γ/γ and π^+/γ Separation with ArborPFA

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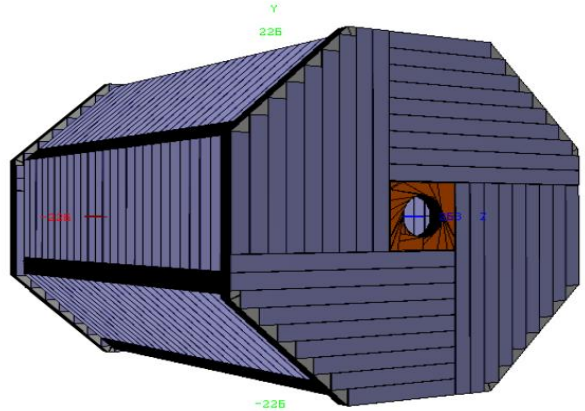
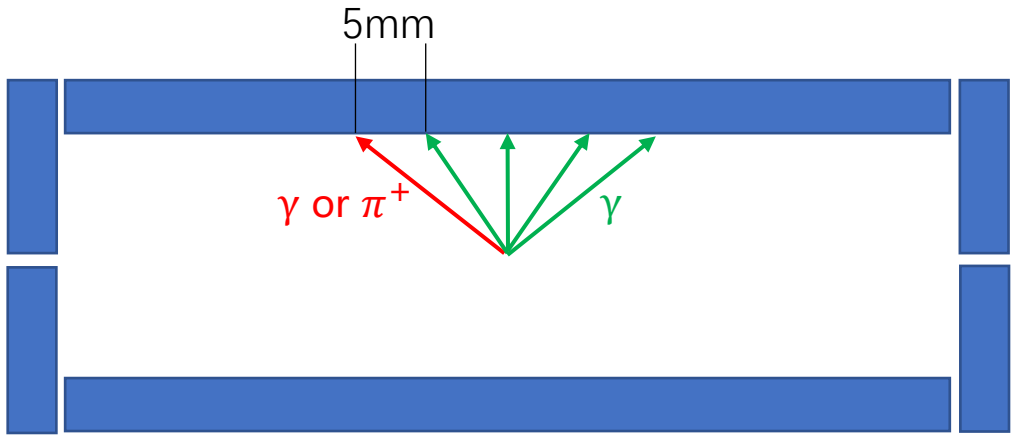
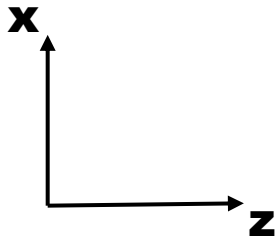
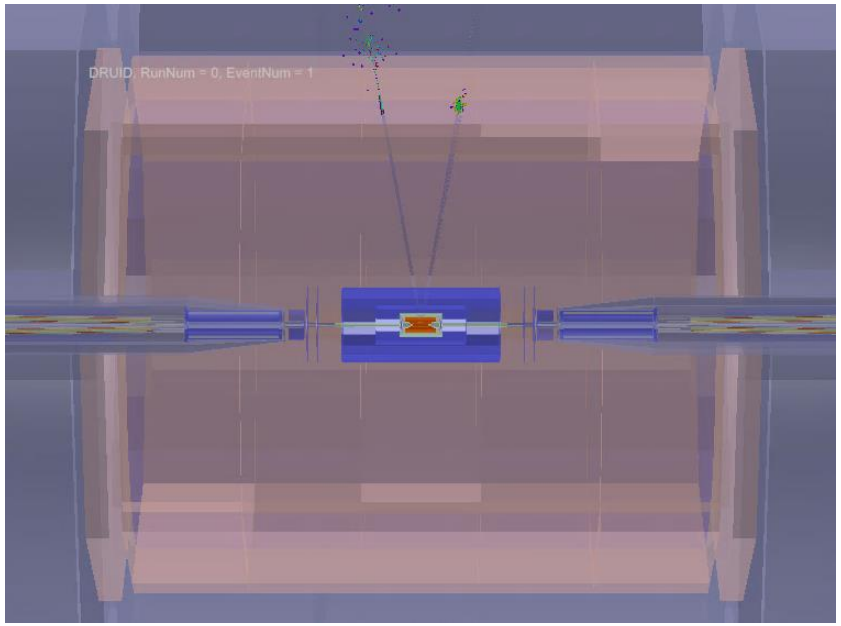
Setup

- Simulate γ/γ and π^+/γ incidence
  - 5/5 GeV γ/γ or 10/5 GeV π^+/γ
  - Incident from the collision point, along x-z plane
  - Distance between 2 particles on the inner surface of ECAL is a multiple of 5mm

