# Overview of the new benchmark

Aug 13 (Tue)
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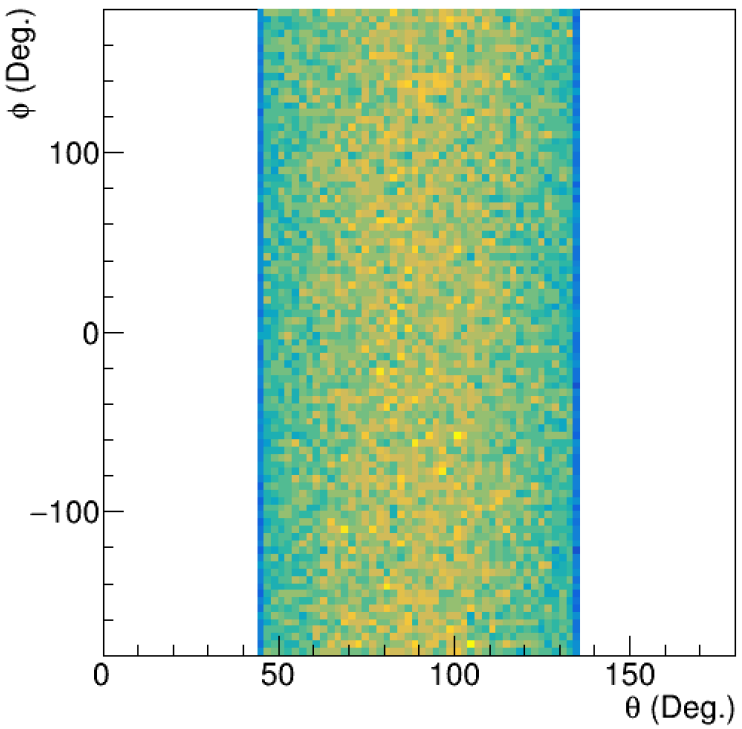
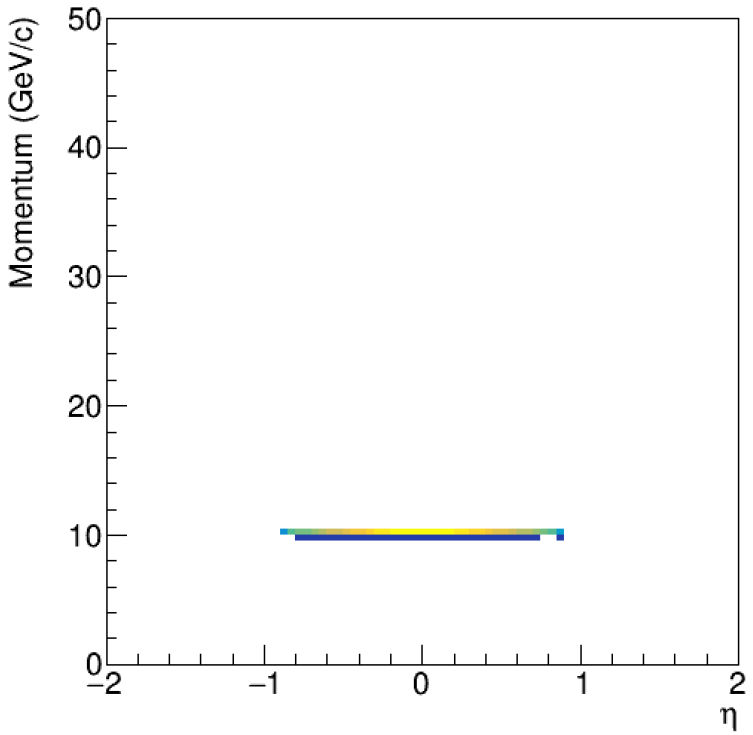
# Items to be checked/presented by the benchmark

- Beam information.
- Whether the shower is well developed in the detector.
- BIC performances.
- Basic studies using BIC.

