Working status of Particle identification algorithm on CEPC AHCAL

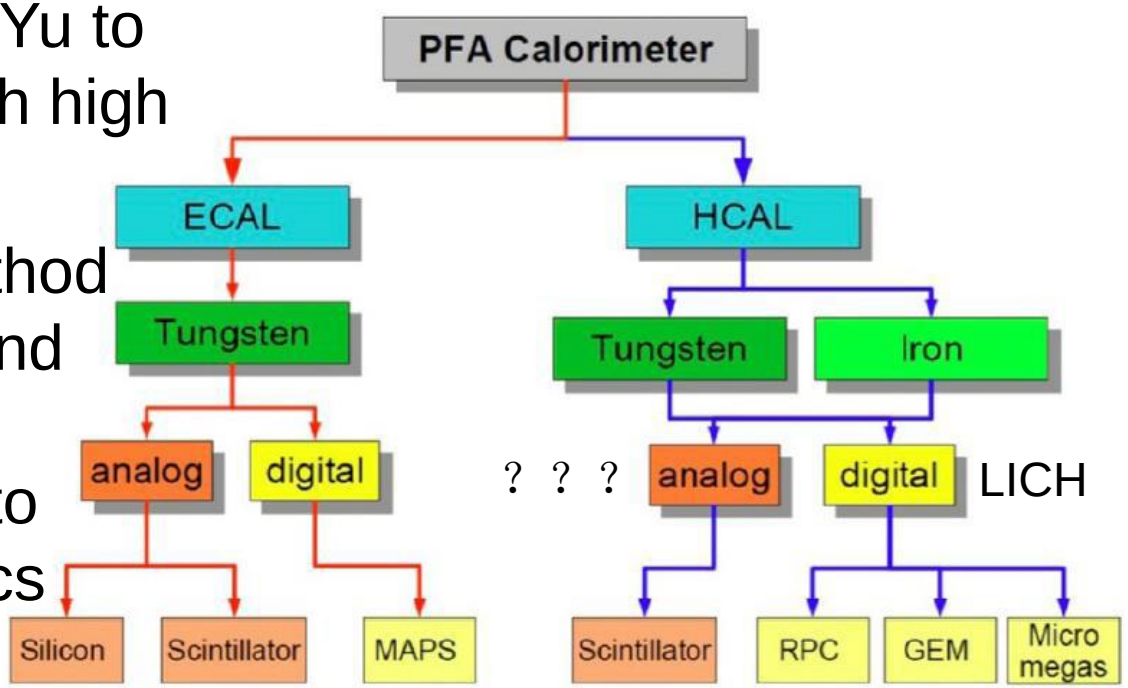
CEPC USTC
石禹坤

Outline

- Background and motivation
- Simulation Setup
- Simulation result
- Plan

Background and motivation

- CEPC PFO calorimeter has many designs
  - PID is important for PFO algorithm
  - LICH is done by DanYu to do PID on DHCal with high efficiency
  - Apply the similar method of LICH on ACHAL and then optimize the algorithm according to AHCAL characteristics



Simulation Setup

- CEPC Software
  - Simplified Geometry：only Ecal + Hcal
    - Ecal：
      - 30 layers:2.8mm W,2mm scintillator,2mm PCB each layer
      - Cellsize:5mm square
    - Hcal：
      - 40 layers:20mm Fe,3mm scintillator,2mm PCB each layer
      - Cellsize:30mm square
    - Magnetic field:0
    - Input particle
      - e,u,π
      - Energy：1,3,5,7,10,20，….100GeV

Simulation Setup

- LICH method:TMVA based
- Select variable for ACHAL
- Candidate
  - FD
  - Hit number
  - Distance
  - Energy

FD

- FD(Fractal Dimension)
  - NHScale: $\text{Scale X} \times Y \times Z$ cells forms a “new cell”,calculate the number of “new cells” with hits
  - $FD = \frac{\log \frac{N_{original}}{N_{scaled}}}{\log ScaleX}, \text{ScaleX} = \text{ScaleY}, \text{Scale Z} = 1$
  - Calculate FD with different ScaleX and Y,Add them together as the final FD variable

distance

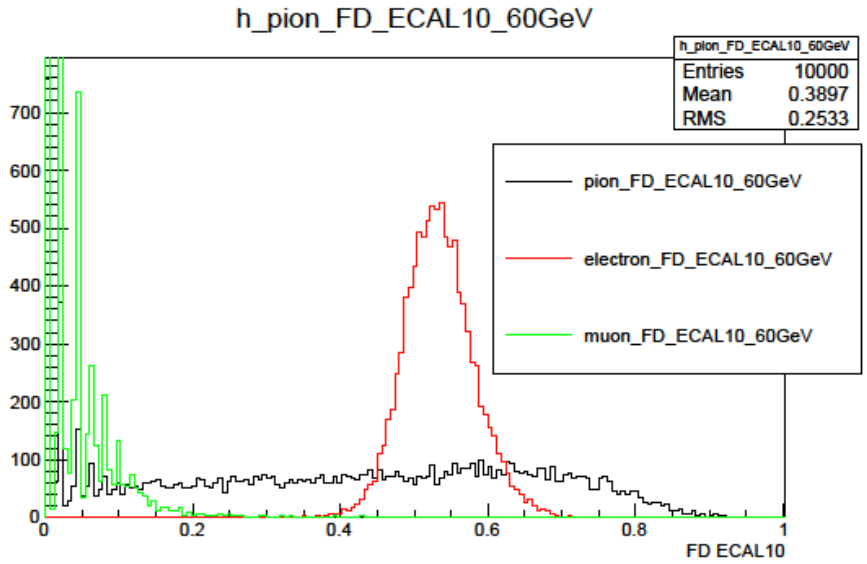
- DisSeedSurface：distance from hit to the calorimeter surface
- Some questions