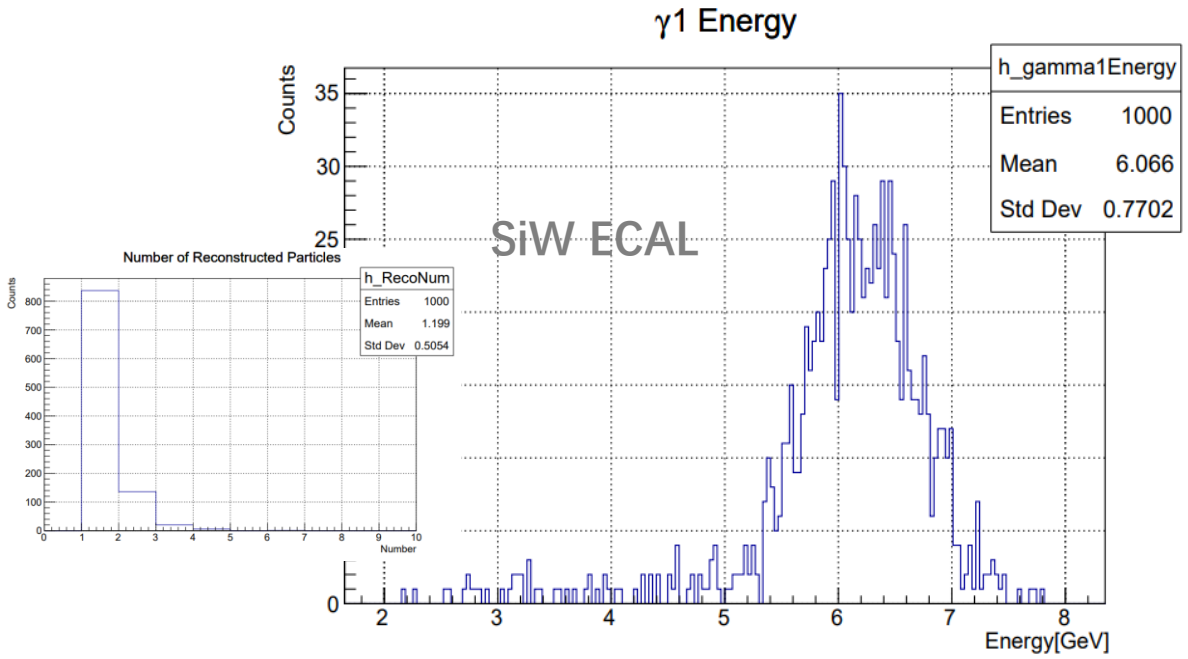


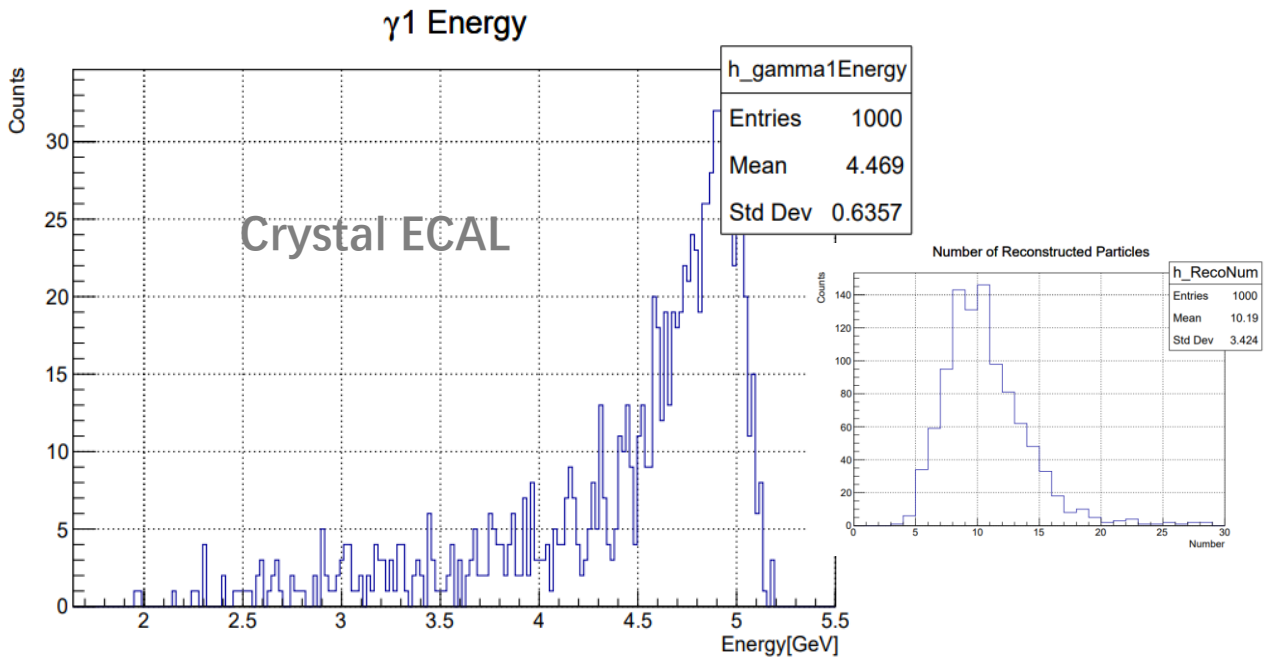






Reconstruction of Single Photon

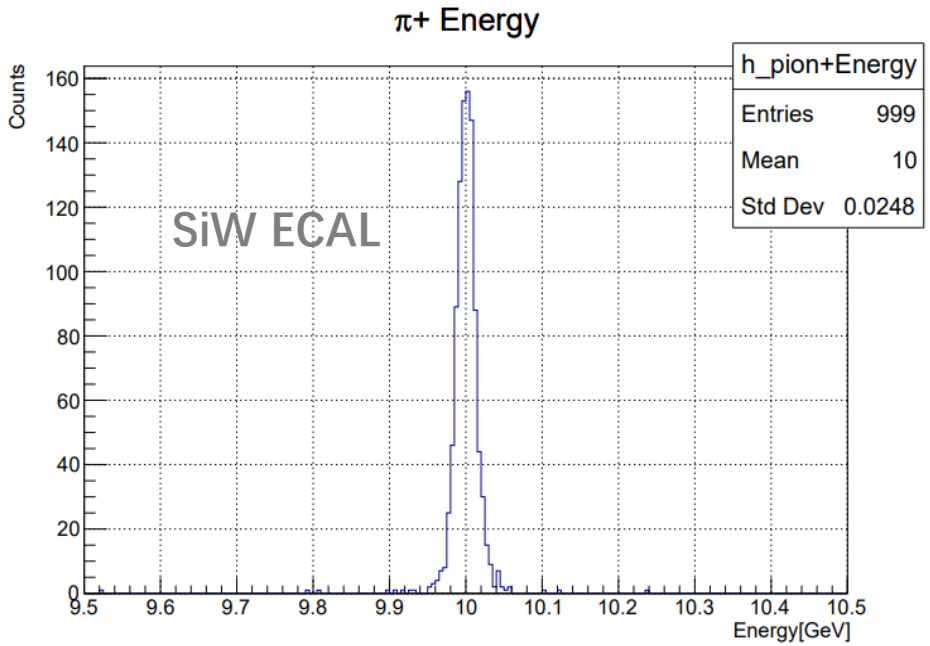


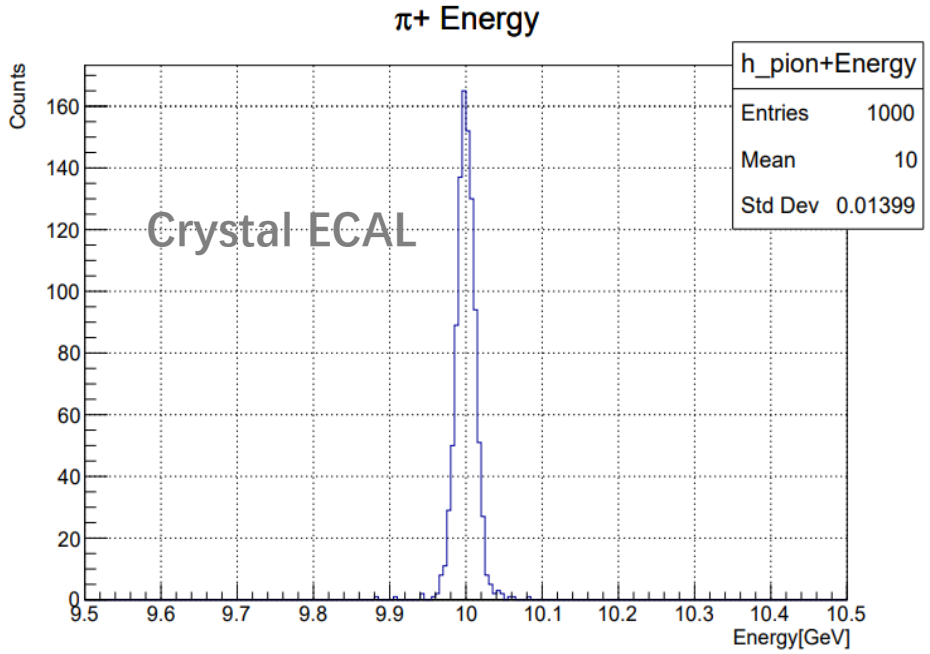


- Location z are both 300mm
- Calibration of SiWECAL : 60.91 81.81, Calibration of Crystal ECAL : 1.11 1.11

- The calibration constant of SiW ECAL too large, needs to be adjusted.
- For Crystal ECAL, the particle is more likely to be reconstructed to more than one particles, which have relatively low energy.

