Status Report

GRAiNITA

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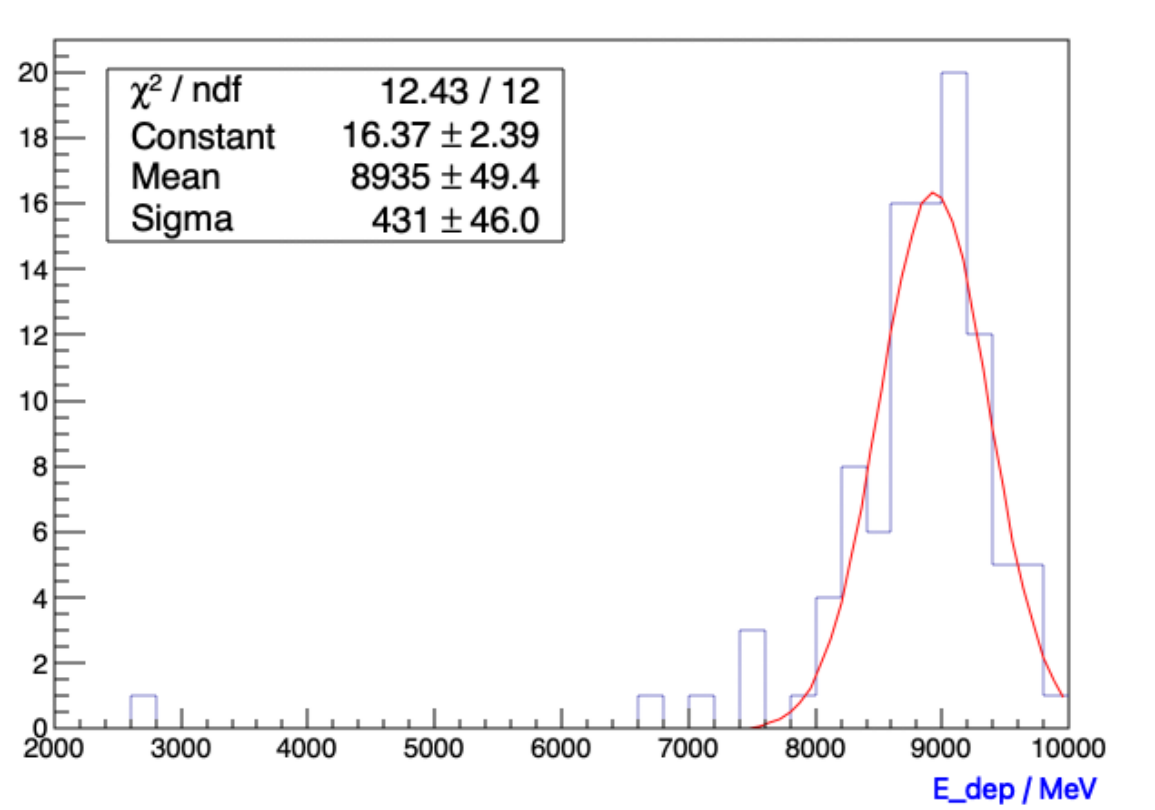
Samples with scintillating process

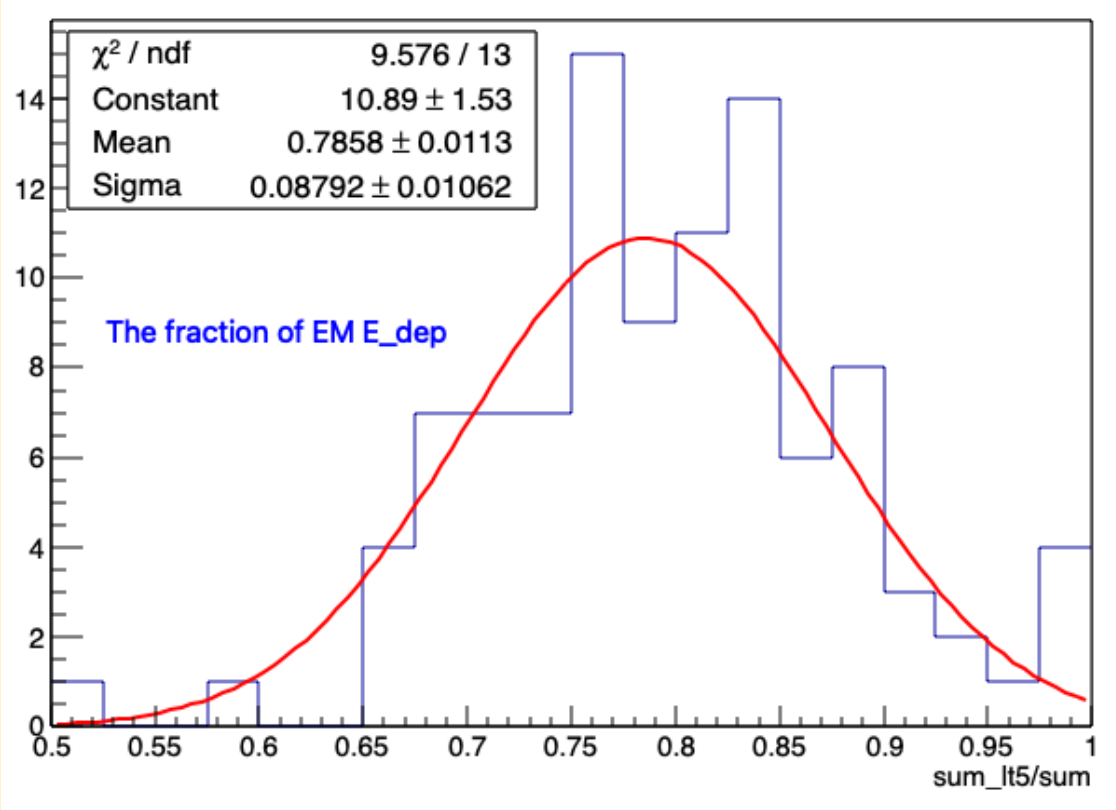
- The detector size: 2m * 2m * 2m (avoid the effect from energy leak)
- Generate the event with scintillating process
  - Save all the scintillating photons
- Pre-scale the sample assuming the efficiency of optical photon to photon-electron is identical for all the optical photons.
  - Light yield in generation: 10_000/MeV
  - Photon-electron yield in pre-scale: 10_000/GeV
  - Randomly pick the photons based on the yield ratio and step energy
- 100 event of pi+ and e- are generated.

With 100 events (pi+)

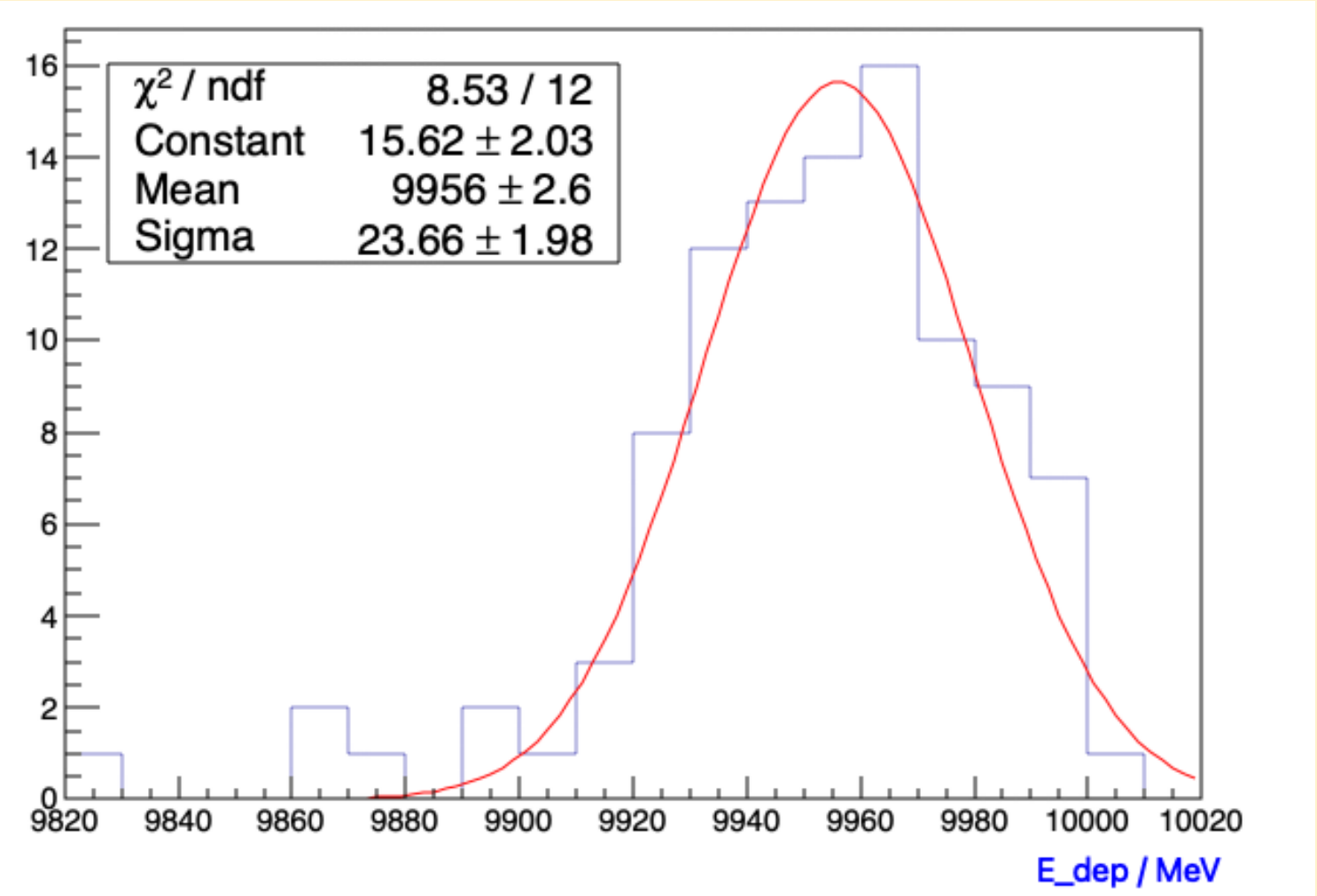
- $\frac{\sigma_E}{E} = 4.8\% = \frac{14.4\%}{\sqrt{E}}$



