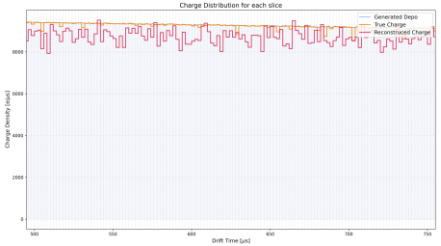
Reco blobs **True Charge**

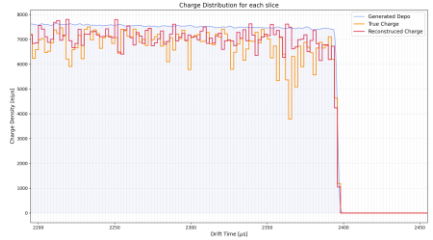


Drift

single long track (x : 10cm – 320cm)







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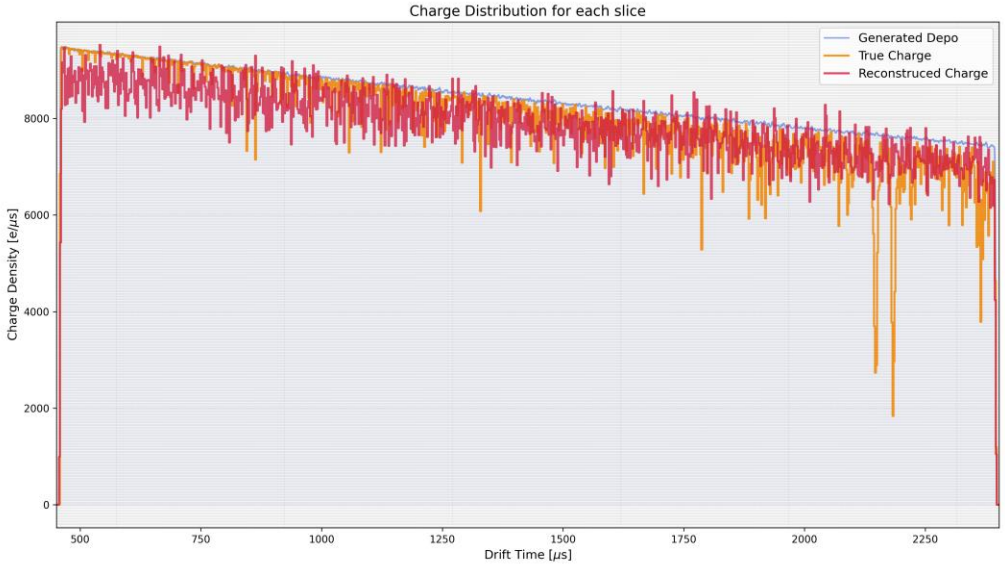
Performance Evaluation

Current Status
- BlobDepoFill node -> Can extract true charges information in blobs
- Using these information, defined purity and efficiency can be calculated.



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

```
Totdal Reco Blobs                |              983
Blobs w/ True Charge(> 0.0)      |              983
-----------------------------------------------------------------
FINAL PURITY                     |     100.000000%
=================================================================
```

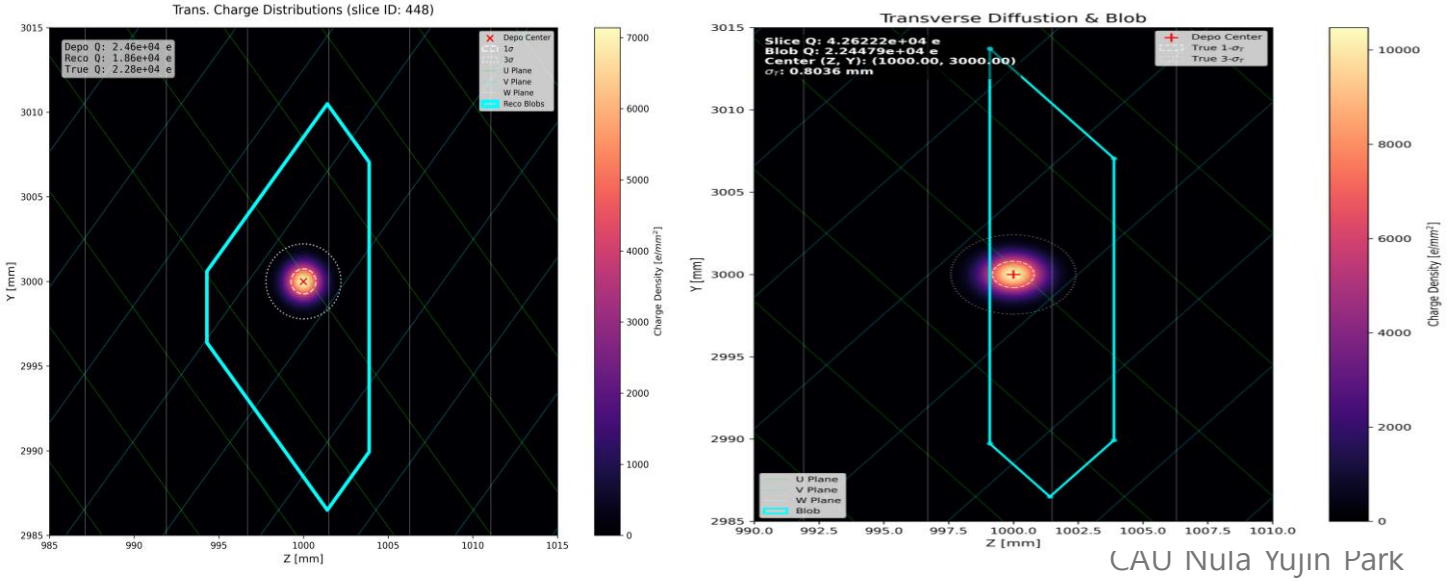
$$\text{Efficiency} = \frac{\text{Total true charge in blob}}{\text{Total true charge}}$$

```
Total True Charge (Depos)        |         1.63e+07
True Charge in Blobs             |         1.56e+07
Lost True Charge                 |         7.69e+05
-----------------------------------------------------------------
FINAL EFFICIENCY                 |           95.29%
=================================================================
```