Reconstruction of Single π^+

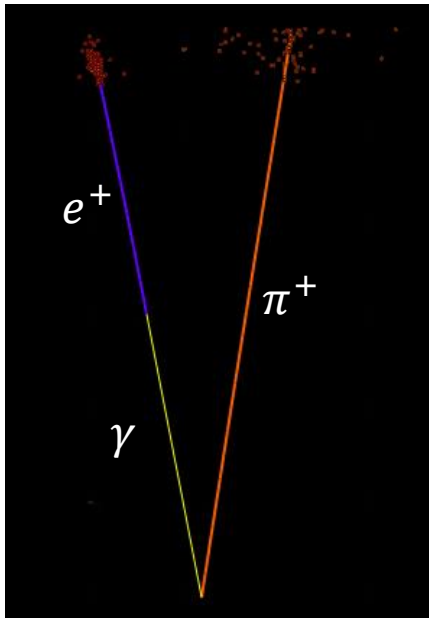


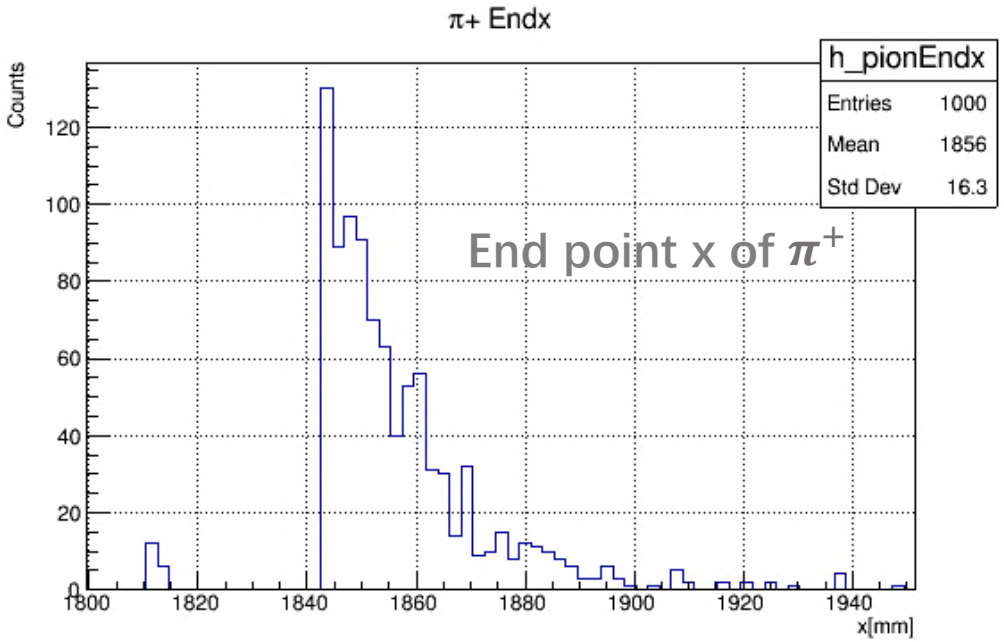


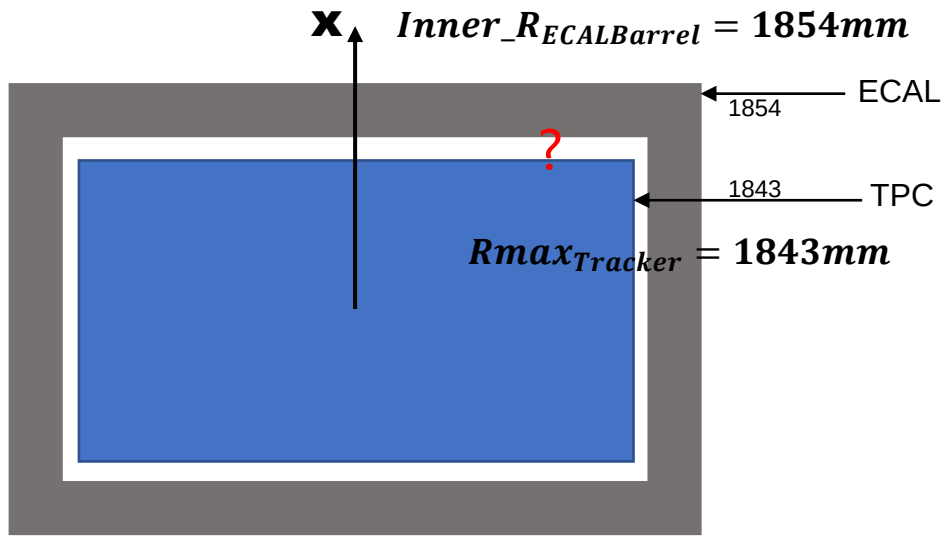
- Because π^+ is a charged particle, its reconstruction is more precise.

Conversion

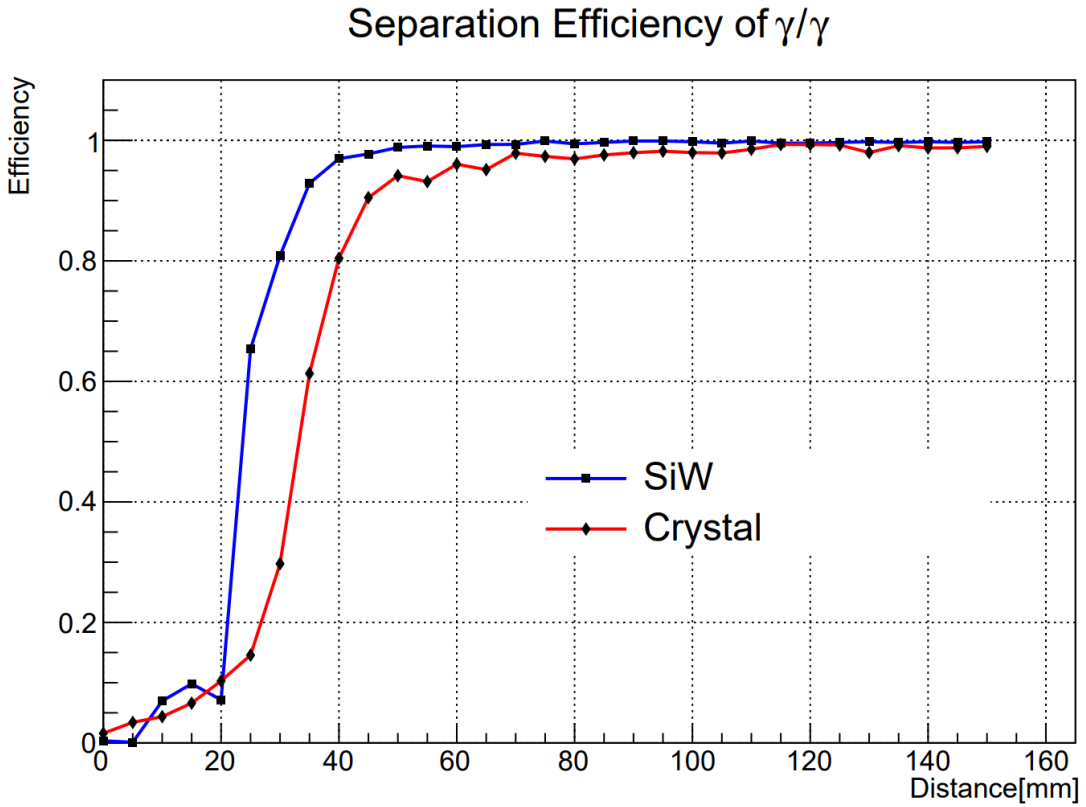
- The conversion that happens in front of calorimeter may lead a wrong reconstruction.
- In the geometry of detector, between ECAL and TPC, there is a gap made up of some materials.
- Delete the events in which particles is convert in front of calorimeter(-1843mm~+1843mm).