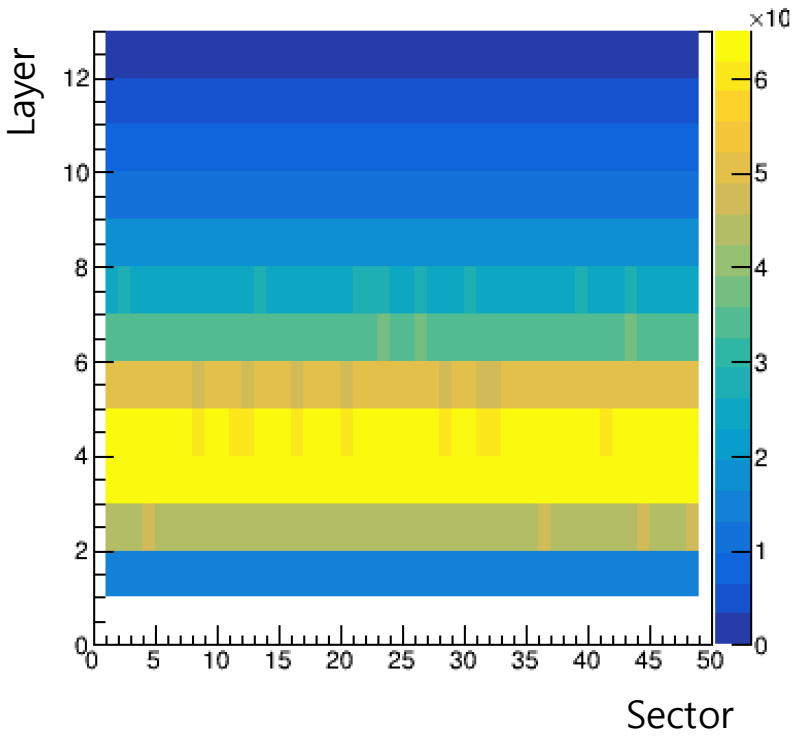
# Beam information

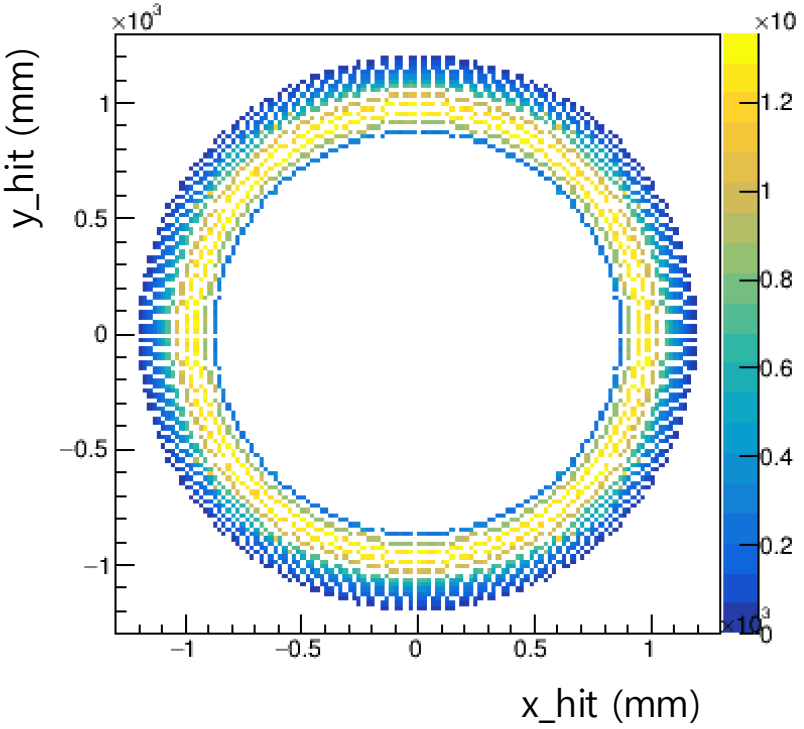



- θ vs ϕ and $\eta$ vs Mom. Distributions show us the beam energy and how the beam spreads out.

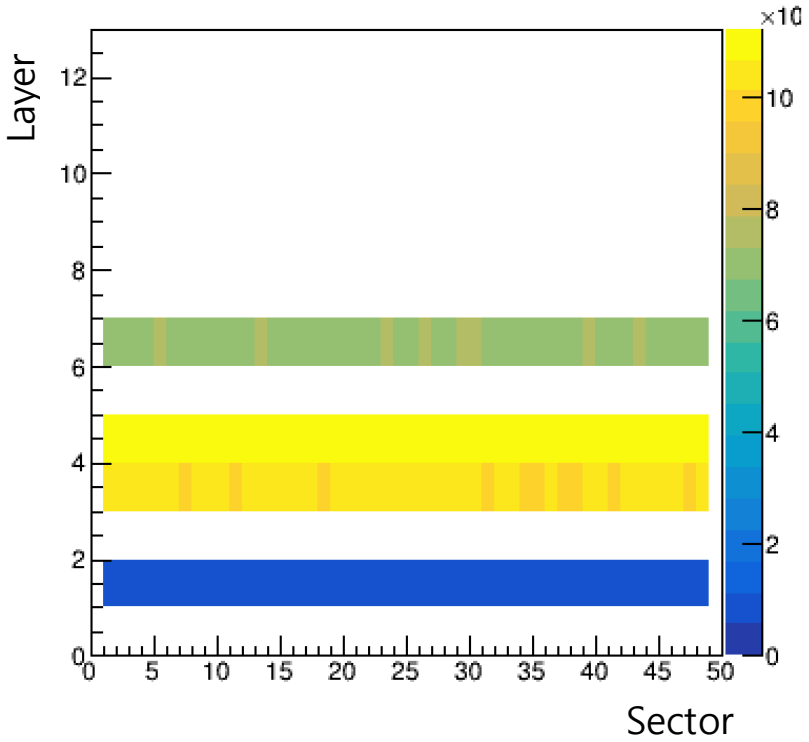
# Shower development (ScFiRecHits)

