FoCal Trigger simulation

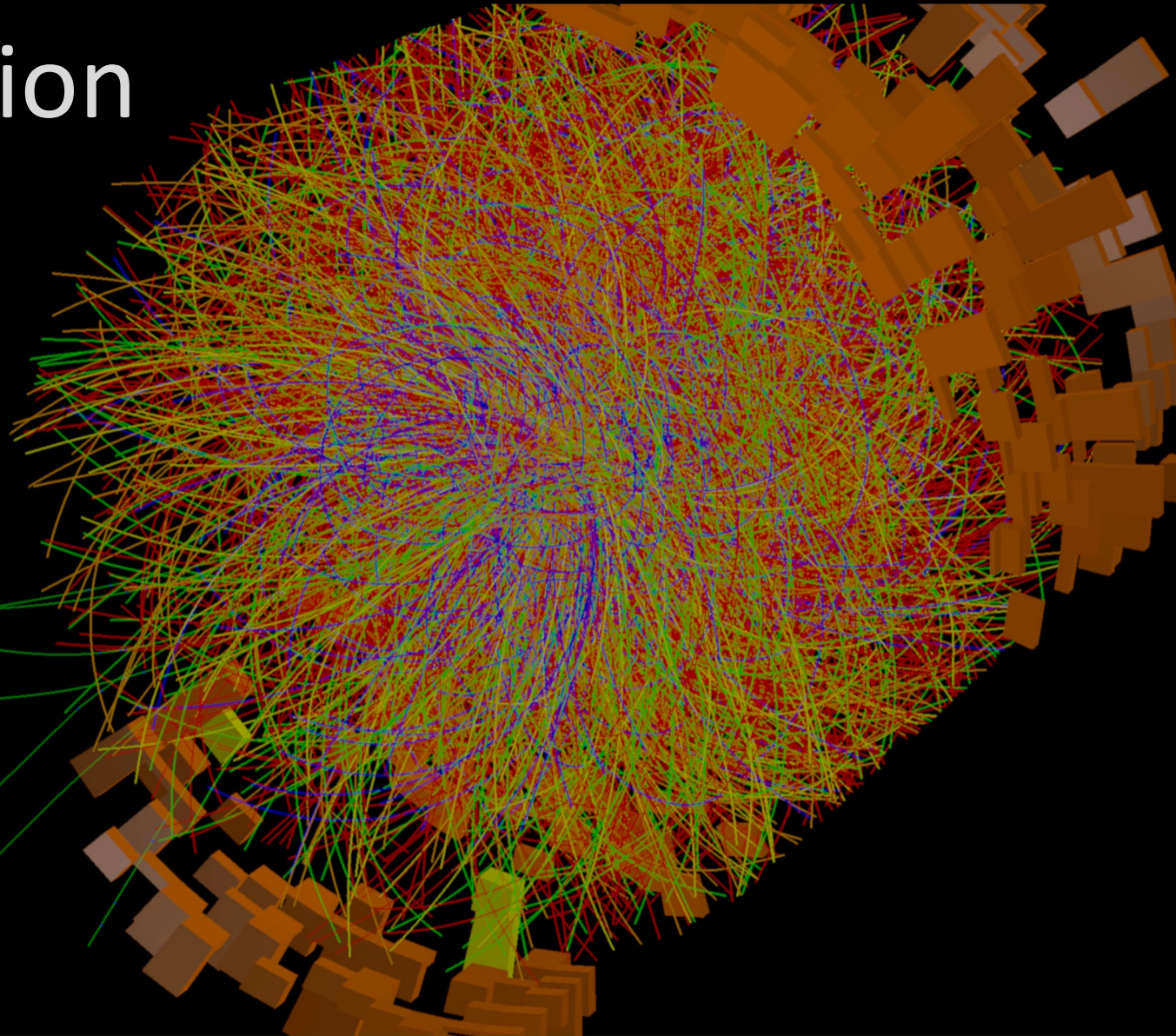Univeristy Grenoble Alpes

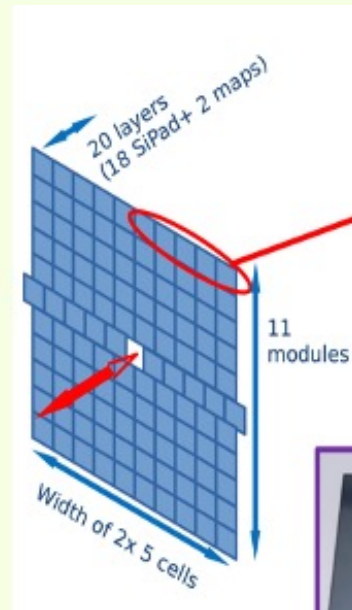University of Tsukuba

RIKEN (JRA)

