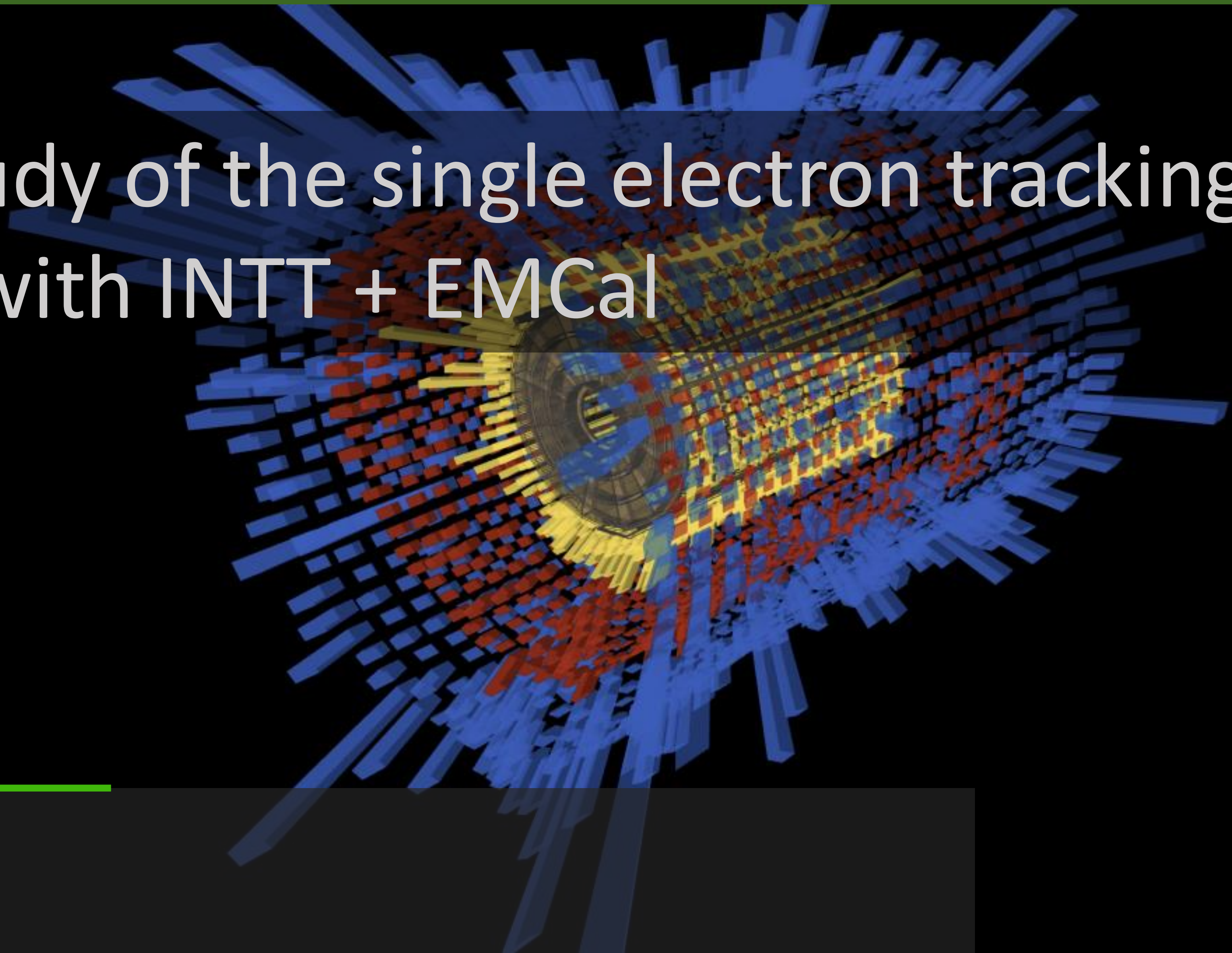
Performance Study of the single electron tracking with INTT + EMCal



RIKEN

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Achievement

- How to run the physics simulation in Fun4All

- How to imprement the detectors in the simulation

- How to lean to use the Condor

- I made a very rough code to reconstruct single electron

Motivation

Improve electron tracking using INTT by adding calorimeters

There is possibility TPC detector do not work well.