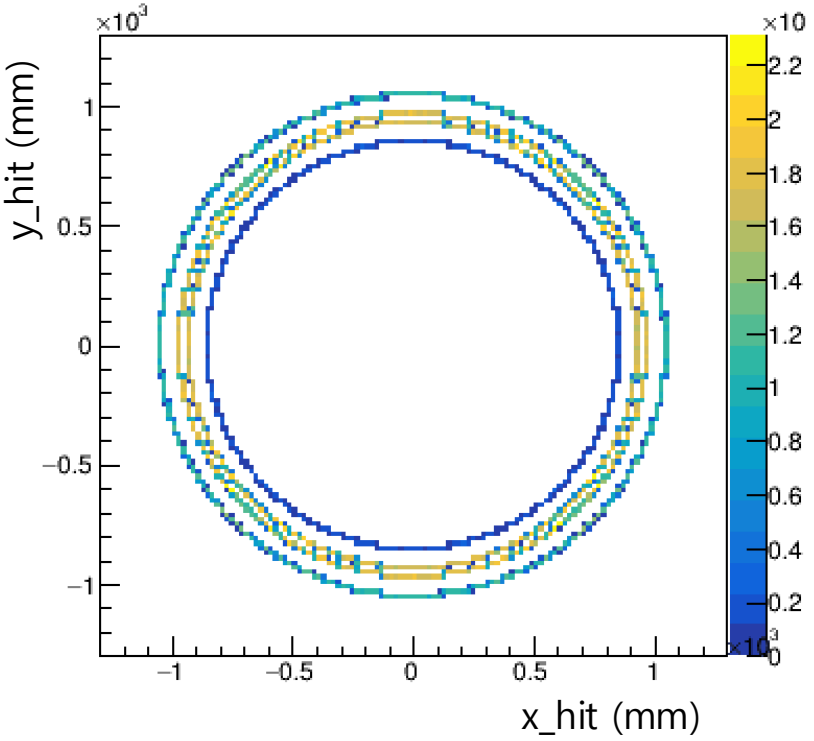



- The energy deposit-weighted sector vs layer and x_hit vs y_hit distributions show that the EM shower was well developed in both ScFi and imaging layers.

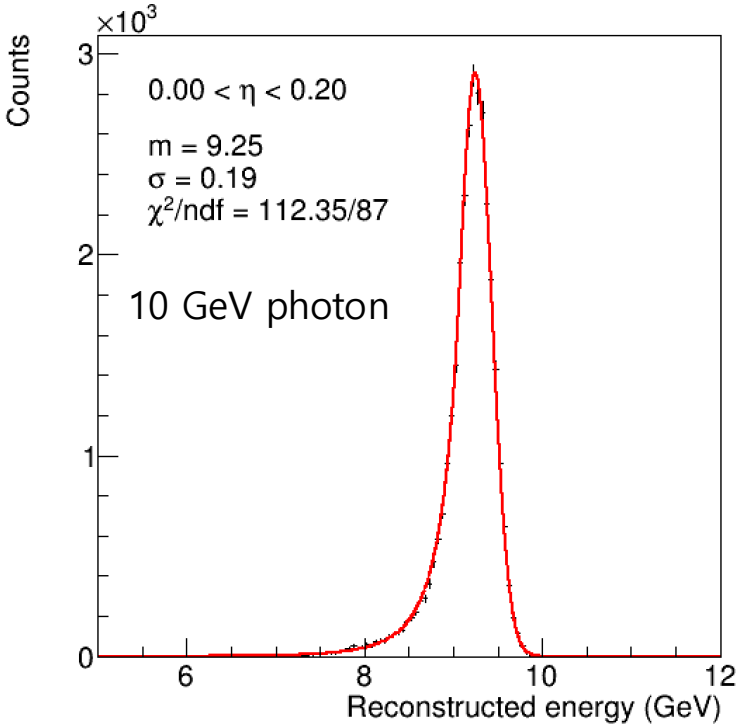
# Shower development (ImagingRecHits)

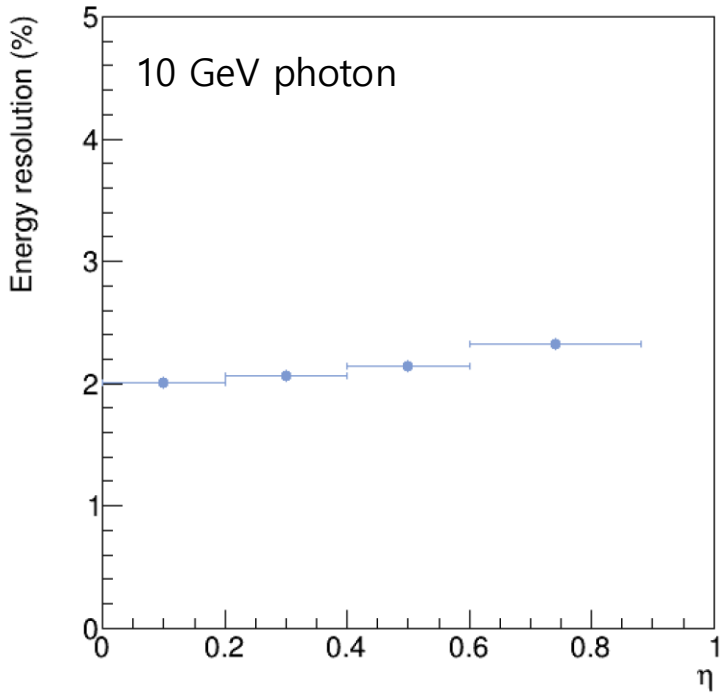



- The energy deposit-weighted sector vs layer and x_hit vs y_hit distributions show that the EM shower was well developed in both ScFi and imaging layers.

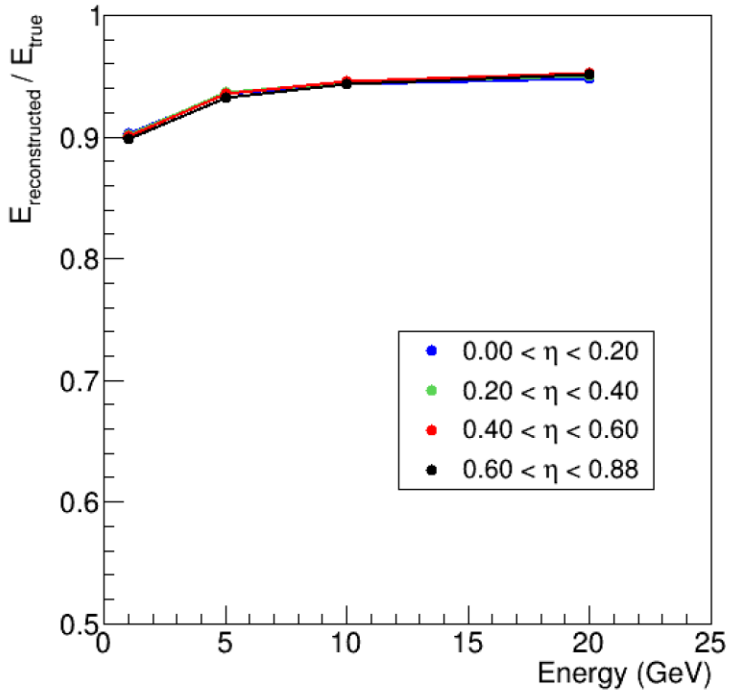
# Energy resolution plots (ScFiRecHits)



