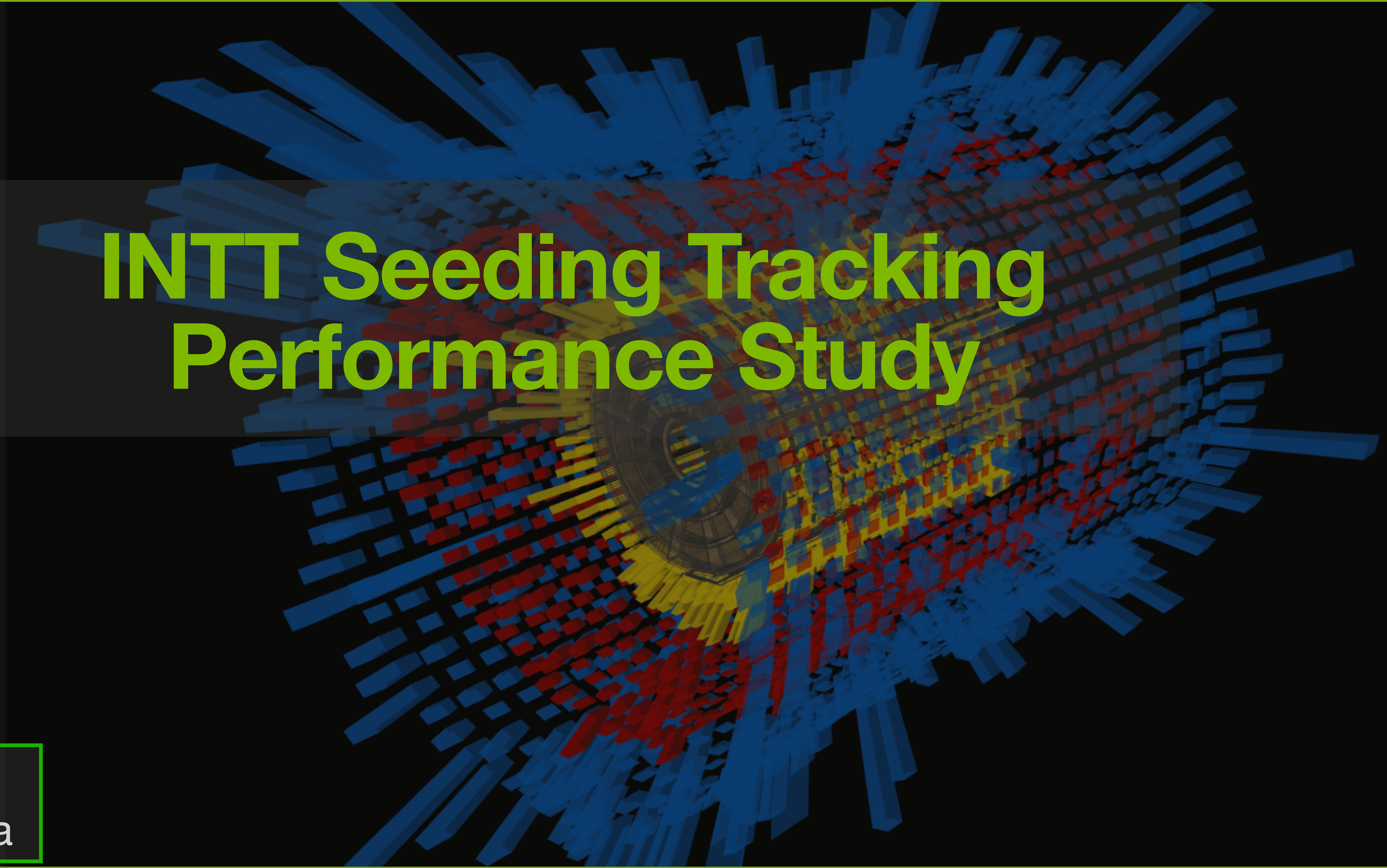
INTT Seeding Tracking Performance Study



RIKEN
Takuya Kumaoka

Aim of this study

Improve electron tracking using INTT + calorimeters

→ By adding calorimeter hit point, the tracking quality is expected to improve.

<**Final goal**> Identify the particles using ***E/p*** and reconstruct **J/ψ**

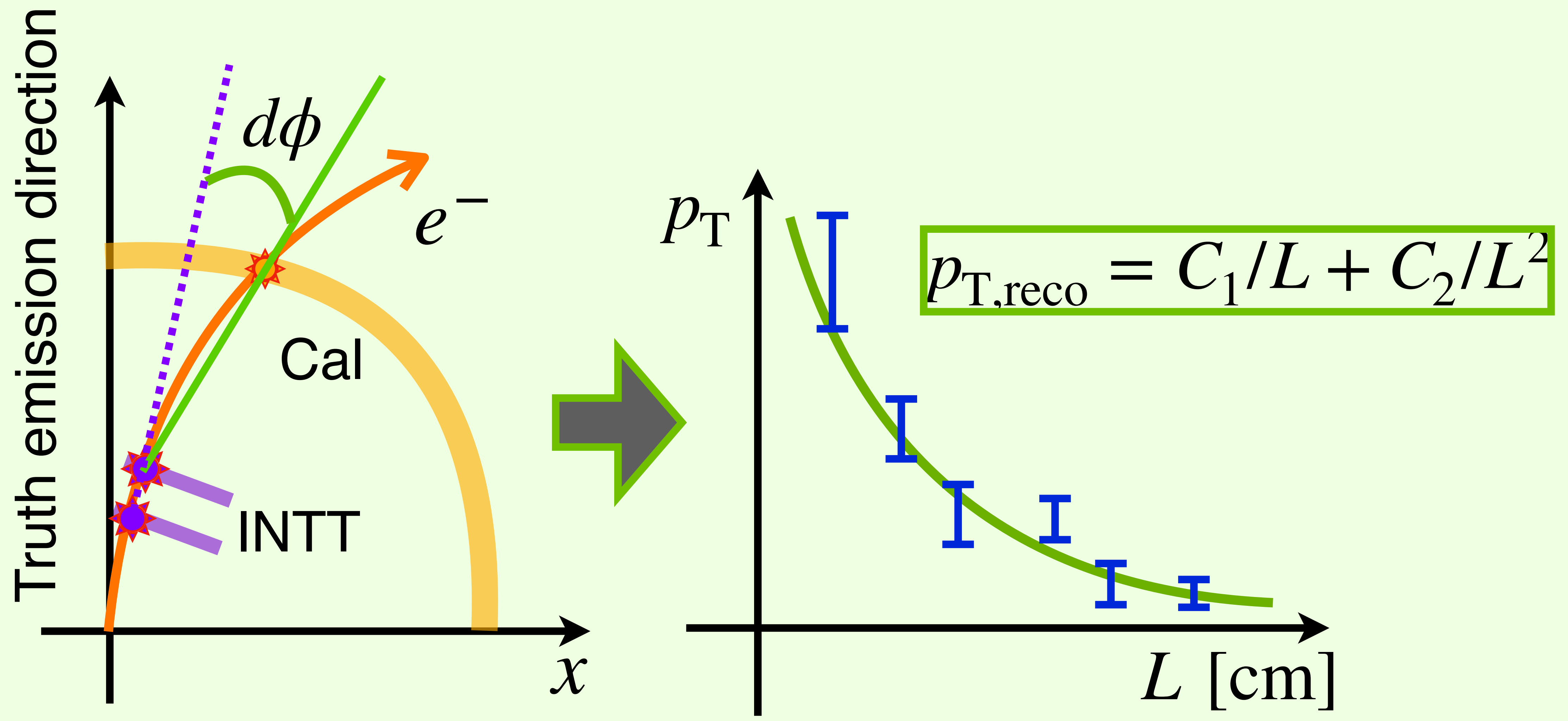
<**My study goal**> Evaluate how improve the **p_T resolution** by including the calorimeter hits.