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

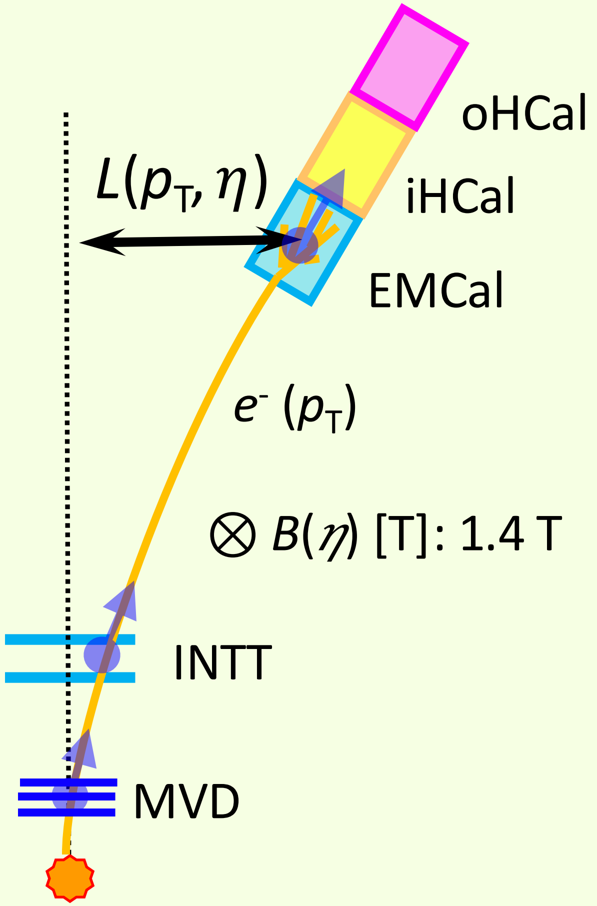
<Final goal>

Impove the E/p and reconstruct J/ψ

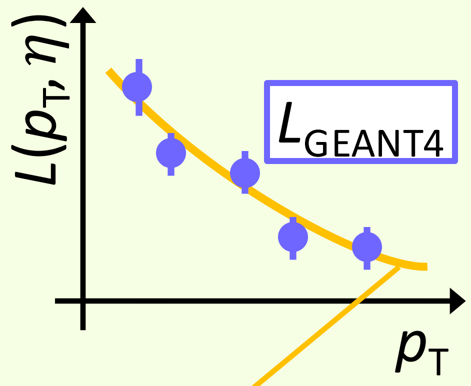
<Short term goal>

(1) Estimate the correlation $p_{T,\,e-}$ and how shift by magnetic field.

(2) Using the INTT and EMCal hit points, we estimate $p_{T,\,e-}$ and it's resolution ($\delta p_T = p_{T,\,reco} - p_{T,\,truth}$)

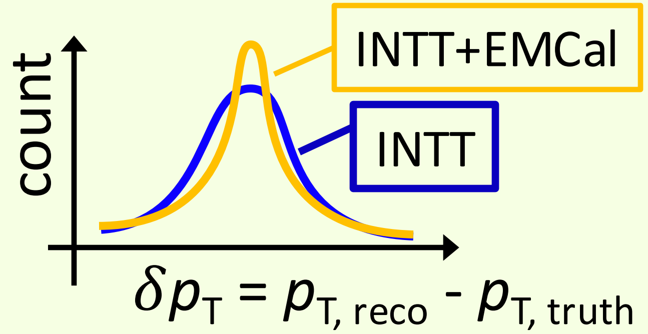


(1)



$$L(p_T, \eta) = \frac{C_1(\eta)}{p_T} + \frac{C_2(\eta)}{{p_T}^2}$$

(2)



Methods

Framework: Fun4all

Simulation: Single particle gun + GEANT4

Inject electron p_{T} : 0.5, 1, 2, 5 GeV/c

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

GEANT4 Setting: Magnet 1.4 T (1.4*1.4 T) (not flat: However, I still do not check the detail)

Detector: MVTX, INTT, TPC, EMCal, iHCal, oHCal

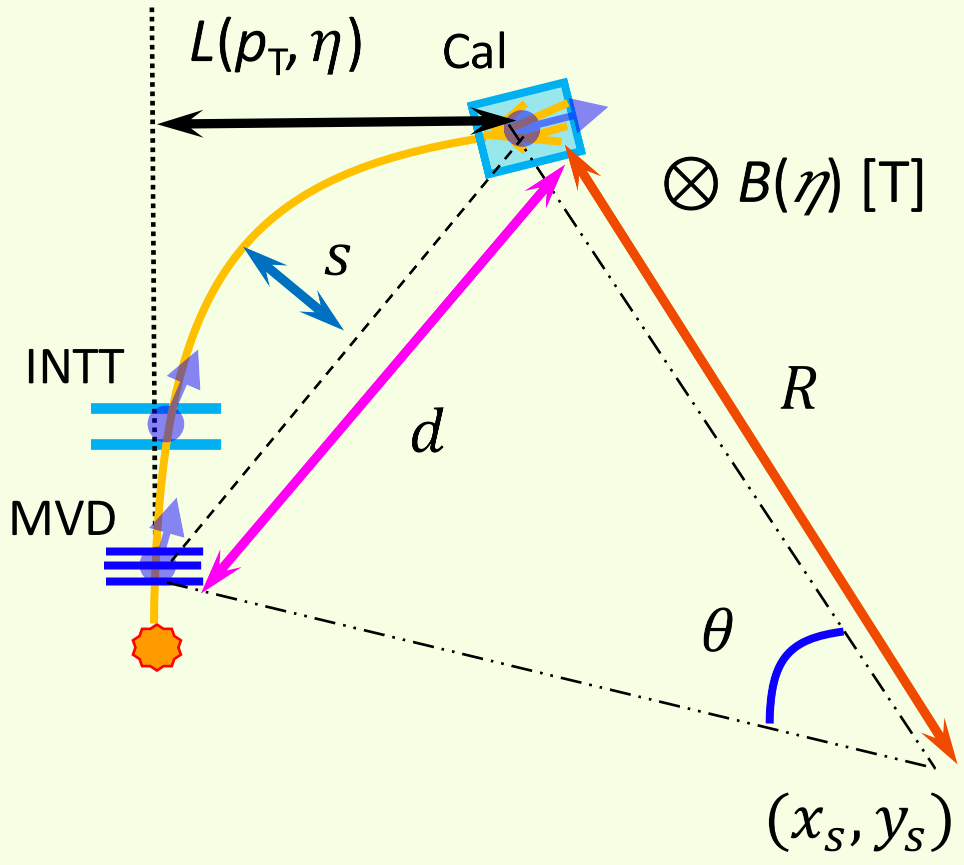
Estimate track p_T using the Sagitta equation