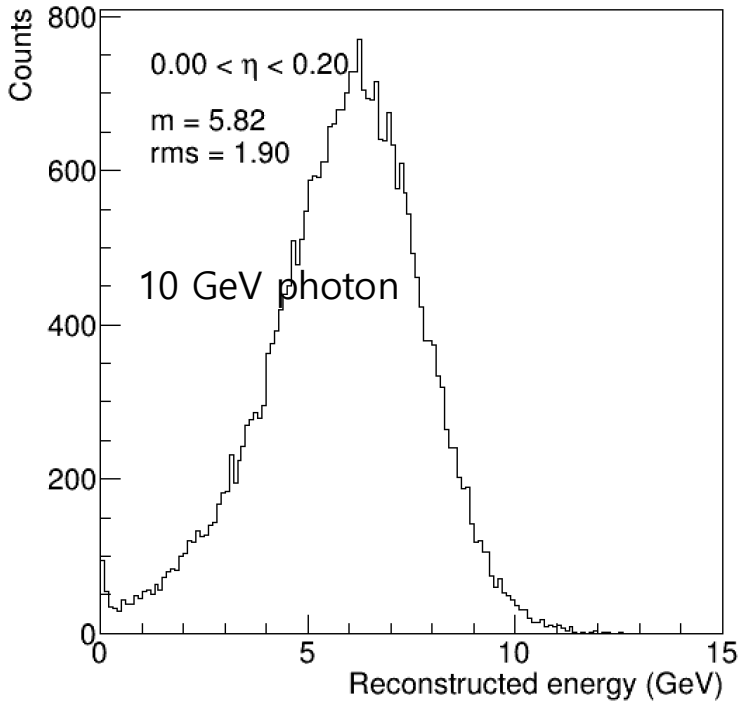

- Energy distributions reconstructed by the ScFi layers will be saved for each η range.
- Energy resolution as a function of η will also be saved.

# $E_{reconstructed}$ / $E_{true}$



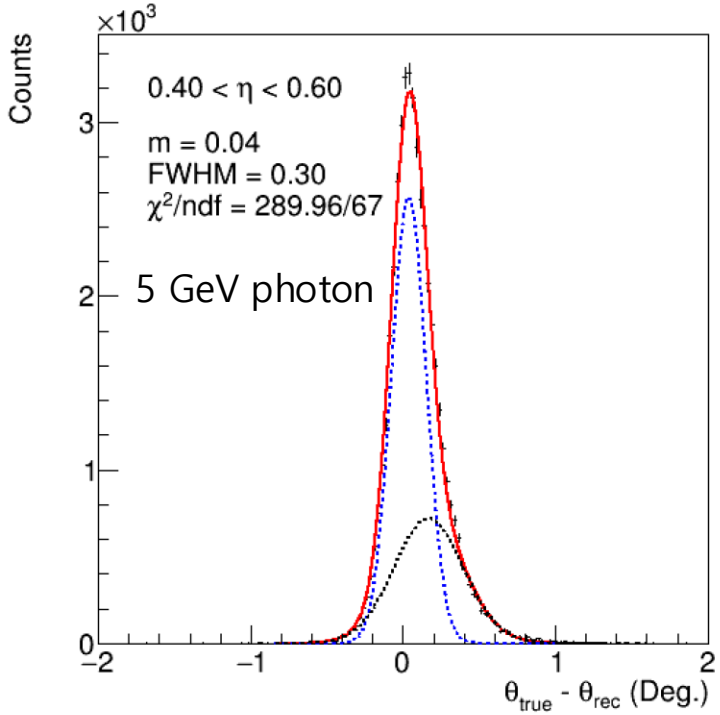

- Fraction to true energy will also be saved. These quantities could be related to a sampling fraction or calibration parameters to be updated.

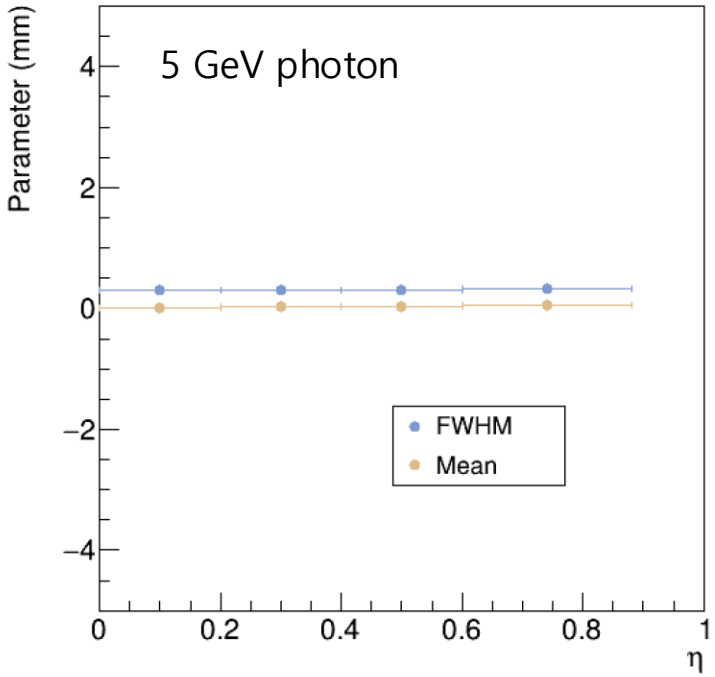
# Energy resolution plots (ImagingRecHits)




- Energy distributions reconstructed by the imaging layers will be saved for each η range as a reference.

