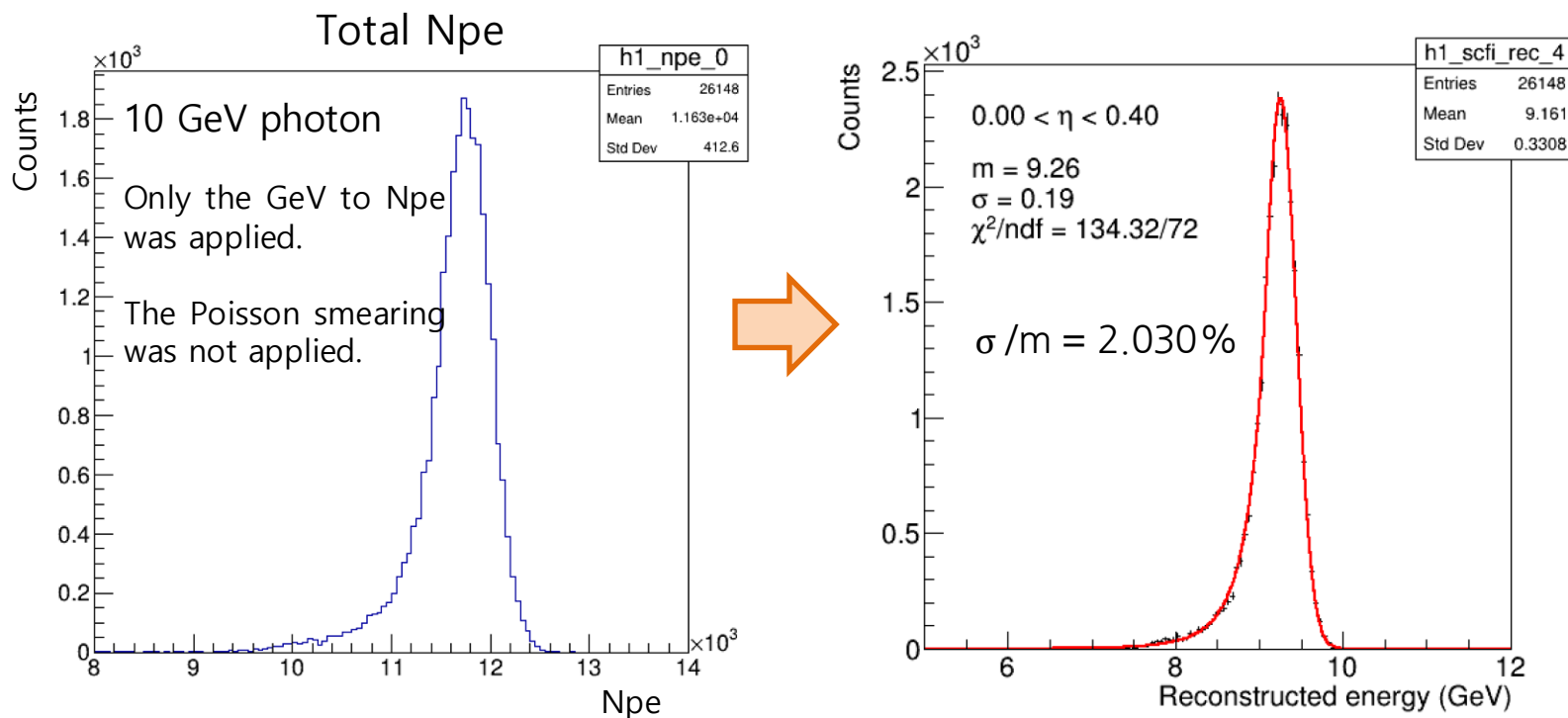# Effect of Poisson smearing and fitting the longitudinal shower profile