Fraction of EM energy (deposited)

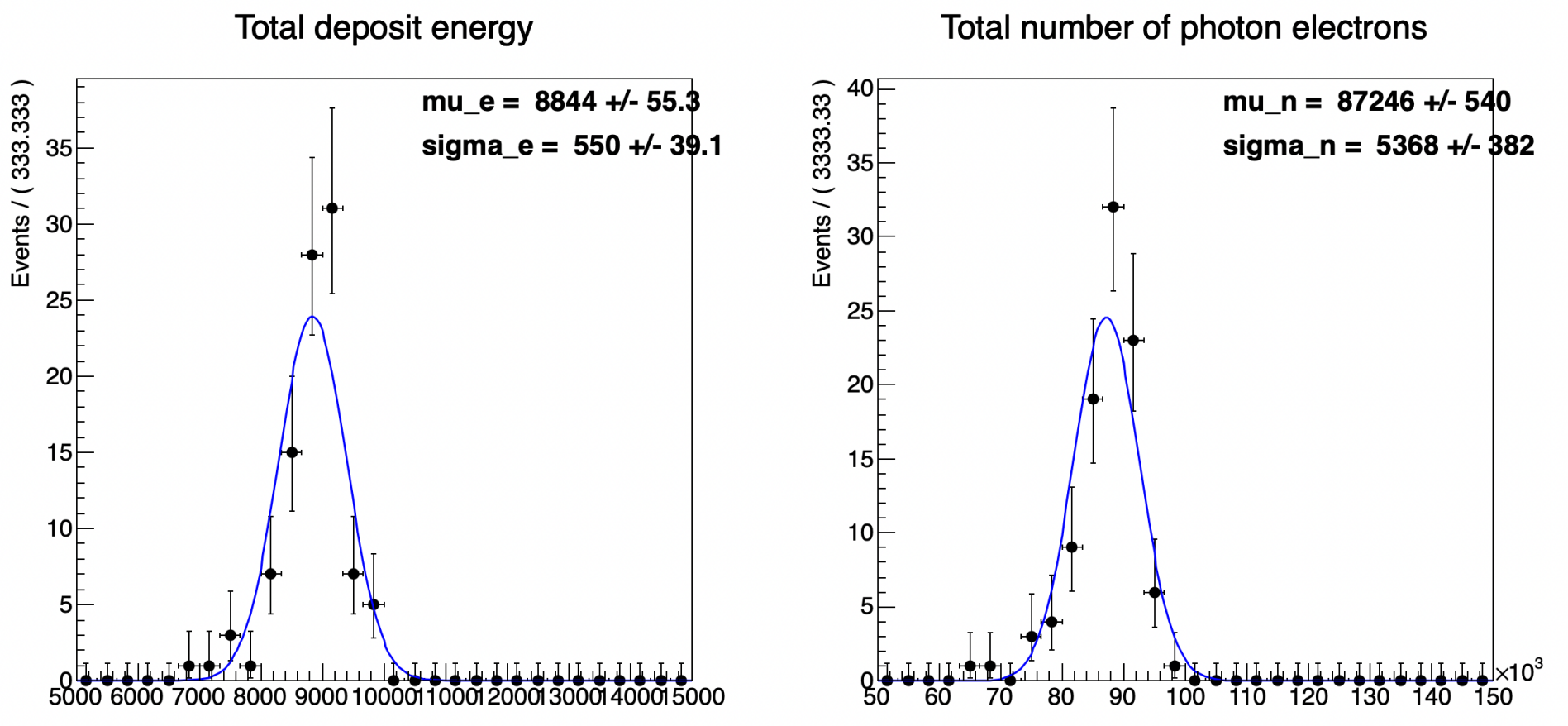


With 100 events (e-)



- $\frac{\sigma_E}{E} = 0.24\% = \frac{0.74\%}{\sqrt{E}}$

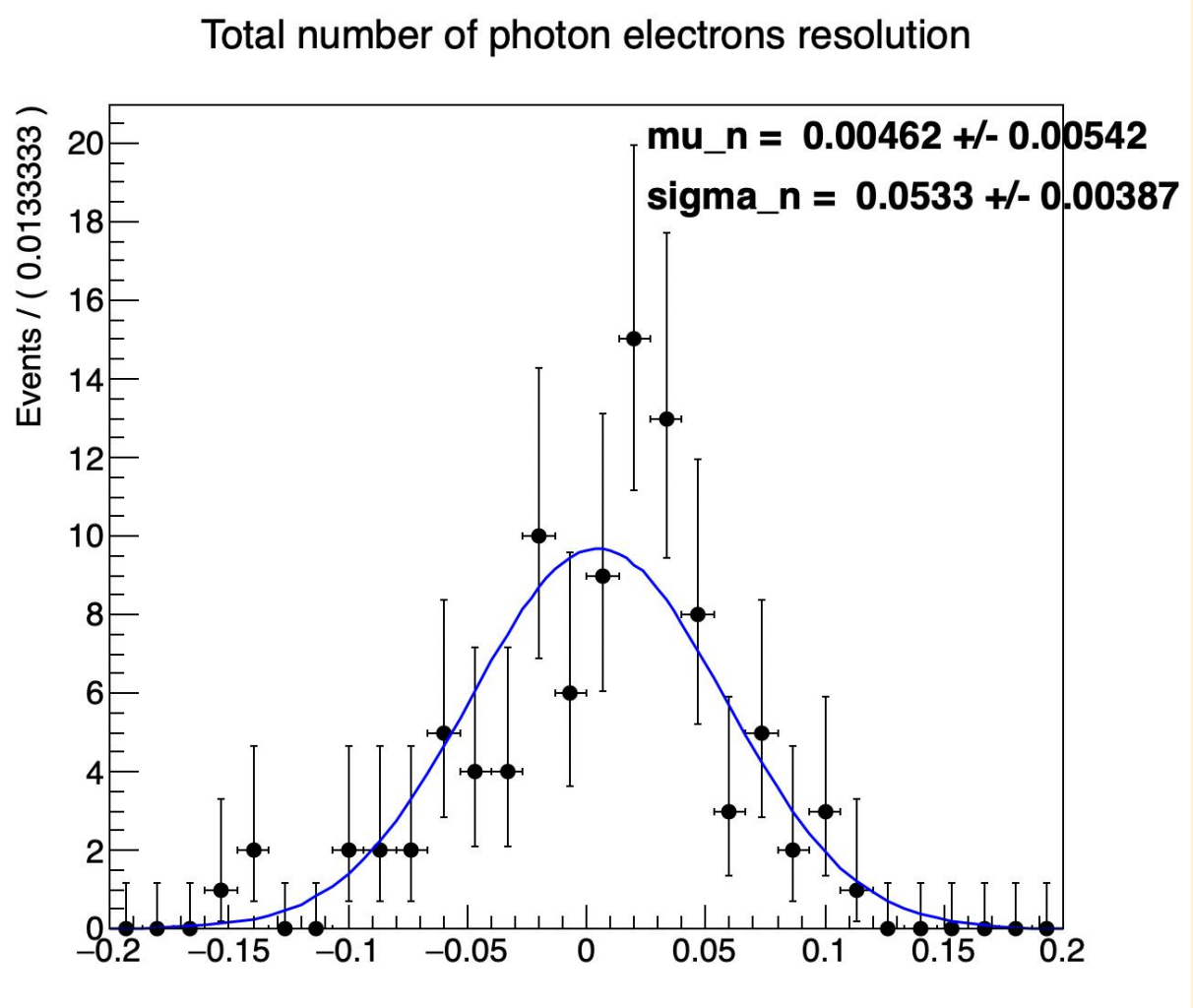
Total deposit energy and N_phe of pi+



- The feature of deposit energy is consistent to that of N_phe
- N_phe will be studied as the equivelent variable as deposit energy