Sagitta p_T equation

$$p_T[\text{GeV}] = qBR$$
$$= 0.3B[T]R[m]$$

Fitting the circle equation ($y = \sqrt{R^2 - (x - x_s)^2} + {y_s}^2$) for the three points (inner INTT, outer INTT, and EMCal) and estimate the R.

Using this R, the p_T can be calculated.



Hit Matching Algorithm

(1) Find a inner INTT cluster having the closest $\phi_{\text{outer INTT}}$

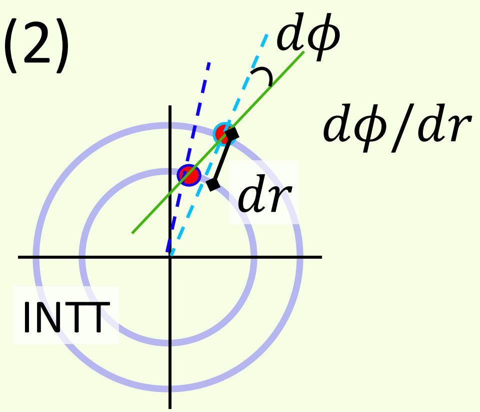
(2) Caclulate $d\phi/dr$ (outer INTT - inner INTT)

(3) Searching for an EMCal cluster having the highest energy in the ϕ_{Cal} range

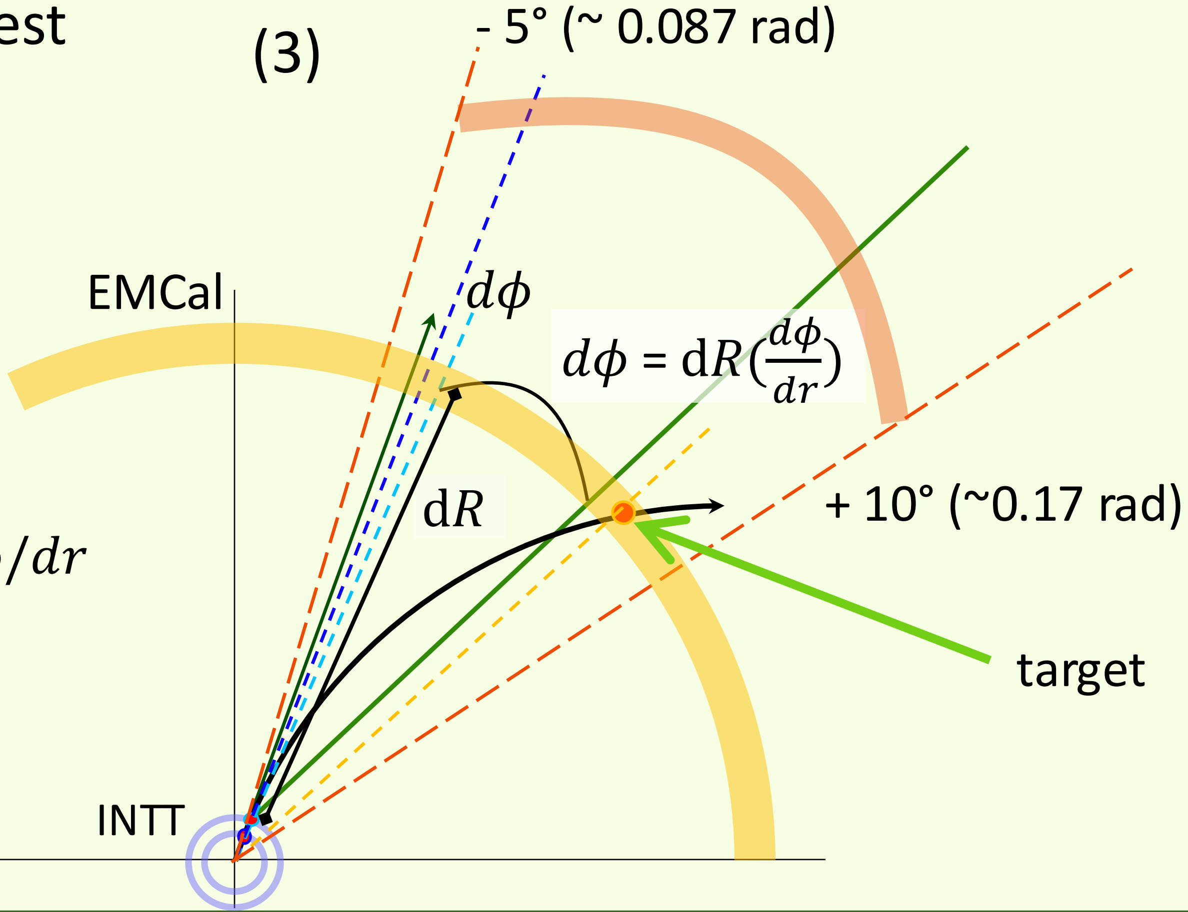
ϕ_{INTT} - 5° < ϕ_{Cal} < ϕ_{INTT} + $d\phi_{\text{Cal}}$ + 10°