We expect the p_{T} can be described by a magnetic shift angle ($d\phi$) equation.

The coefficients (C_1 and C_2) is estimated using single electron simulation.

→ The function performance is evaluated by:

$$\sigma p_T = \frac{p_{\mathrm{T,reco}} - p_{\mathrm{T,truth}}}{p_{\mathrm{T,reco}}}$$



My Study Informations

Study Wiki Page:

https://wiki.sphenix.bnl.gov/index.php?title=INTT_AnalysisWorkshop2024_TakuyaKumaoka

Git link of this study:

- Particle Generation Simulation Codes
  https://github.com/sPHENIX-Collaboration/INTT/tree/main/general_codes/tkumaoka/InttSeedingTrackDev/ParticleGen
- INTT Seed Tracking Codes
  https://github.com/sPHENIX-Collaboration/INTT/blob/main/general_codes/tkumaoka/InttSeedingTrackDev/InttSeedTrackPerformance/src/InttSeedTracking.cxx
- INTT Seed Tracking Performance Estimation Codes
  https://github.com/sPHENIX-Collaboration/INTT/blob/main/general_codes/tkumaoka/InttSeedingTrackDev/InttSeedTrackPerformance/src/InttSeedTrackPerformance.cxx

How to run this study codes

https://indico.bnl.gov/event/24622/contributions/99967/attachments/58840/101806/2024Dec16_Kumaoka_HowToRunMyCode.pdf