Takuya Kumaoka

New Progress

- Test z direction sum (tower)
- Single photon / pi0 simulation

Single Events
pT flat: 0-20 GeV/c
$3.0 < \eta < 6.0$
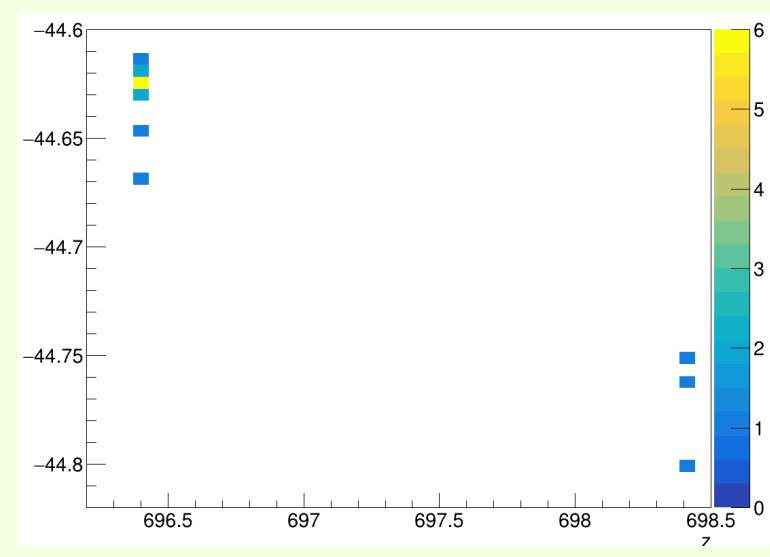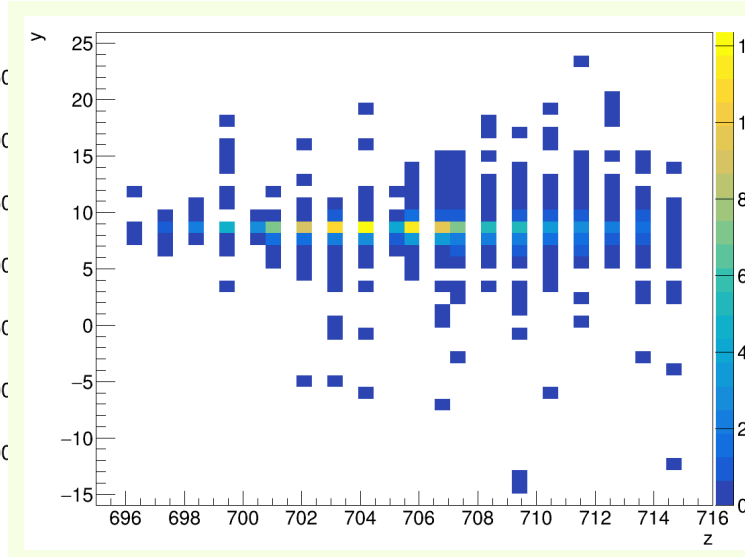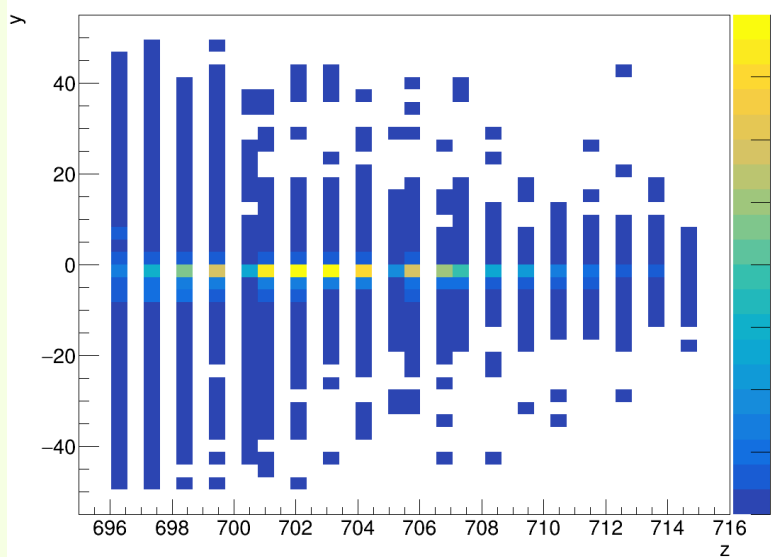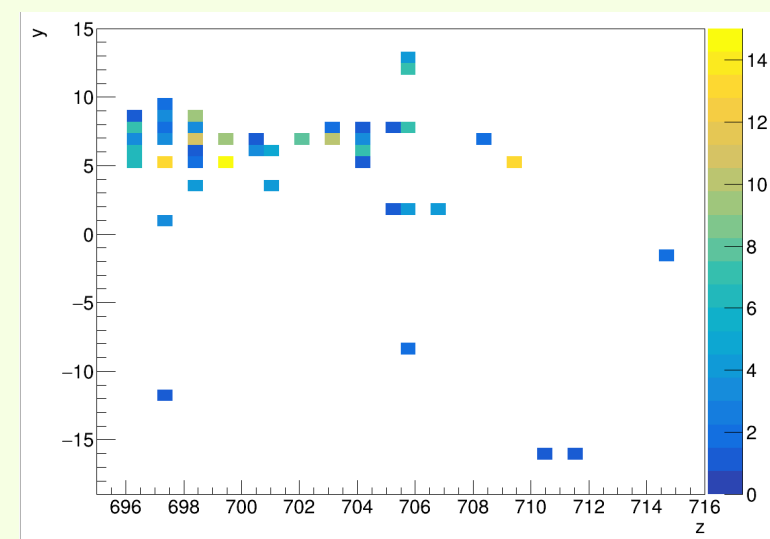(FoCal $3.4 < \eta < 5.8$)

