

ePIC Calorimeter CC-WG Meeting

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<https://github.com/eic/ElCrecon/pull/2844>

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Truth Association Information in Simulation Campaign Datasets

Analysis goal :

- Study $\pi^0 \rightarrow \gamma\gamma$ reconstruction and cluster merging probability.
- Identify which photon contributes to each reconstructed cluster.

Observation :

For the simulation campaign single- π^0 datasets:

- the SimCalorimeterHit truth association points only to the parent π^0 ,
- the intermediate photon information is not available through the stored truth association for the single simulation campaign.

Thus,

- **Both photon showers are associated with the same parent π^0 .**
- **It is therefore not possible to determine which reconstructed cluster (or hit) originated from each photon using the stored truth association.**

Current truth association : SimCalorimeterHit $\rightarrow$ π^0

For $\pi^0 \rightarrow \gamma\gamma$ studies, the desired association would be : SimCalorimeterHit $\rightarrow$ γ

or more generally, SimCalorimeterHit $\rightarrow$ shower-initiating particle.

<https://github.com/eic/EICrecon/pull/2844>

The updated **primaryFrom** introduces a configurable **promptDecayPDGs** list.

```
// List of PDGs that are treated as promptly decaying  
std::vector<int> promptDecayPDGs{111, 221, 331, 310, 3122};
```

When a particle such as the π^0 is configured as promptly decaying, it is skipped during primary-particle selection, allowing the calorimeter contributions to be associated with the photons instead .

Debug : Current Truth Association (Single Pi0 simulation)

```
[e:3] [BEMC:EcalBarrelScFiClustersWithoutShapes] [debug] Associated cluster #0 to MC Particle #0 (pid = 111, status = 1, energy = 10.000910892641105) with weight (1.0000000004805254)
[e:7] [BEMC:EcalBarrelScFiClustersWithoutShapes] [debug] Associated cluster #0 to MC Particle #0 (pid = 111, status = 1, energy = 10.000910892641107) with weight (1.000000000392722)
[e:9] [BEMC:EcalBarrelScFiClustersWithoutShapes] [debug] Associated cluster #0 to MC Particle #0 (pid = 111, status = 1, energy = 10.000910892641107) with weight (0.9999999994862874)
```

Debug : New Truth Association (Single Pi0 simulation)

```
[e:3] [BEMC:EcalBarrelScFiClustersWithoutShapes] [debug] Found 2 primaries contributing a total of 0.8335551694493902 GeV
[e:3] [BEMC:EcalBarrelScFiClustersWithoutShapes] [debug] Associated cluster #0 to MC Particle #1 (pid = 22, status = 0, energy = 9.596355349532722) with weight (0.9753813547997845) [e:3] [BEMC:EcalBarrelScFiClustersWithoutShapes] [debug] Associated cluster #0 to MC Particle #2 (pid = 22, status = 0, energy = 0.4045555431040902) with weight (0.024618645680741)

[e:7] [BEMC:EcalBarrelScFiClustersWithoutShapes] [debug] Found 2 primaries contributing a total of 0.9492076434772801 GeV
[e:7] [BEMC:EcalBarrelScFiClustersWithoutShapes] [debug] Associated cluster #0 to MC Particle #1 (pid = 22, status = 0, energy = 0.973616518175237) with weight (0.08660760676421195) [e:7] [BEMC:EcalBarrelScFiClustersWithoutShapes] [debug] Associated cluster #0 to MC Particle #2 (pid = 22, status = 0, energy = 9.027294374444251) with weight (0.91339239362851)

[e:9] [BEMC:EcalBarrelScFiClustersWithoutShapes] [debug] Found 2 primaries contributing a total of 0.9317760981867593 GeV
[e:9] [BEMC:EcalBarrelScFiClustersWithoutShapes] [debug] Associated cluster #0 to MC Particle #1 (pid = 22, status = 0, energy = 0.644989474071417) with weight (0.05929855395253864) [e:9] [BEMC:EcalBarrelScFiClustersWithoutShapes] [debug] Associated cluster #0 to MC Particle #2 (pid = 22, status = 0, energy = 9.35592141855112) with weight (0.9407014455337488)
```

Thank You