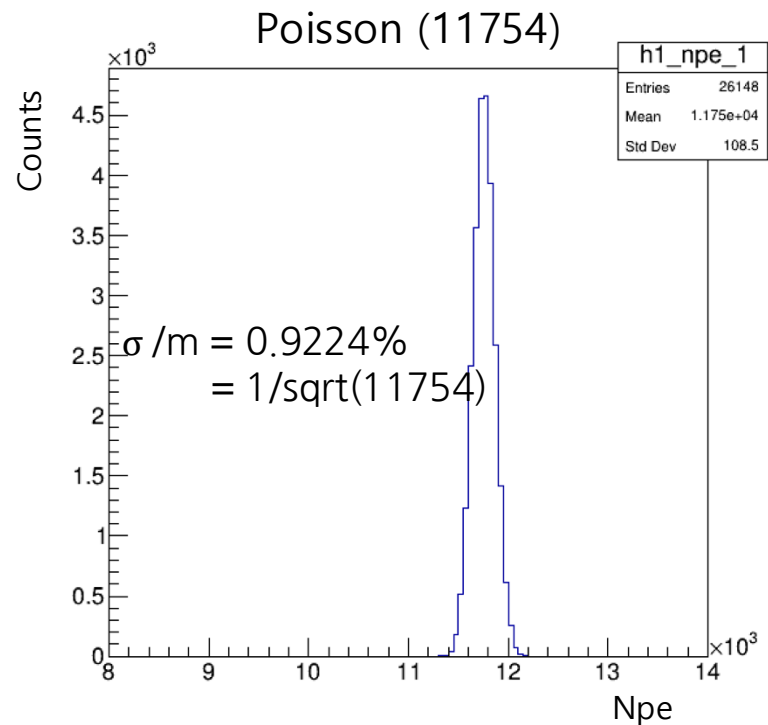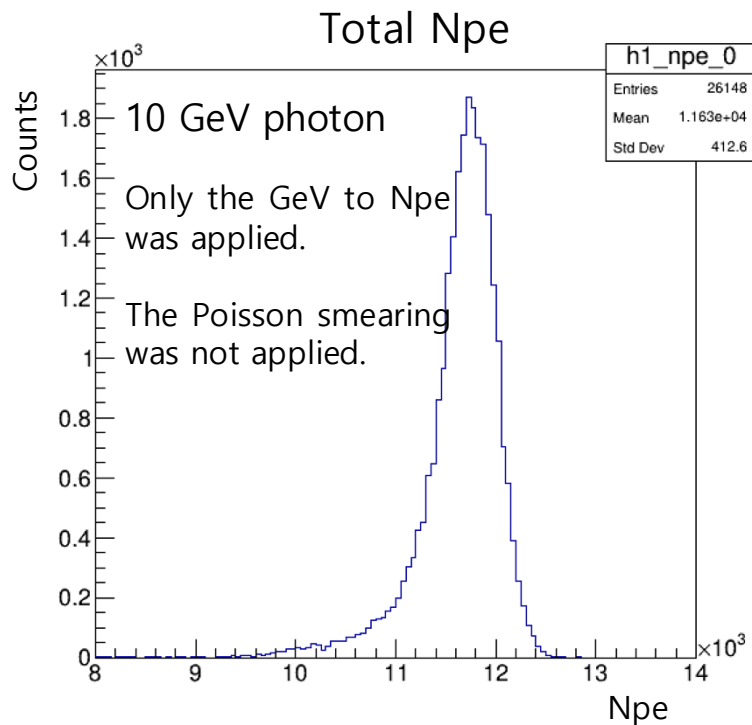
Sep 17 (Tue)
Minho Kim