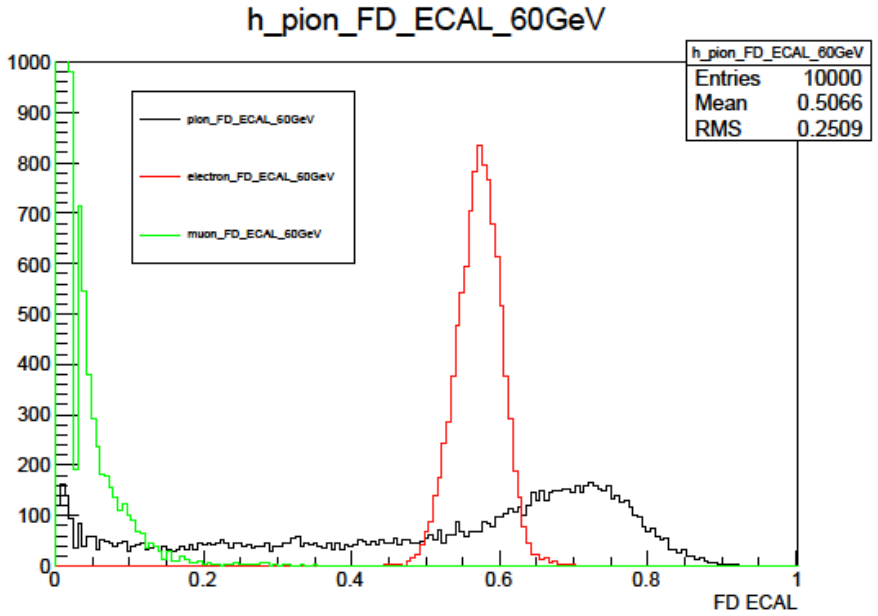
```
else if( SeedPos.Perp() > rminBarrelEcal + 400 )
{
    DisSS = SeedPos.Perp() - rminBarrelEcal - 100;
}
else if( (SeedPos.Phi() > 0 && int(SeedPos.Phi() * 4/TMath::Pi() + 0.5) % 2 == 0 ) || (SeedPos.Phi() < 0 && int(SeedPos.Phi() * 4/TMath::Pi() + 8.5) %
{
    DisSS = min( fabs(fabs(SeedPos[0]) - rminBarrelEcal), fabs(fabs(SeedPos[1]) - rminBarrelEcal ) );
}
else
{
    DisSS = min( fabs(fabs(SeedPos[0] + SeedPos[1])/TMath::Pi() -rminBarrelEcal), fabs(fabs(SeedPos[0] - SeedPos[1])/TMath::Pi() - rminBarrelEcal) );
}

return DisSS;
```

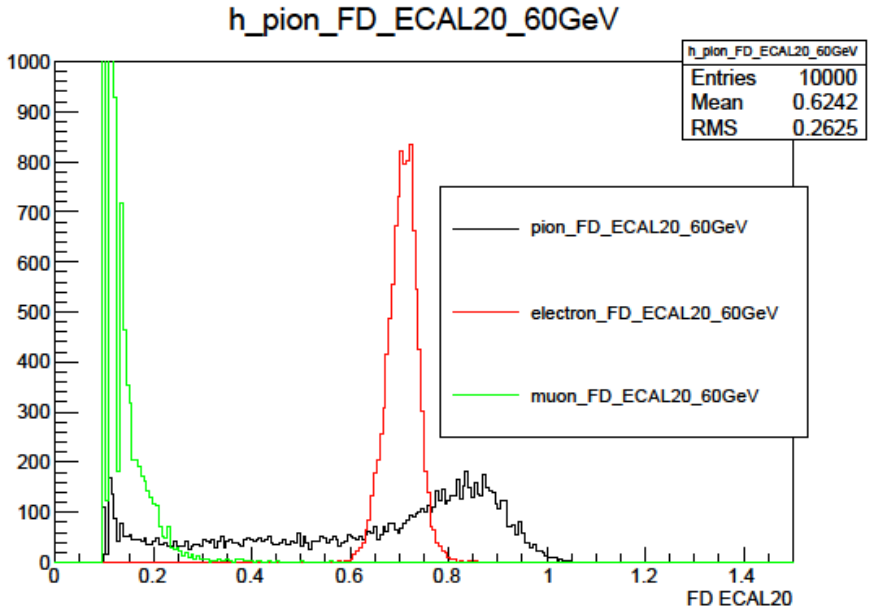
  - Cluster direction:min_DisSeedSurface point to COG
  - DisHtol:distance from present position to Cluster direction