# Angle resolution plots (θ)

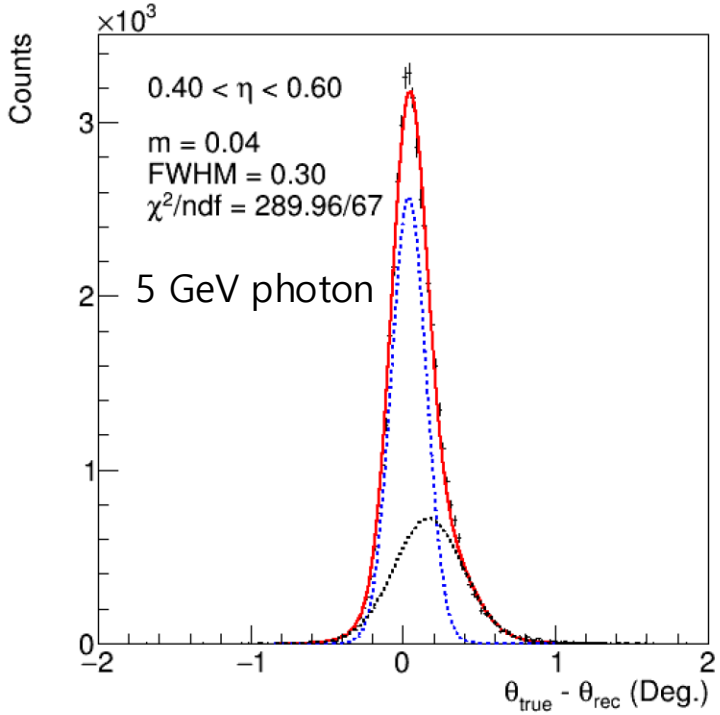


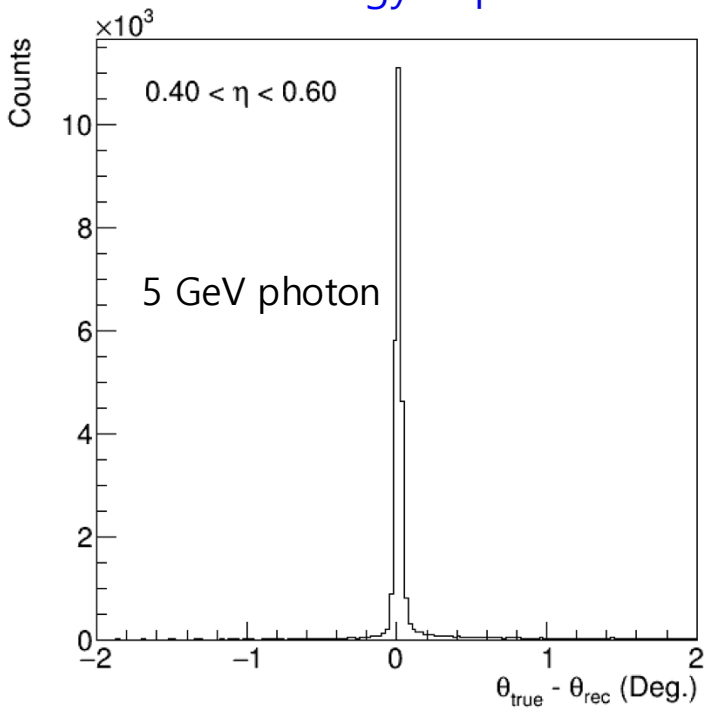

- The θ difference distribution has a right-side tail due to the magnetic field. The shower particles experience forces to ±x directions. → Makes the $\theta_{rec}$ smaller.
- The distribution was fitted by a superposition of two Gaussians.