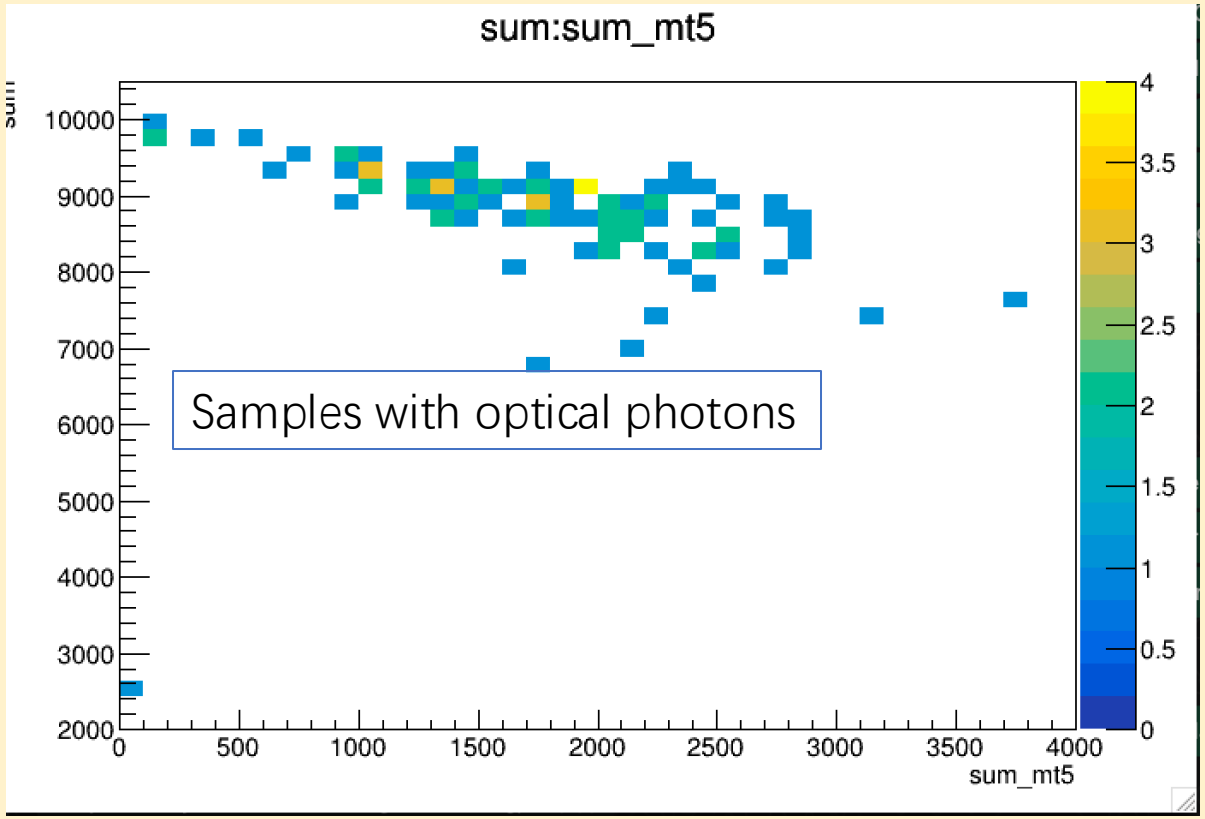
Resolution of N_phe

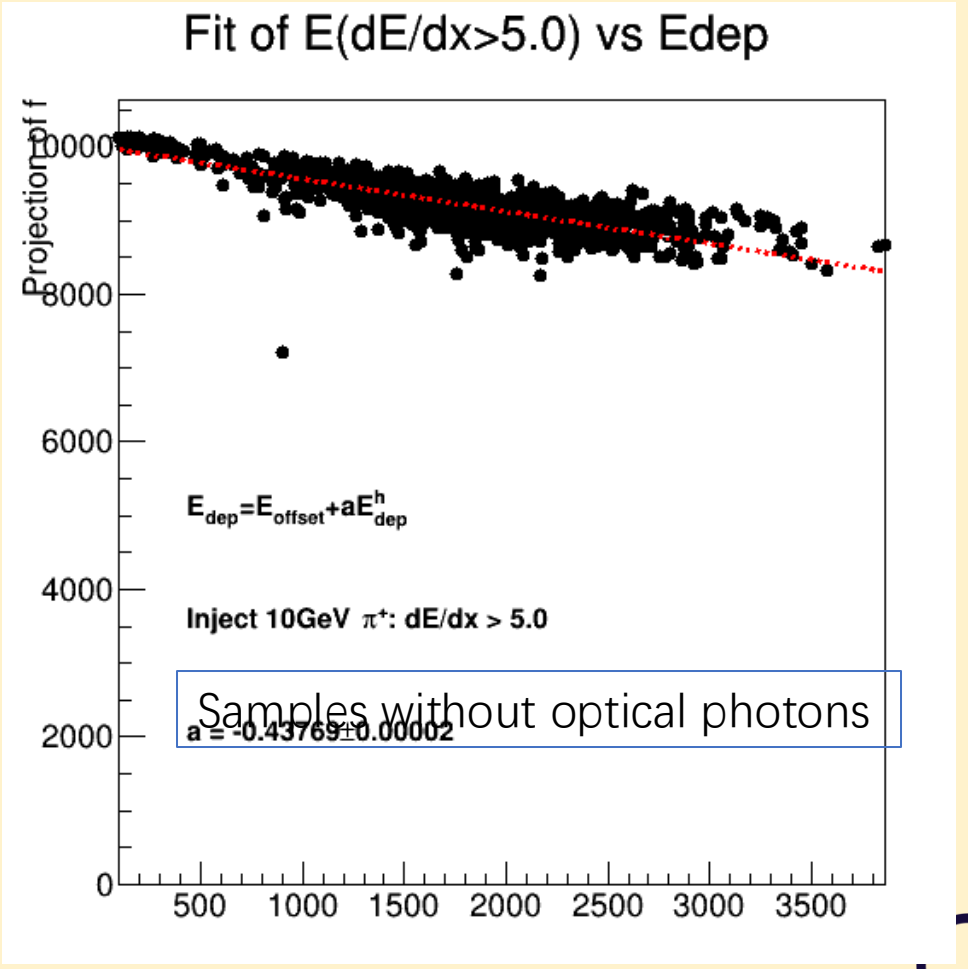
- $\frac{\Delta E_i}{\langle E \rangle} = \frac{E_i - \langle E \rangle}{\langle E \rangle} \Rightarrow \frac{\Delta \mathrm{N_i}}{\langle N \rangle} = \frac{N_i - \langle N \rangle}{\langle N \rangle}$
- The resolution of N_phe is checked here, with (5.3+/-0.4)%, consistent with that from deposit energy.