$$d\phi_{\text{Cal}} = d\phi/dr * (R_{\text{EMCal}} - R_{\text{INTT}})$$

(2)

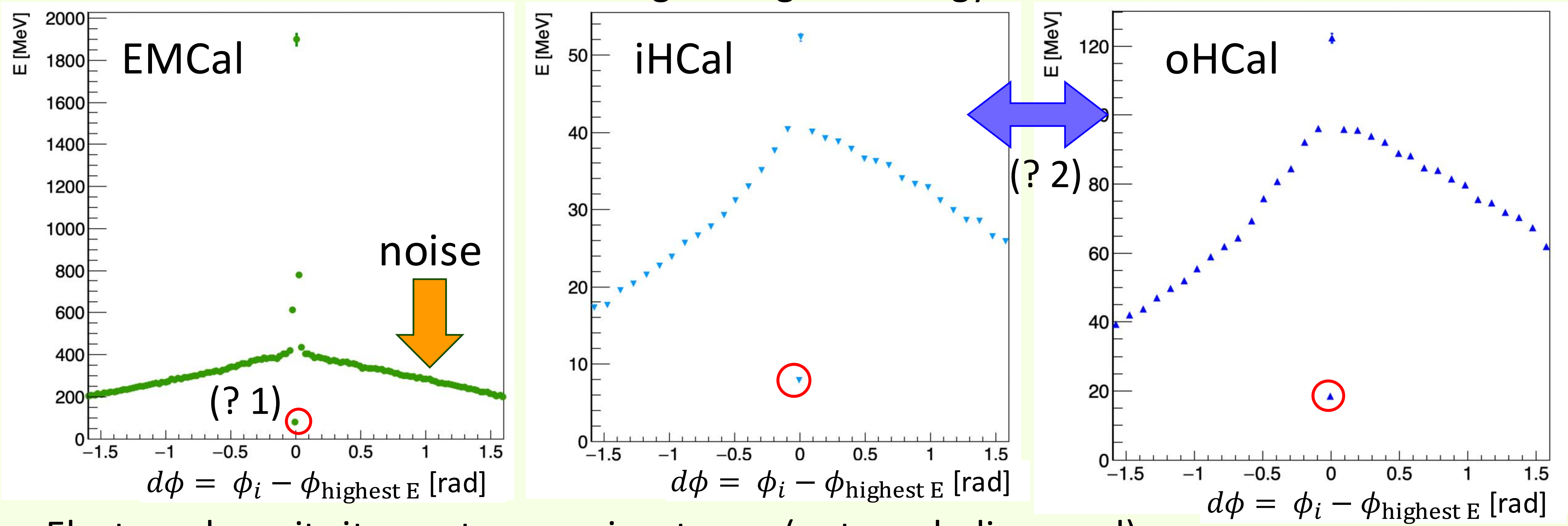


(3)



Calorimeter Deposit Energy Dispartion

Check the criteria to use a tower having the highest energy



- Electron deposits its most energy in a tower (not much dispersed).

