An updated MC truth implementation for the EMC

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Outline

- Introduction
- MC-truth implementation
- Preliminary results
- Summary

Introduction

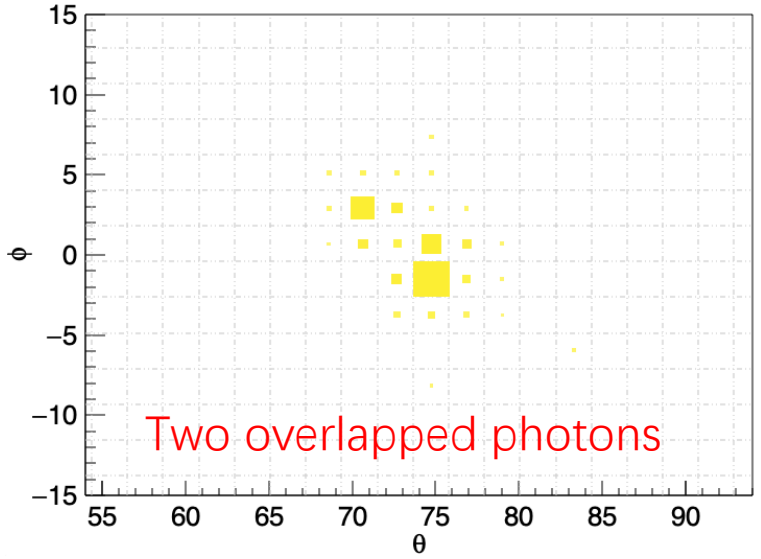
Motivation:

- Cluster-splitting is a key function in EMC reconstruction. It is especially important in high momentum pi0 reconstruction.
- One may need the MC truth information of the deposited energy in an EmcHit with overlapped clusters.
- This information is useful in the cluster-splitting algorithm study and also in ML.

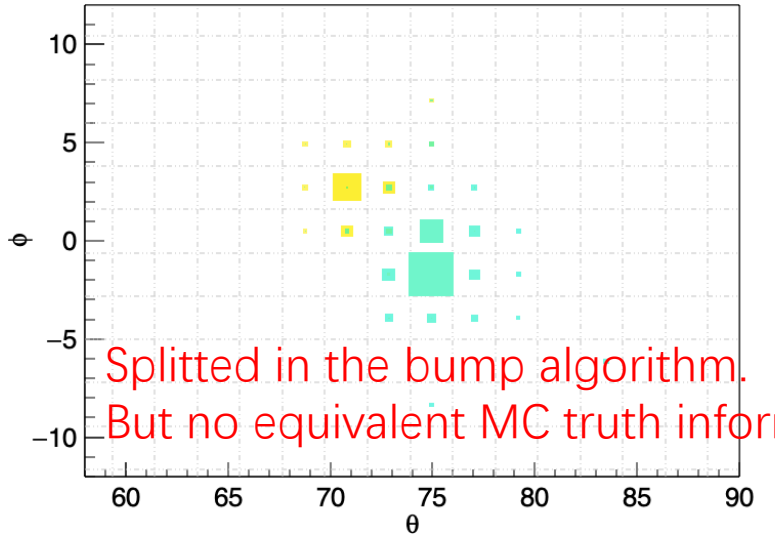
My Job:

- Build energy-fraction information in a single hit in MCTruth level (this talk).
- Optimize the cluster-splitting algorithm