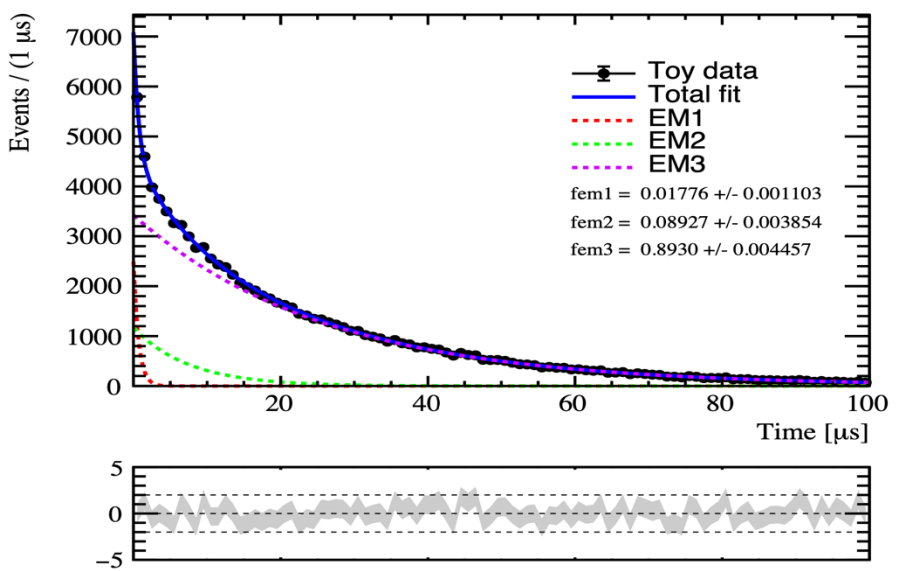
The energy correlation

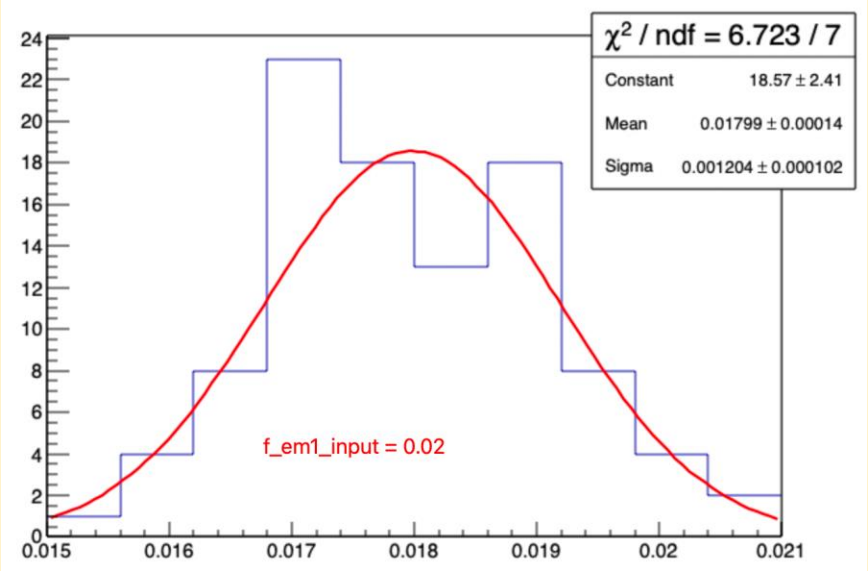
- The correlation seems consistent with and without optical process in the simulation.

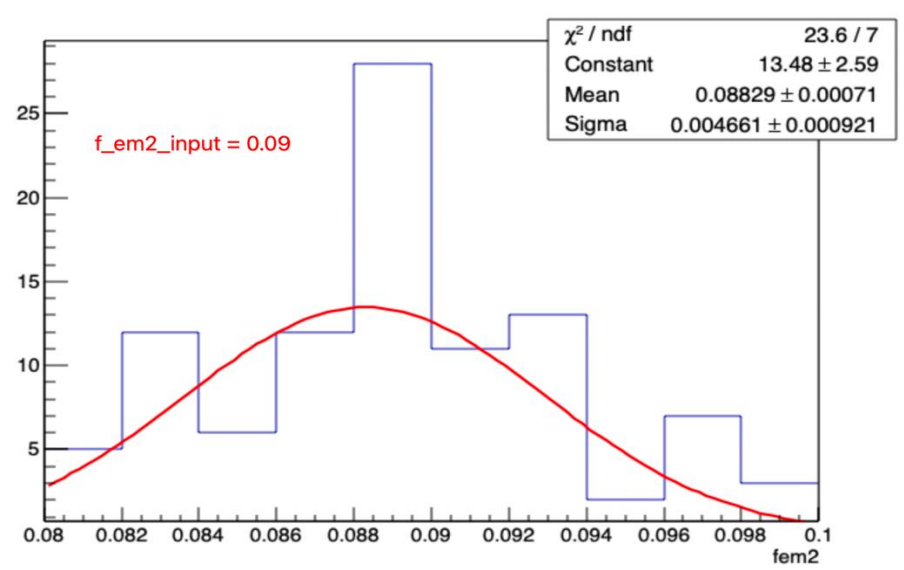


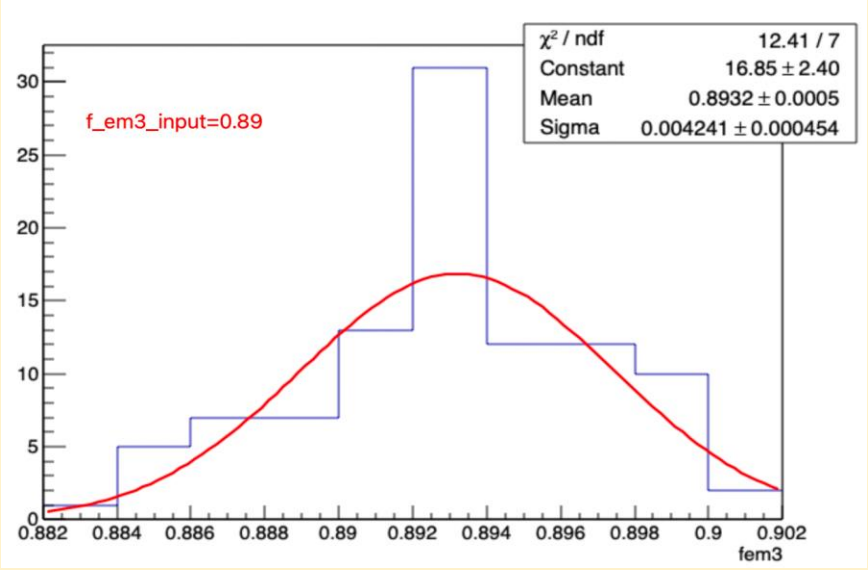


Fits to the EM energy (e-)