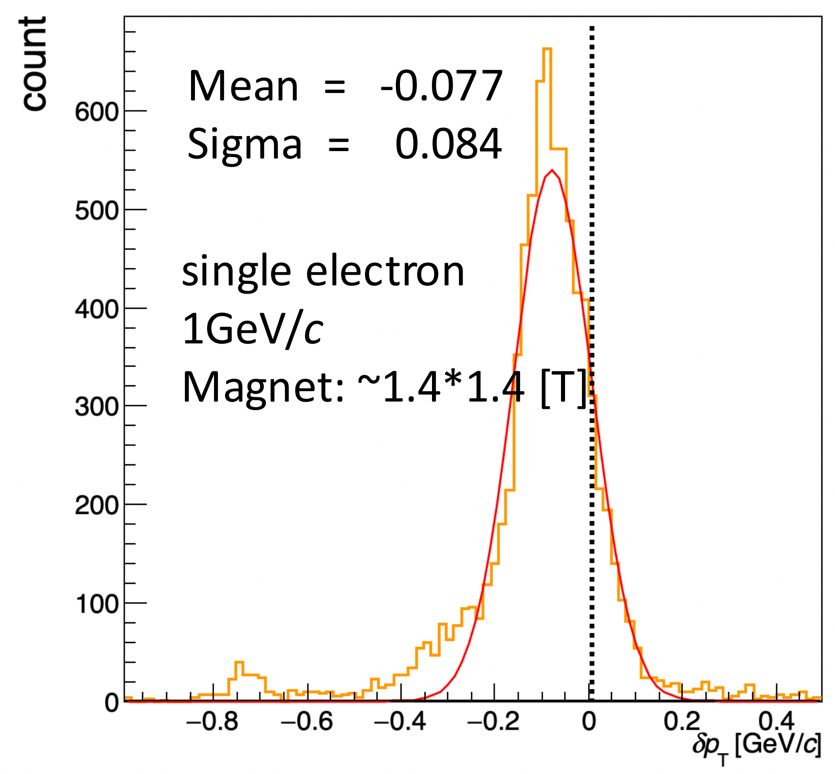
→ It seems well to use only the highest energy tower, temporally.

(?1) There is a weird point.

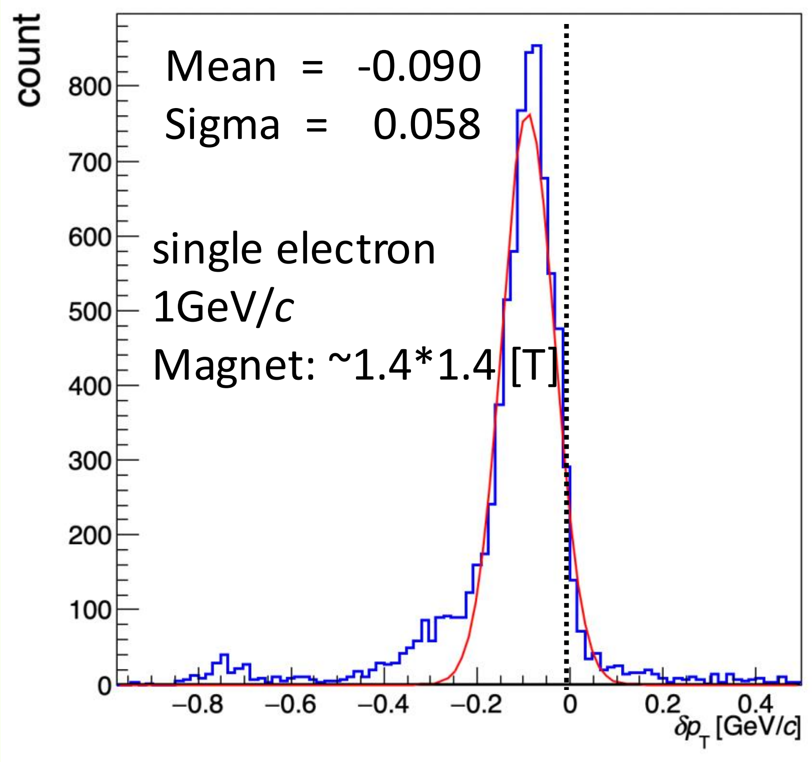
(?2) The energy of iHCal is smaller than oHCal.