Energy distribution of Cluster



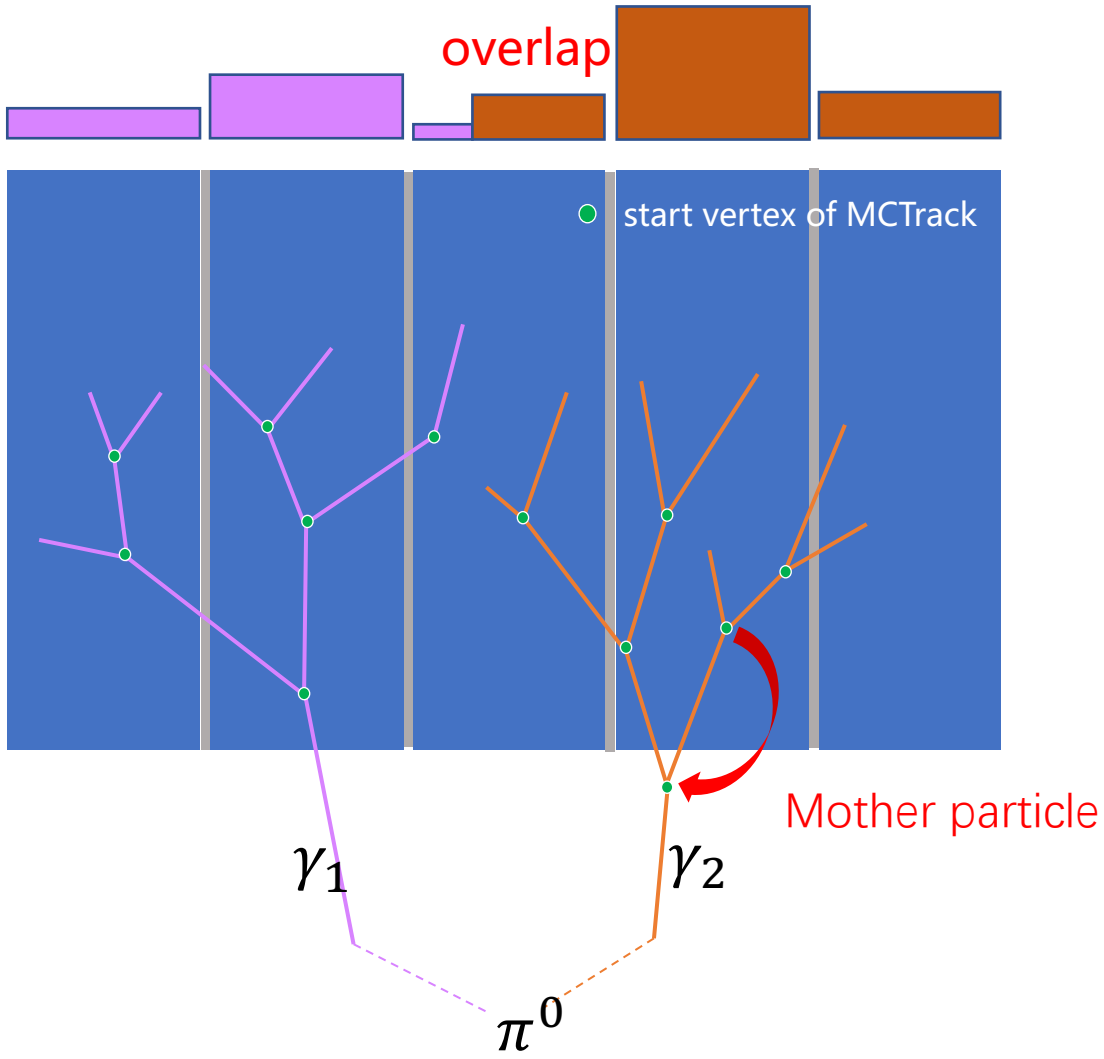
Energy distribution of Bump



Study overview

- Mother-tracker algorithm
  - In this talk, we implement a simpler version of mother tracker in order to proceed the study
  - Will use Tobias' algorithm presented in the computing meeting on May 5th
    - https://panda-wiki.gsi.de/foswiki/pub/Computing/MinutesComputingMeeting05May2020/EMC_MCInformation_05052020.pptx

- Information storage
  - Store the mother id and energy information in EmcPoint and EmcHit