Wire-Cell 3D Imaging & Clustering
Performance Evaluation

Some Considerations

- In the current definition of purity, is non-zero true charge reasonable? (numerator)
  - ➢ Some threshold? (e.g. Counts blobs with charge above 50e-)
- Only charges in blobs are considered now.
  - ➢ Some inevitable charge losses -> Limits on charge evaluation.
  - ➢ Rather than charge evaluation, use for spatial evaluation? (Check spatial alignments)
- If a blob is reconstructed largely, Could it be evaluated? (Blob size)
  - ➢ Charge density indicate blob size



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

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

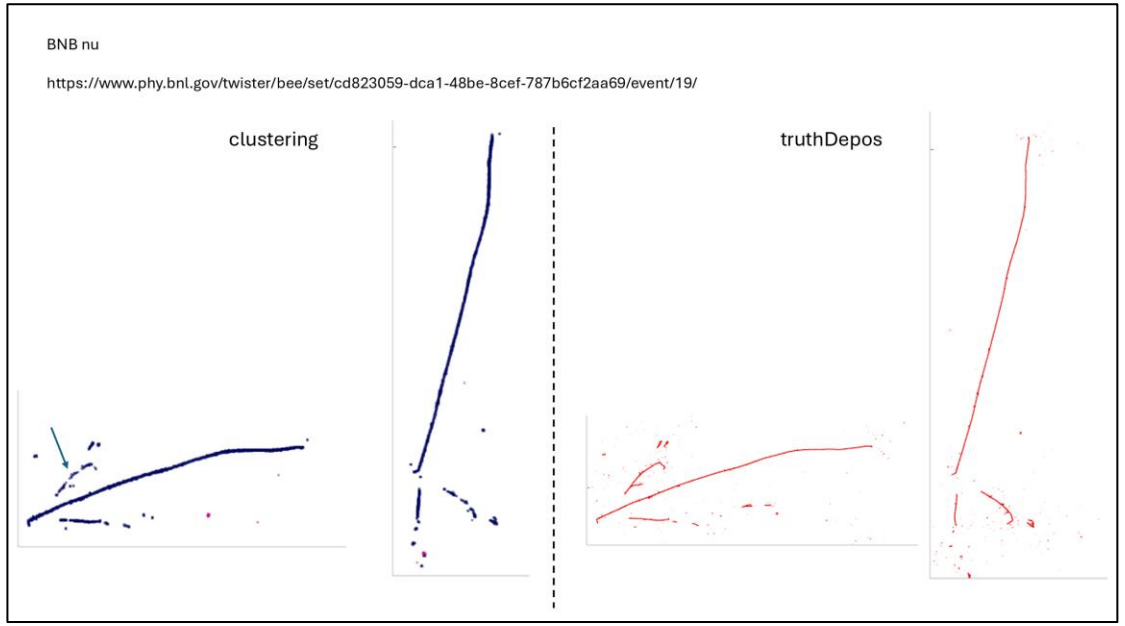
✚

Charge Density?

Wire-Cell 3D Imaging & Clustering
My Evaluate Strategies(Idea/Plan)

