Wire Cell ProtoDUNE Local Meeting

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Feb 17, 2026 (Wed)

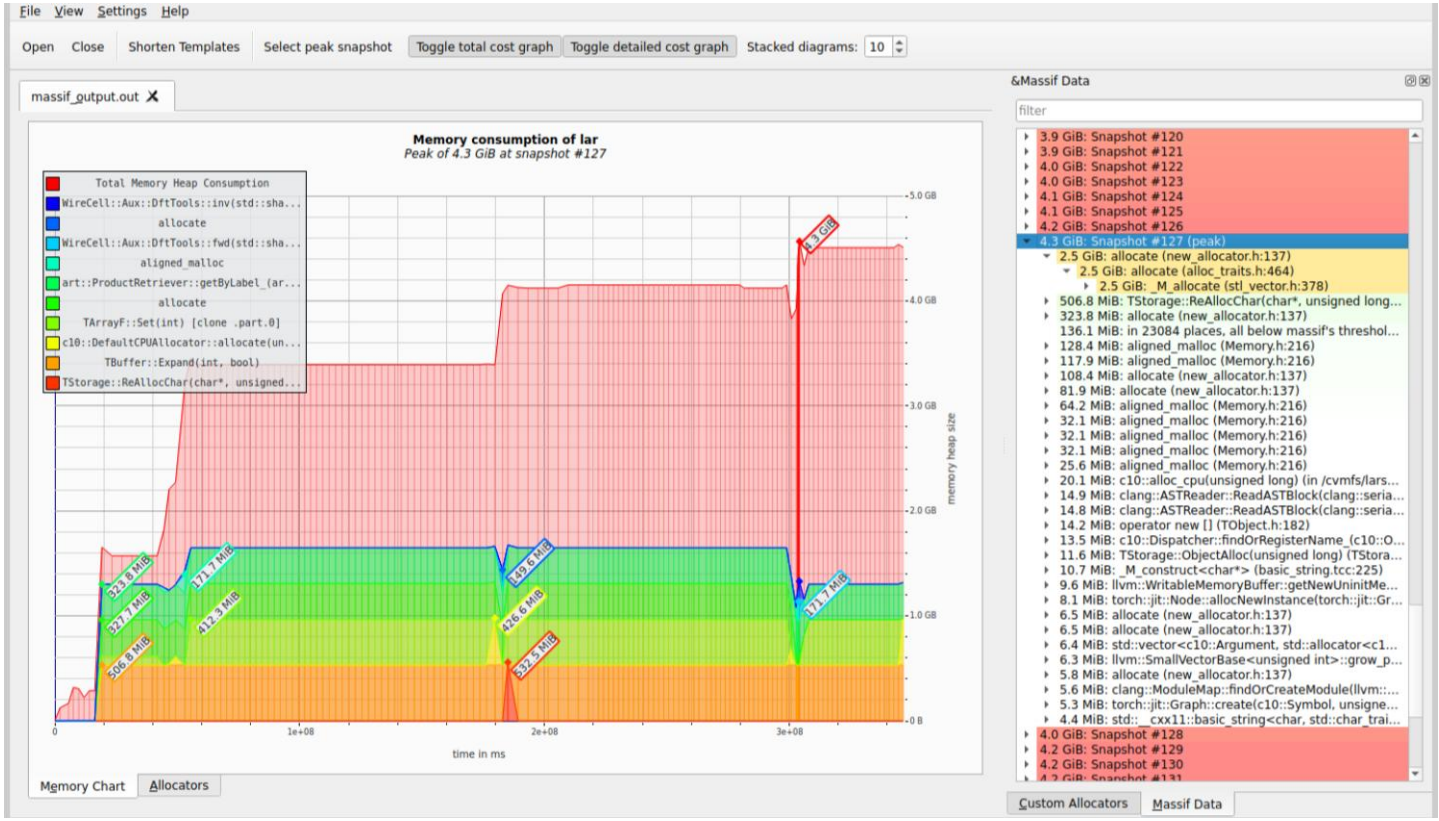
Outline

1. **Wire-Cell Signal Processing**
   - Learning related tasks from Hokyeong and Preparing hand-over
   - PDHD Memory Consumption Issue

2. **Wire-Cell 3D Imaging & Clustering**
   - 3D Imaging Performance Evaluation Metrics

1. Wire-Cell Signal Processing

Memory Consumption Issue



Memory Profiling Tool: Valgrind

- How to operate
- How to read, and interpret

Approach

- Traditional SP and DNN SP Memory Comparison
- Figure out whether DNN SP really effects the memory issue
- If not, find other possible causes

2. Wire-Cell 3D Imaging & Clustering
3D Imaging Performance Evaluation Metrics

In MicroBooNE paper, there are two major metrics for 3D Imaging [2021 JINST 16 P06043]

- **Purity:**
  how well reco hits are reconstructed along the true hits and algorithm's performance in suppressing ghost hits.