p_T resolution

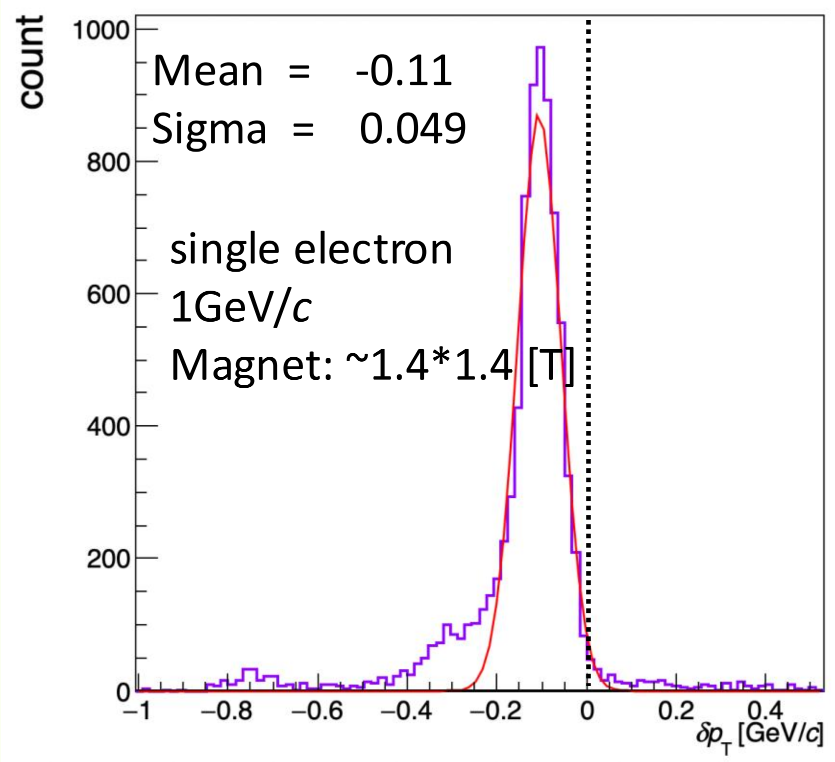
iINTT+oINTT+EMCal



Vertex+iINTT+oINTT+EMCal



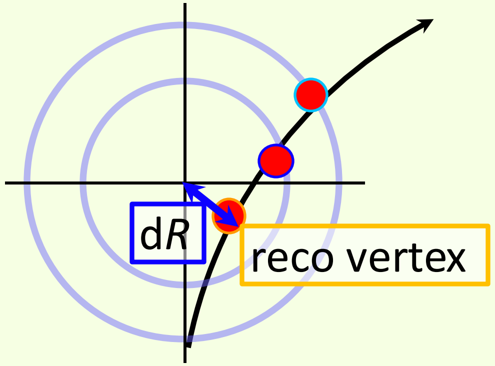
MVTX+iINTT+oINTT+EMCal



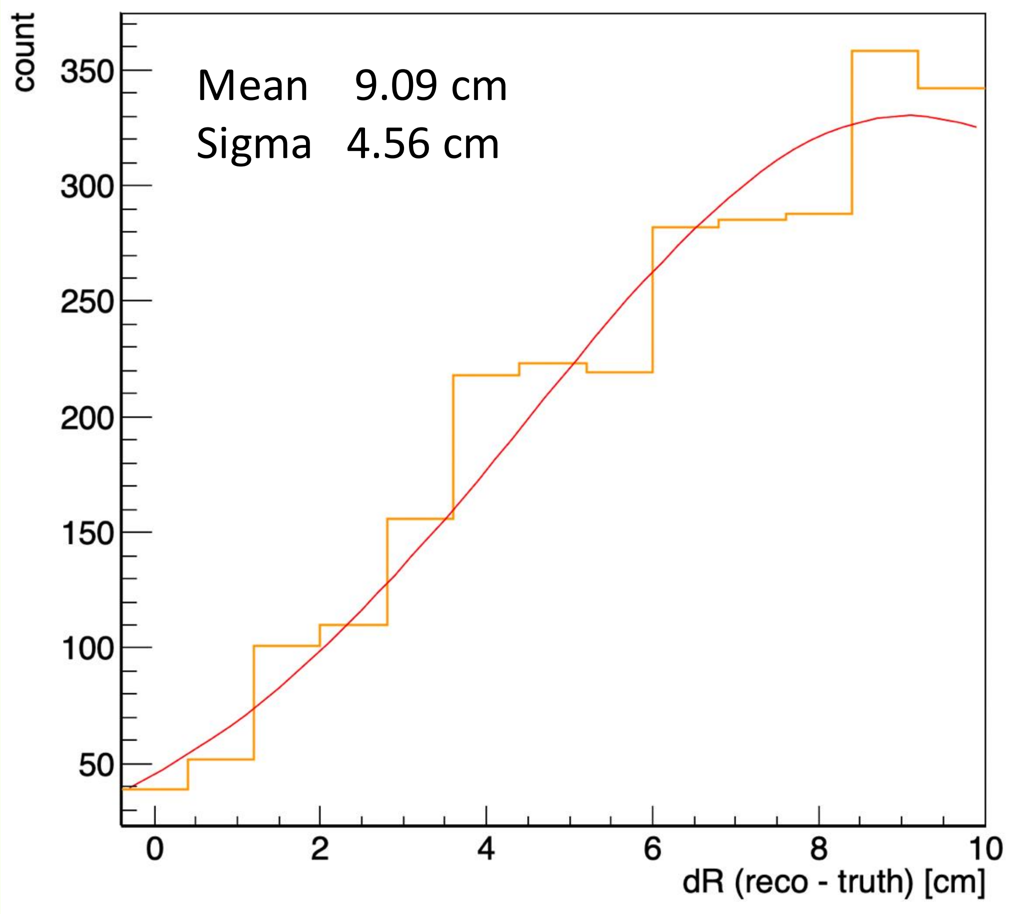
$\delta p_T = p_{T,reco} - p_{T,truth}$, $p_{T,\,reco} = 0.3*1.4*1.4*R_{sagitta}$, (I misstook the magnetic field)

→ Have to check the reason of the peak shift.