Single Gamma 6 event samples
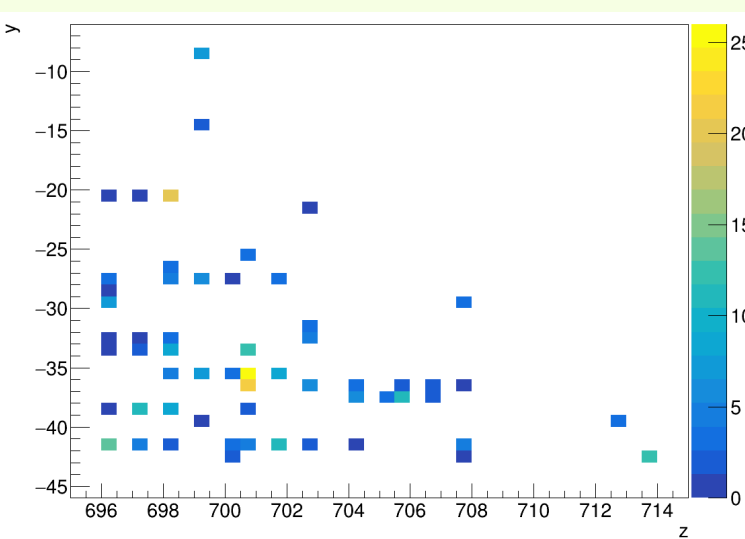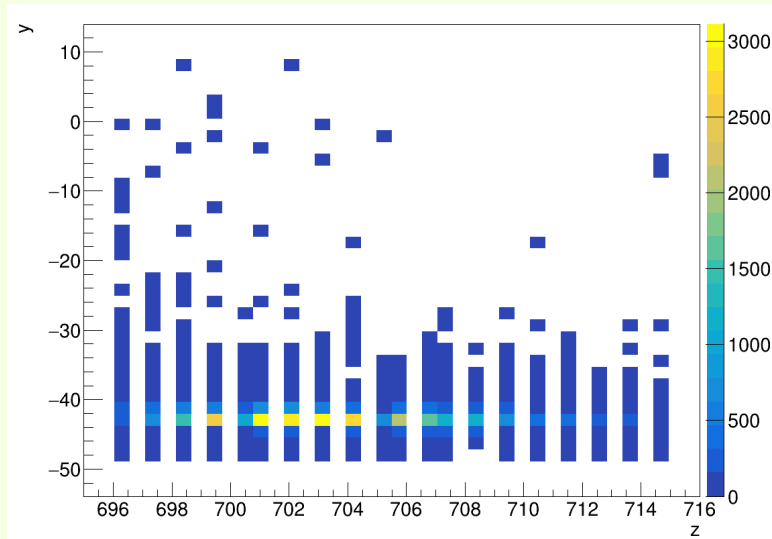
Single Pi0 6 event samples
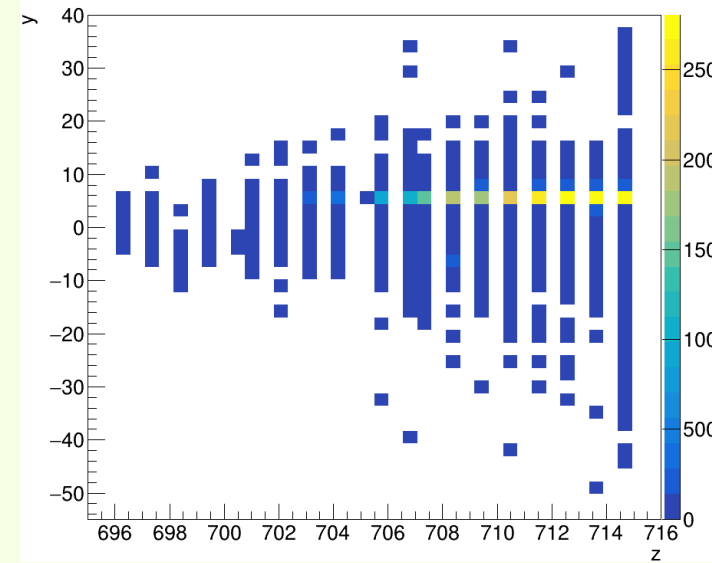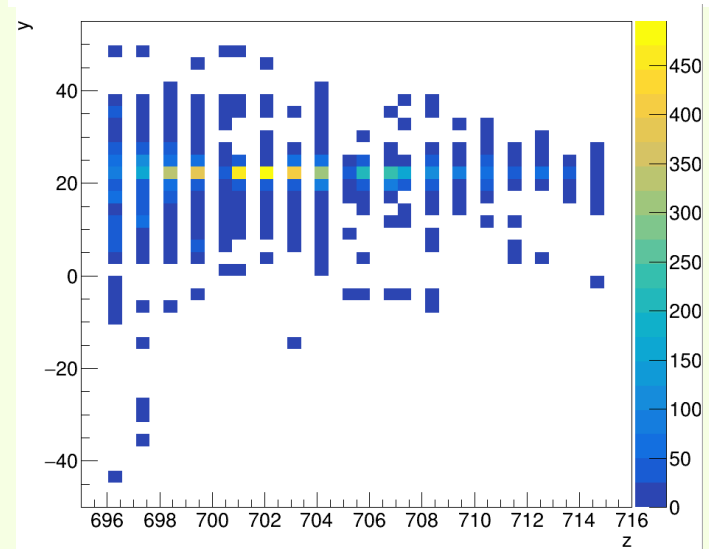