# Angle resolution plots (θ)

Cluster



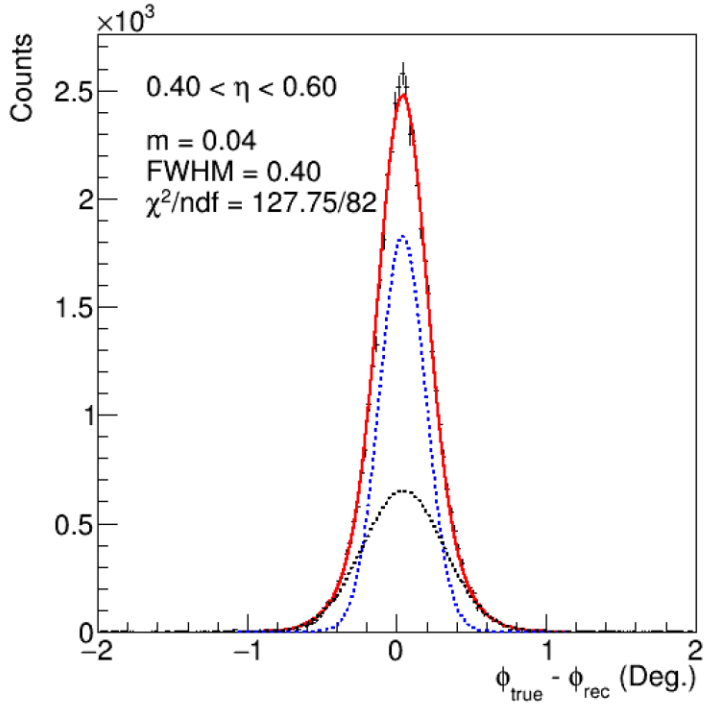

Max. energy deposit hit



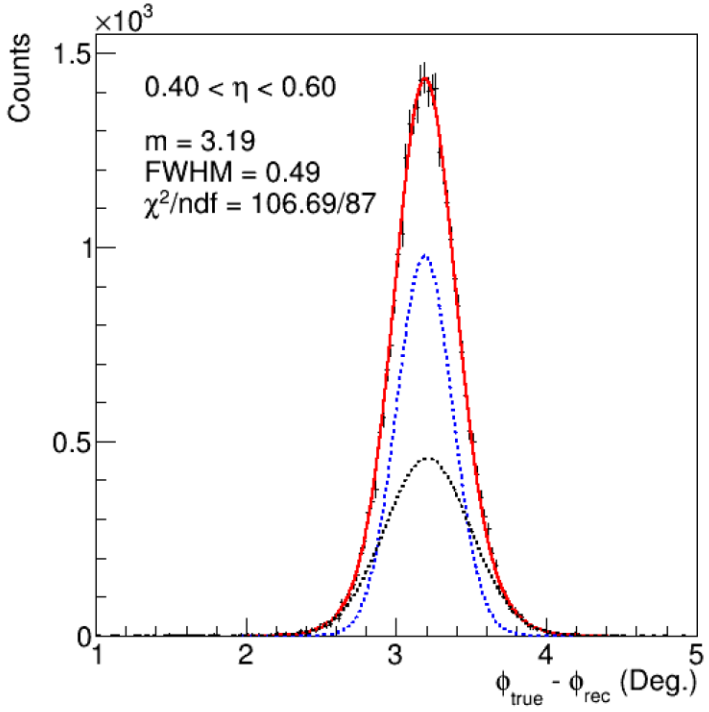

- The θ difference distribution has a right-side tail due to the magnetic field. The shower particles experience forces to ±x directions. → Makes the $\theta_{rec}$ smaller.
- The distribution was fitted by a superposition of two Gaussians.
- If the maximum energy deposit hit is used, the θ resolution is greatly improved, but just a maximum energy deposit makes the number of bad events increase.

# Angle resolution plots (ϕ)

5 GeV photon



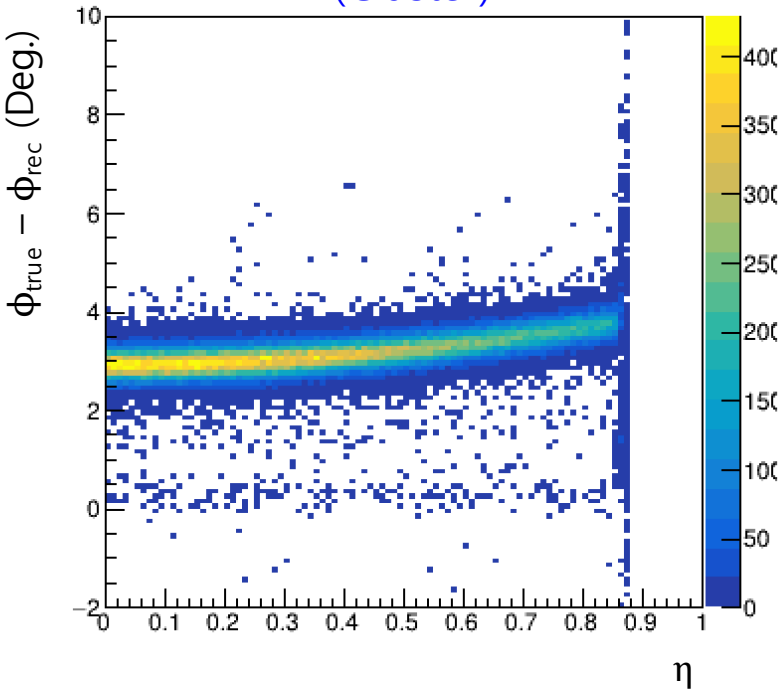

5 GeV electron



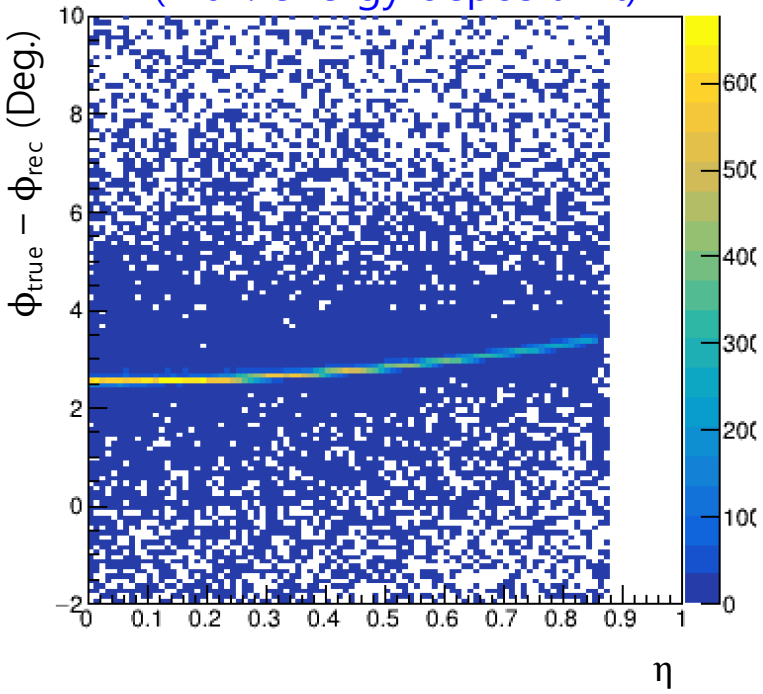

- The electron distribution has an offset due to the magnetic field.
- The shower particles experience forces to the ±x directions. → Makes the $\phi_{rec}$ smeared. Therefore, there is no right-side tail.