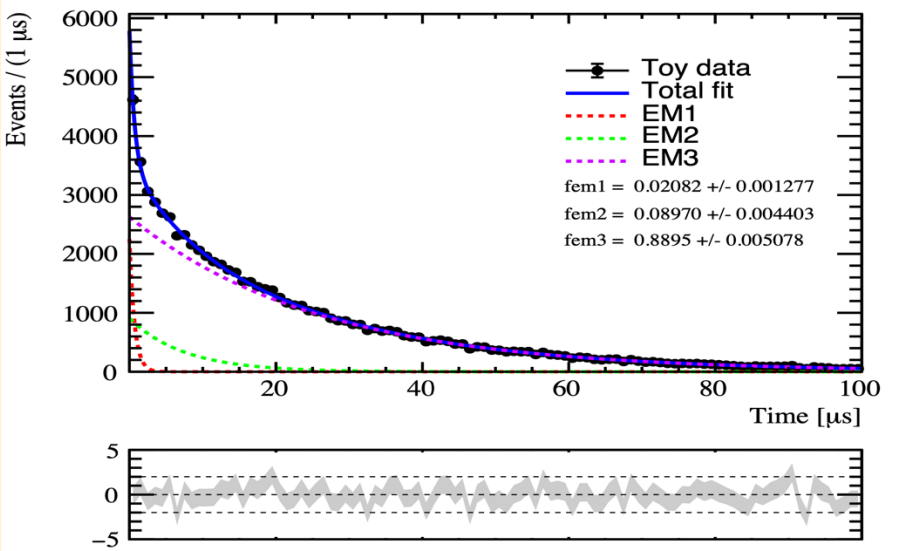


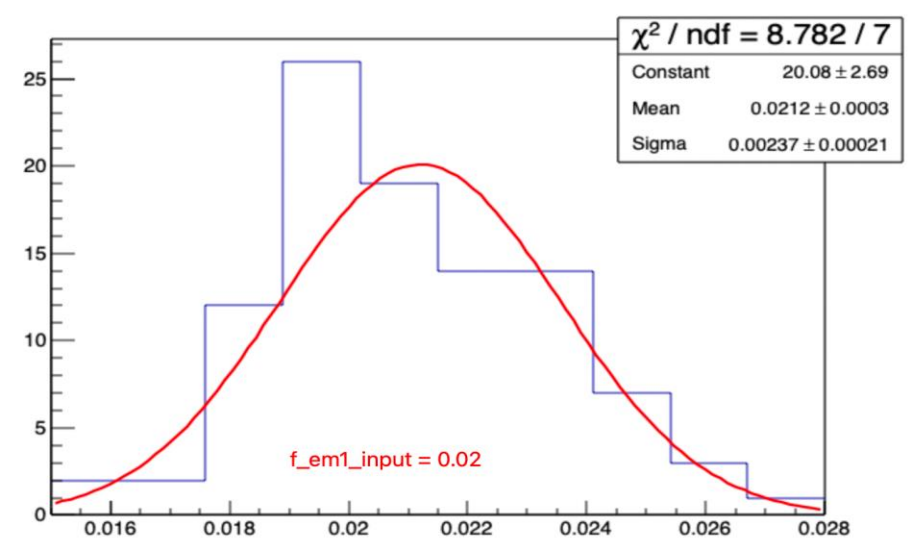


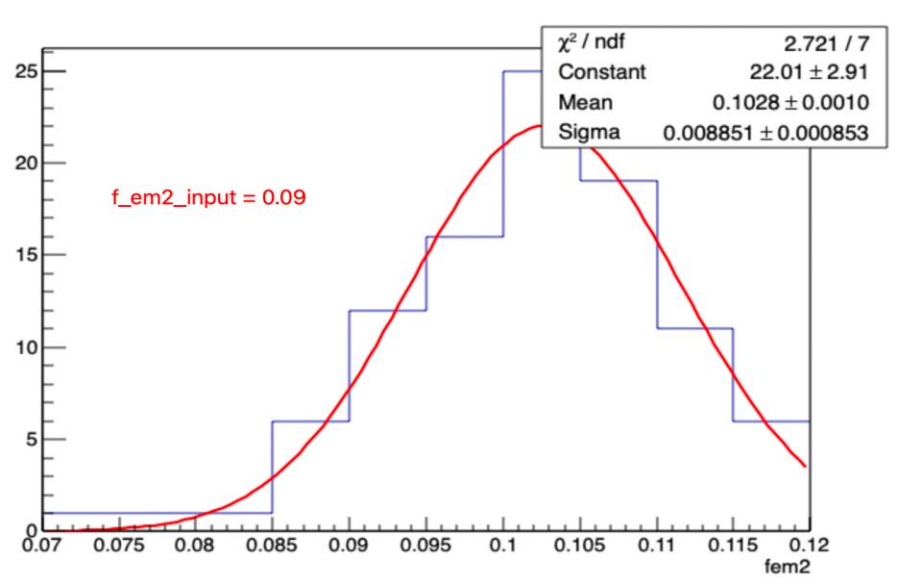


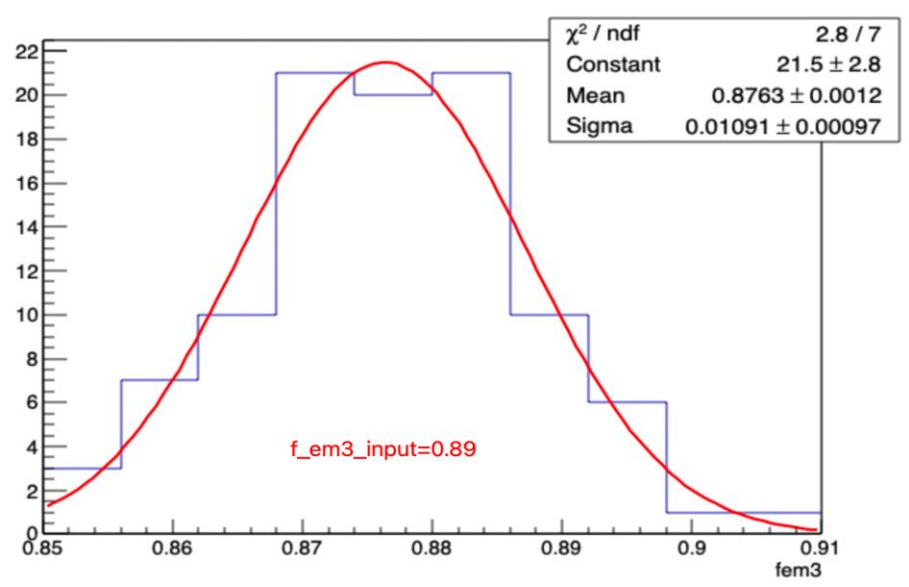


Fits to the EM energy (pi+)