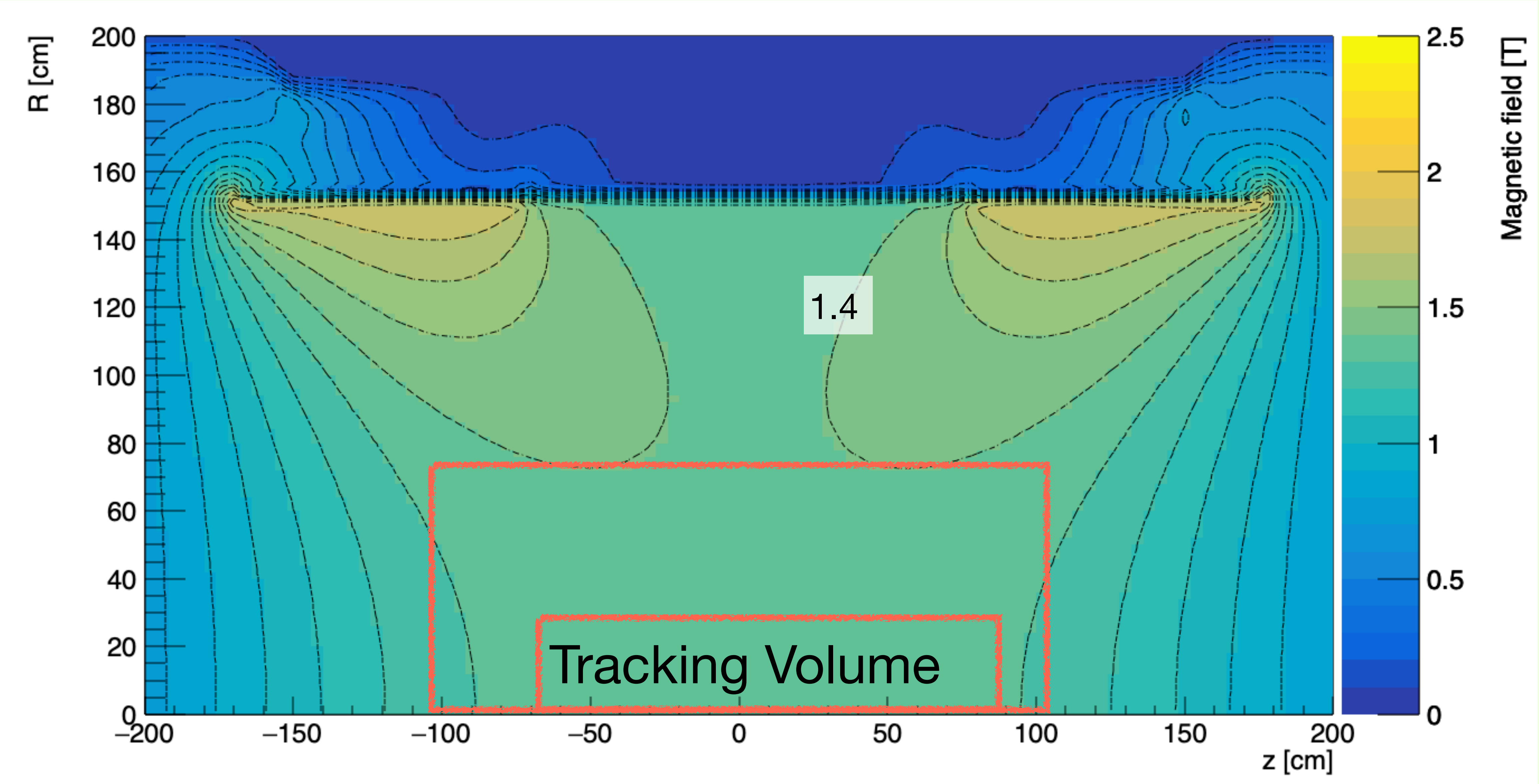
Input Event File

Simulation: Single particle gun + GEANT4
→ output: DST file format

Inject electron p_T : 0-10 GeV/c

Inject range: ϕ: $-\pi$ to π, η: -1 to 1

GEANT4 Setting: Magnet 1.4 T
Detector: MVTX, INTT, TPC, EMCal, iHCal, oHCal

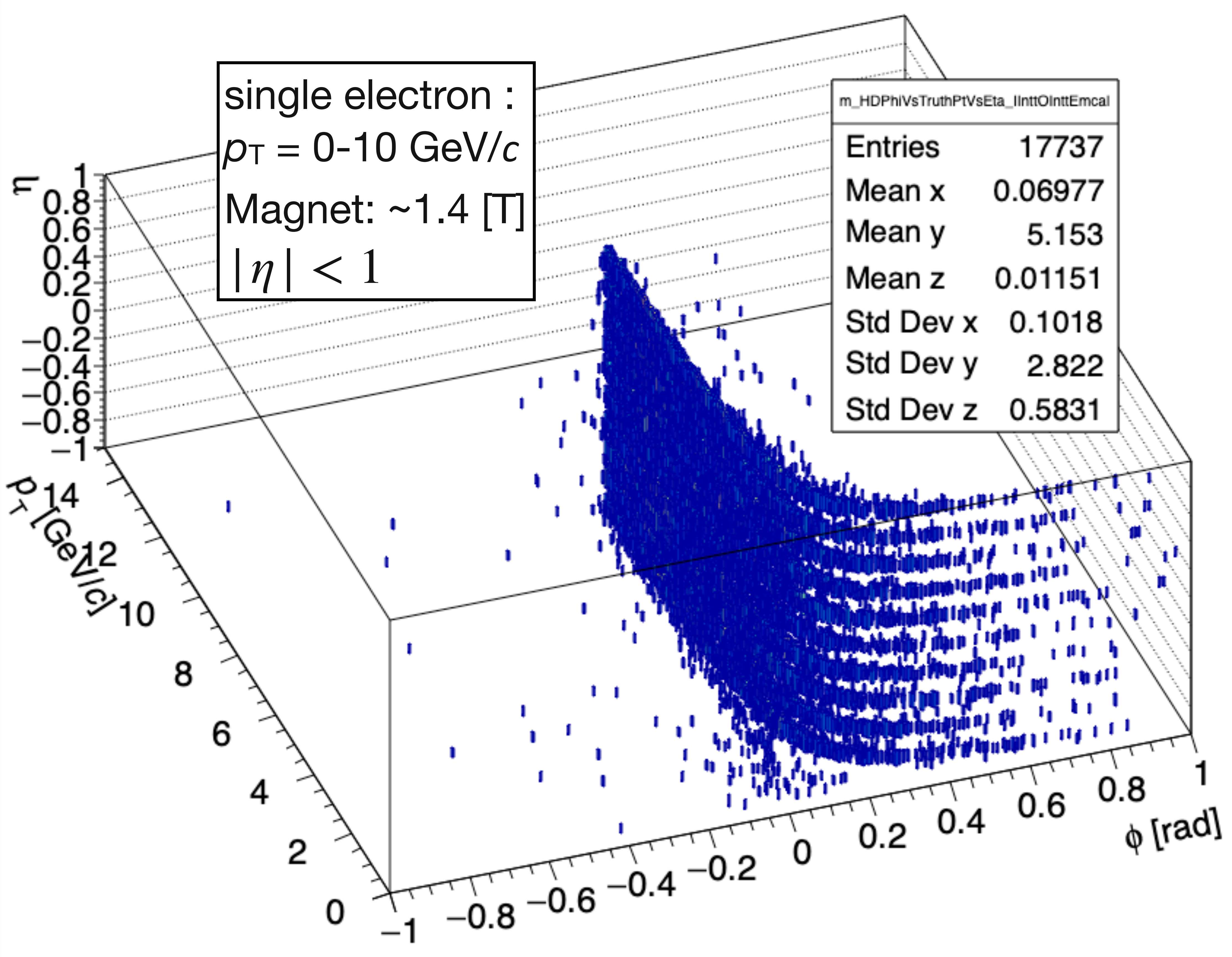


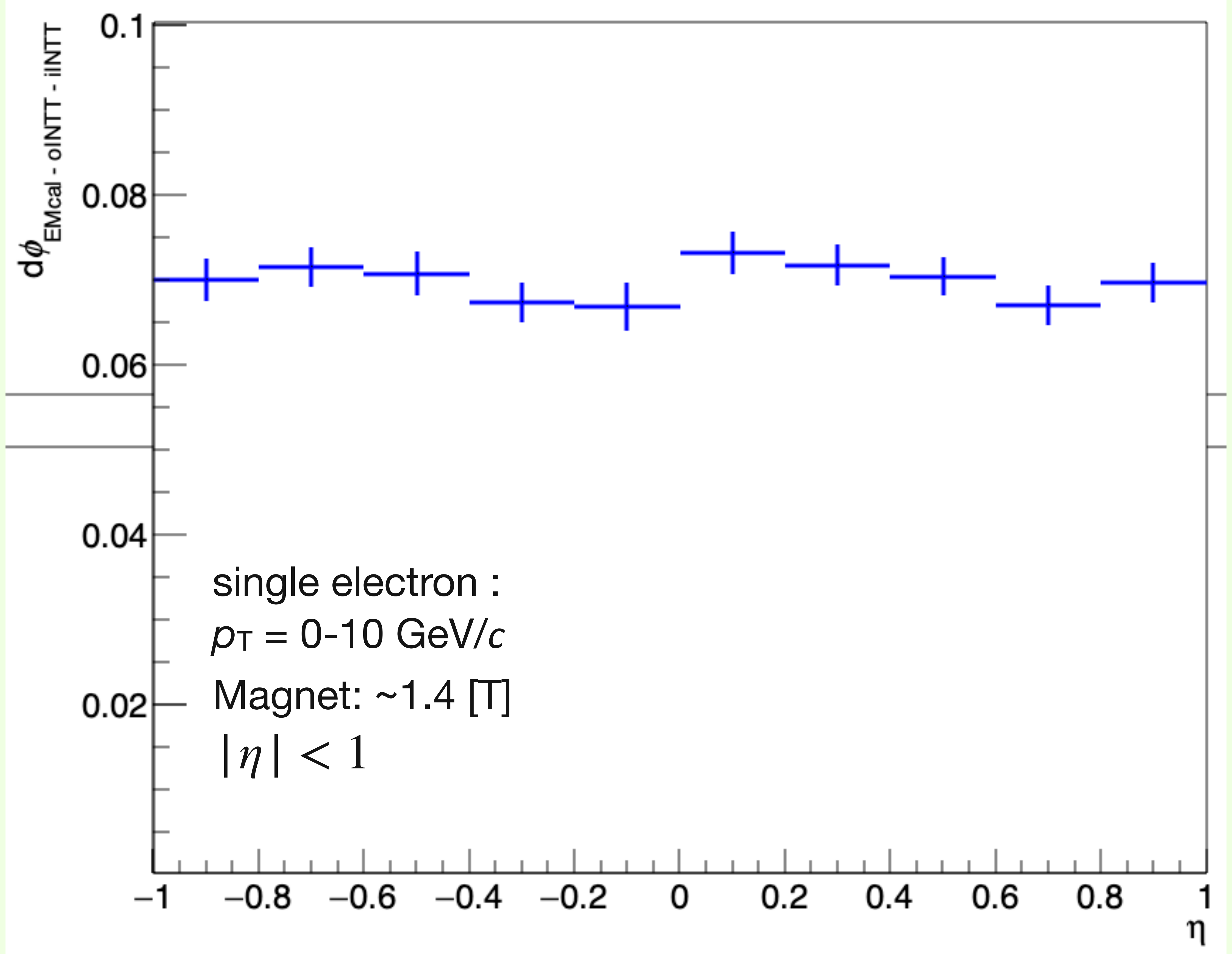
η Dependency of the Emission Angle Shift dϕ by Magnetic Field