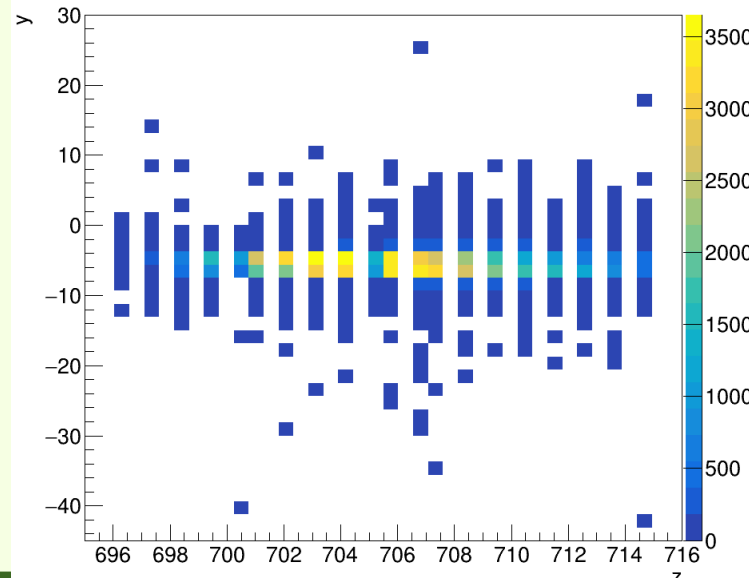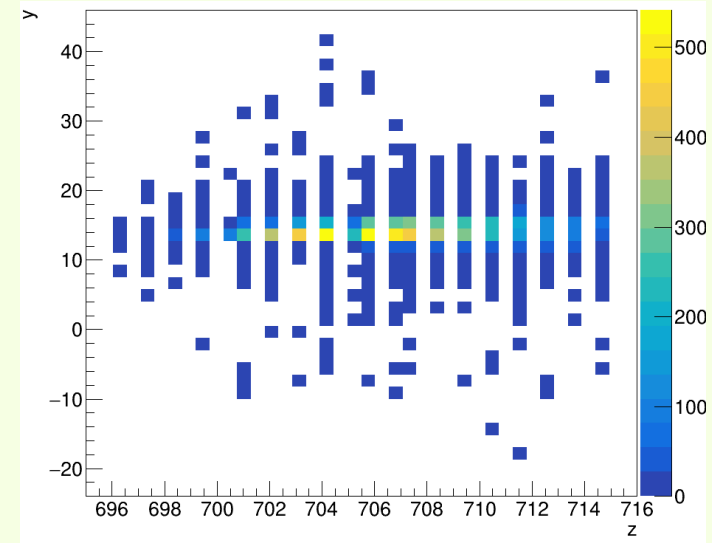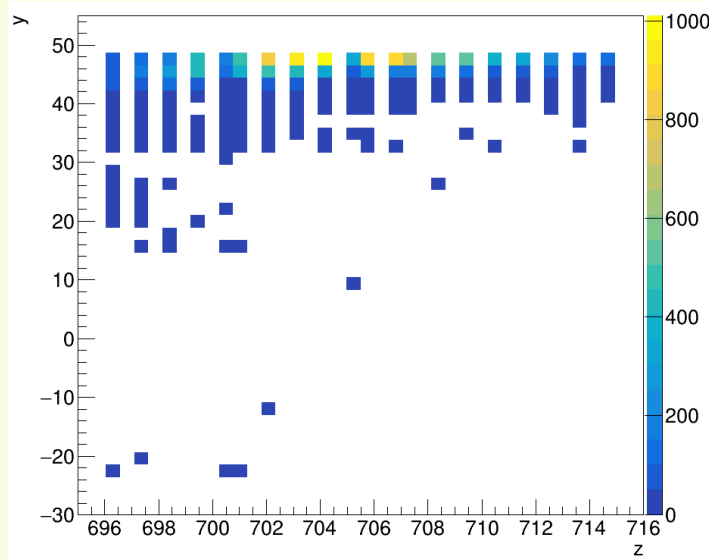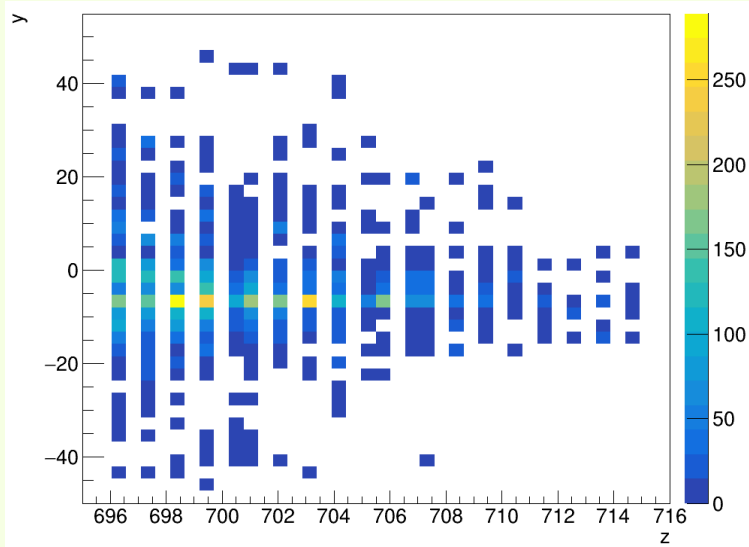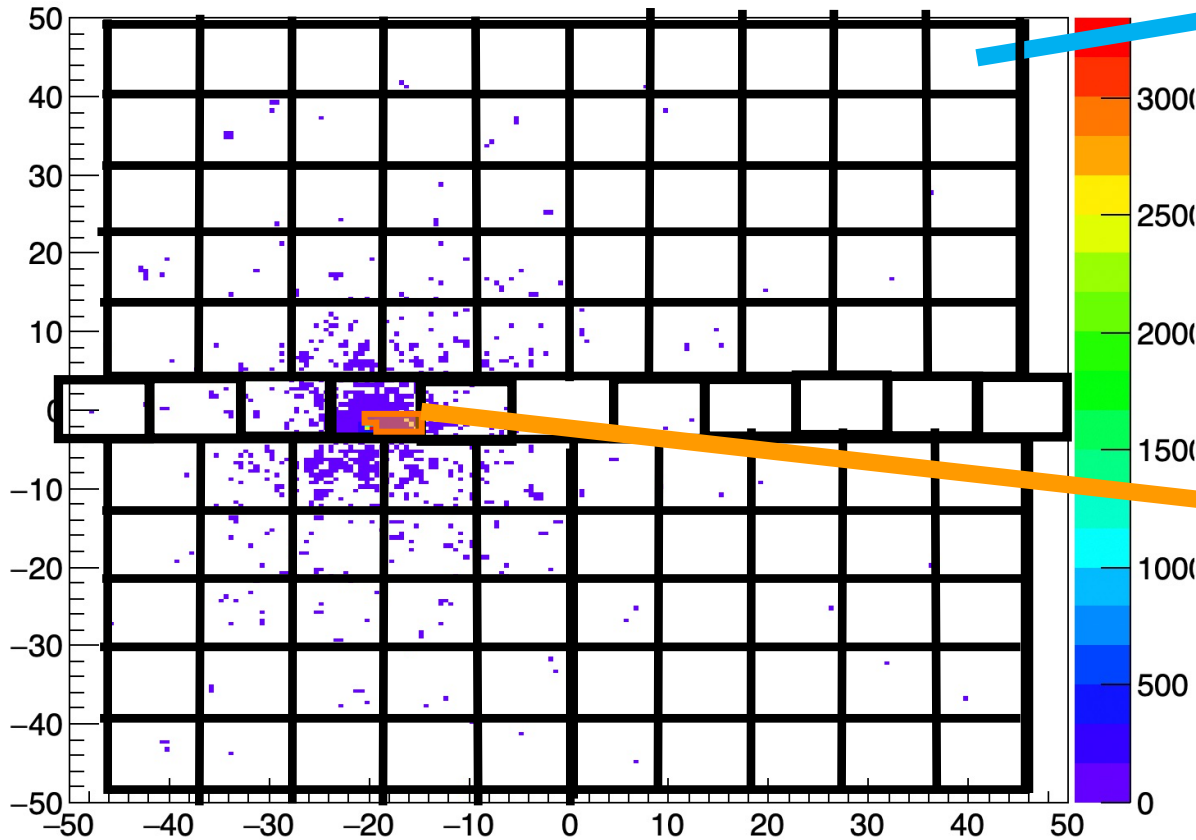
FoCal-E Pad