The number of the reconstructed hits overlapping true TPC hits divided by the total number of the reconstructed hits.

$$P = \frac{N(\text{Matched Reco Hits})}{N(\text{Total Reco Hits})}$$

- **Completeness:**
  how well the information of true hits is conserved within the reconstructed hits

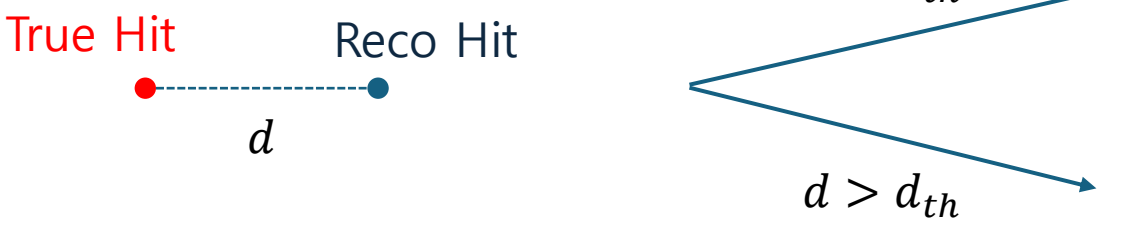
The number of the true hits overlapping the reconstructed hits divided by the total number of the true hits. The true hits are required to be within the TPC active volume and are weighted by their true deposited (visible) energy.

$$C = \frac{\sum E(\text{Matched True Hits})}{\sum E(\text{Total True Hits})}$$

2. Wire-Cell 3D Imaging & Clustering
3D Imaging Performance Evaluation Metrics

1st step: True and Reco hit Matching

- How to define "overlapping"



Reco hit is well reconstructed if charge is similar.

Reco hit doesn't have any matched true hits, this Reco hit can be ghost.

How can define the distance

- simplest distance: $d = \sqrt{\Delta x^2 + \Delta y^2 + \Delta z^2}$
- ellipsoid distance: $d = \sqrt{w_x \Delta x^2 + w_{yz} \Delta y^2 + w_{yz} \Delta z^2}$

different principles are used to determine x and (y, z)
-> different weights need to be considered?

Need to be considered further

- one-to-many match case

2. Wire-Cell 3D Imaging & Clustering
3D Imaging Performance Evaluation Metrics

2nd step: Purity

- how well reco hits are reconstructed along the true hits and algorithm's performance in suppressing ghost hits.

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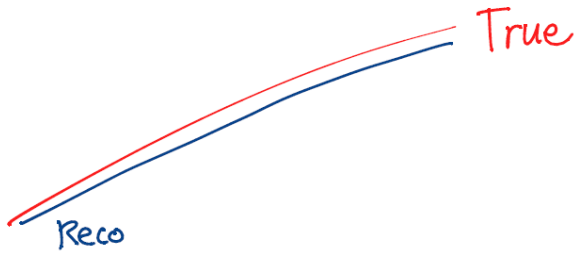
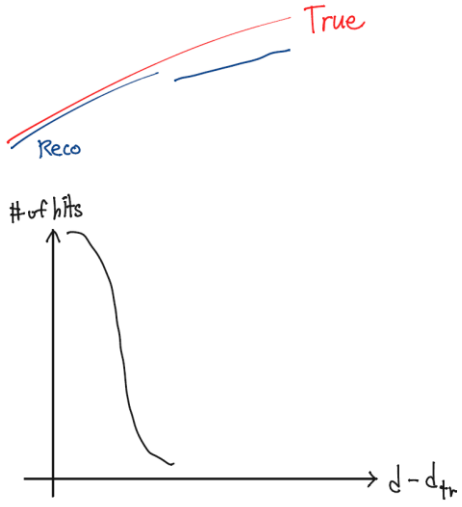
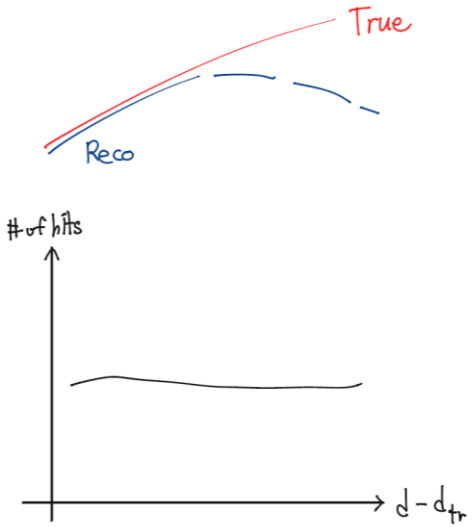


- For non-overlapping Reco hits, how can be quantified?