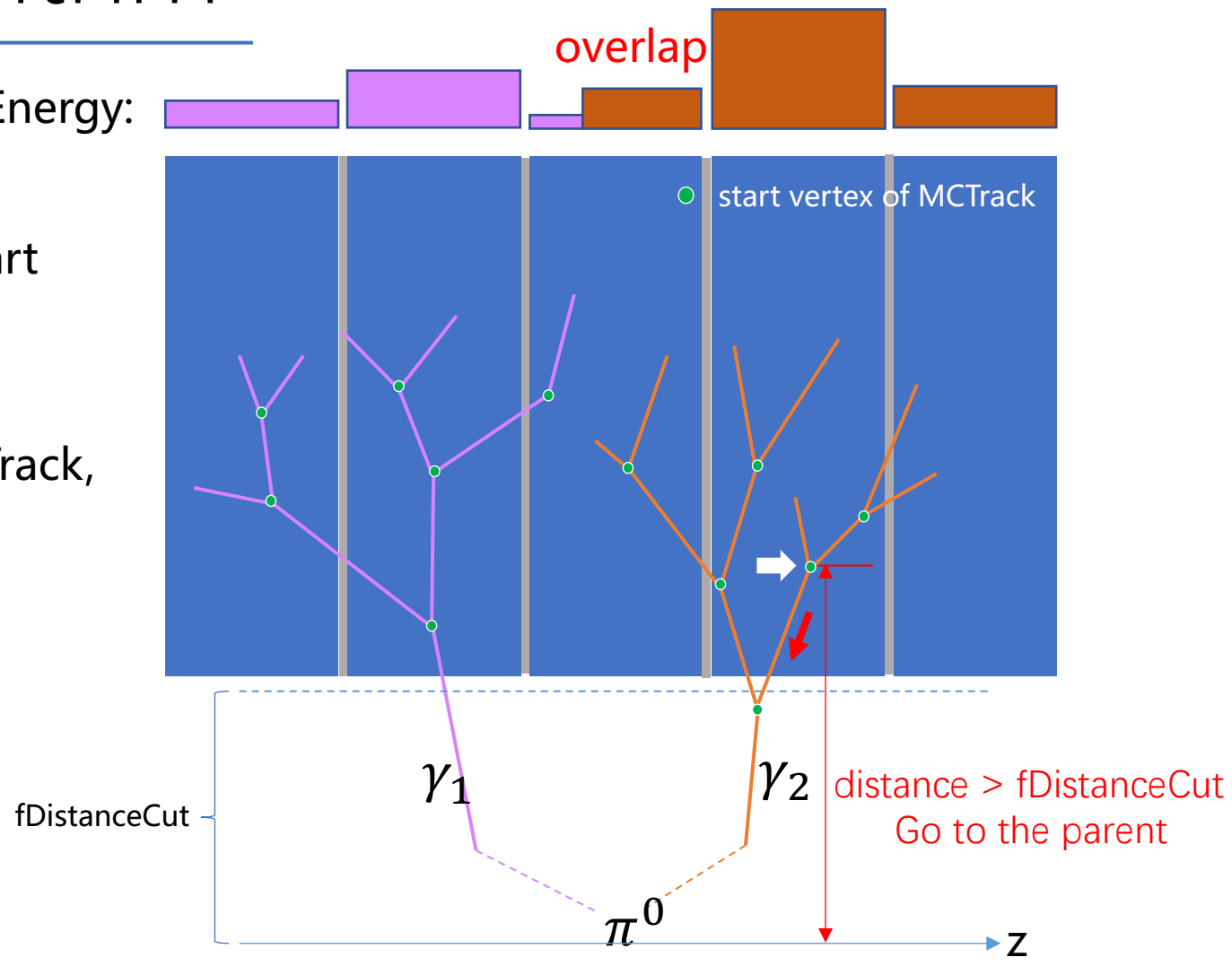
Mother-tracker algorithm

1. Get the MCTrack of the EmcPoint.

2. Determine whether the distance from the start vertex of MCTrack to the Z axis is less than fDistanceCut.

3. If yes, go to step 4; If no, get the parent MCTrack, go back to step 2

4. Store the final track information for the EmcPoint.



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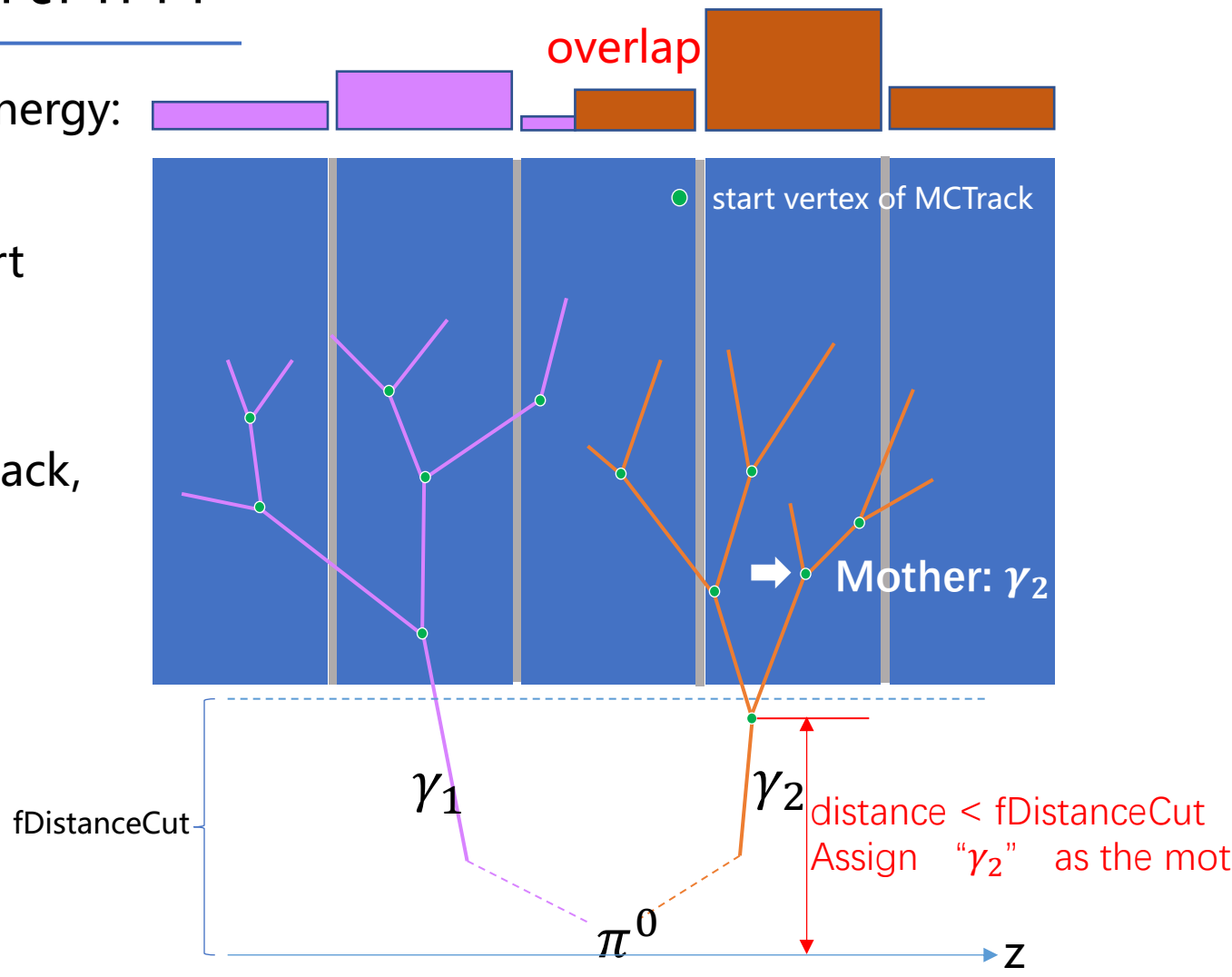


Calculate the energy corresponding to each mother

Detector ID

Mother track ID

Deposition energy for this mother track

PndEmcProducer.h

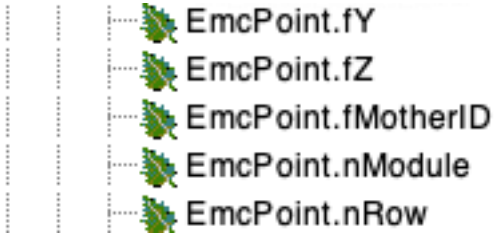
```
+ map<Int_t, std::map<Int_t, Double_t> > fShower;
```

PndEmcProducer.cxx

```
...
+ Int_t MId = point->GetMotherID();
...
for (Int_t iPoint = 0; iPoint < nPoints; iPoint++) {
    ...
    if (fUse_nonuniformity != 0) {
    ...
+   fShower[DetId][MId] += point->GetEnergyLoss() * energyscalefactor;
    ...
    }else{
    ...
+   fShower[DetId][MId] += point->GetEnergyLoss();
    ...
    }
}
...
+ hit->SetMcSourceEnergy( fShower[detID] );
```