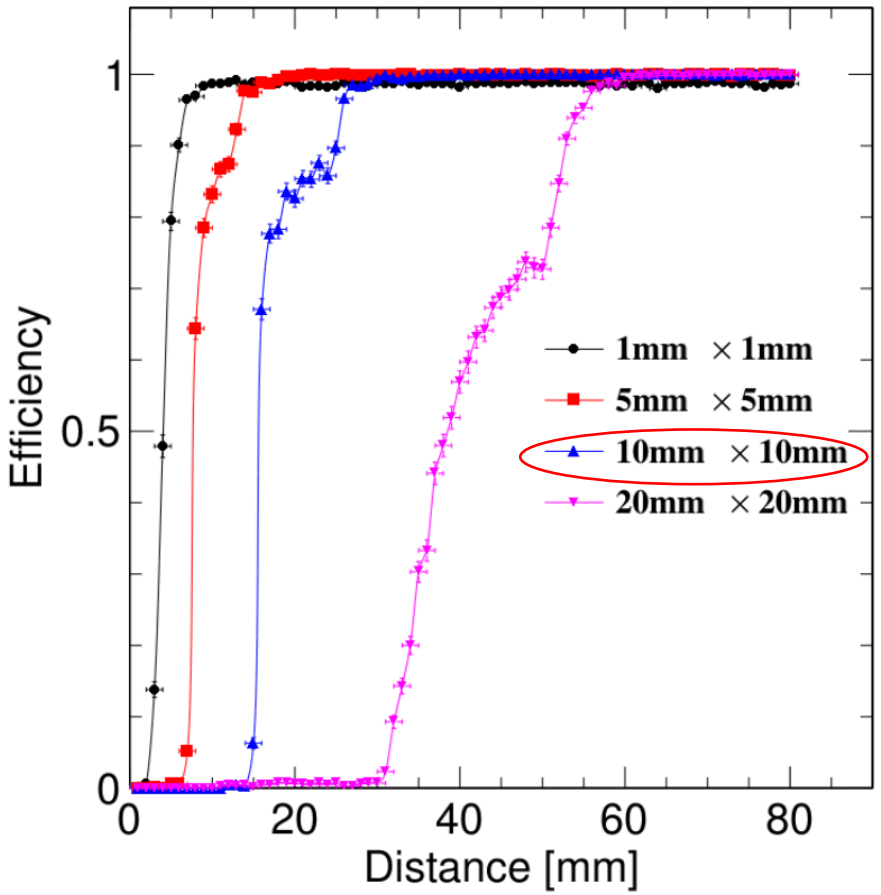




γ/γ Separation

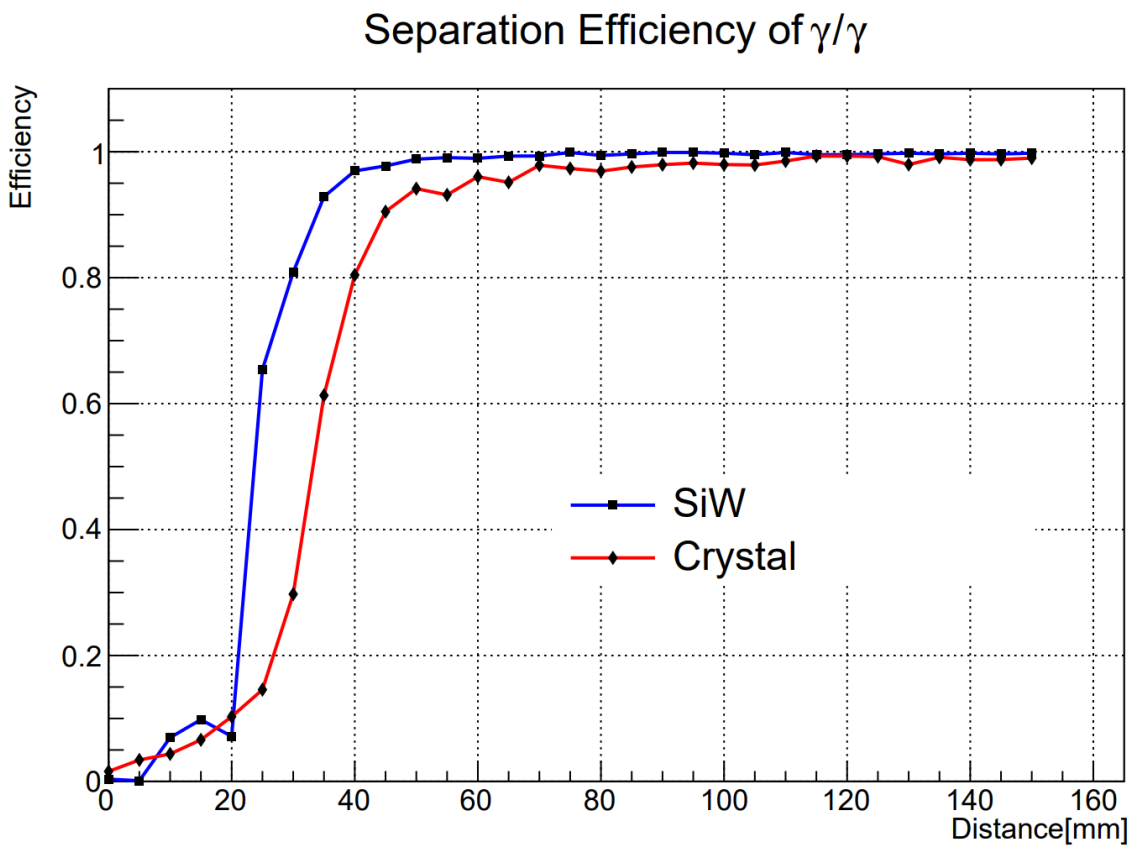


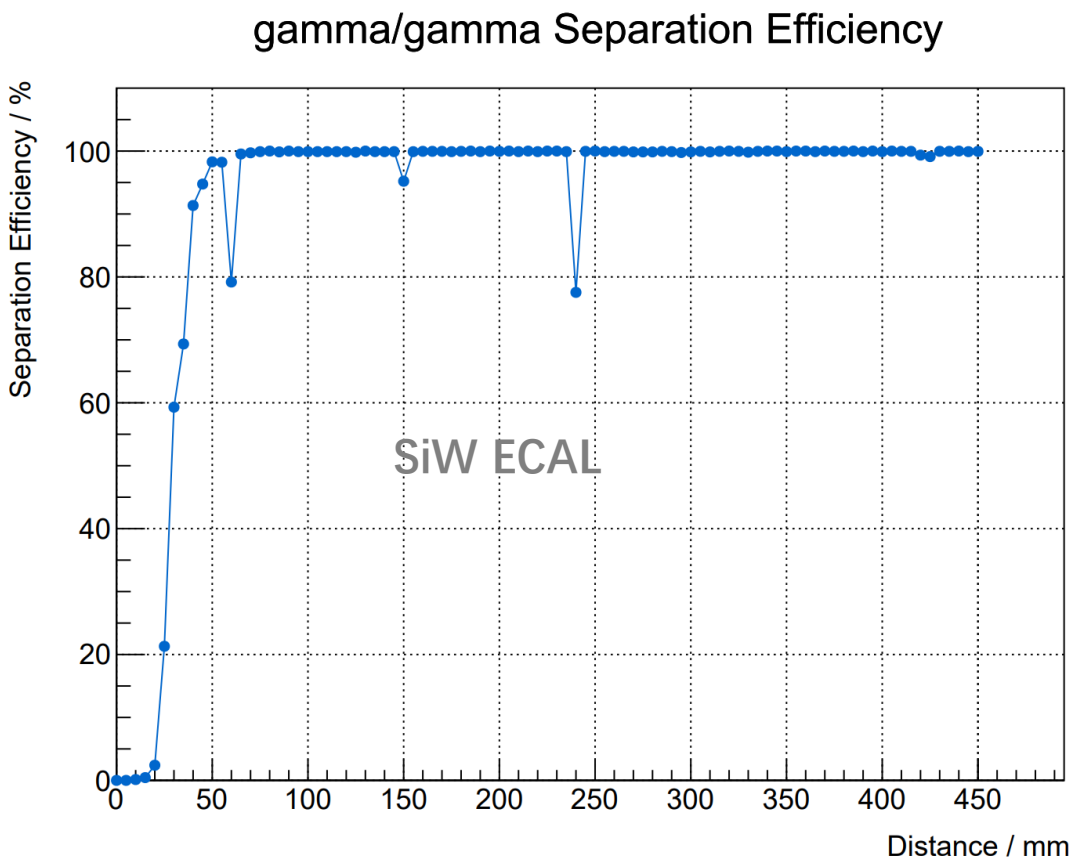
CDR SiW ECAL



- 5GeV photons
- Successful Separation: 4GeV < E_γ < 8GeV for SiW ECAL, 2.5GeV < E_γ < 6GeV for Crystal ECAL
- Location z: -300mm ~ -150mm