Total Npe

10 GeV photon

Only the GeV to Npe was applied.

The Poisson smearing was not applied.

h1_npe_0	
Entries	26148
Mean	1.163e+04
Std Dev	412.6

h1_scfi_rec_4	
Entries	26148
Mean	9.161
Std Dev	0.3308

$0.00 < \eta < 0.40$

$m = 9.26$
$\sigma = 0.19$
$\chi^2/\text{ndf} = 134.32/72$

$\sigma/m = 2.030\%$

- We would like to study how much the Poisson smearing worsens the energy resolution.

- For the simplest case, we can study the smearing of the total Npe.

Effect of the Poisson smearing

Total Npe

10 GeV photon

Only the GeV to Npe was applied.

The Poisson smearing was not applied.

h1_npe_0	
Entries	26148
Mean	1.163e+04
Std Dev	412.6

Poisson (11754)

$\sigma/m = 0.9224\%$
$= 1/\sqrt{11754}$

h1_npe_1	
Entries	26148
Mean	1.175e+04
Std Dev	108.5

- Because each Npe in the left histogram will have ~0.9224% of smearing, the Poisson-smeared total Npe distribution will have about sqrt(2.03*2.03 + 0.92*0.92) = 2.23% resolution.

Effect of the Poisson smearing
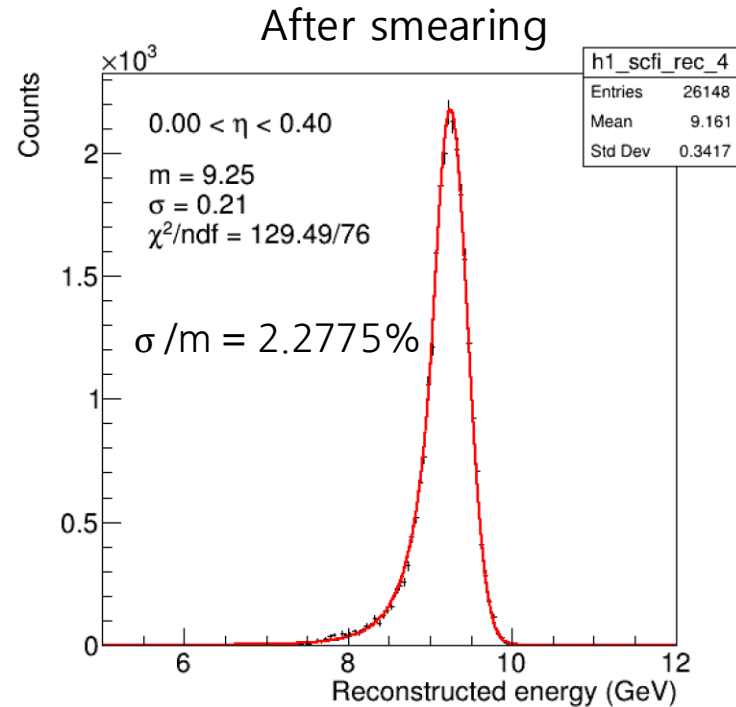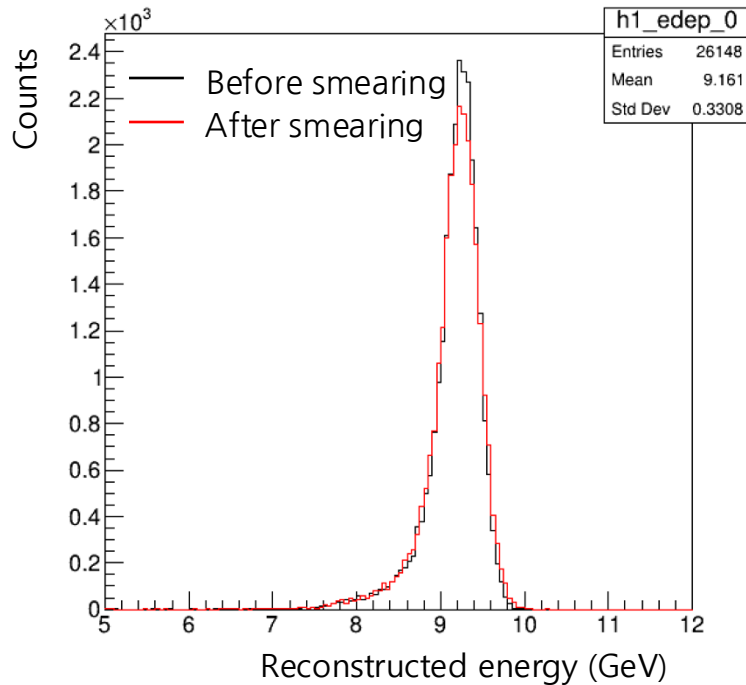
- The result is comparable. The difference is because the total Npe is not always 11754 and the distribution shape is not Gaussian.