FD

- ECAL 10:firsr 10
- ECAL 20:last 20

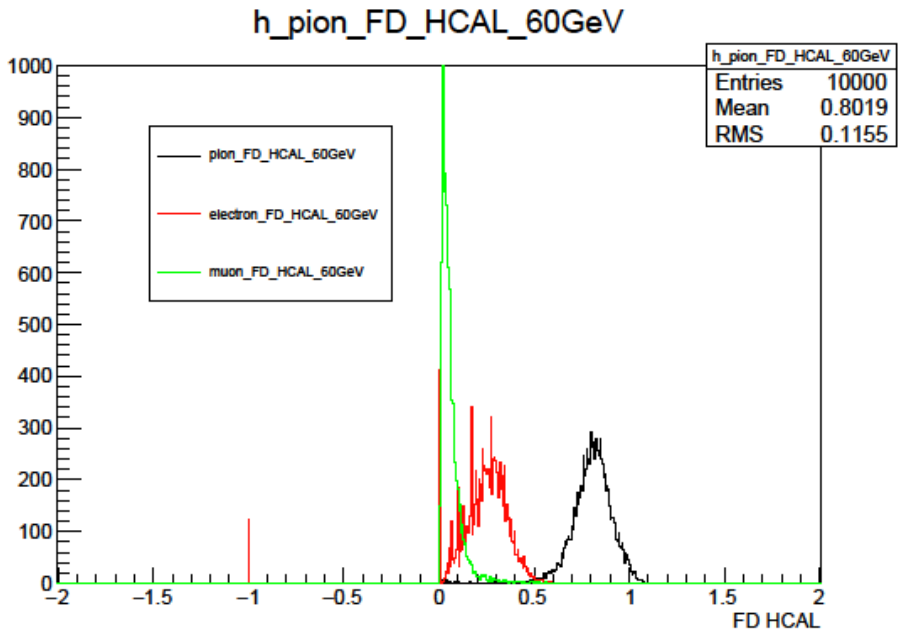


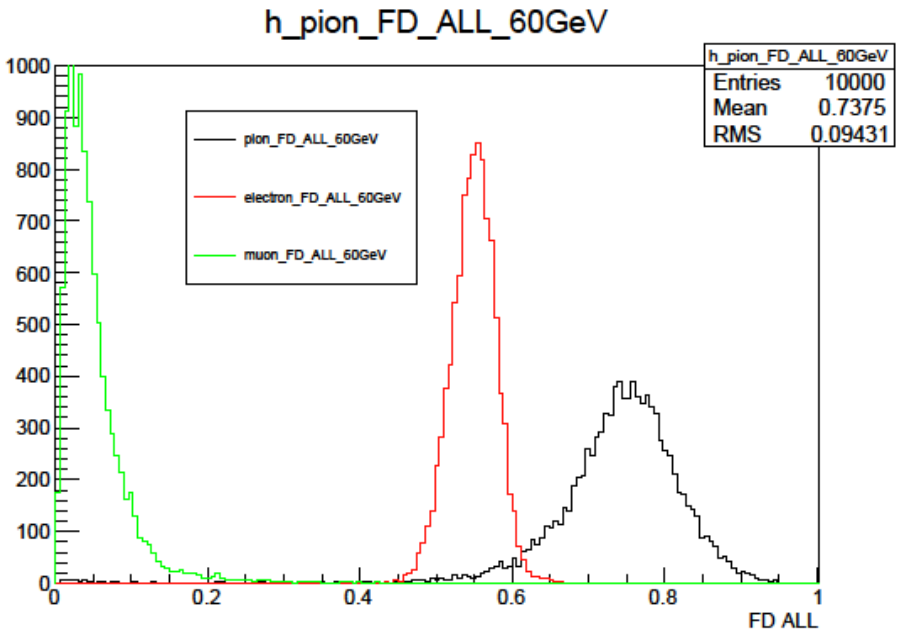




FD

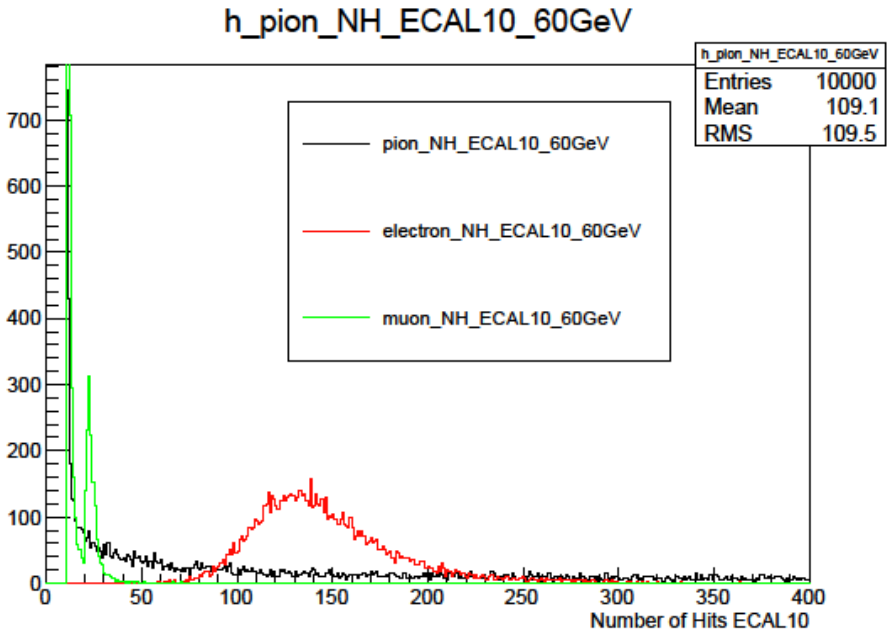
- FD = -1 when no hit

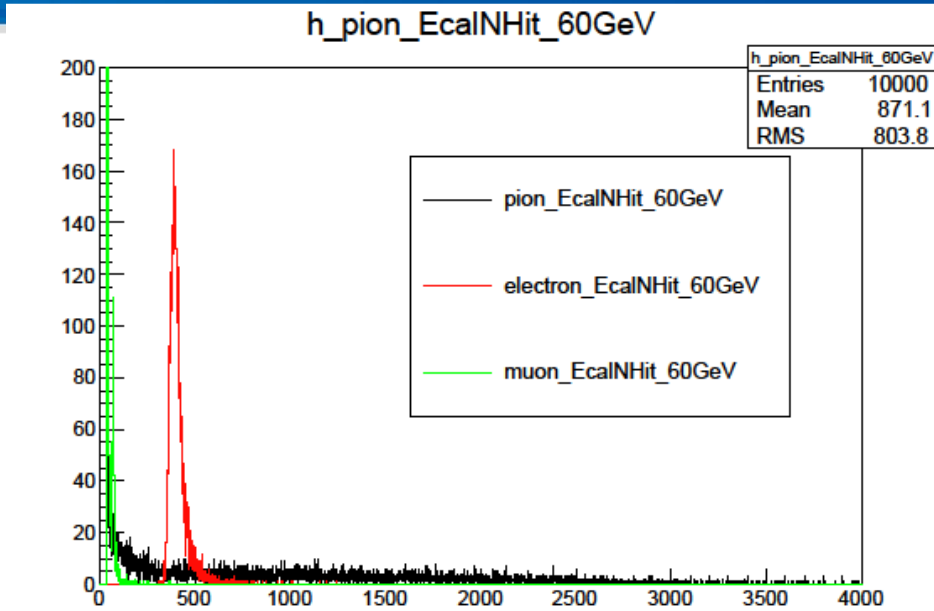


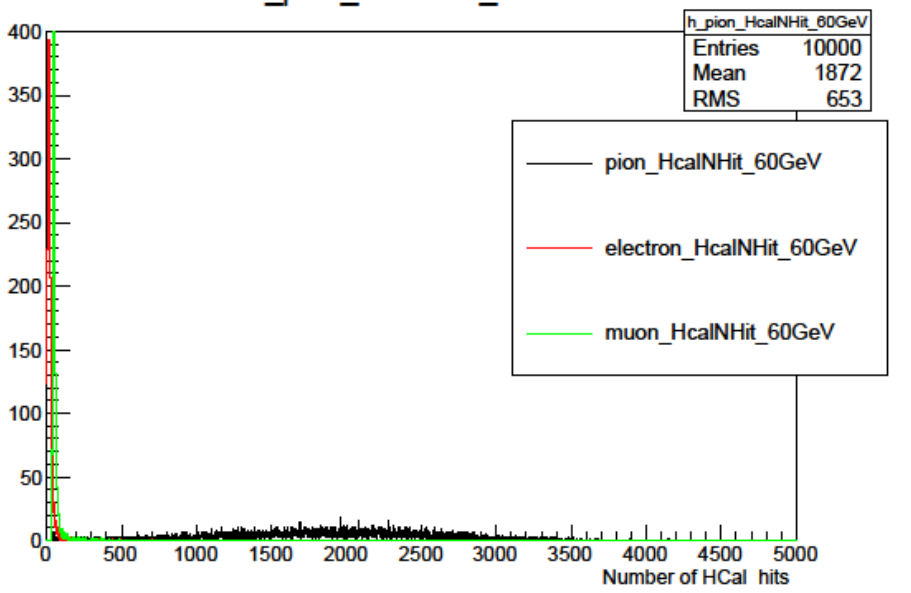


Hit

- NH:Number of Hits
- ECAL10:ECAL first 10 layers