1 Pad

- Find a tower that has the highest deposit energy or pT. (pT = deposit energy / sinθ)
- Trigger events that there is a tower having deposit E/pT over **threshold.**

→ Determine the threshold value of deposit E/pT based on the data reading rate

Check threshold deposit energy for readout rate
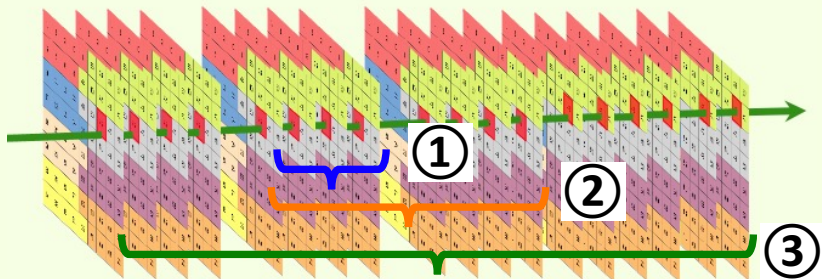
Tower unit

Fill the most highest energy from the energy the tower units have in an event.

①

①
70 kHz / 1 MHz
28.8 MeV

②
70 kHz / 1 MHz
38.0 MeV
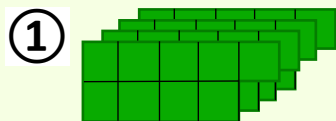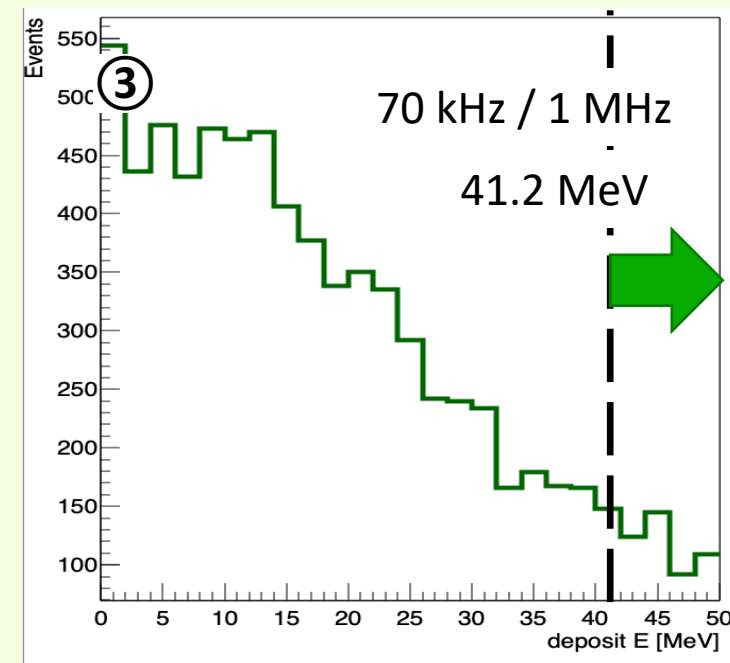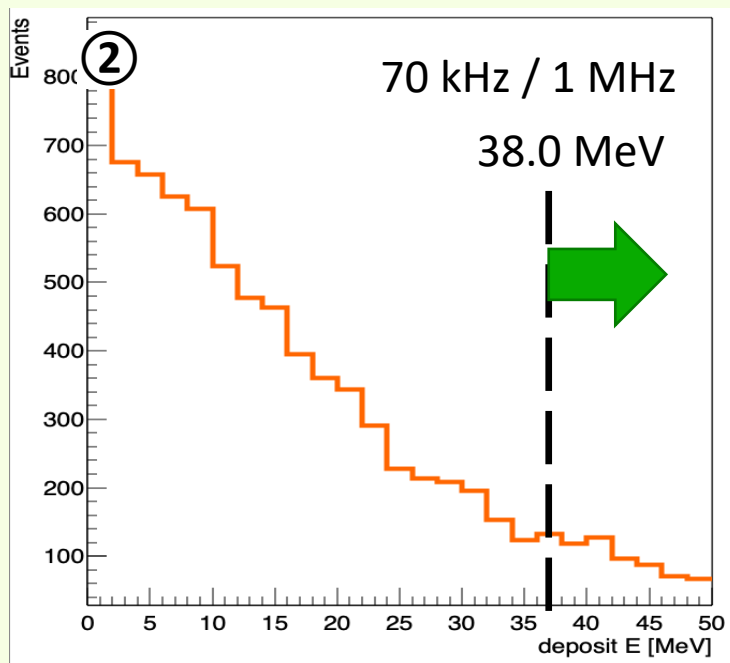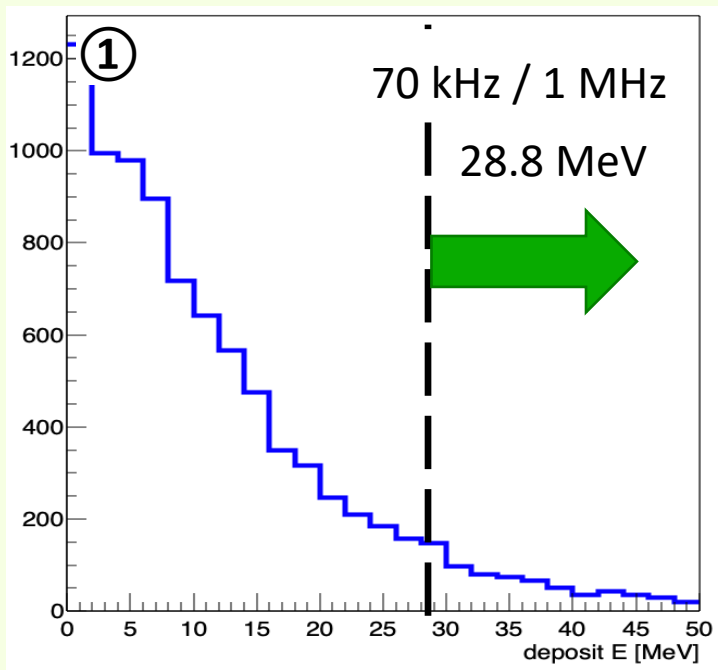
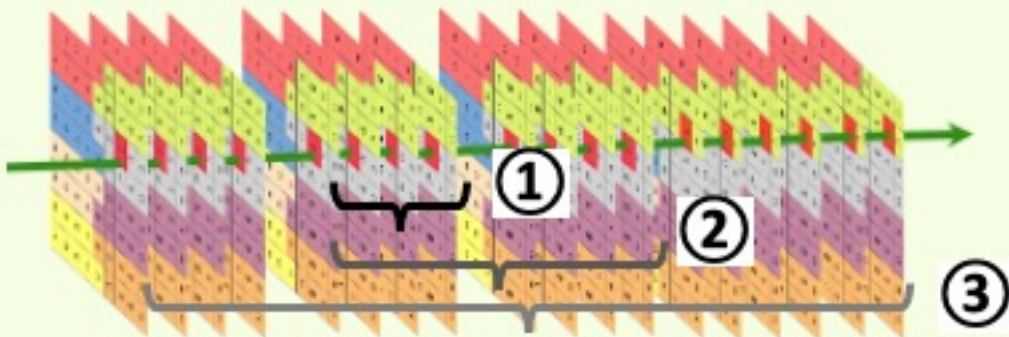**③**
70 kHz / 1 MHz
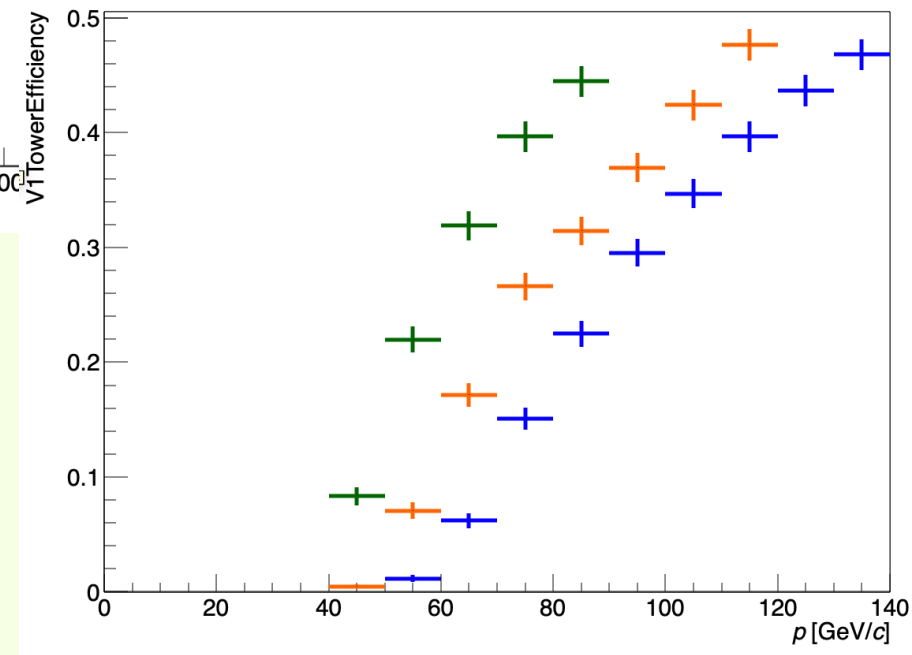41.2 MeV