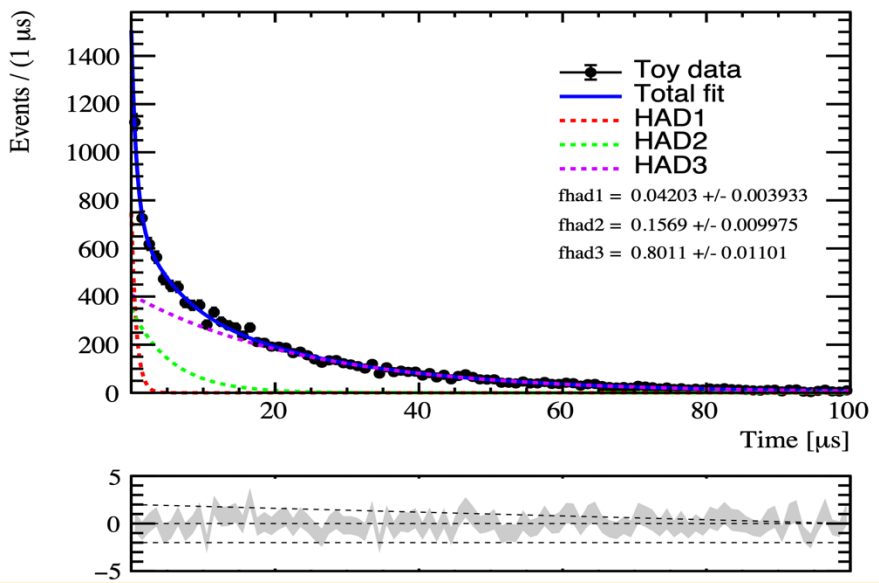


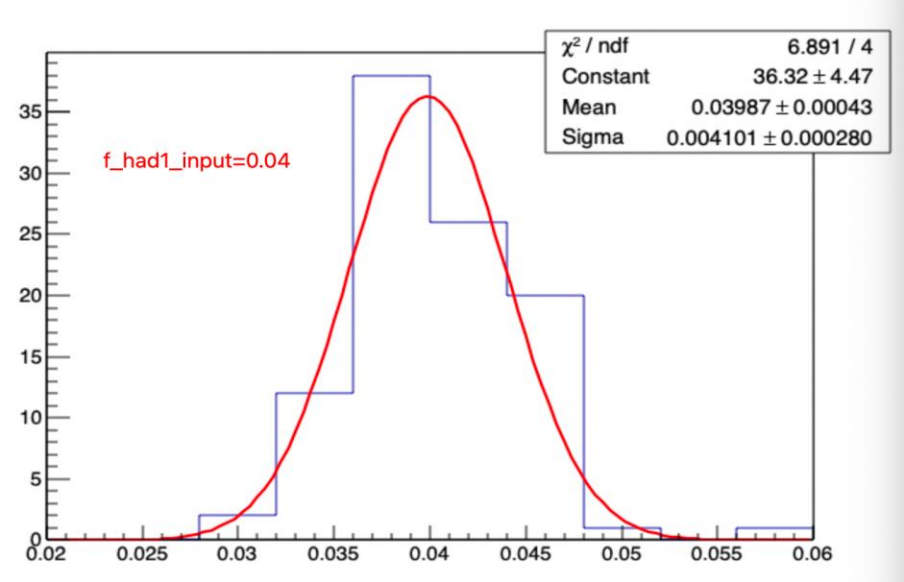


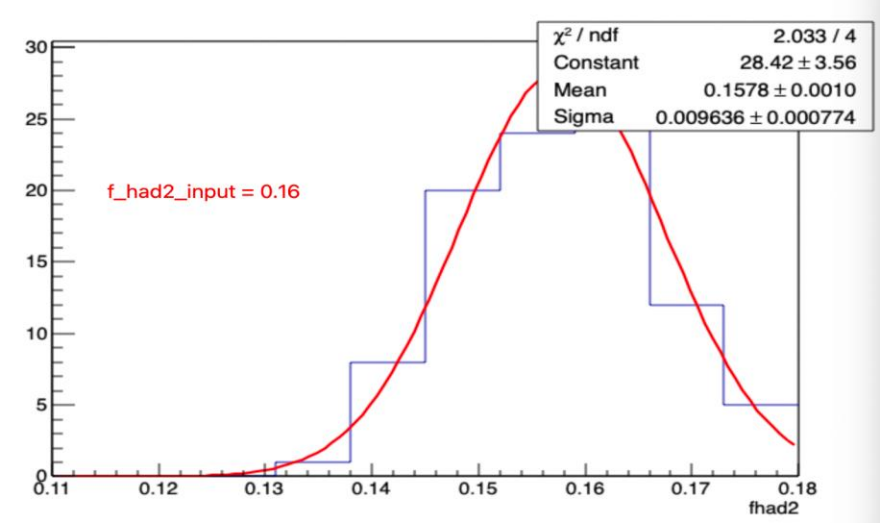


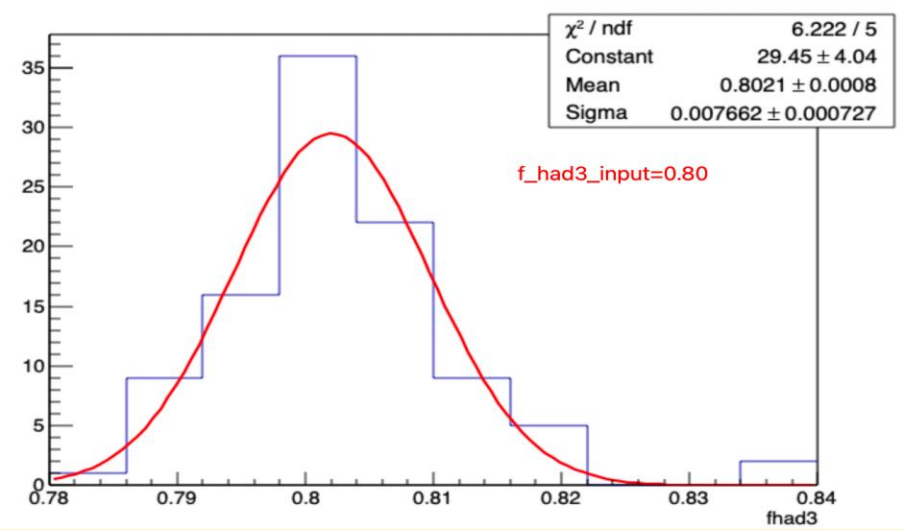


Fits to the hadron energy (pi+)

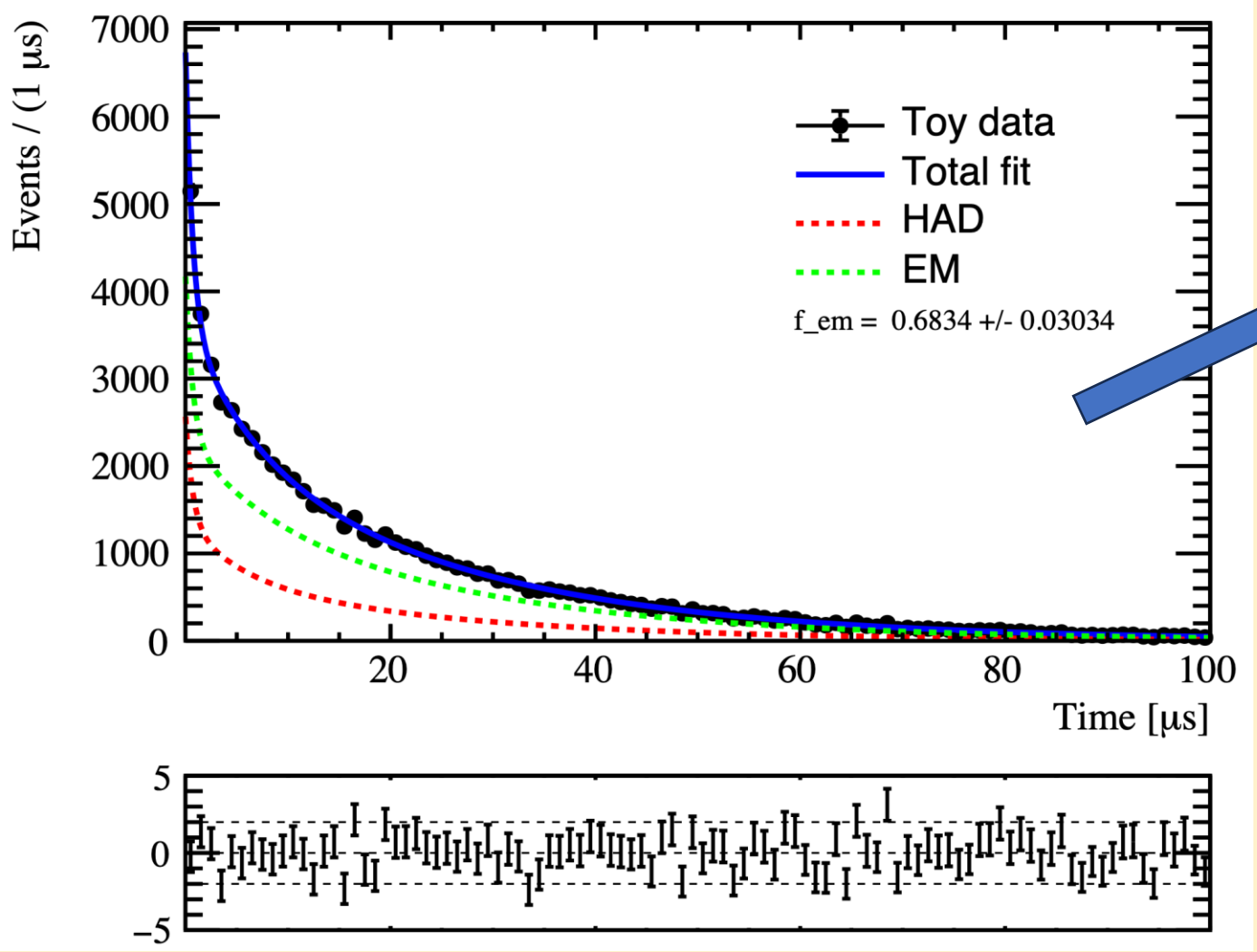




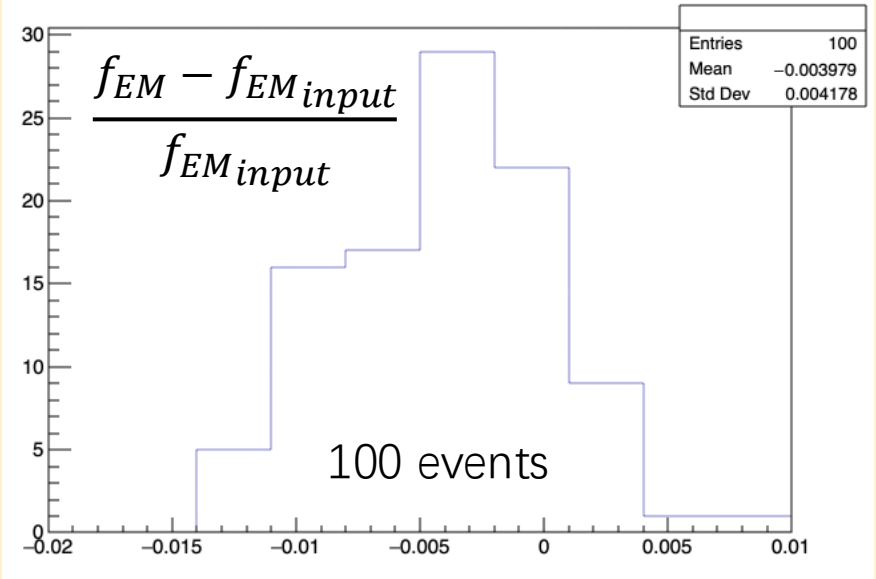




Fits to the EM fraction (pi+)