There is a possibility that the bending of a track by magnetic field is depends on η.

a. The magnetic field is not completely uniform for η.

b. Flight length in the higher η region is longer than the smaller η one.

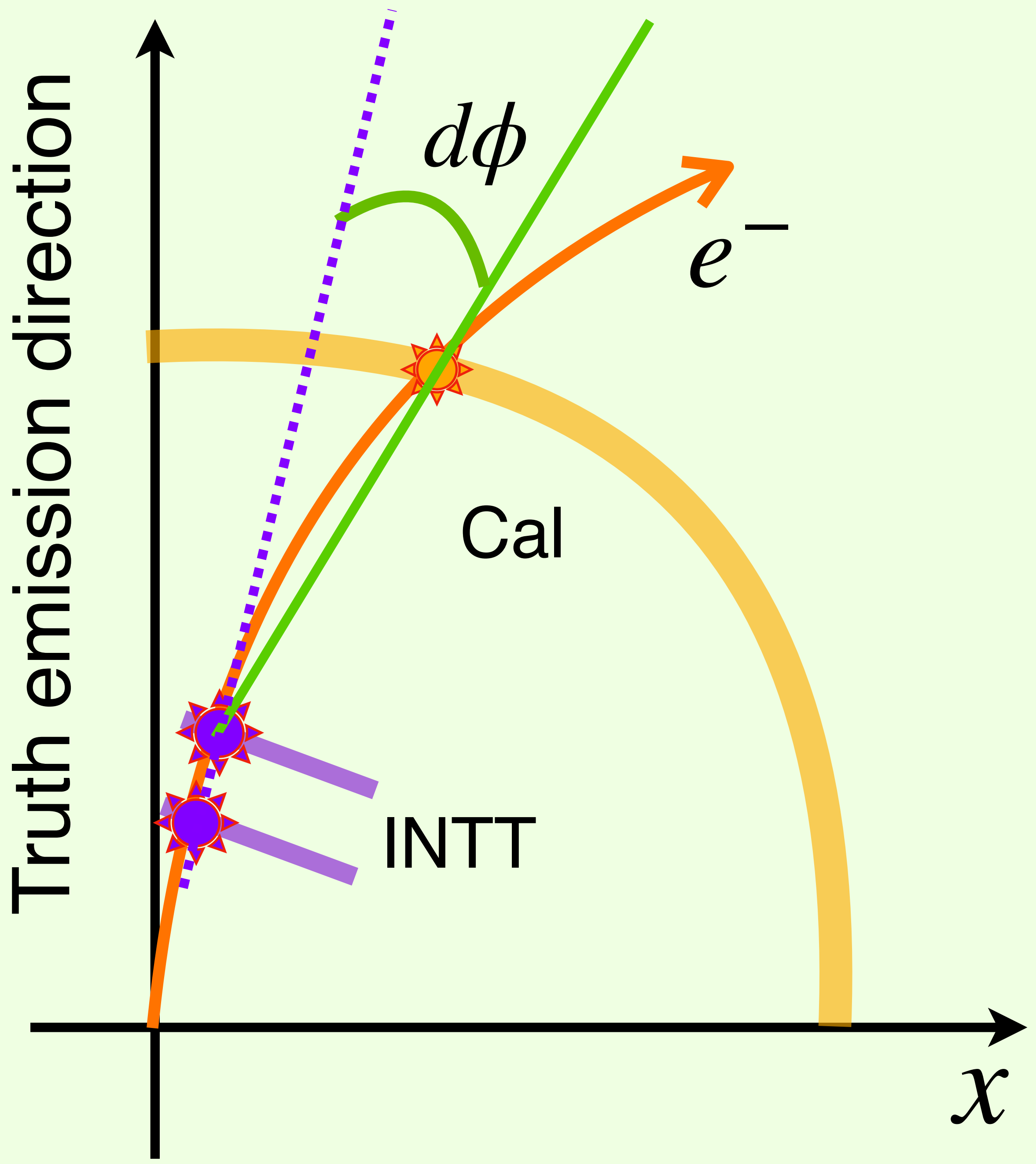


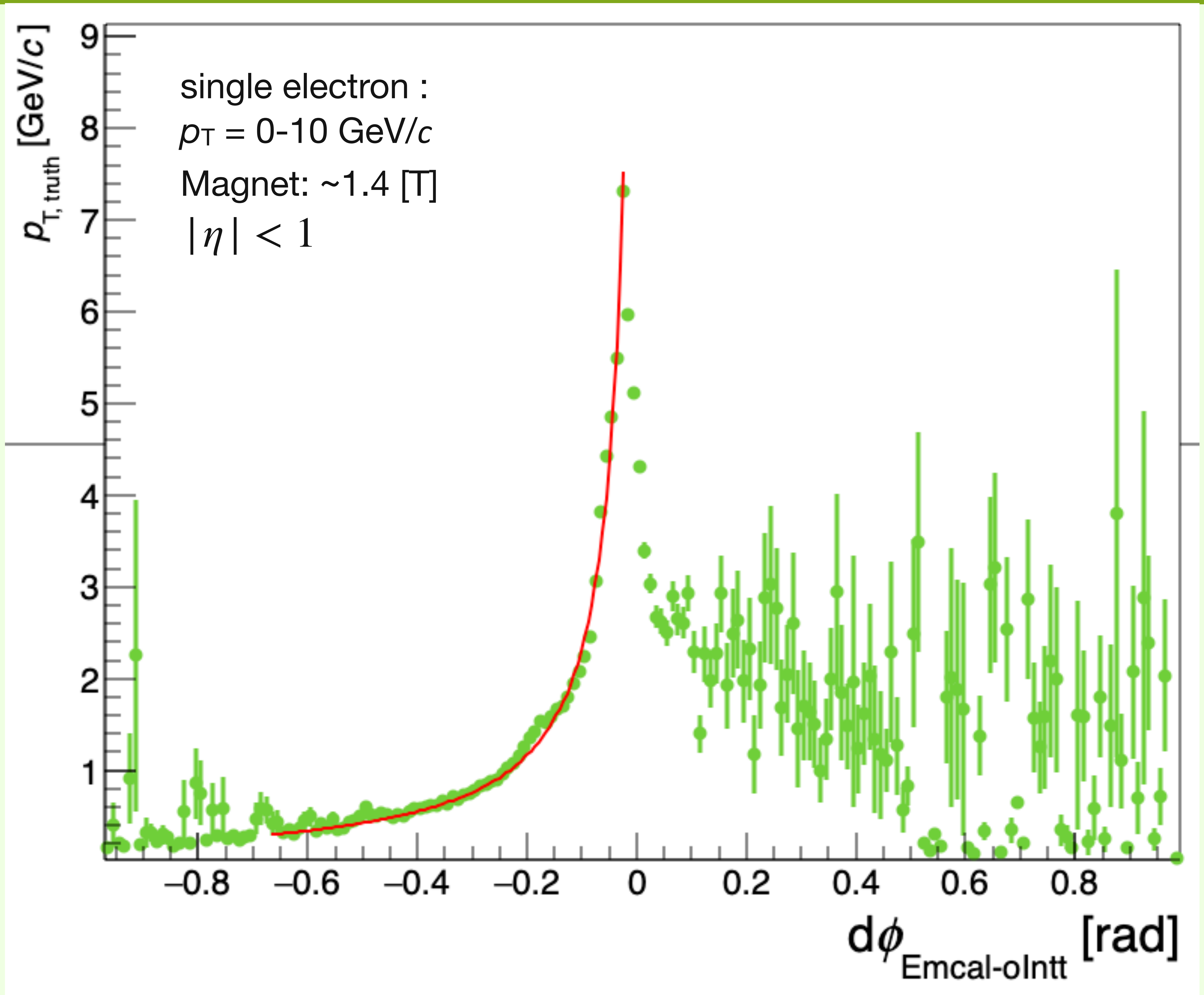


➡ The η dependency seems negligible.

Use fitting function

$$p_{\mathrm{T}} = \mathrm{p0} + \frac{\mathrm{p1}}{d\phi} + \frac{\mathrm{p2}}{d\phi^2}$$