γ/γ Separation

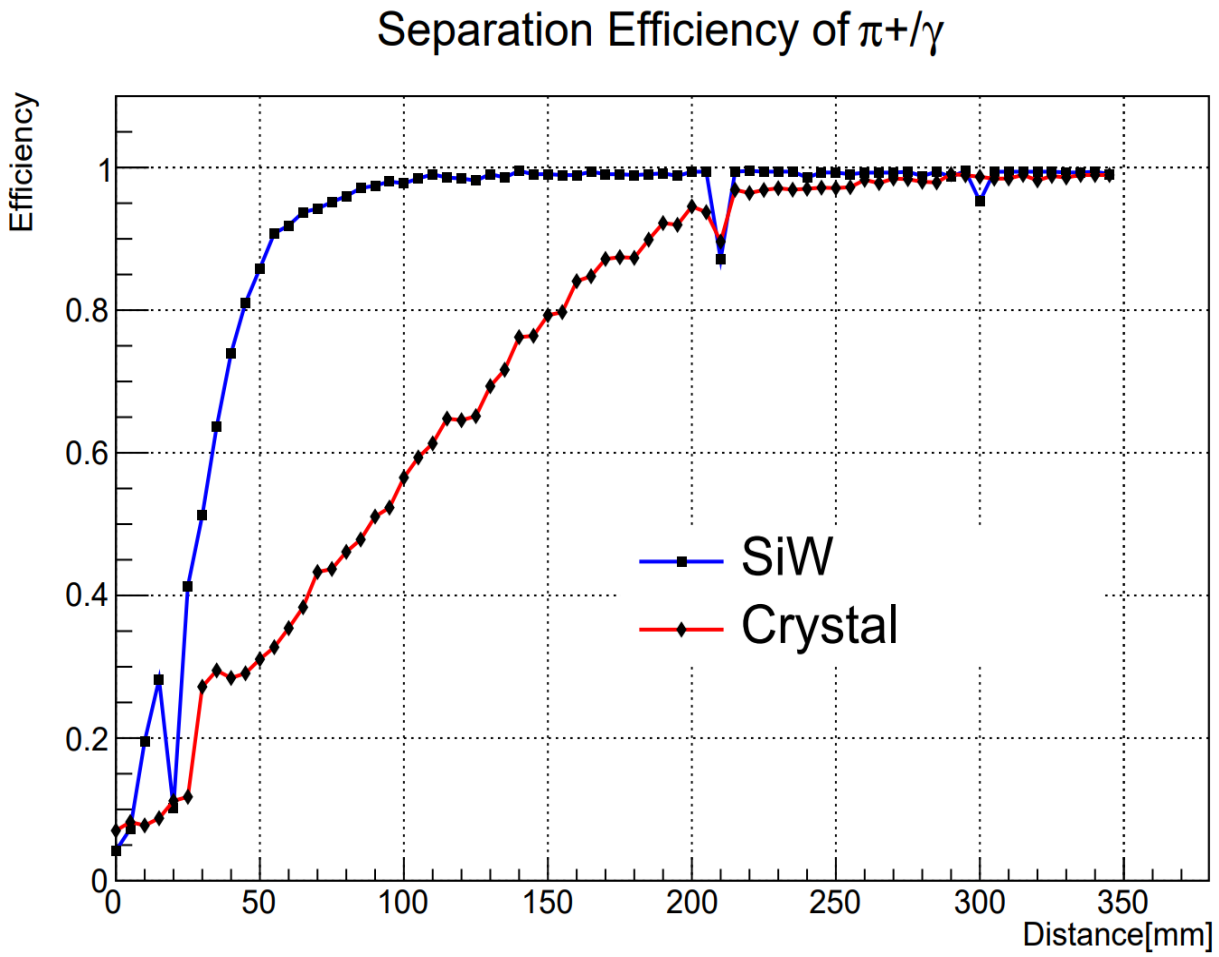




Made by Baohua Qi

Number of MCParticle is limited to be 2

π^+/γ Separation



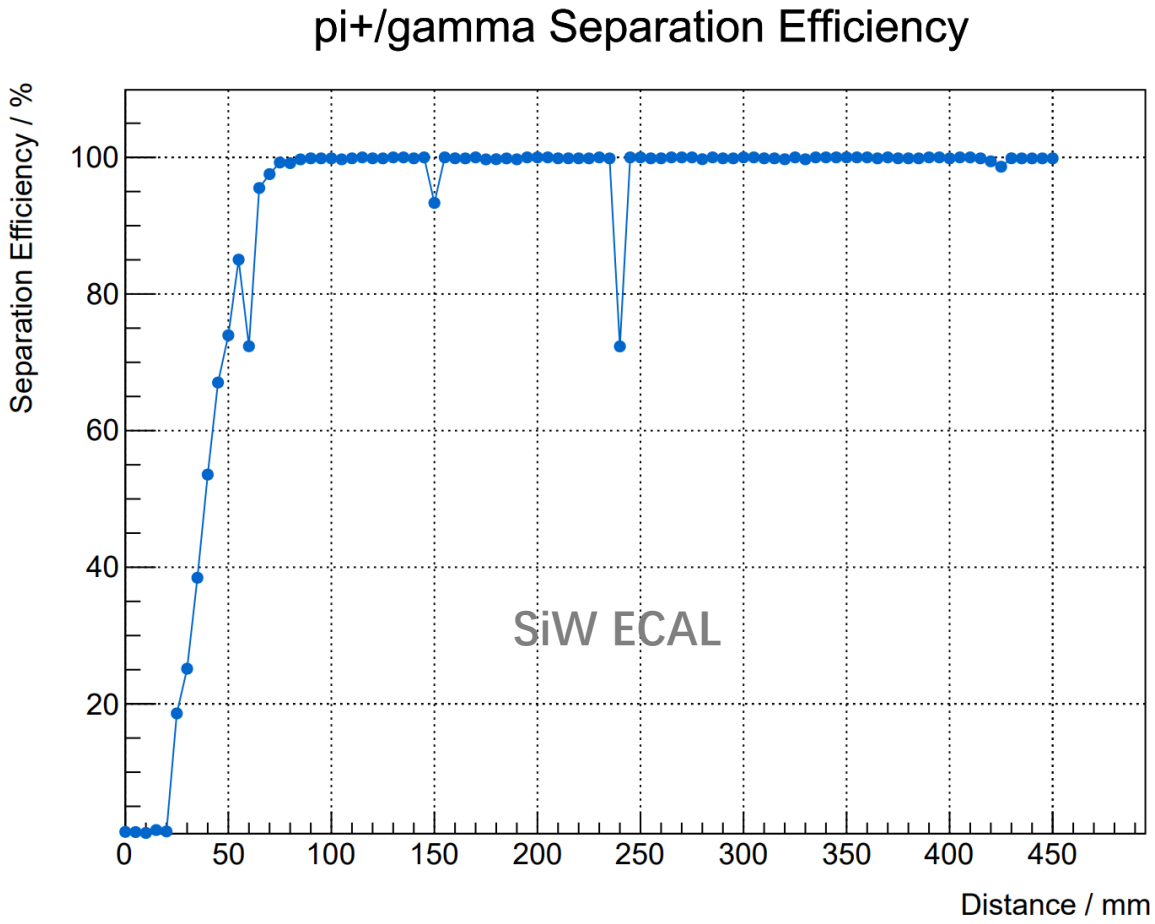
- 10GeV π^+, 5GeV photon
- Successful Separation: At least one charged particle and one neutral particle were reconstructed,