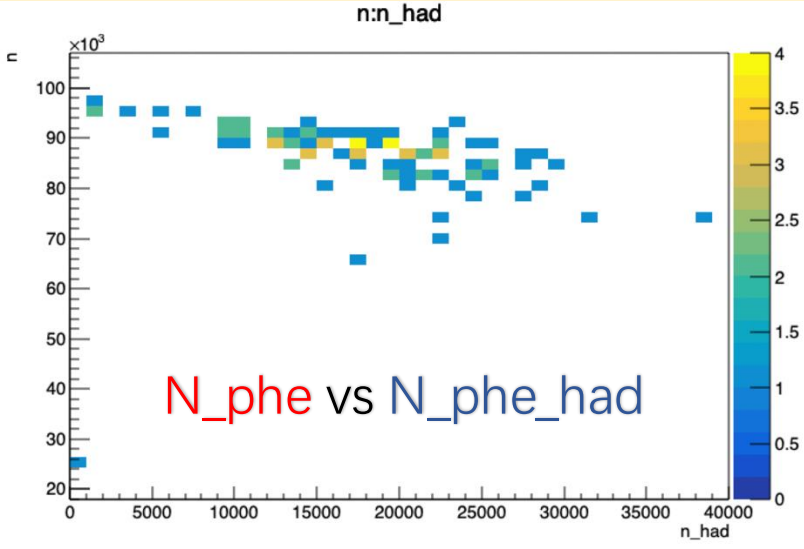
N_phe	69779
f_em (input)	0.69
f_em	0.68(3)
f_had	0.32(3)
N_phe_EM	47690
N_phe_HAD	22089

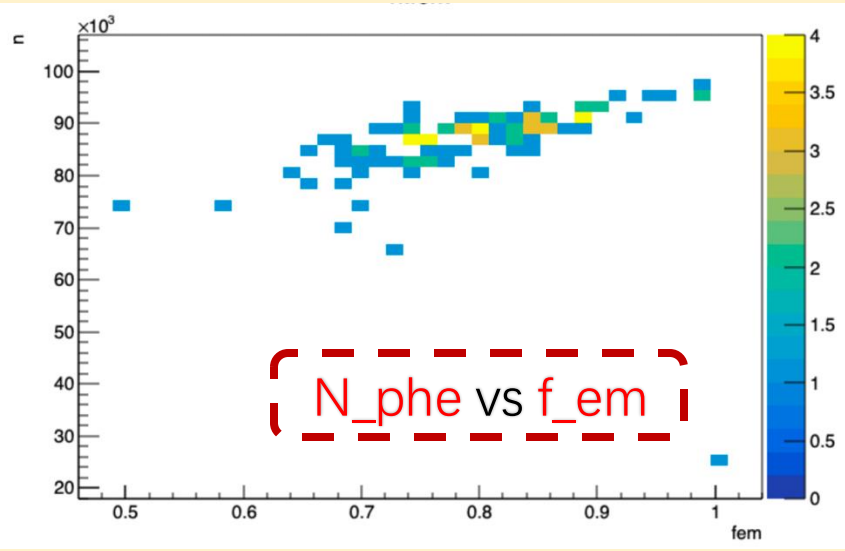


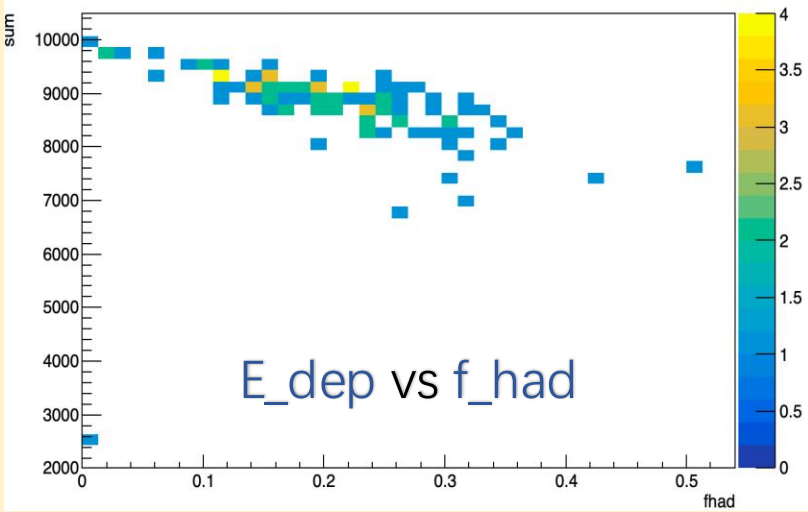
Time shape fit

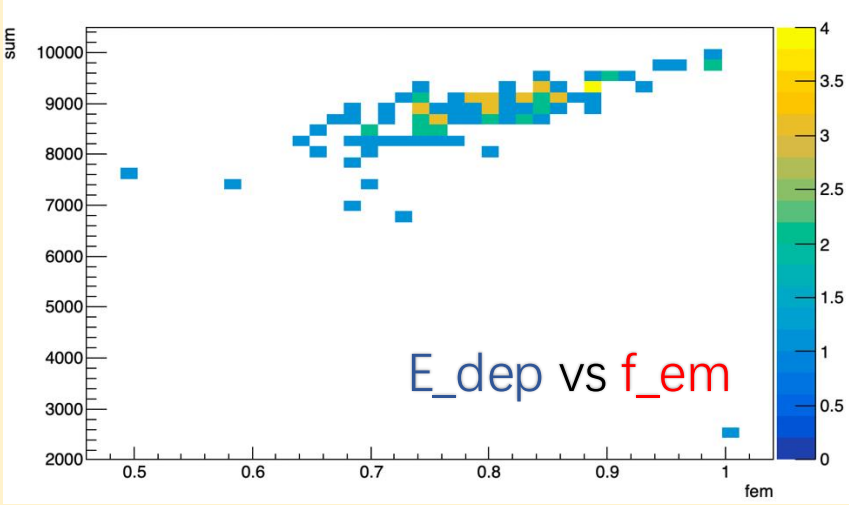
- From the checks with e- sample and pi+ sample
  - The time distribution fit well with acceptable fitting qualities in each event
  - The fit to the time distribution from hadronic shower is unbias and can get back the input parameters.
  - There's a bias in the fitting to the EM part, causing a small and possibly accepted shift in the f_em, 0.4%, with the mean value around 78%
- In short, we can extract the f_em with small bias from the fit to time distribution.