pp 14 TeV MB, ~10000 events
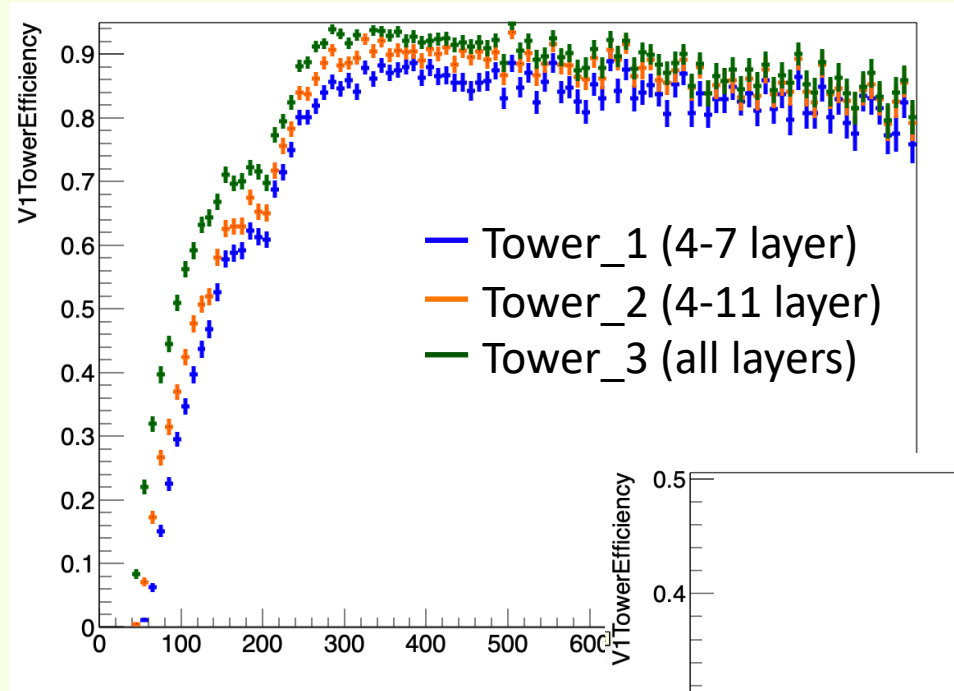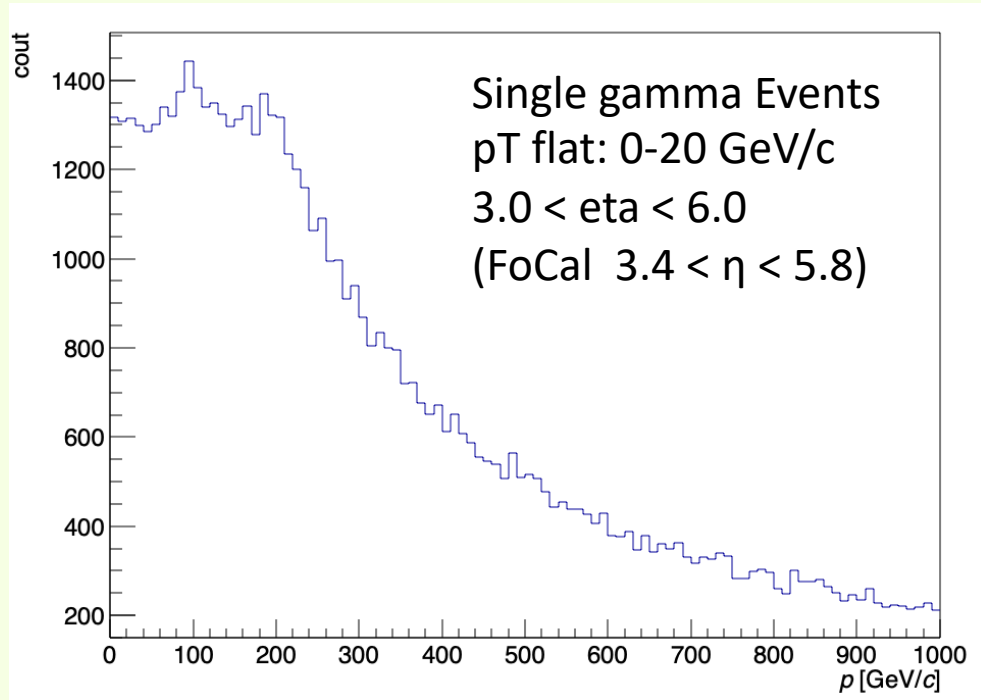
- 1 HGCROC:32bit x 72 ch = 2304 bit
- Read 1 HGCROC by GBT (3.2 Gbps)
- 1 aggregator board has 20 HGCROC   **-> 3.2x10^9 / 20 / 2304 = 70 kHz**

Gamma Deposit Energy Trigger Efficiency

Single gamma Events
pT flat: 0-20 GeV/c
3.0 < eta < 6.0
(FoCal 3.4 < η < 5.8)

Tower_1 (4-7 layer)
Tower_2 (4-11 layer)
Tower_3 (all layers)

Tower unit

① ② ③
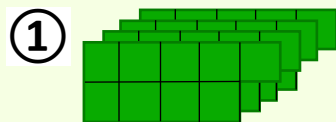
①
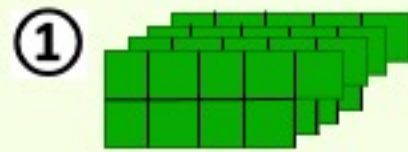
Check threshold deposit pT for readout rate