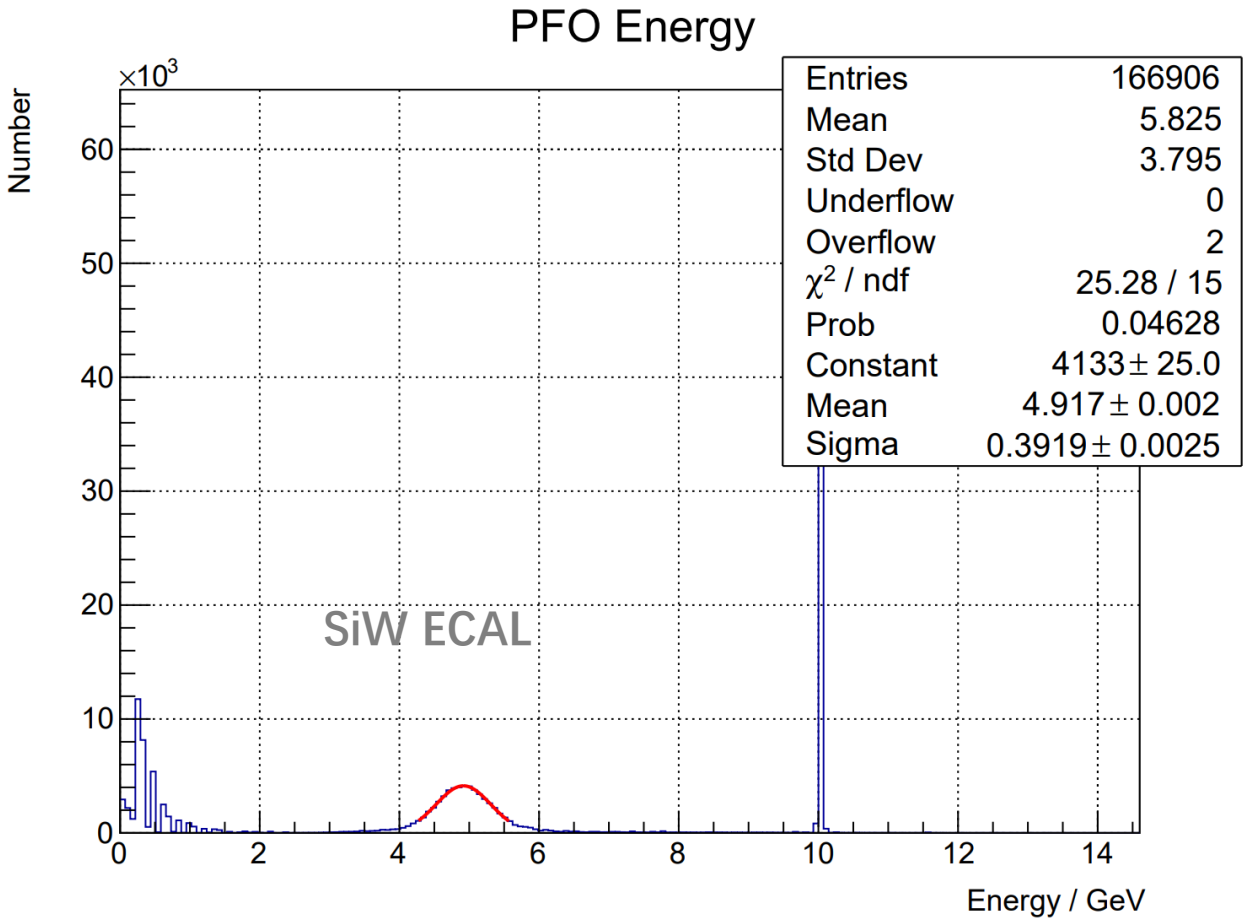
9.5GeV < E_{Charge} < 10.5GeV,

4GeV < $E_{Neutral}$ < 8GeV(SiW),

2.5GeV < $E_{Neutral}$ < 6GeV(Crystal)