- Even after the Poisson smearing was applied for each ScFiRecHit, the resolution was almost the same.

- It is reasonable that the Poisson smearing ~0.25% worsens the resolution for 10 GeV.

Effect of the threshold
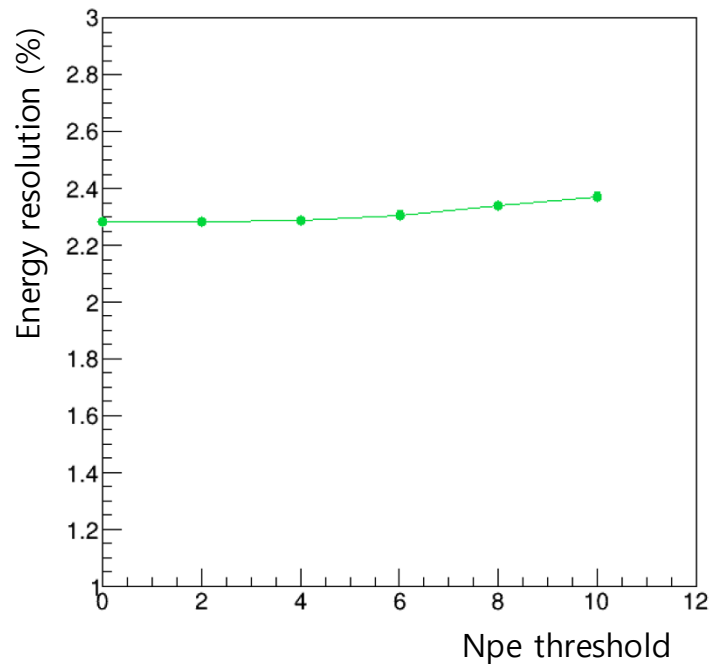
- The finite thresholds slightly worsens the resolution.

Fitting the longitudinal shower profile

10 GeV photon
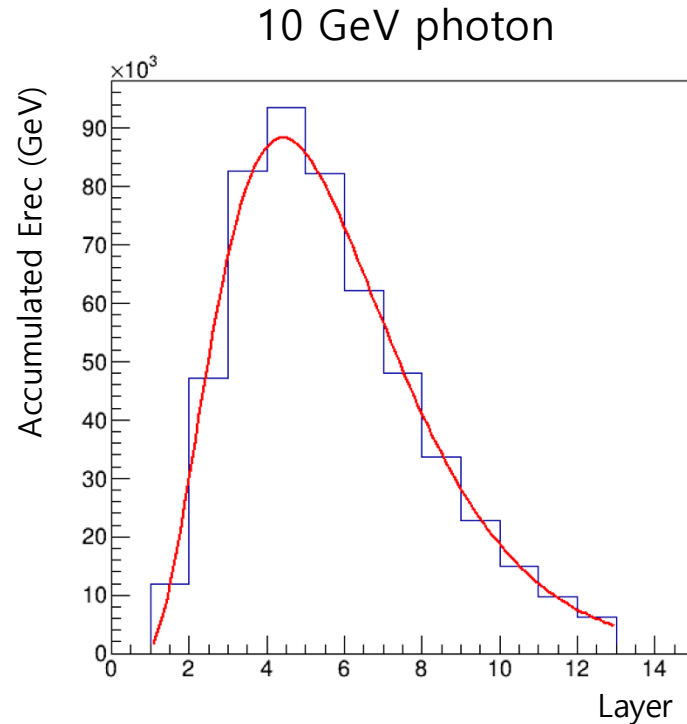
- It is known that the average shower profile can be described by the Γ–distribution.