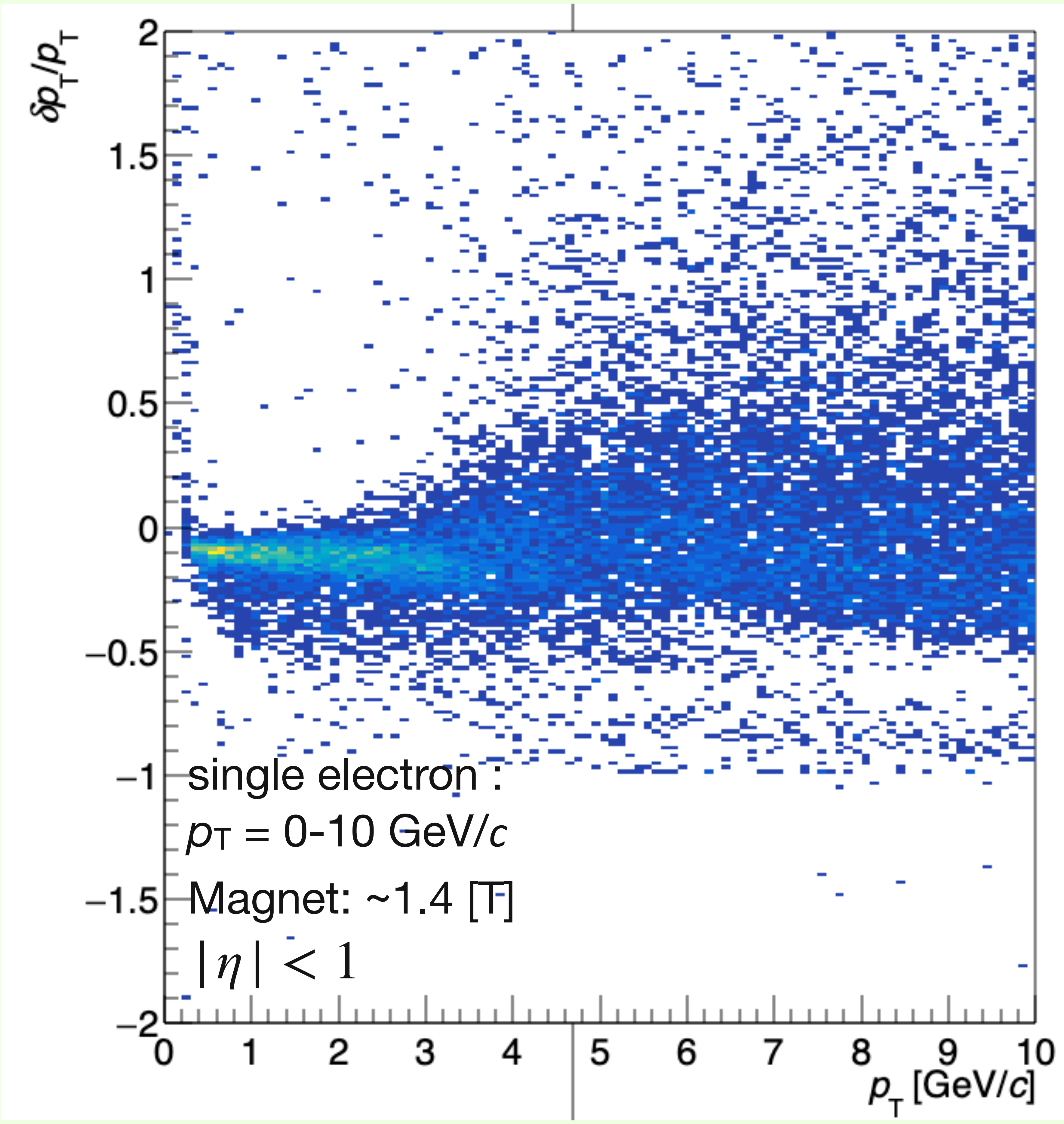


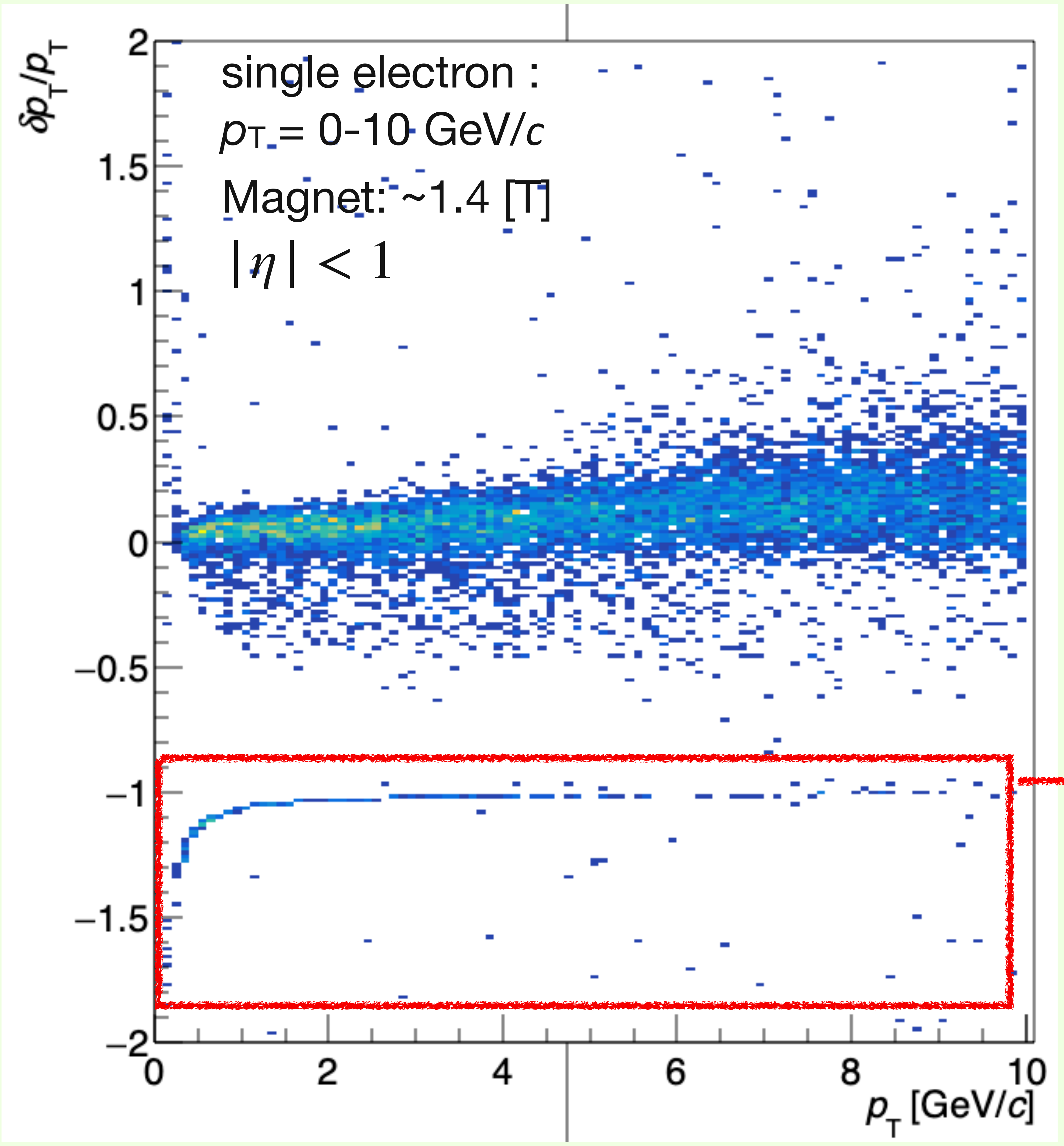
$$p_{\mathrm{T}} = \mathrm{p0} + \frac{\mathrm{p1}}{x} + \frac{\mathrm{p2}}{x^2} = -0.085 - 0.26/x - 0.0019/x^2$$

MVTX+iINTT+oINTT+EMCal

ordinal way: $p_T[\mathrm{GeV}] = qBR$