π^+/γ Separation



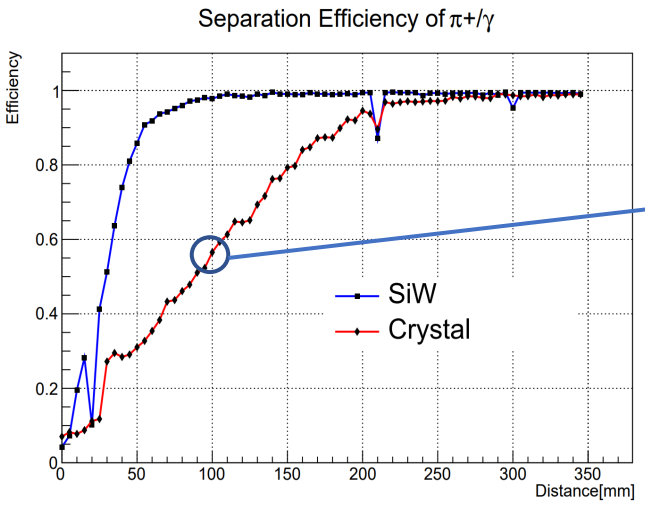


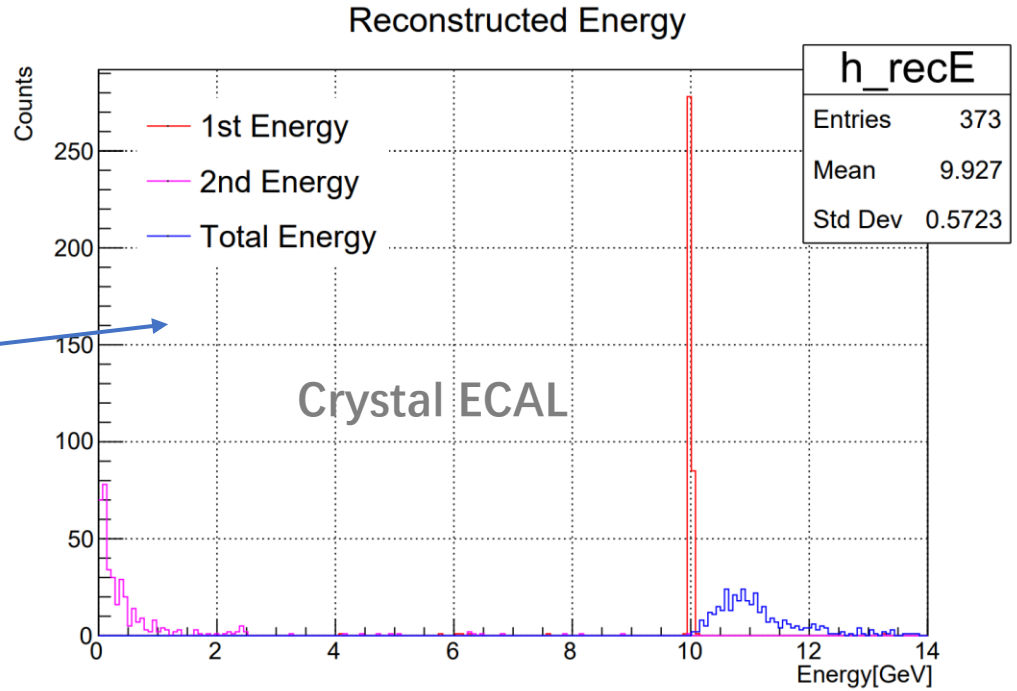
Made by Baohua Qi

Number of MCParticle is limited to be 2

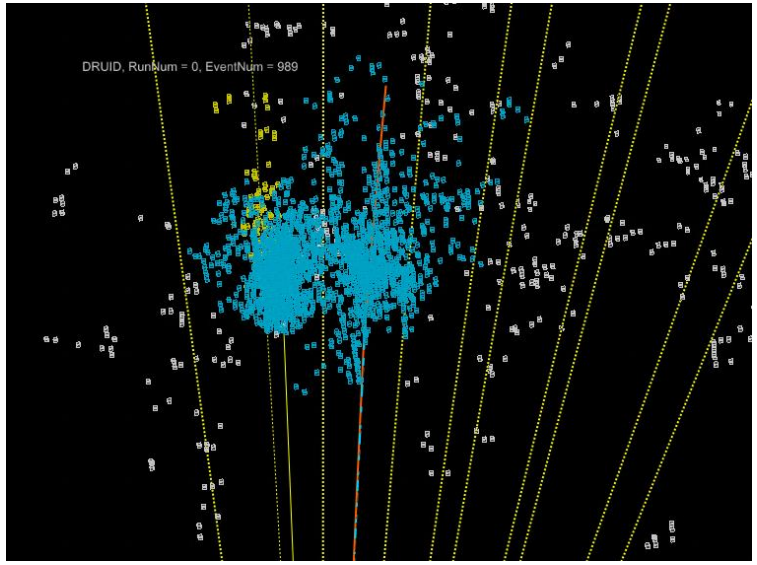
π^+/γ Separation

- $z_{\pi^+} \approx -300\text{mm},\ z_\gamma = -200\text{mm}$
- Select tht events that failed to reconstruct.
- The 1st Reconstructed Energy(charged) are about 10GeV, while the 2nd Reconstructed Energy(neutral) are much lower than 5GeV.



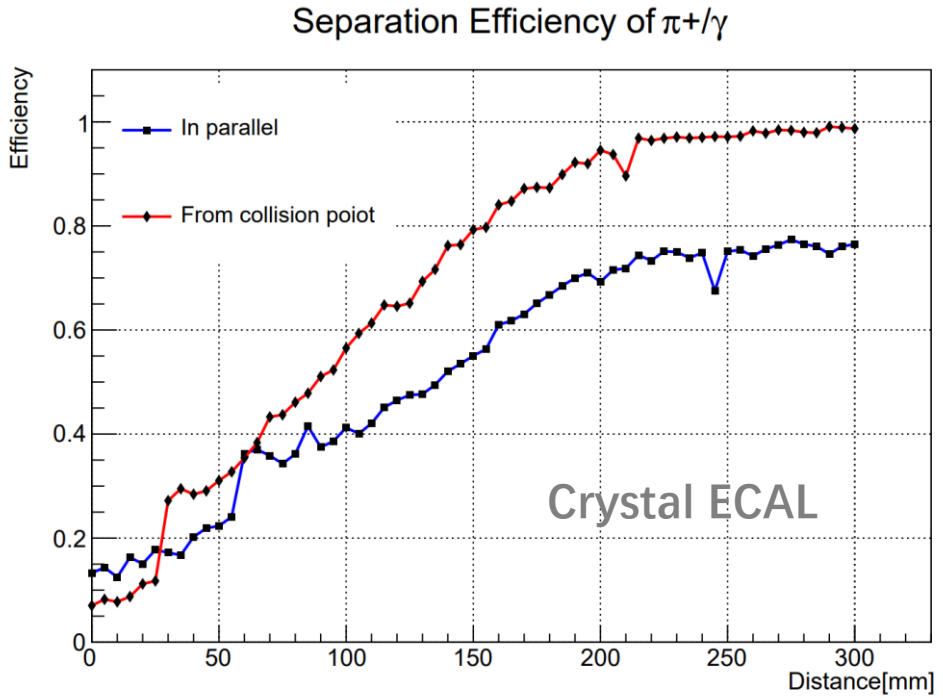


The cluster of photon(left) was merged into the cluster of π^+(right)

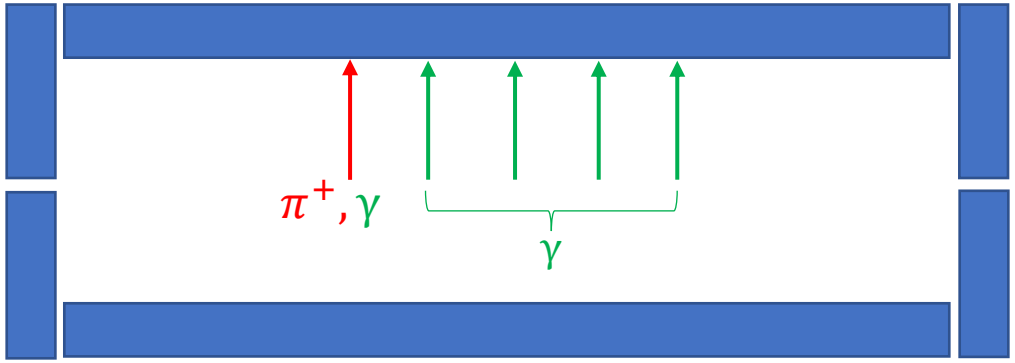


π^+/γ Separation

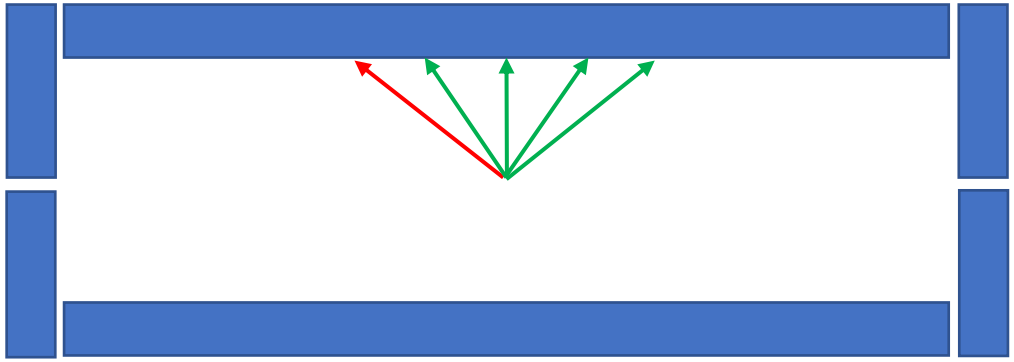
- If 2 particles incient in parallel, the saparation efficiency will be lower than incidence from collision point. It is probably because the track of π^+ cannot be matched with its cluster precisely.