# Angle resolution plots (ϕ)

5 GeV electron
(Cluster)



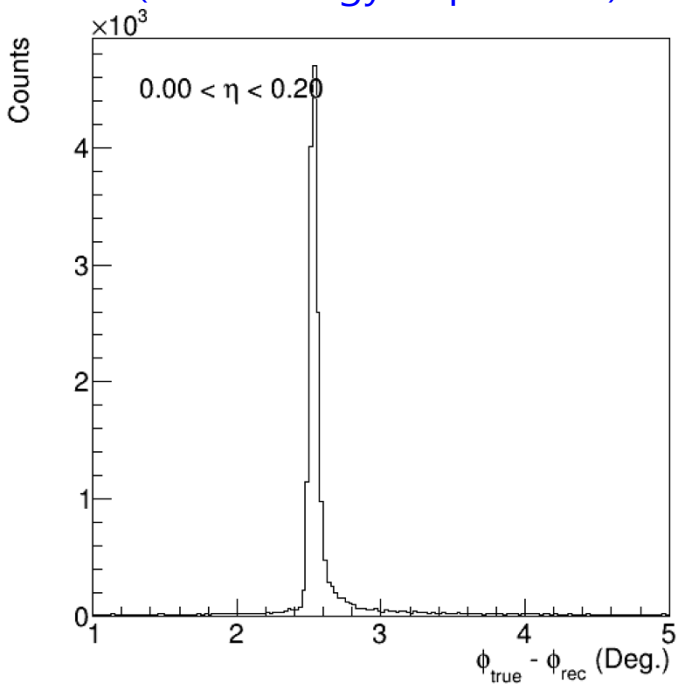

5 GeV electron
(Max. energy deposit hit)



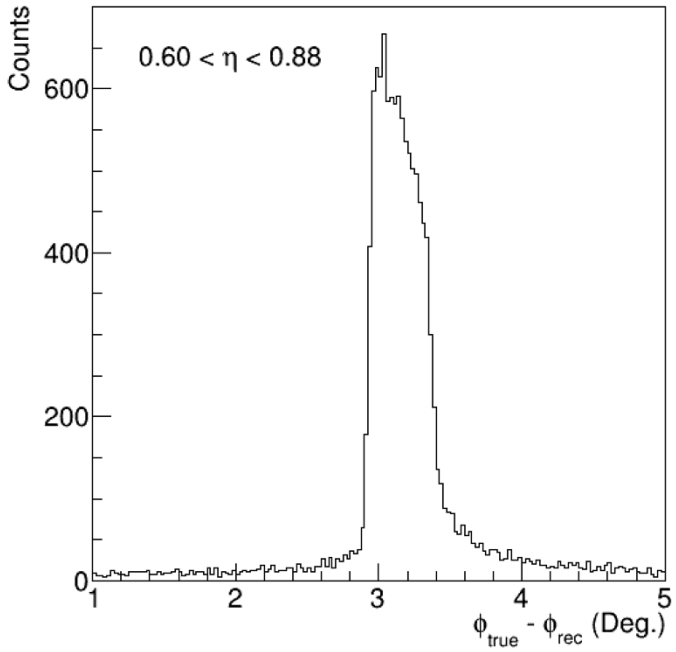

- We can see the effect of the magnetic field from the η vs Δϕ plots.