Near the true hit
This can be due to the smearing or diffusion?



Pure ghost due to ambiguity or noise?



From the distribution(e.g. mean & standard deviation)

- Can we evaluate the effect of ghost?

2. Wire-Cell 3D Imaging & Clustering
3D Imaging Performance Evaluation Metrics

2nd step: Purity

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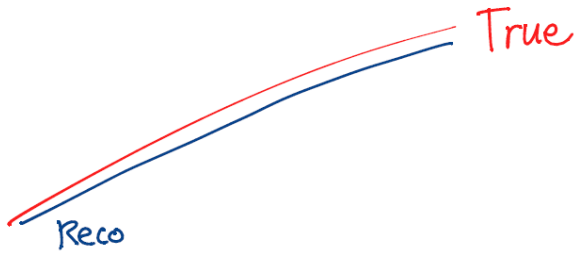
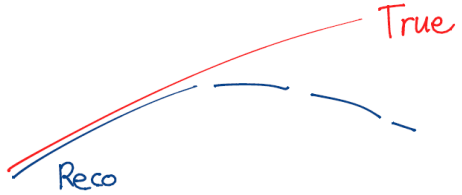
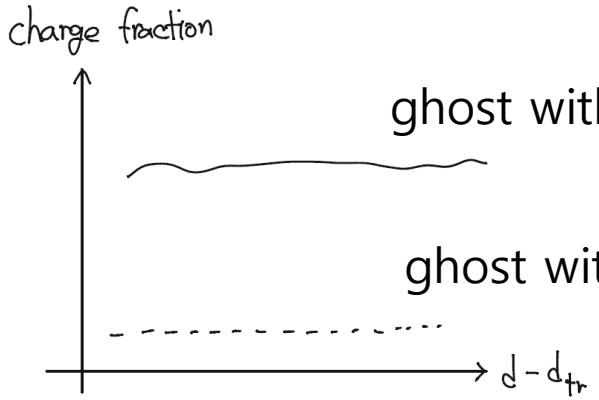


- For non-overlapping Reco hits, how can be quantified?

charge fraction = charge of non-overlapping Reco hits / total charge of matched Reco hits





ghost with large charge -> more problematic

ghost with small charge

From the distribution(e.g. mean & standard deviation)

- Can we evaluate the effect of ghost?

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3D Imaging Performance Evaluation Metrics

3rd step: Completeness

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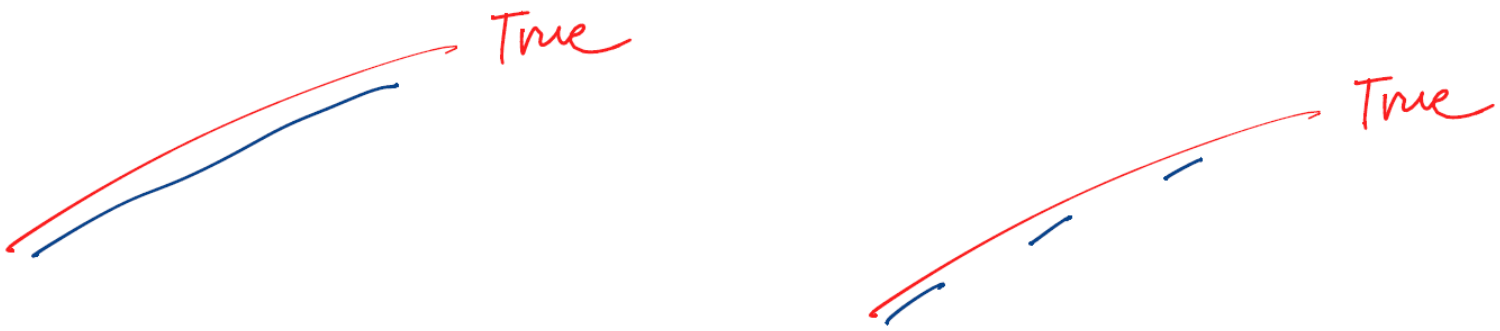
Not yet, but the similar method/approach in the purity can be used



Backup