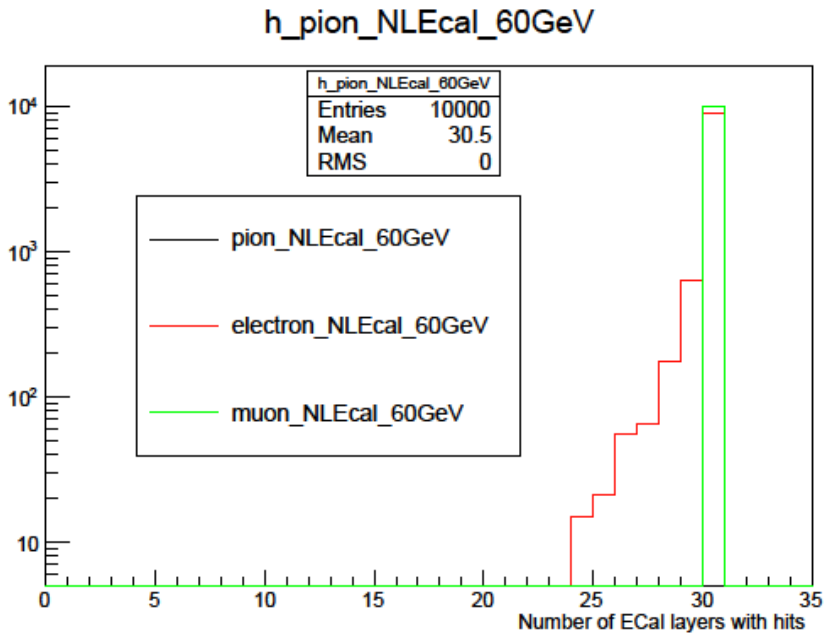


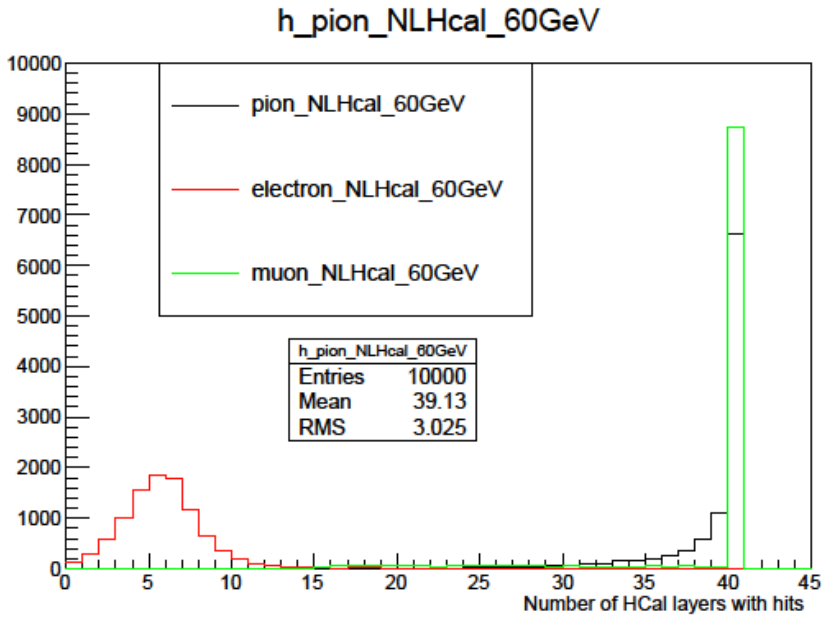




Hit

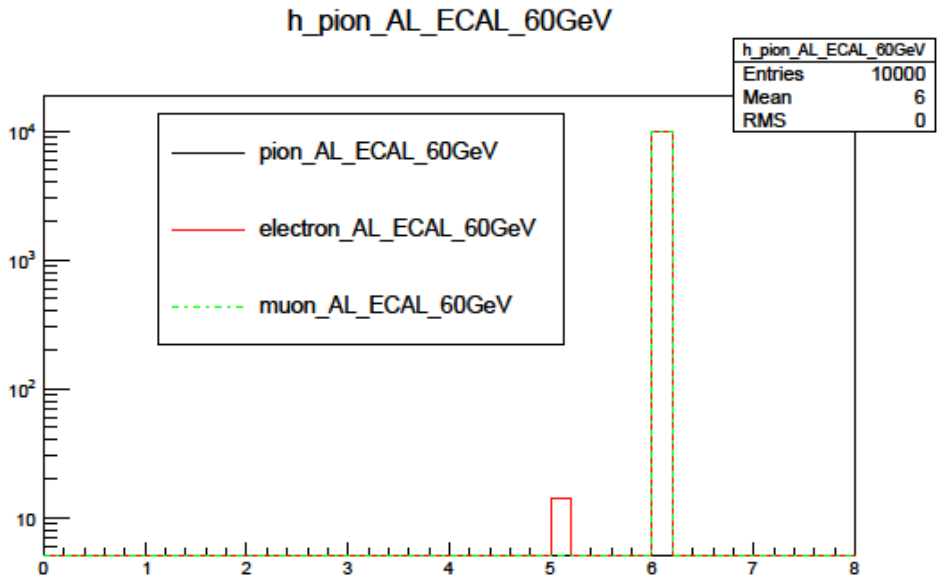
- NL:number of layers with hits

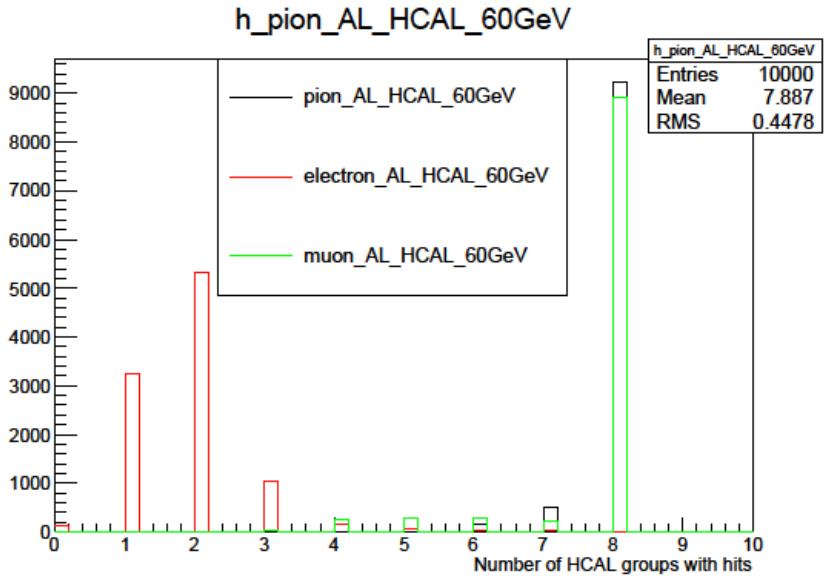




Hit

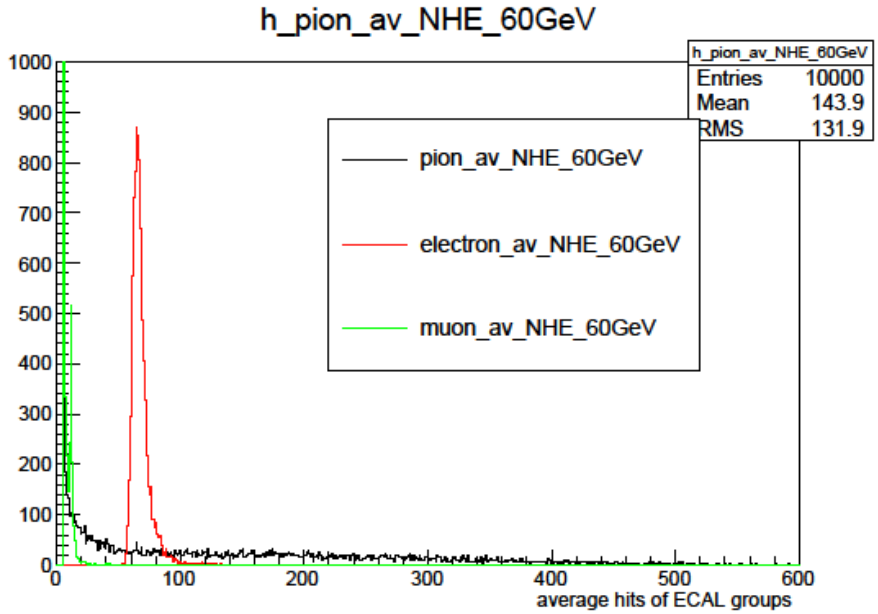
- All layers are grouped into 5 layers
- AL:number of groups with hits