- It could complement the energy splitting because there should be correlations between particle energy, shower max position, and size of the profile.

Fitting the longitudinal shower profile
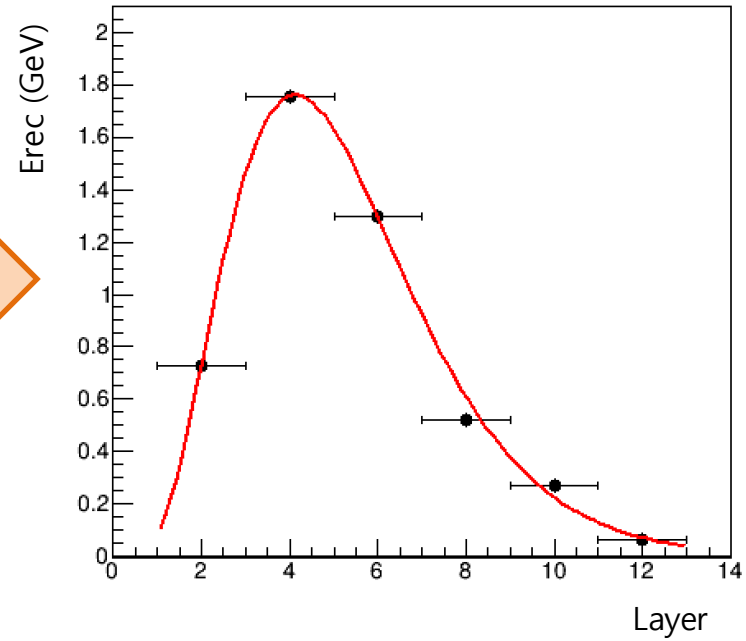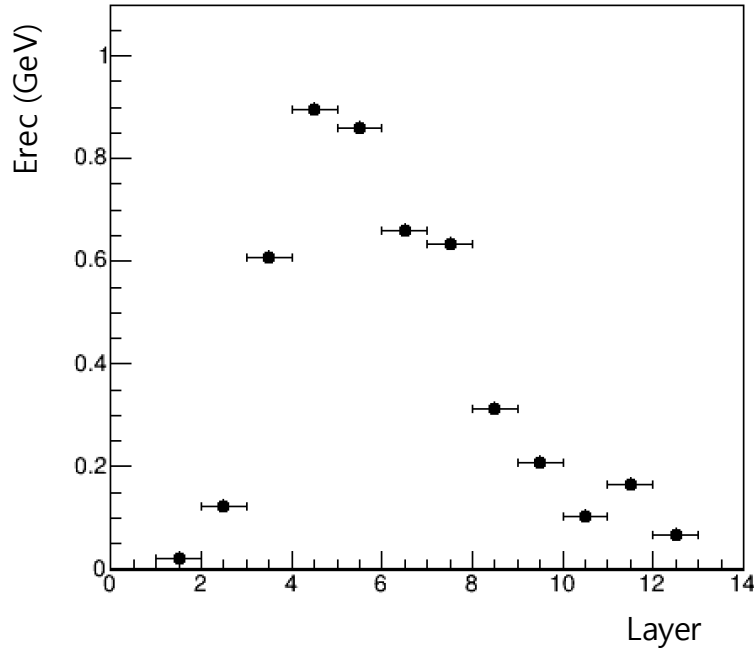
- It seems that the one layer-equivalent radiation length is too short to see a smooth shower profile and fit it.

- If we group two layers each for fitting, we may have some information to complement the energy splitting.

Plan

- Will study the energy splitting using the AstroPix information and test if the shower profile shape can complement it.

- Will better understand the issues on the energy and position resolution plots and solve them.

  ex) The events where the number of the first imaging layer hits is 1.

    Behavior of the energy and position reconstruction performances taking into account the experimental structure.

    How to reduce the effect of the magnetic field when we reconstruct position.