The correlations



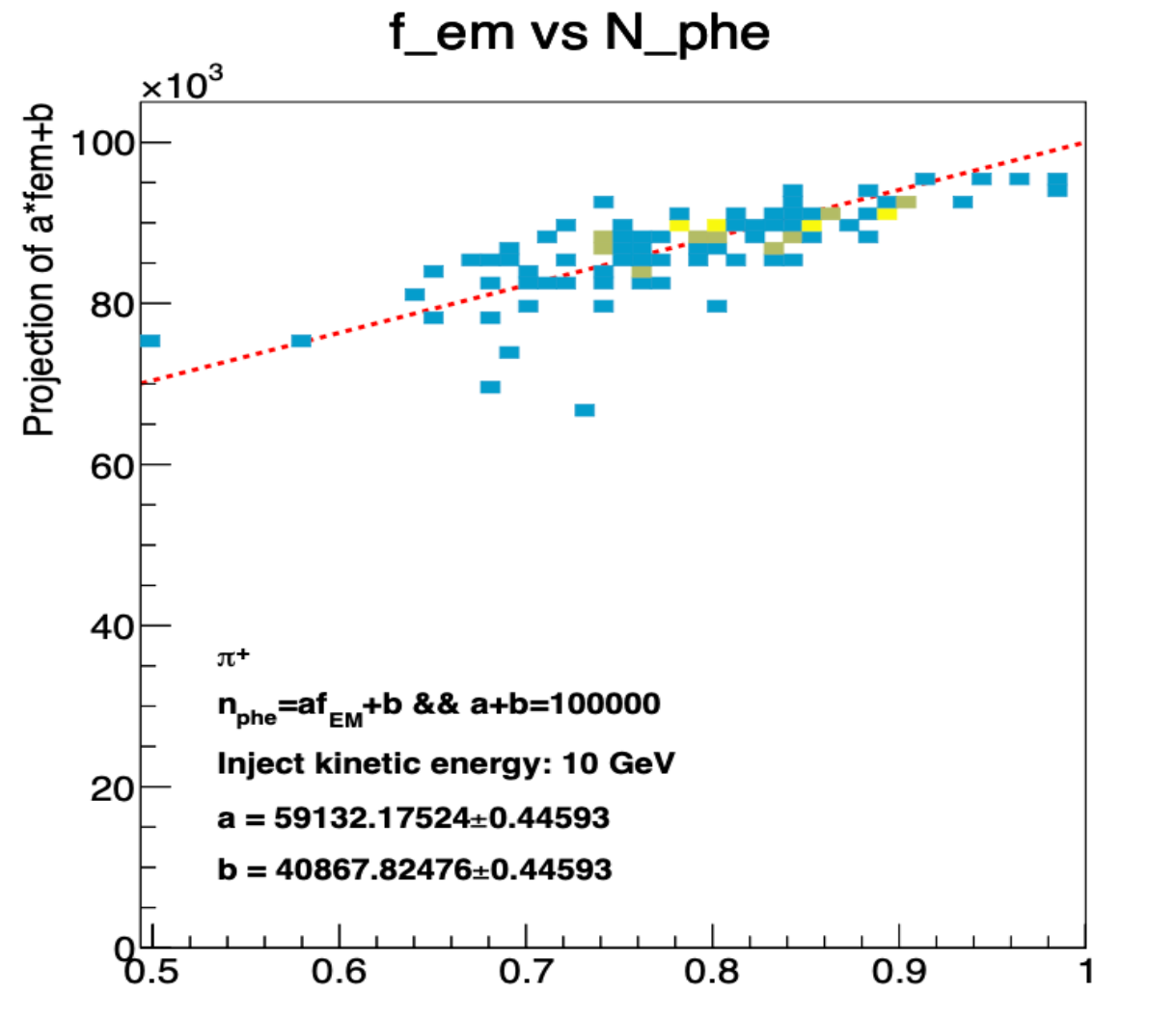




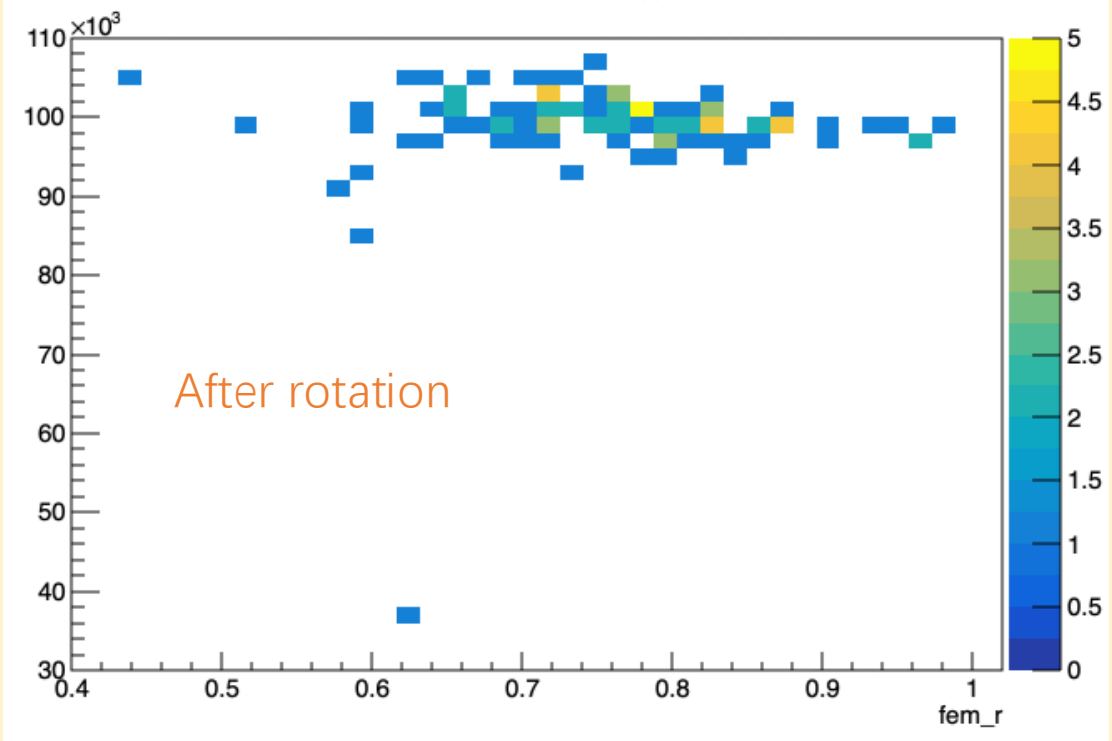


- The N_phe and f_em correlation is taken in the fit and correction.

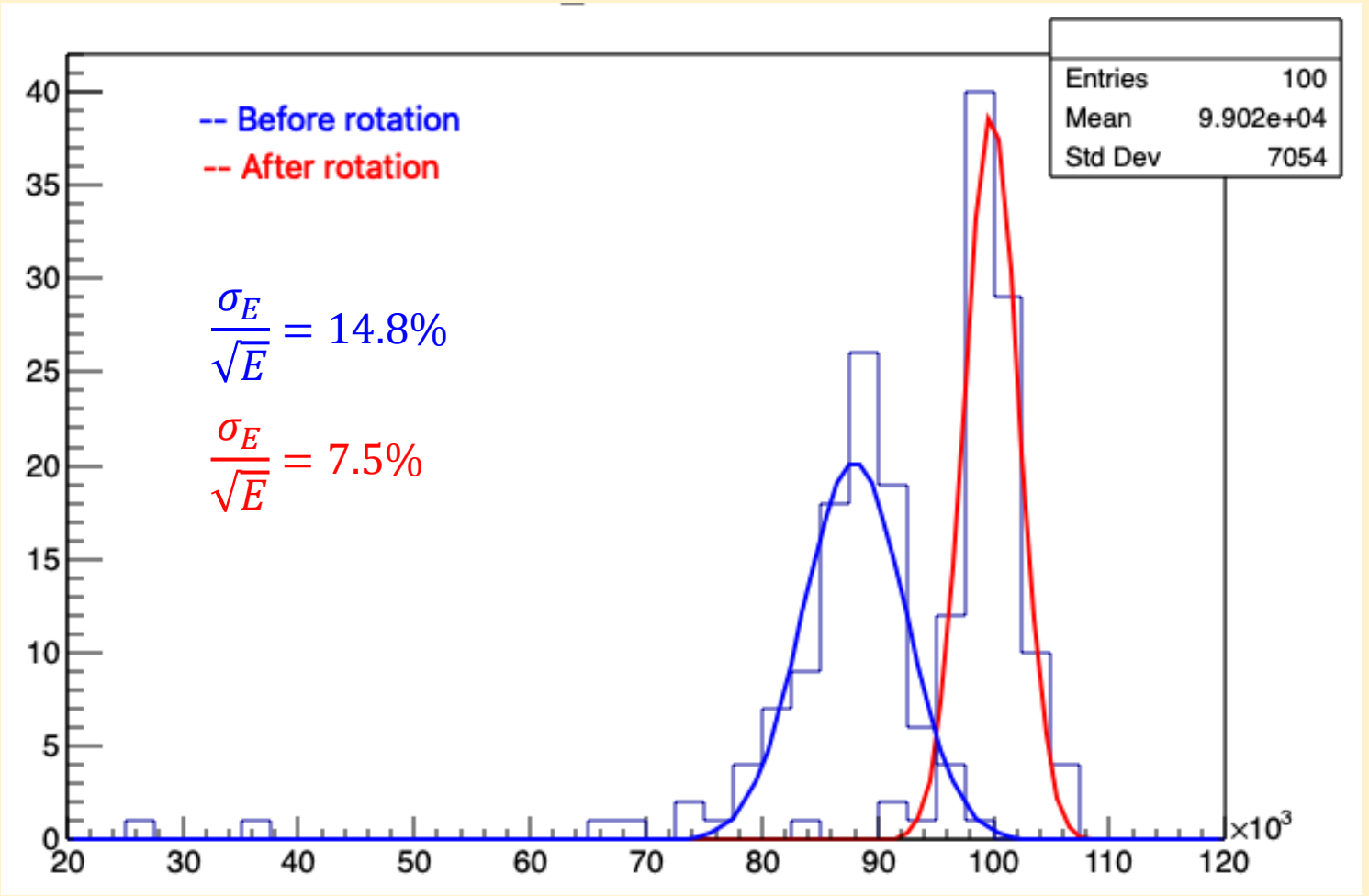
Single fit to the correlation E_dep vs f_em



- N_phe = af_em + b
  - Constrain linear with fem=1.0, N_phe=100_000



The N_phe after rotation



- After rotation, the resolution is improved by a facto of 2

Summary

- After correcting the N_phe by the correlation N_phe vs f_em, the resolution is improved by a factor of 2
  - With sample 10 GeV pi+, 100 events
  - Detector size in simulation: 2m * 2m * 2m
- To be confirmed
  - Is the correlation universal with different energies?
    - Samples with 1 GeV, 5 GeV, 15 GeV, 25 GeV, 50 GeV will be generated to check the effect