Information storage

- For each EmcPoint, the mother track ID is stored



The track ID stored in EmcPoint

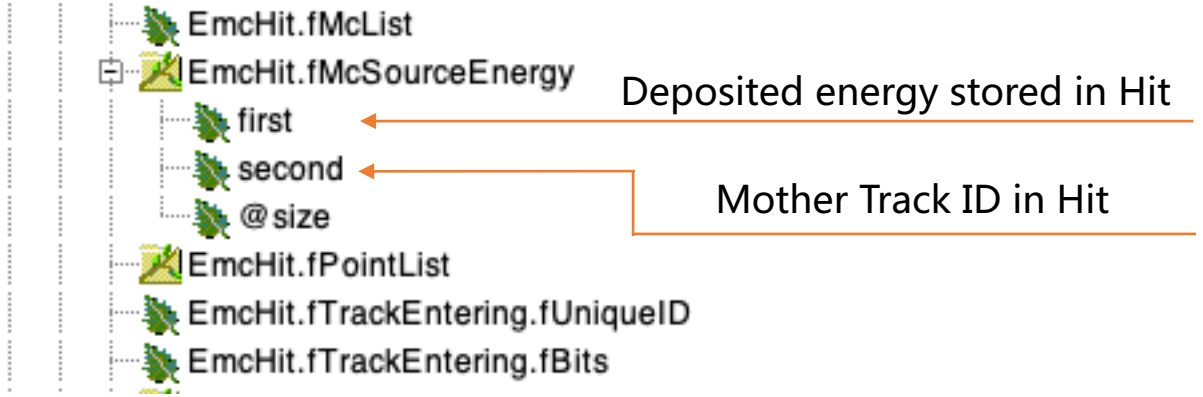
- For each EmcHit, the deposition energy for each mother track is stored.

PndEmcHit.h:

std::map<Int_t, Double_t> fMcSourceEnergy;