Tower unit

①

Fill the most highest pT from the pT the tower units have in an event.
(pT = towerDepE / sinθ)
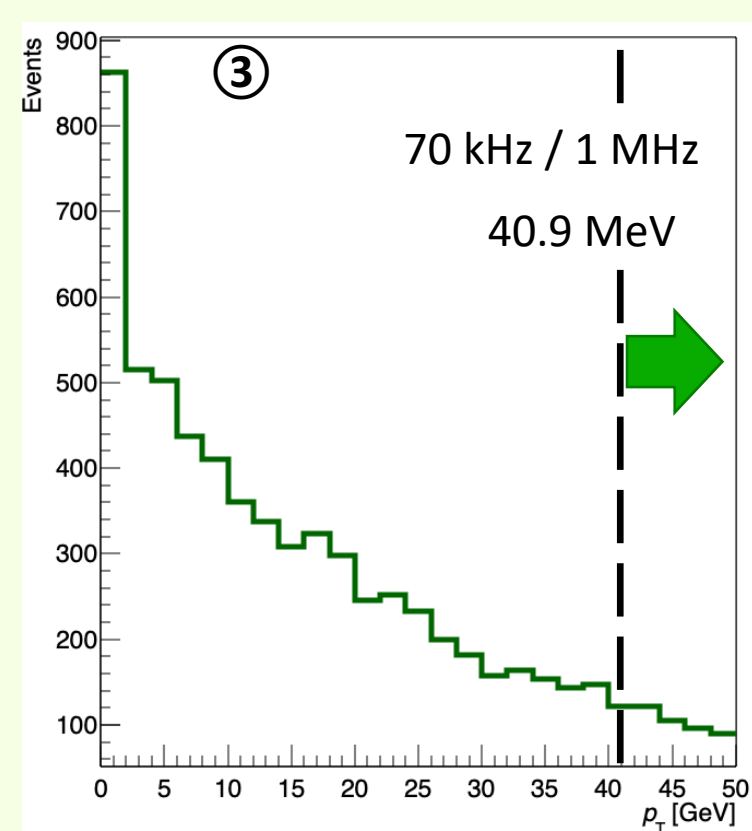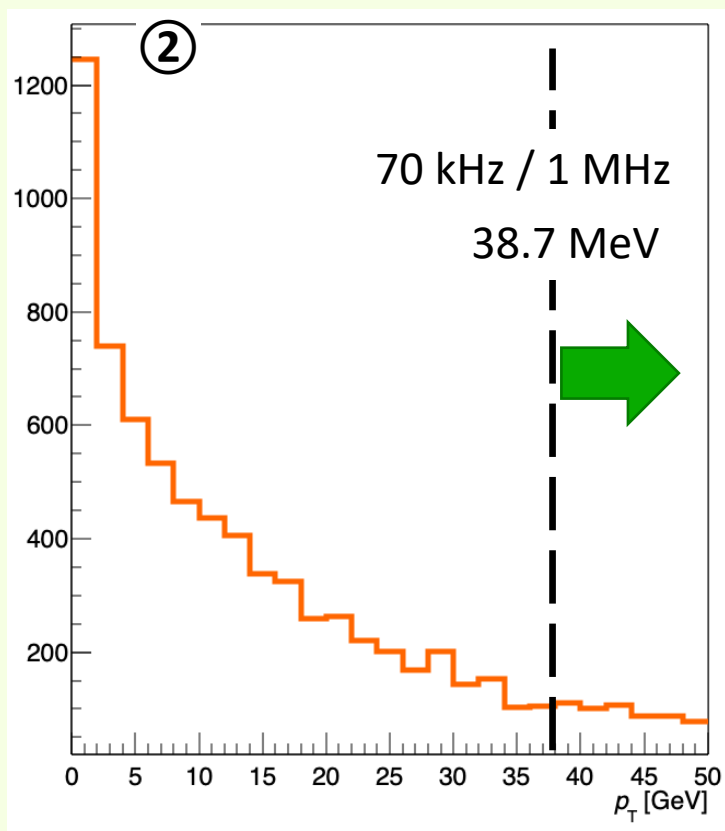
① 70 kHz / 1 MHz
33.5 MeV

② 70 kHz / 1 MHz
38.7 MeV

③ 70 kHz / 1 MHz
40.9 MeV

Gamma Deposit Energy Trigger Efficiency

Single gamma Events
pT flat: 0-20 GeV/c
$3.0 < \eta < 6.0$
(FoCal $3.4 < \eta < 5.8$)