Fitting Function way: $p_T = \mathrm{p0} + \frac{\mathrm{p1}}{d\phi} + \frac{\mathrm{p2}}{d\phi^2}$





?
Probably it made by mis-tracking
(reco-truth)/truth

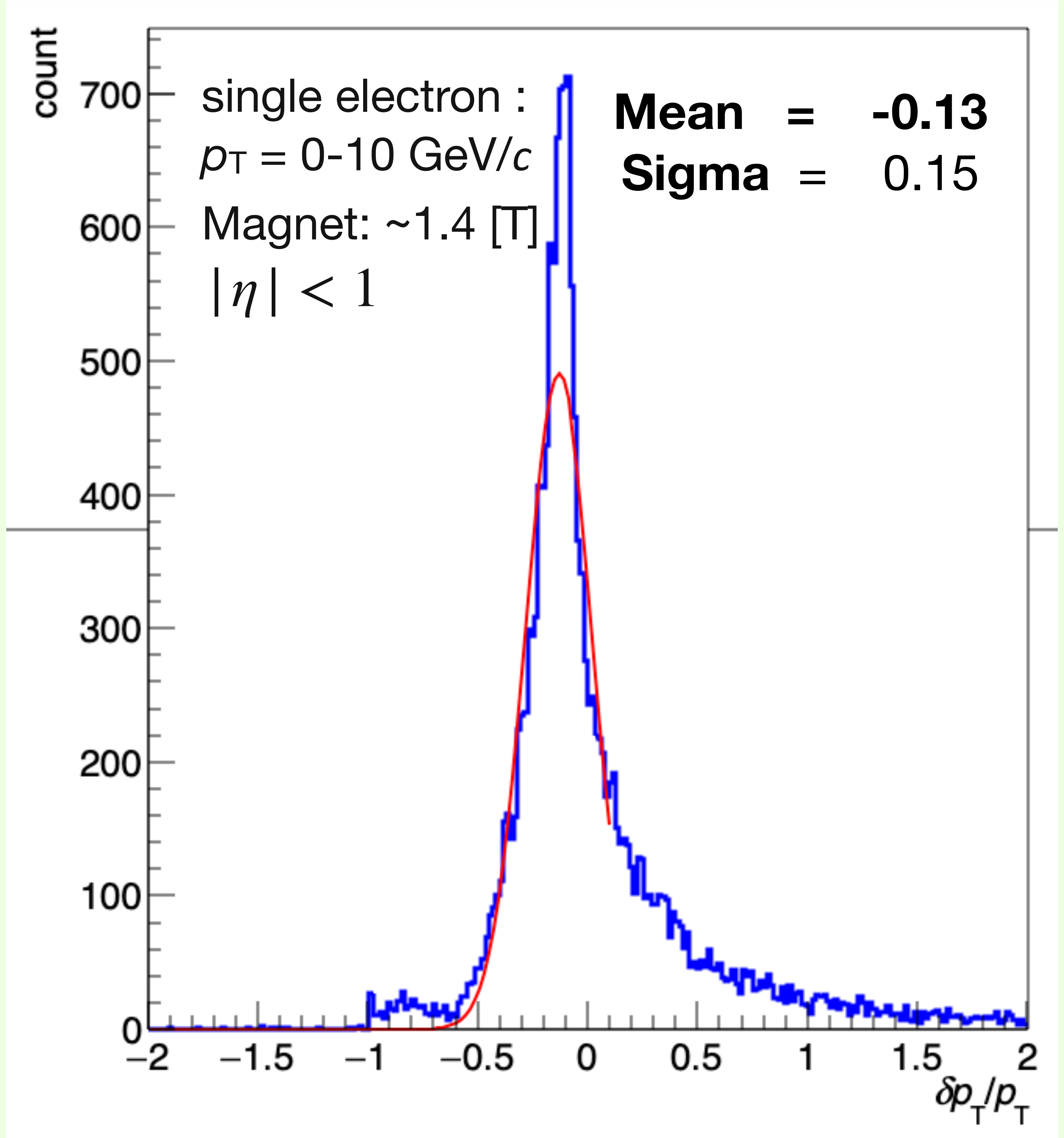
For the pT fluctuation, the fitting function way is clearly better than the ordinal way.