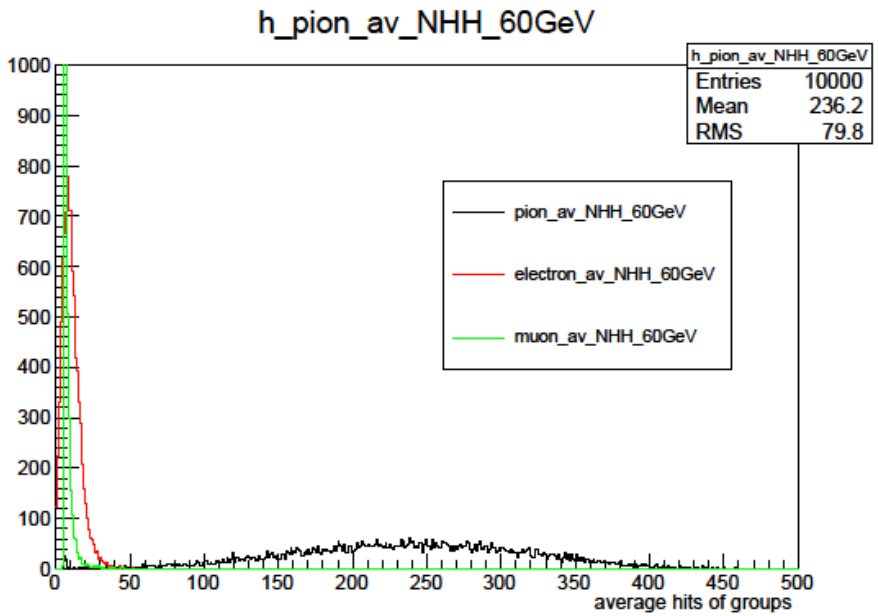




Hit

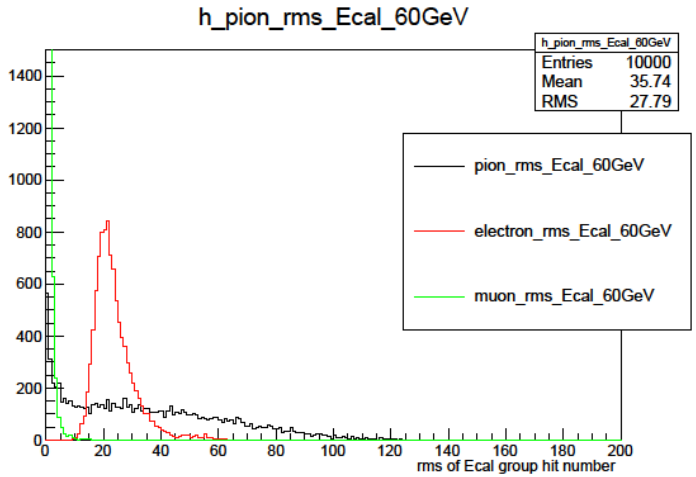
- Average hit number of ECAL,HCAL groups

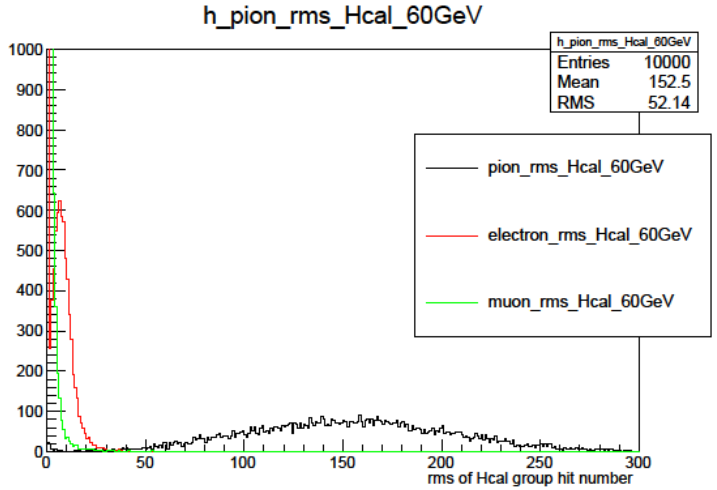


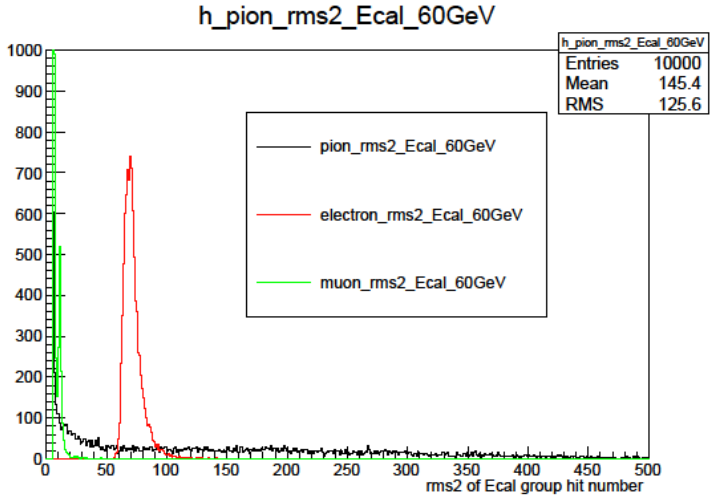


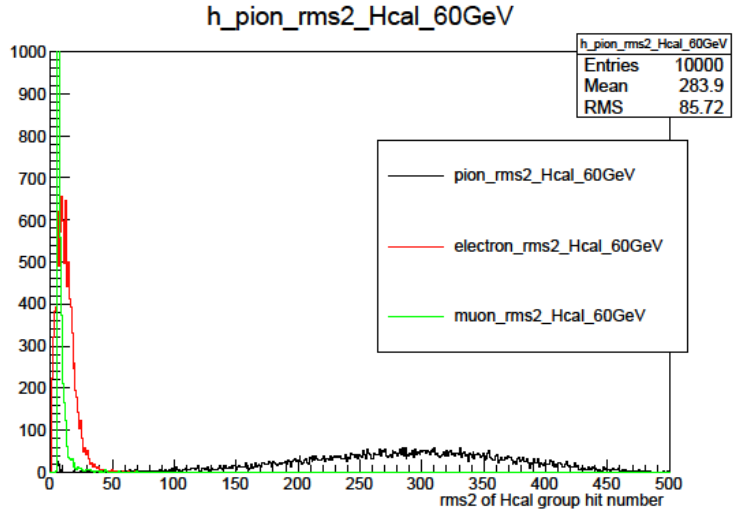
Hit

- rms for hit number of groups
- rms2 is just the sum of square,then divided by AL