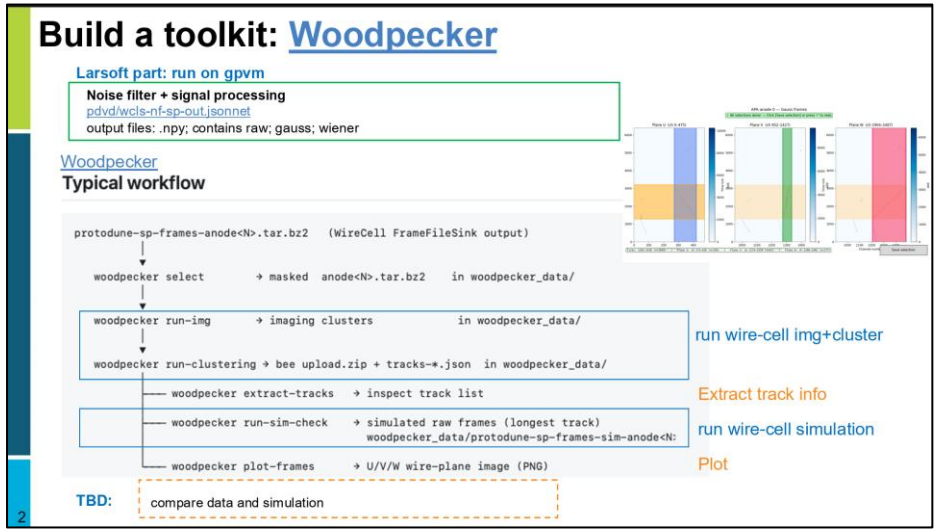
Prepare Evaluation Target events

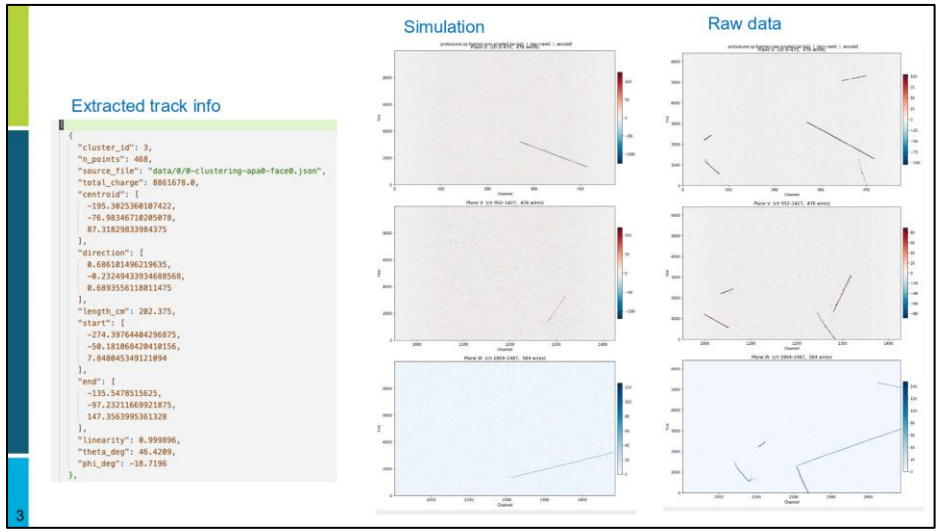
- *Clustering evaluation tools(WC general meeting - Jan30 2025 - Ewerton)*
- *First-pass clustering evaluation in SBND(WC general meeting - Mar20 2025 - Ewerton)*



- In SBND, they generated true depos and compared with reconstruction result directly
- This method can evaluate more realistic and complicated topologies.
- Some technical difficulties can be arisen
- Simpler method?
  - Woodpecker can be used?
  - From raw data, simulate simple track events
  - Calculate metrics for each tracks

Credit: Xuyang(Mar25, 2026)



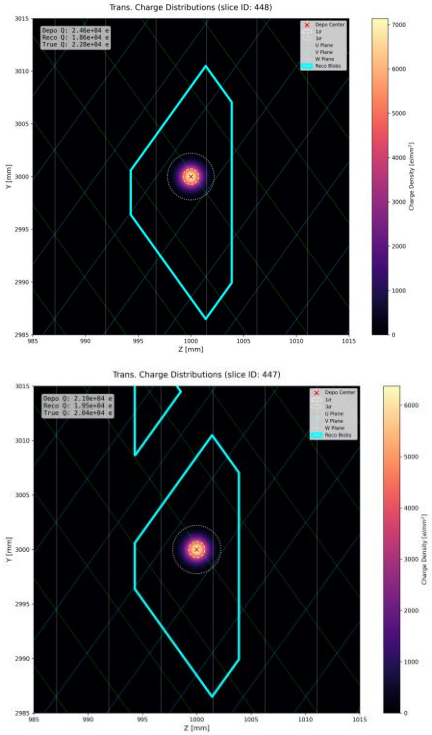


Wire-Cell 3D Imaging & Clustering
My Evaluate Strategies(Idea/Plan)

Step 2) Spatial Evaluation
Evaluate the accuracy of the 3D spatial reconstruction by analyzing the size, position, and geometric alignment of each blob within an event.
- Quantify the reconstruction performance using Purity and Efficiency metrics to evaluate geometry cleanliness and spatial coverage
- Group the sub-events/blobs into "Good" and "Bad" categories based on established Purity and Efficiency thresholds (e.g., > 0.8).
- Only the "Good" group passes through to the subsequent De-ghosting and Charge evaluation stages.

Step 3) Ghost Discrimination and De-ghosting Algorithms Evaluation
Evaluate the performance of the de-ghosting algorithm by quantifying its capacity to eliminate ghosts while preserving genuine signals.
- Quantify pure ghost rejection and check true signal preservation before/after de-ghosting.

Step 4) Charge Evaluation
Perform a pure charge evaluation exclusively on the refined, well-deghosted blobs that survived the previous spatial cuts.
- Use similar concepts of charge bias and charge resolution in the signal processing.



Backup