Mother track ID

Deposition energy for this mother track



Deposited energy stored in Hit

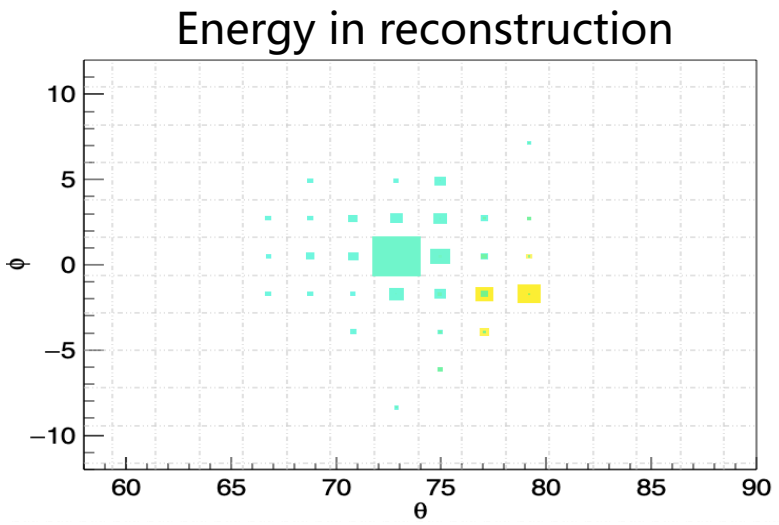
Mother Track ID in Hit

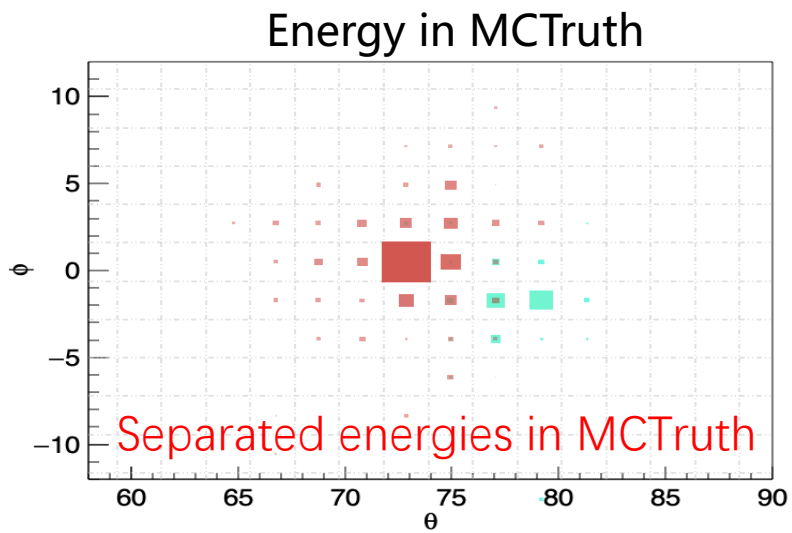
Preliminary Results

- Pi0 (3GeV)
- Events 1000
- Geant3
- Generator: Box
- Phi(0, 0)
- Theta(74, 74)

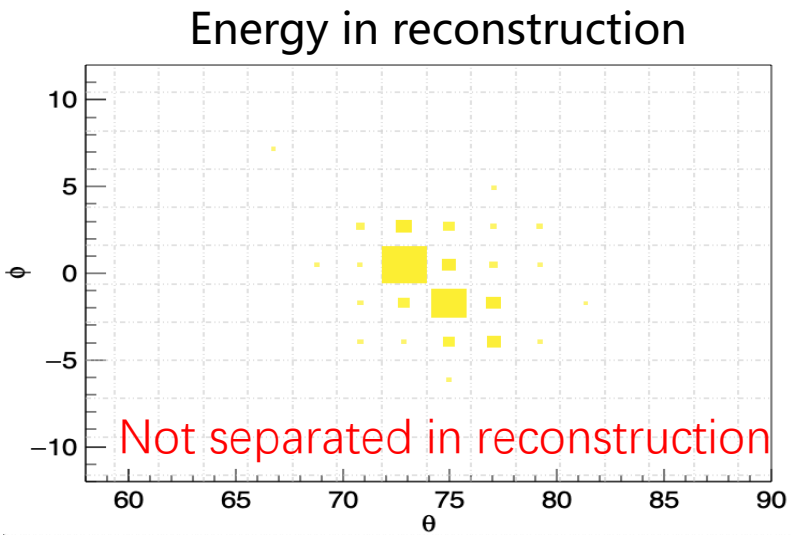
- The new MC truth provides an opportunity to optimize the cluster splitting algorithm

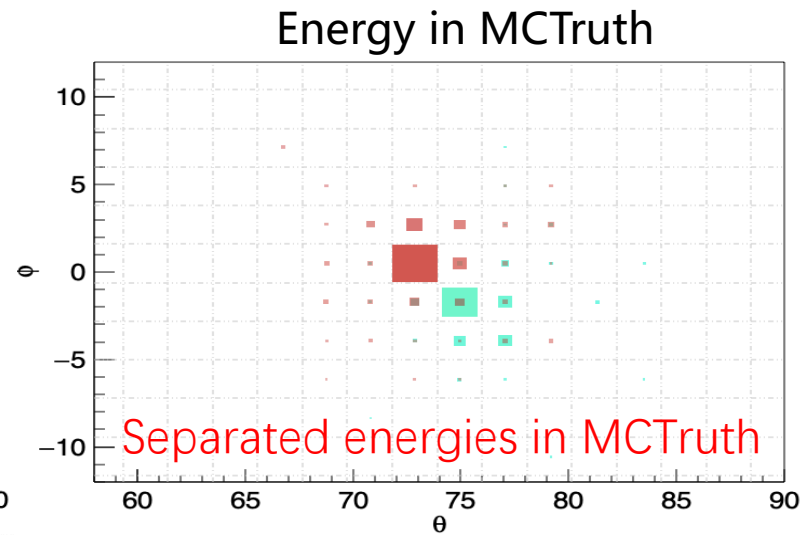
Case1





Case2





Summary

- An MC-truth implementation for the EMC is proposed. The energy information is stored in EmcPoint/EmcHit for each mother track.
- The code has been merged with Tobias' MC truth matcher code. Will be merged to the main development branch.
- The update provide an opportunity to optimize the cluster splitting algorithm.

Thank you for your attention!