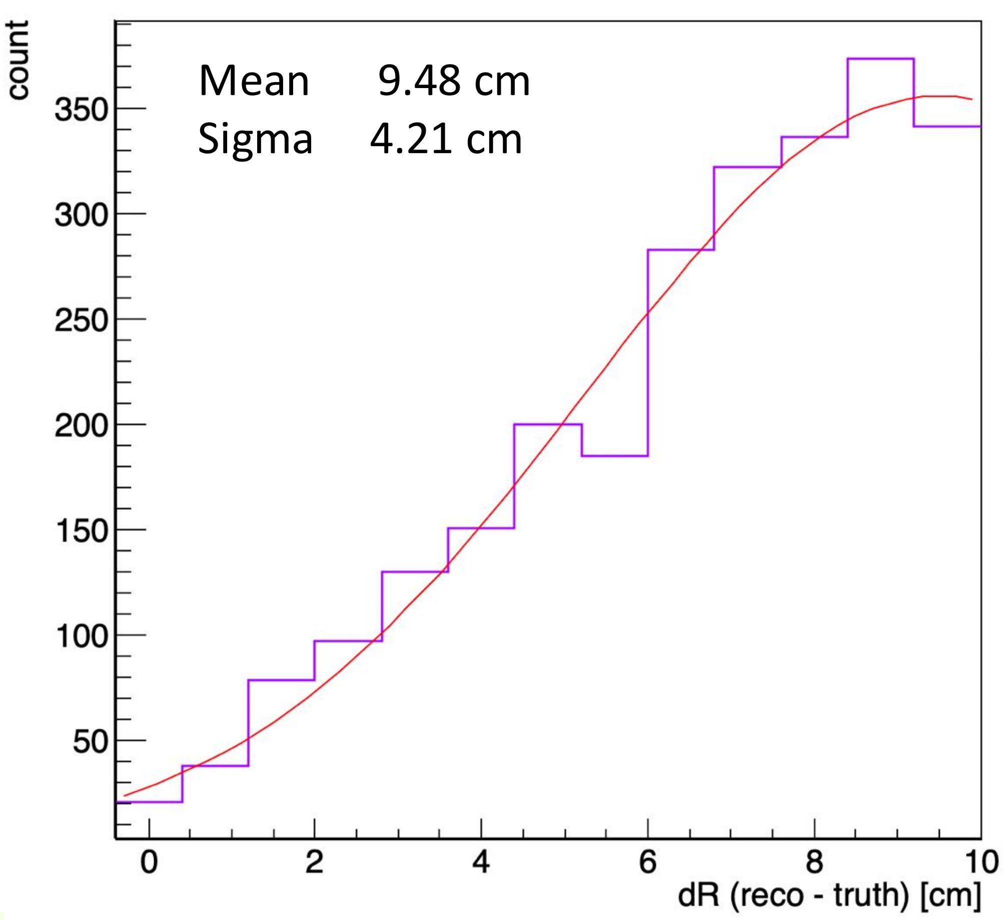
Vertex Estimation



iINTT+oINTT+EMCal



MVTX+iINTT+oINTT+EMCal



The distribution width is still so large. I have to improve it.

Outlook

- Have to check some weird points of my results.

- Re-make simulation in the correct magnetic filed (1.4*1.4 T -> 1.4 T)

- Increase p_T range of single electrons (p_T = 0.5, 1, 2, 5 GeV/c)

- Check what does the calorimeter tower making and clustering do

- Check that it work in PYTHIA simulation (tracking efficiency, p_T resolution)