# Angle resolution plots (ϕ)

5 GeV electron
(Max. energy deposit hit)

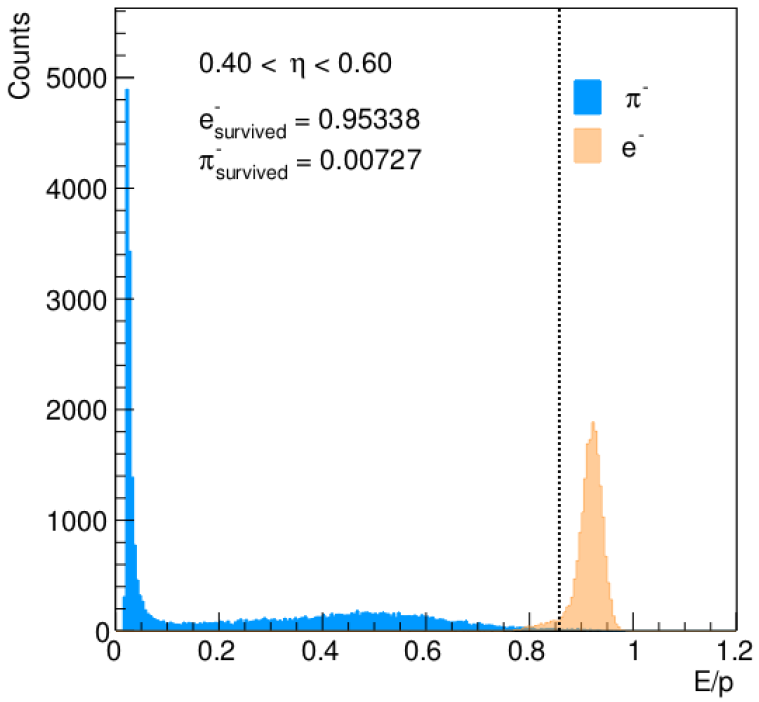


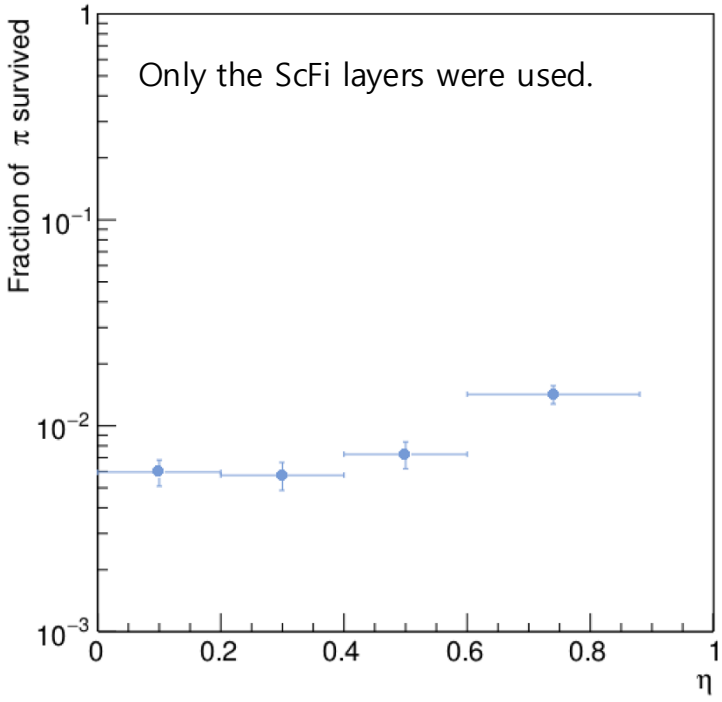

5 GeV electron
(Max. energy deposit hit)




- Because the ϕ reconstructed by the maximum energy deposit hit has no smearing, the ϕ difference distribution doesn't follow the Gaussian.
- It might be better not to include the ϕ difference distribution obtained by the Max. energy deposit hit or better to just include the 2-dimensional one.

# e/π separation plots

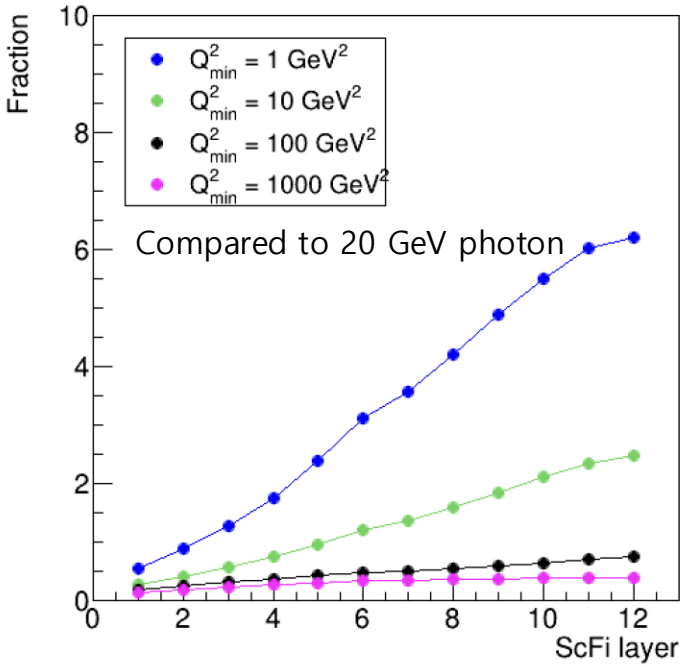


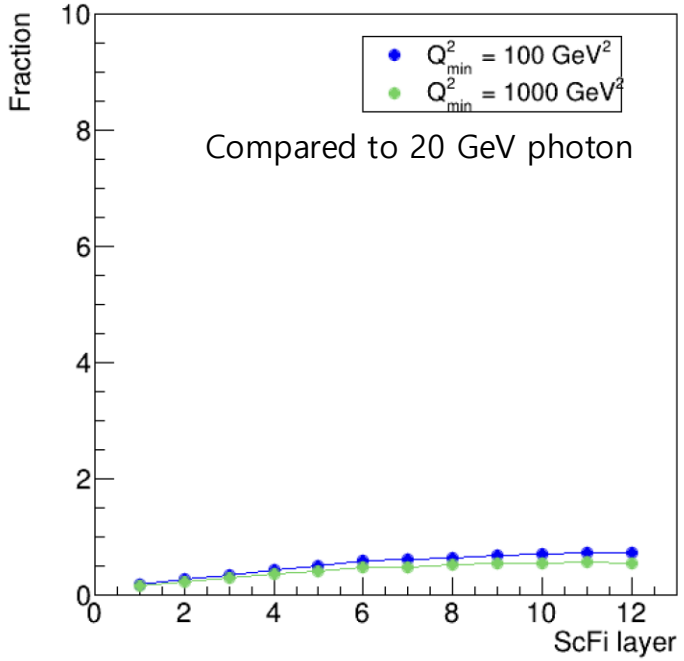

- E/p distributions of e and π will be plotted with a dashed threshold line that makes the e efficiency higher than 95%.
- Fraction of the survived π will also be presented as a function of η.

# Multiplicity

Neutral current (18x275)




Charged current (18x275)




- As an example of the basic quantities studied by the BIC, we can compare the number of hits on the ScFi layers between the single particle and DIS.

# Codes to be added

emcal_barrel_single_particle_energy.cxx

emcal_barrel_single_particle_angle.cxx

emcal_barrel_epi_sepration.cxx

emcal_barrel_multiplicity.cxx