Incident in parallel

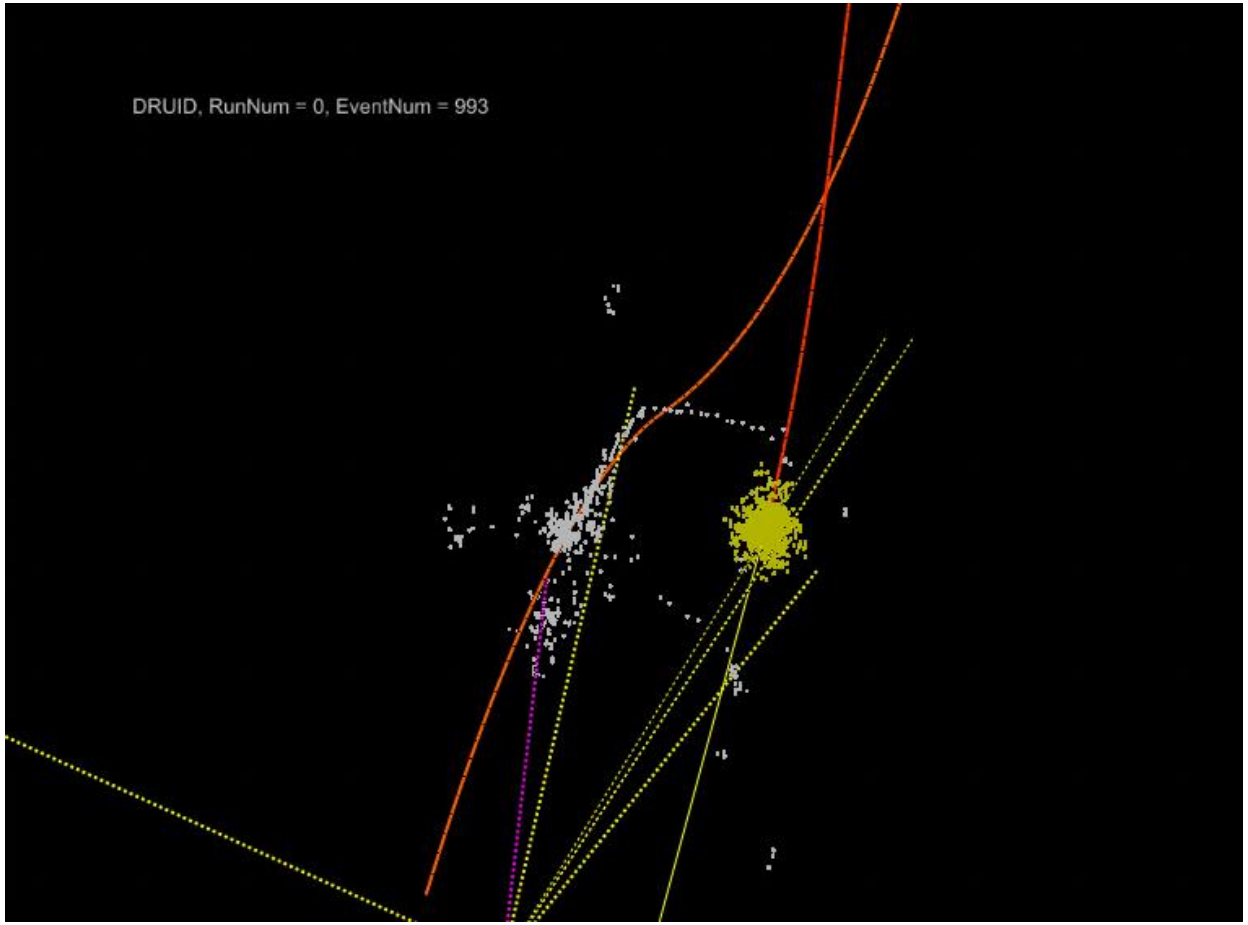


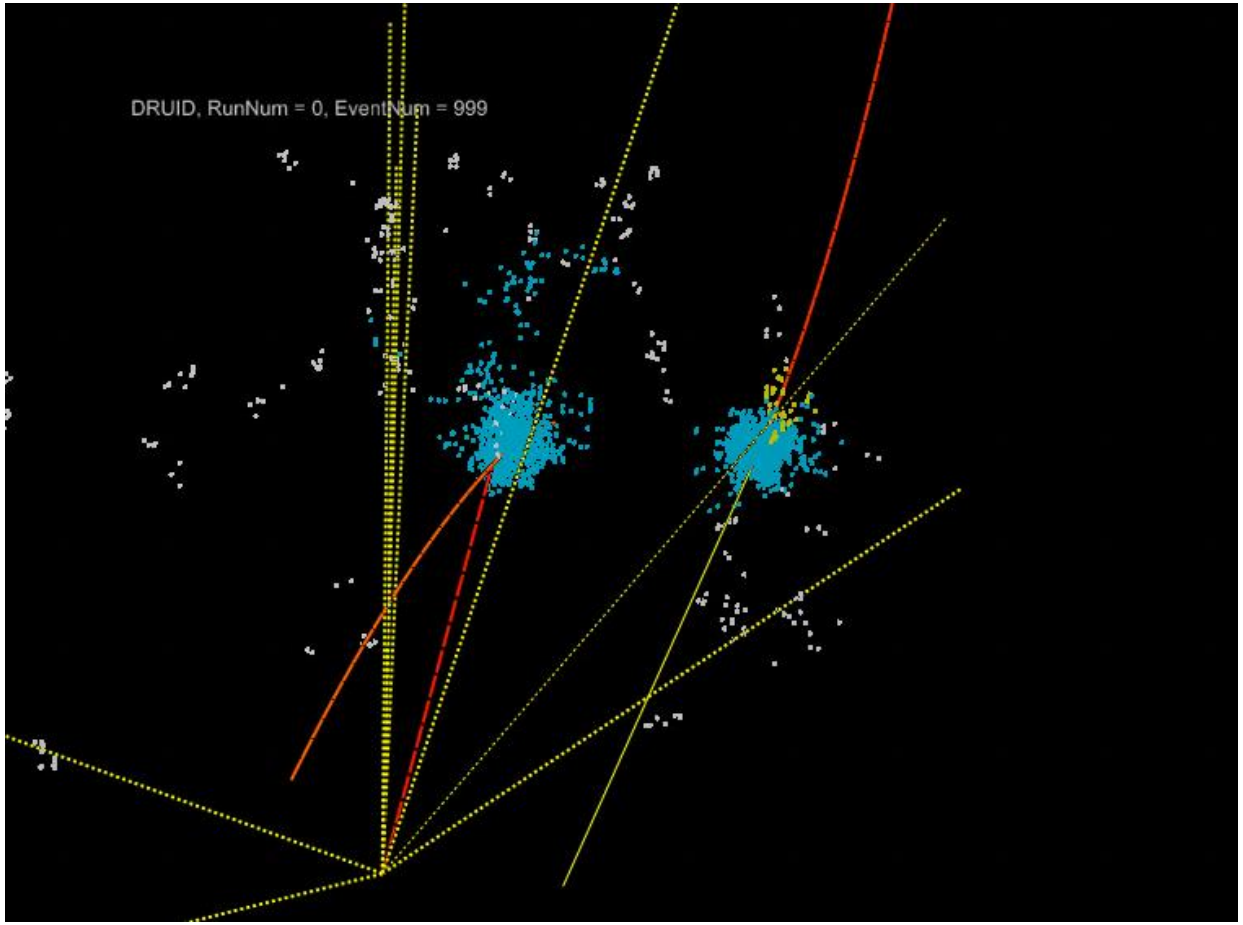
Incident from collision point



π^+/γ Separation

Incient in parallel





Summary

- Show γ/γ and π^+/γ separation efficiency in SiW ECAL and Crystal ECAL. Study the reason for wrong reconstruction.
- Compare the parallel incidence of particles and the incidence of particles from the collision point.
- Next step:
  - Adjust the calibration and other parameters.
  - Adjust the incidence direction of π^+ to avoid hitting the gap area.
  - Change the energy of γ and π^+ .