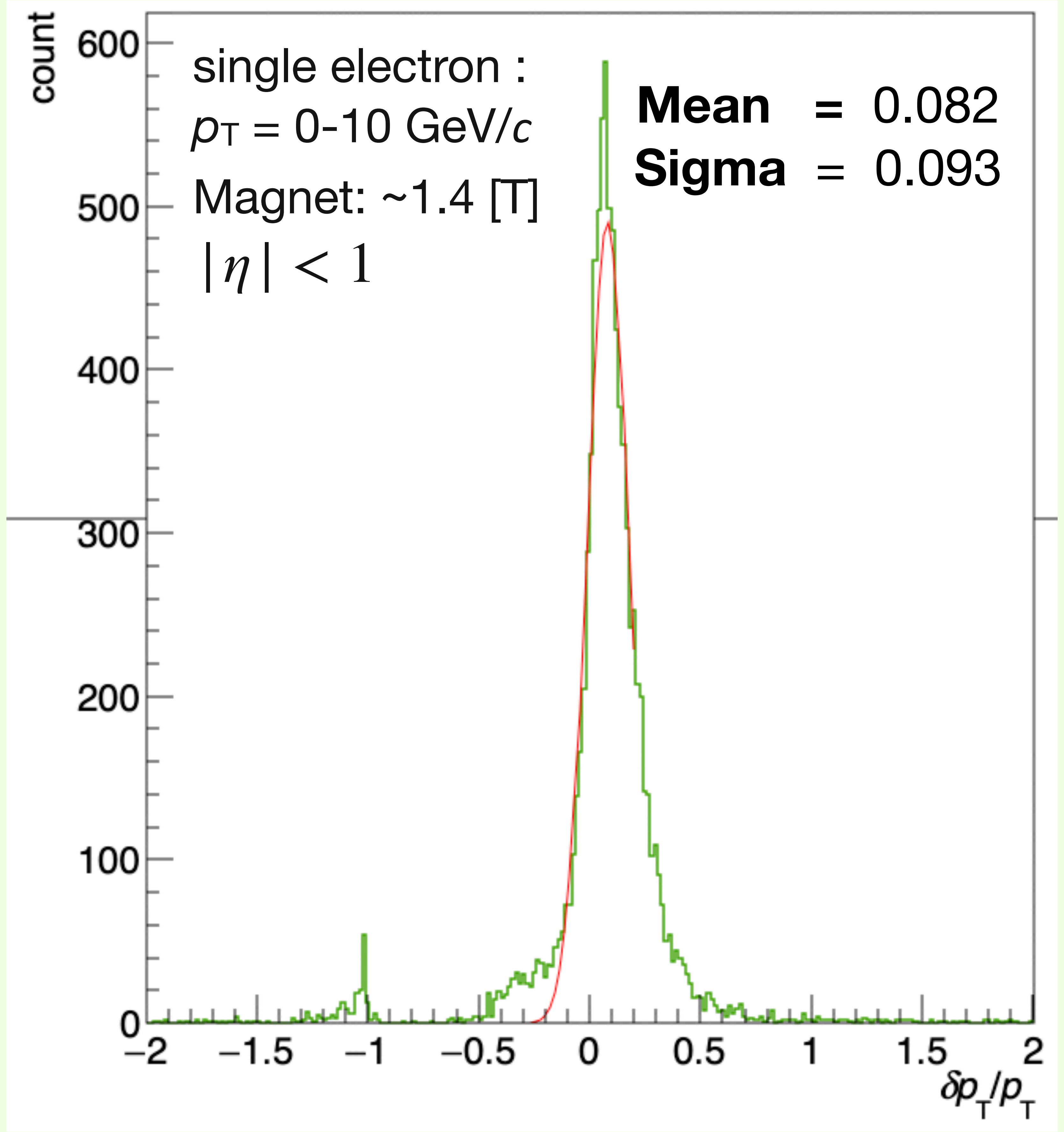
pT resolution with fitting function

MVTX+iINTT+oINTT+EMCal

$$p_T[\mathrm{GeV}] = qBR$$

$$p_T = \mathrm{p0} + \frac{\mathrm{p1}}{d\phi} + \frac{\mathrm{p2}}{d\phi^2}$$

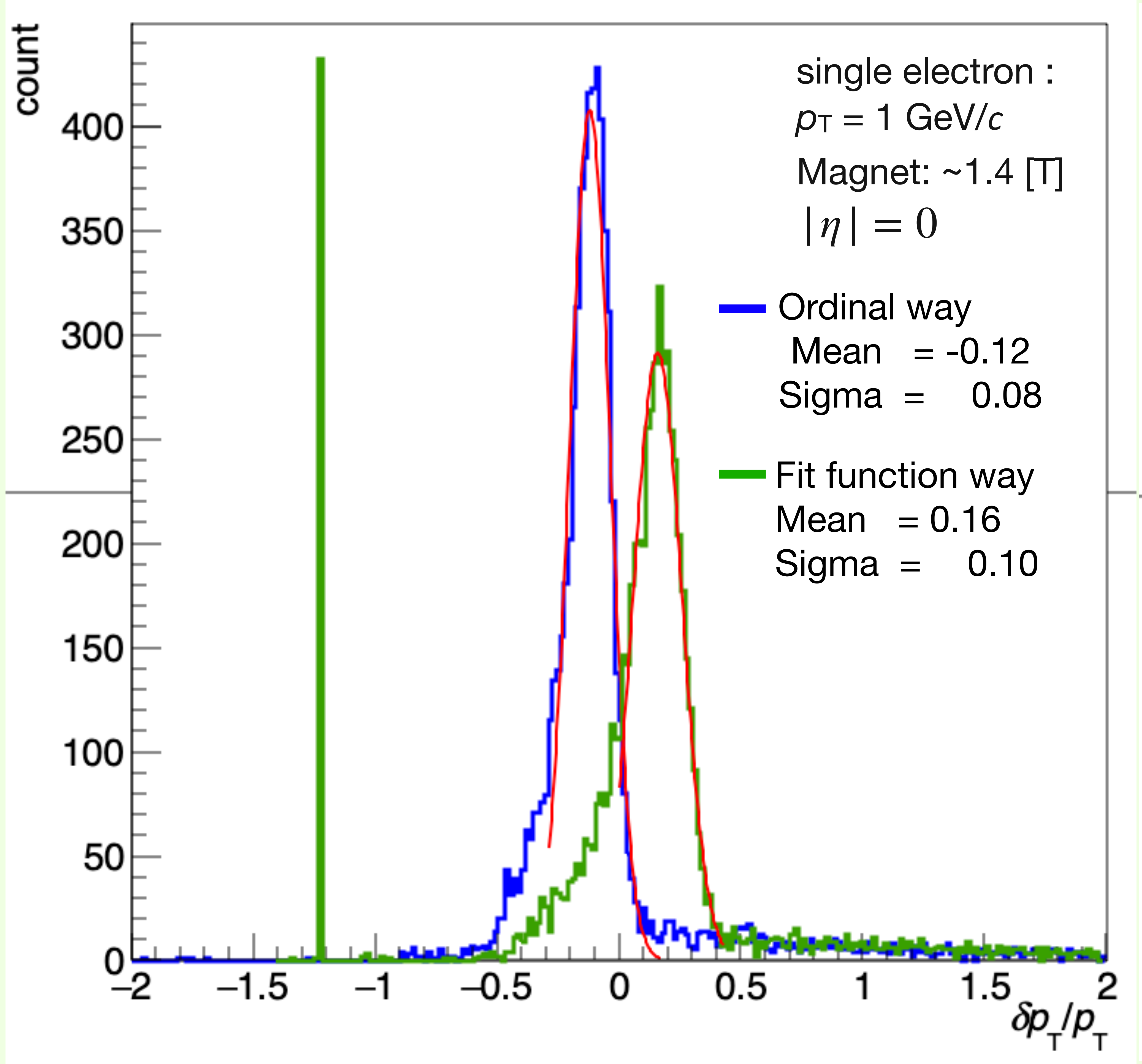




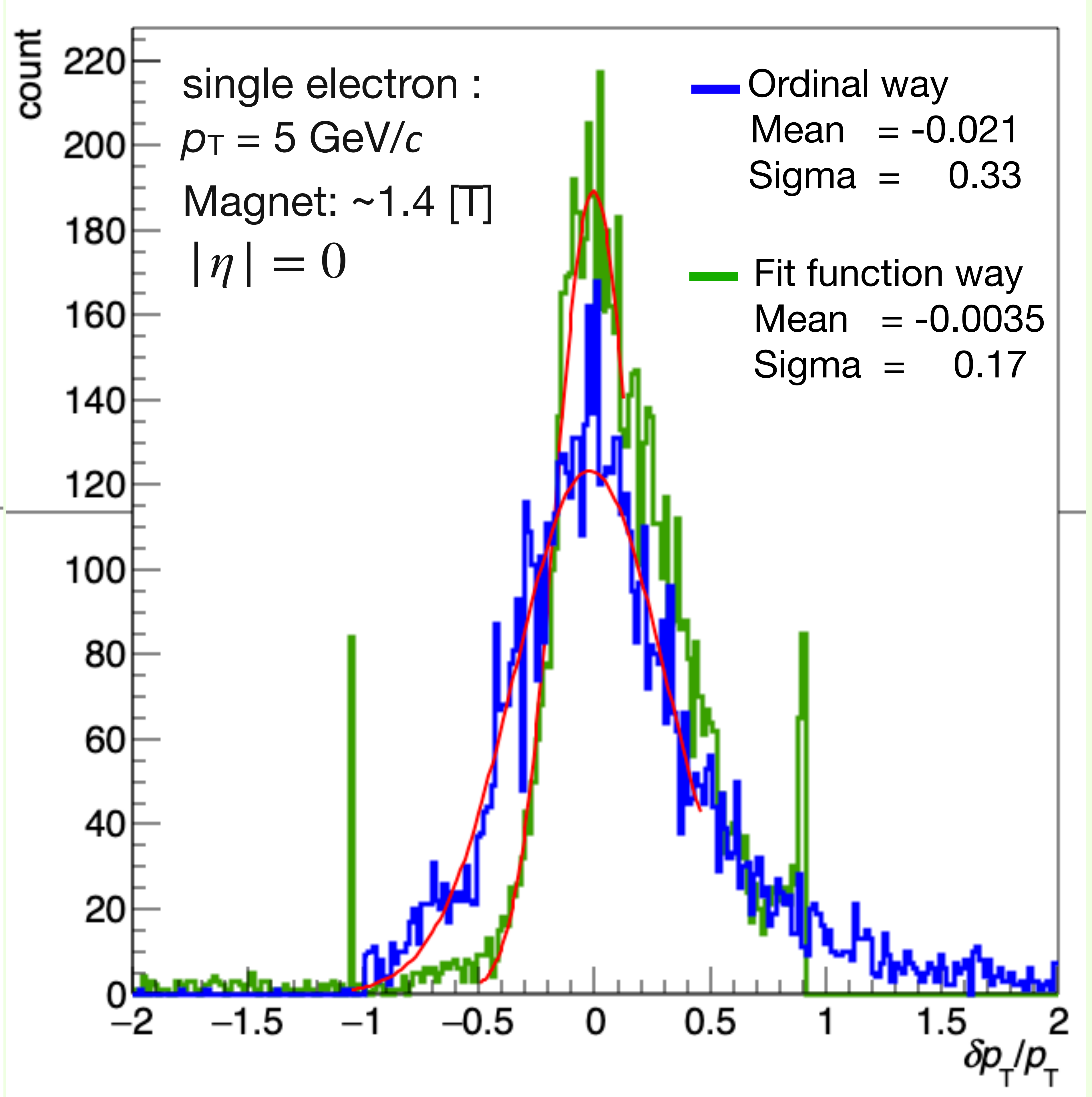
The comparison is not fair because the fitting does not work well.
While the shape seems sharper than the old way.

p_T resolution with fitting function (pT slice)

1 GeV/c



5 GeV/c



The fit function does not work well in low p_T region, and the peak also non-zero.
I have to check the fit function more.

Next

- Check the fitting function quality.
- Clarify the wired peak of the delta pT distribution.
- Try to test for other particles.