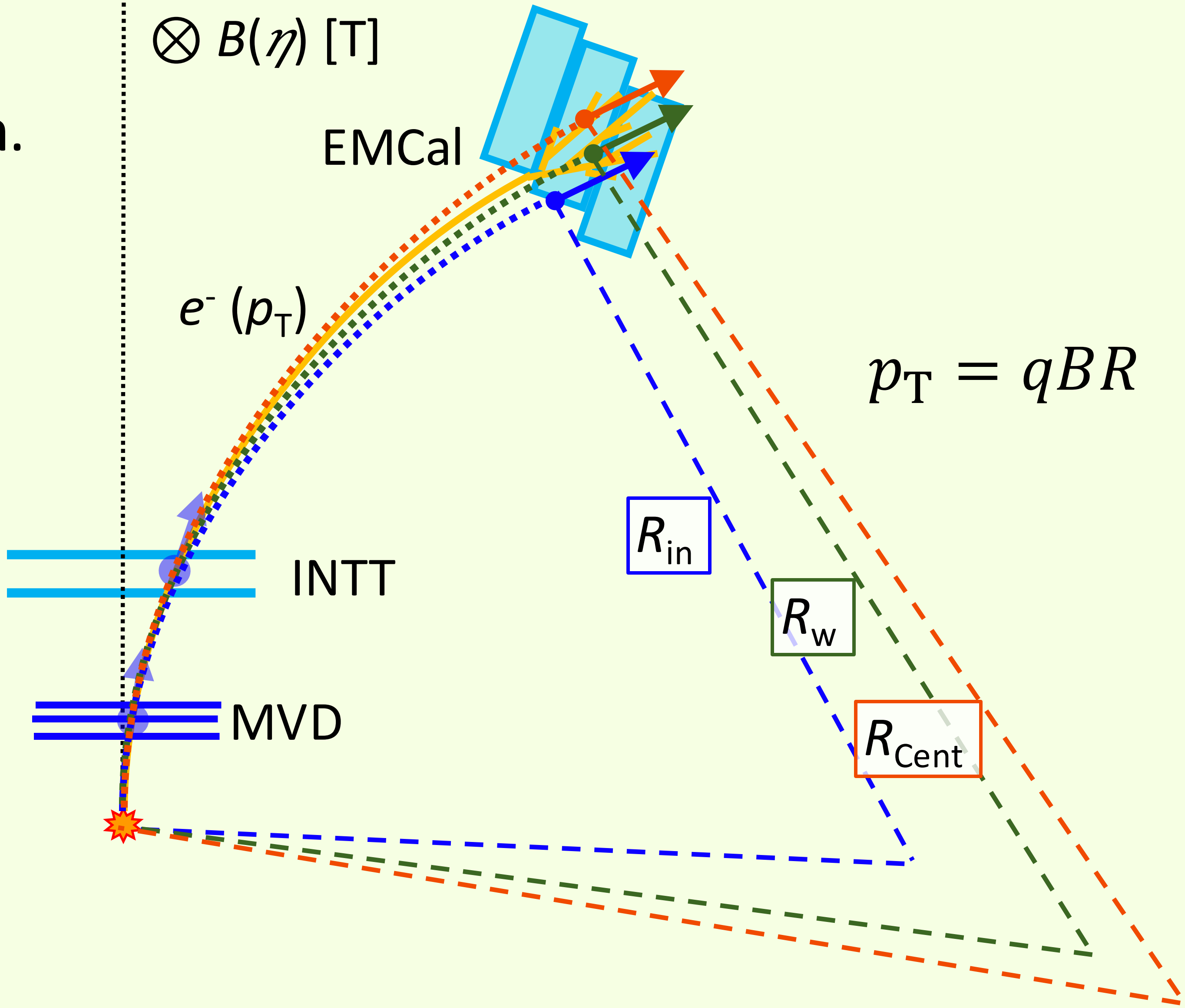
- Make event displays

(<1> vertex + inner INTT + outer INTT (to compare with the NWU results))

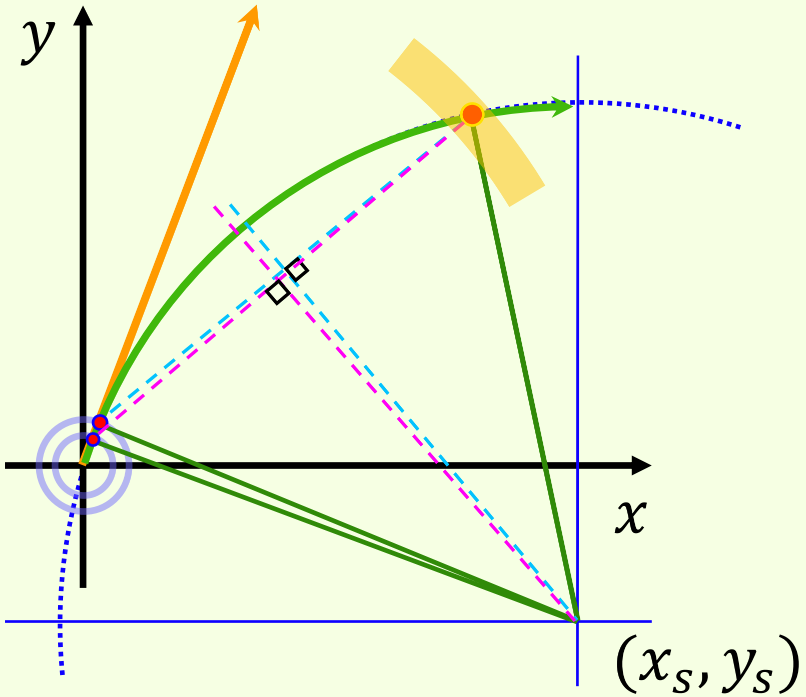
Understand the Way to Make a Calorimeter's Tower/Cluster

Clastering way and the postion is very sensitive for the p_{T} estimation.

→ Need to modify clustering or shift position.



Backup Slides


y
x
(x_s, y_s)