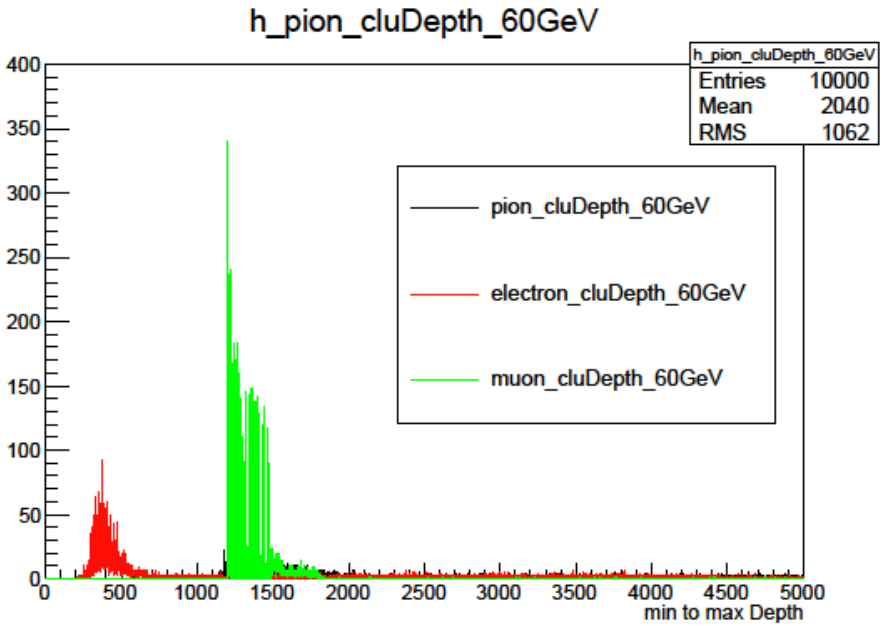


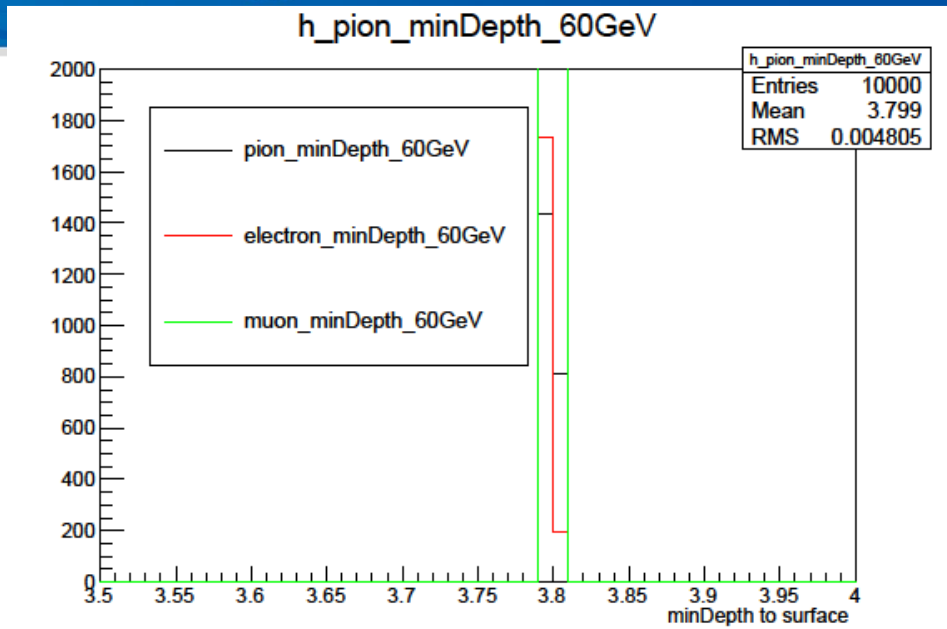


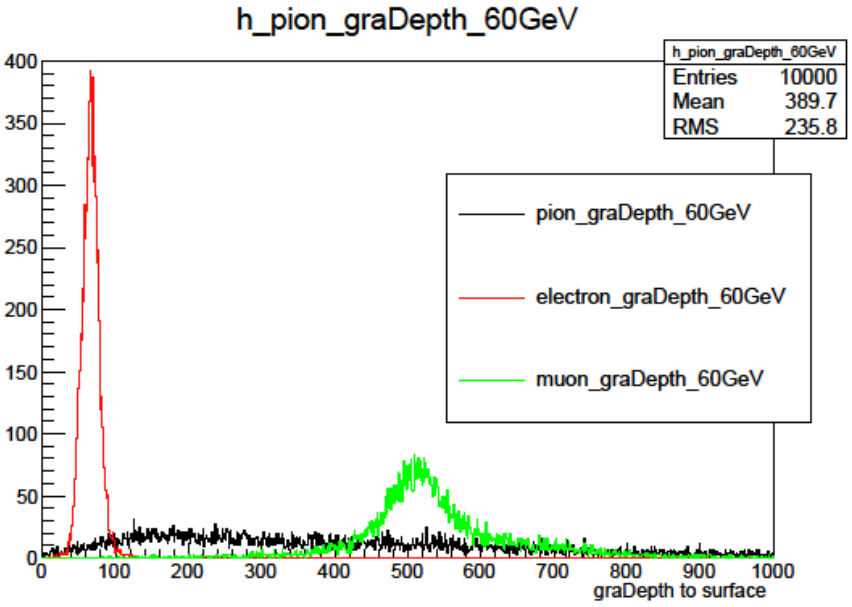


distance

- minDepth:min DisSeedSurface,so is the max
- cluDepth:distance from max position to min position
- graDepth:DisSeedSurface of COG

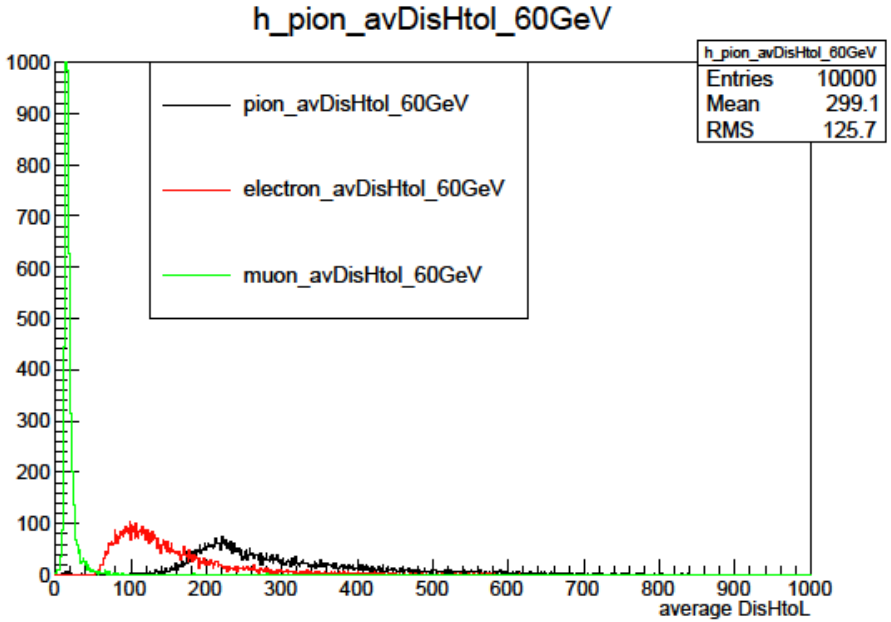


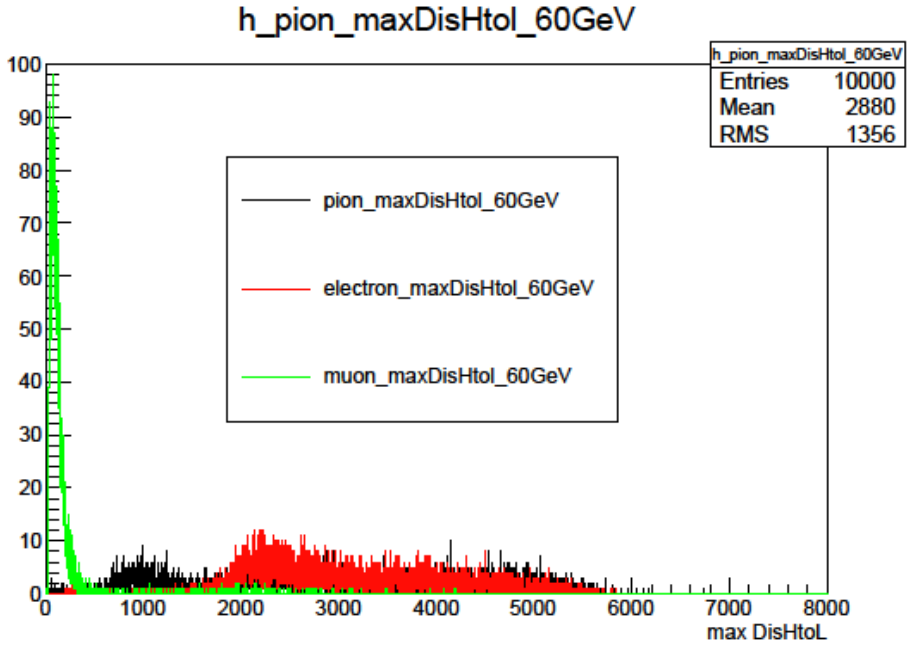




distance

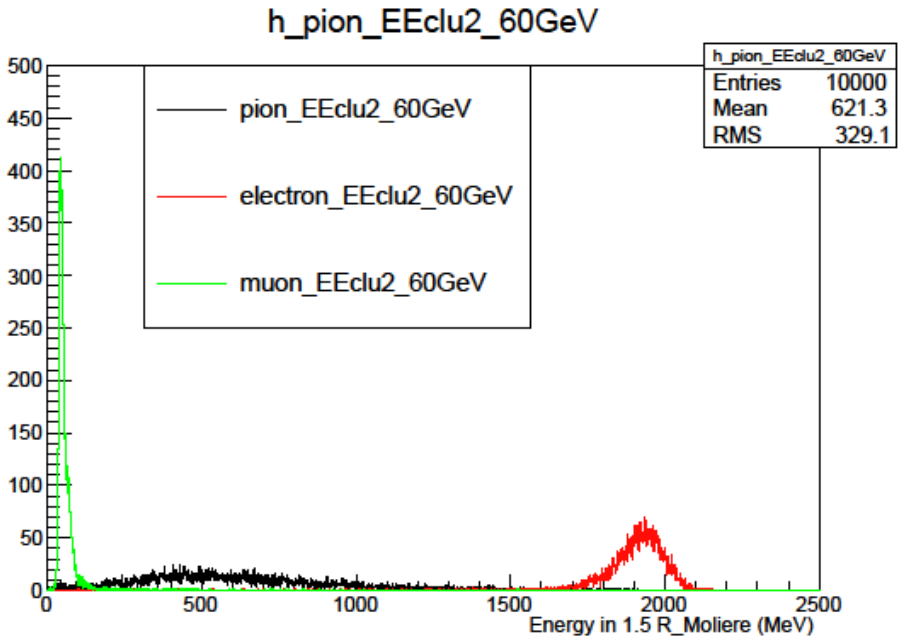
- DisHtol:distance from present position to Cluster direction

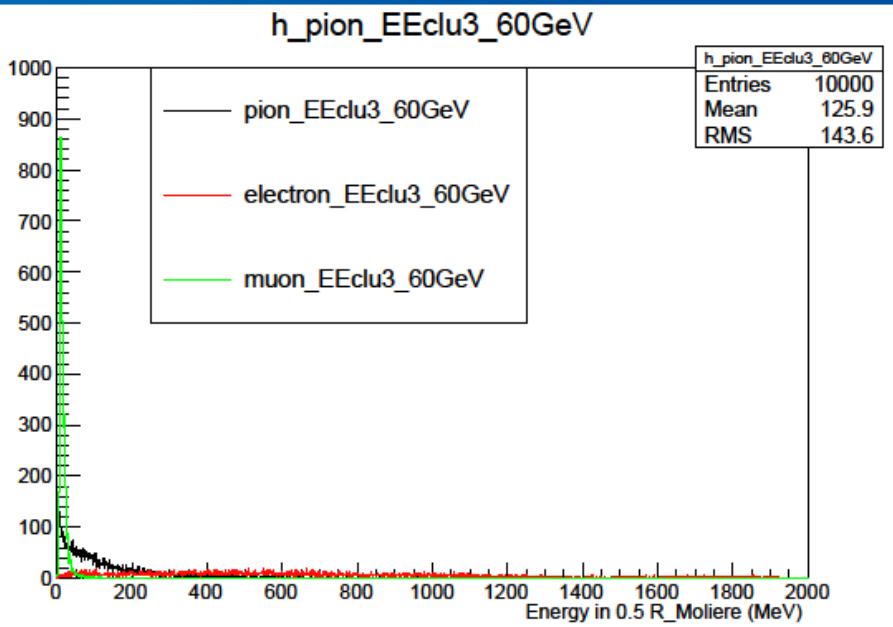


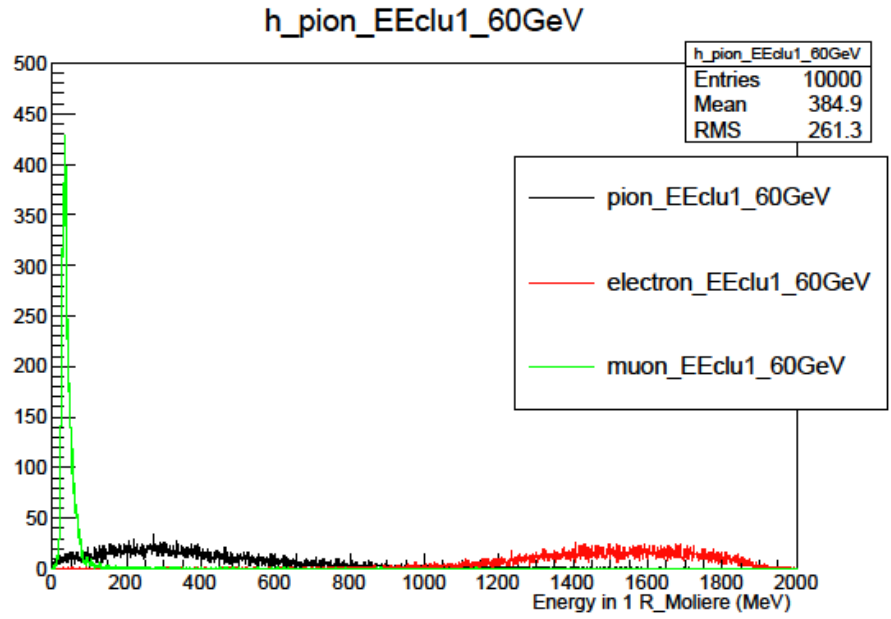


Energy

- EEClu：Energy in the cylinder around the cluster direction with a radius of X Moliere radius
- X = 0.5,1,1.5

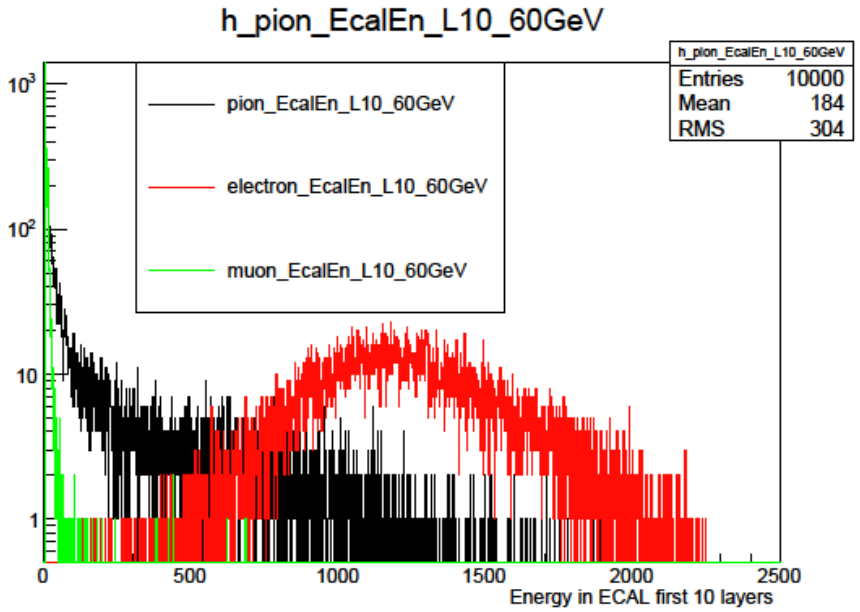


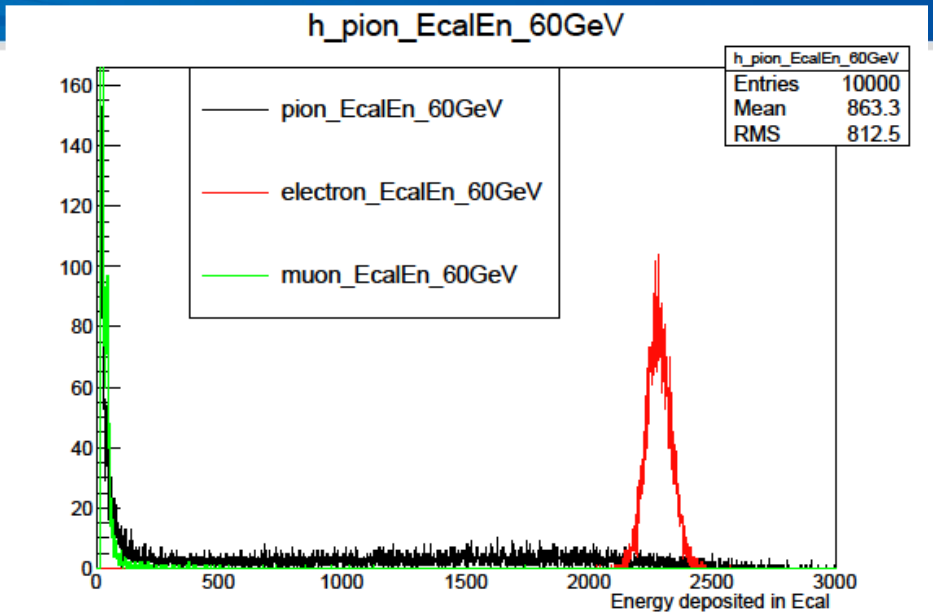


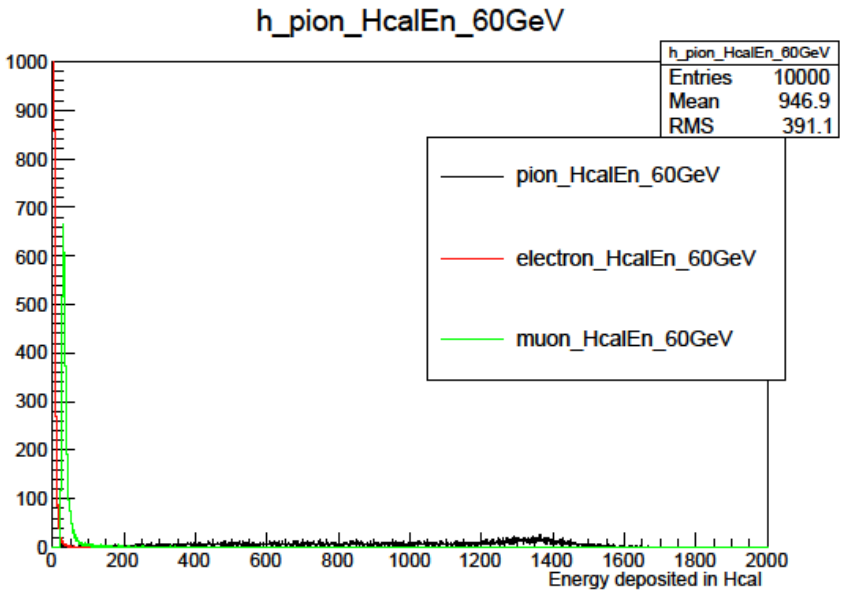


Energy

- L10:first 10 Layers







Plan

- Optimize and find some variable according to AHCAL characteristics
  - Cellsize
  - Time related
- Calculate the co-relation between the variables
- Use machine learning algorithm to identify particle with these variables