Tower_1 (4-7 layer)
Tower_2 (4-11 layer)
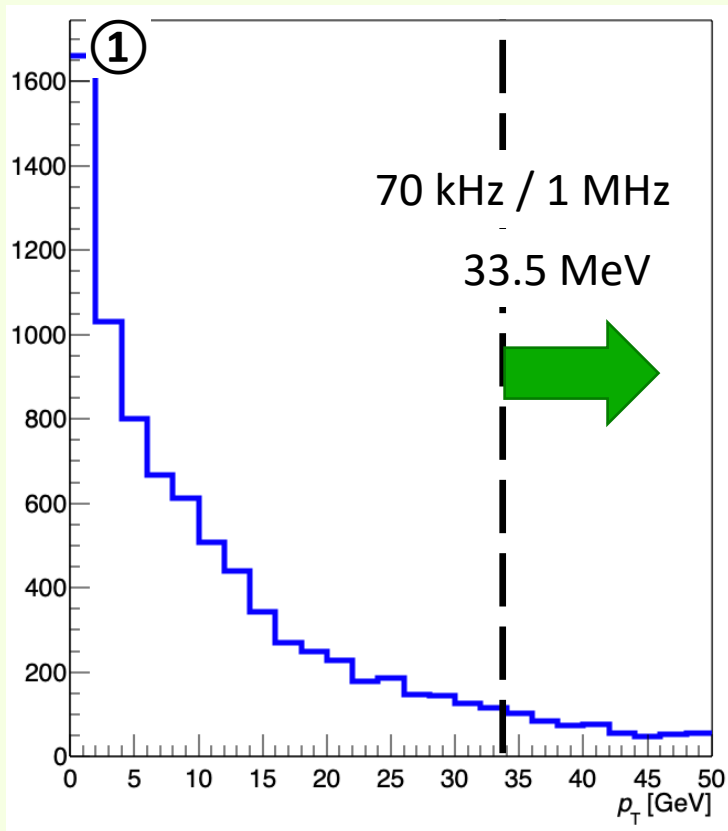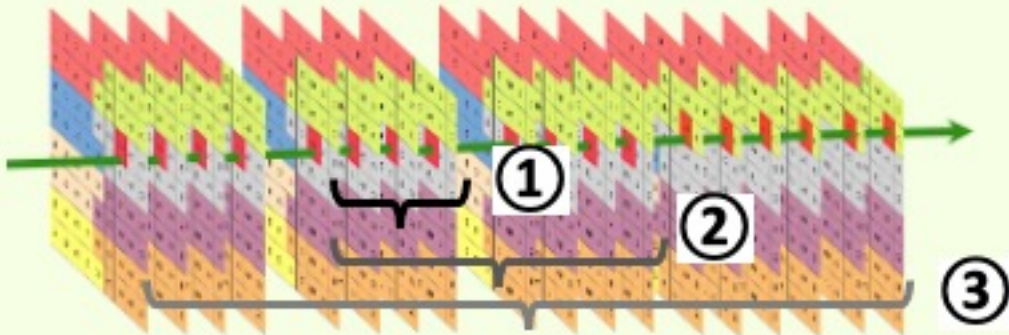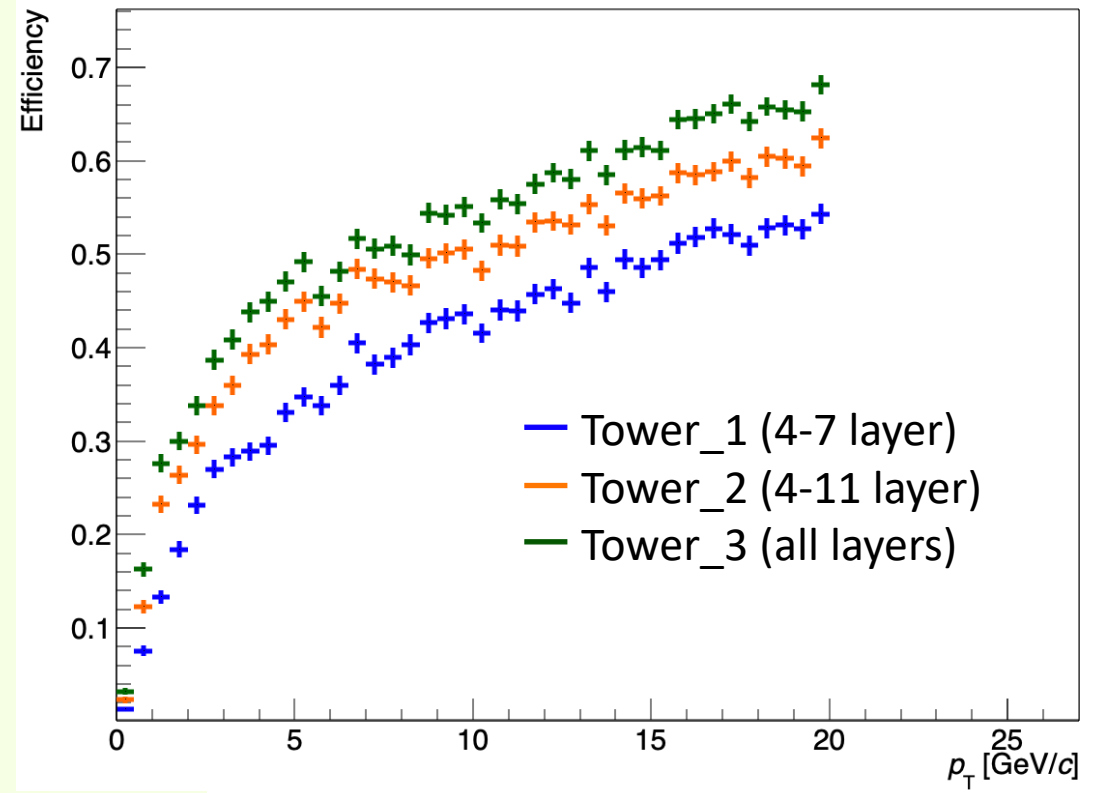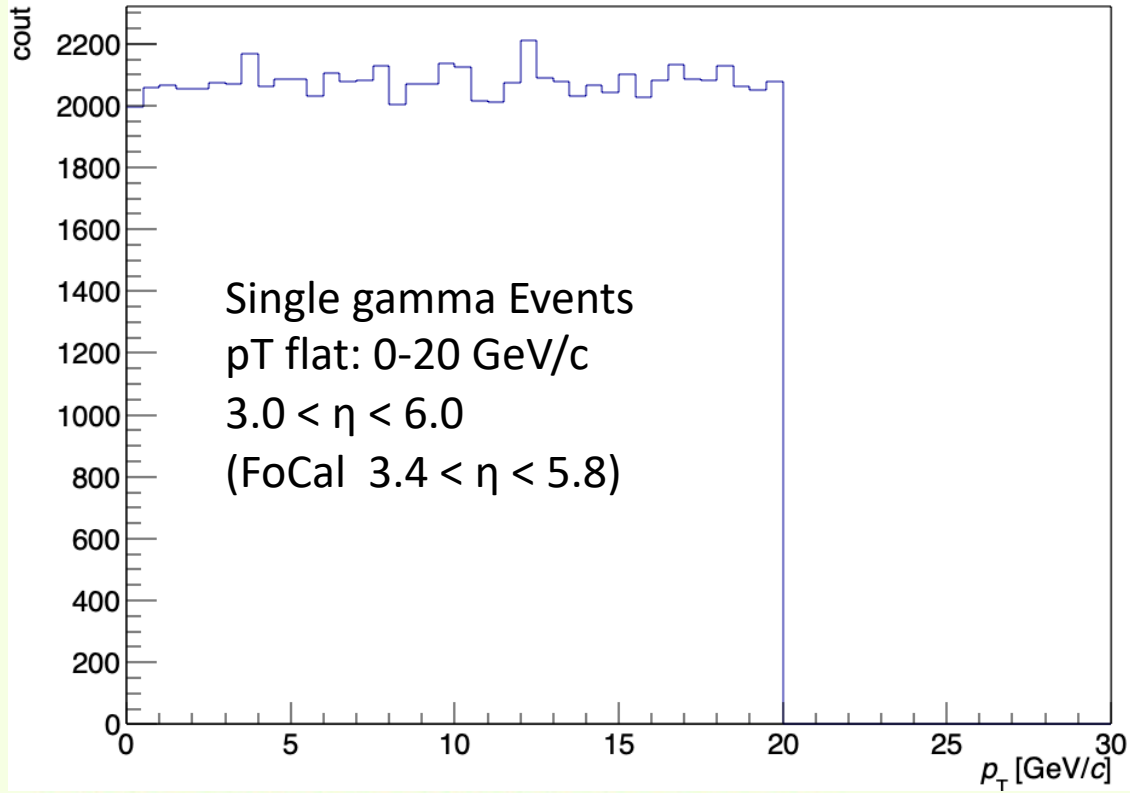Tower_3 (all layers)

Tower unit
① ② ③

Tower unit
①

①
②
③

Single pi0 Events
pT flat: 0-20 GeV/c
3.0 < η < 6.0
(FoCal 3.4 < η < 5.8)

Tower_1 (4-7 layer)
Tower_2 (4-11 layer)
Tower_3 (all layers)
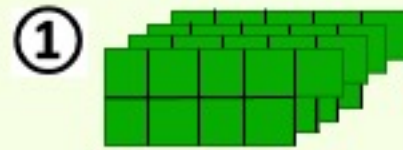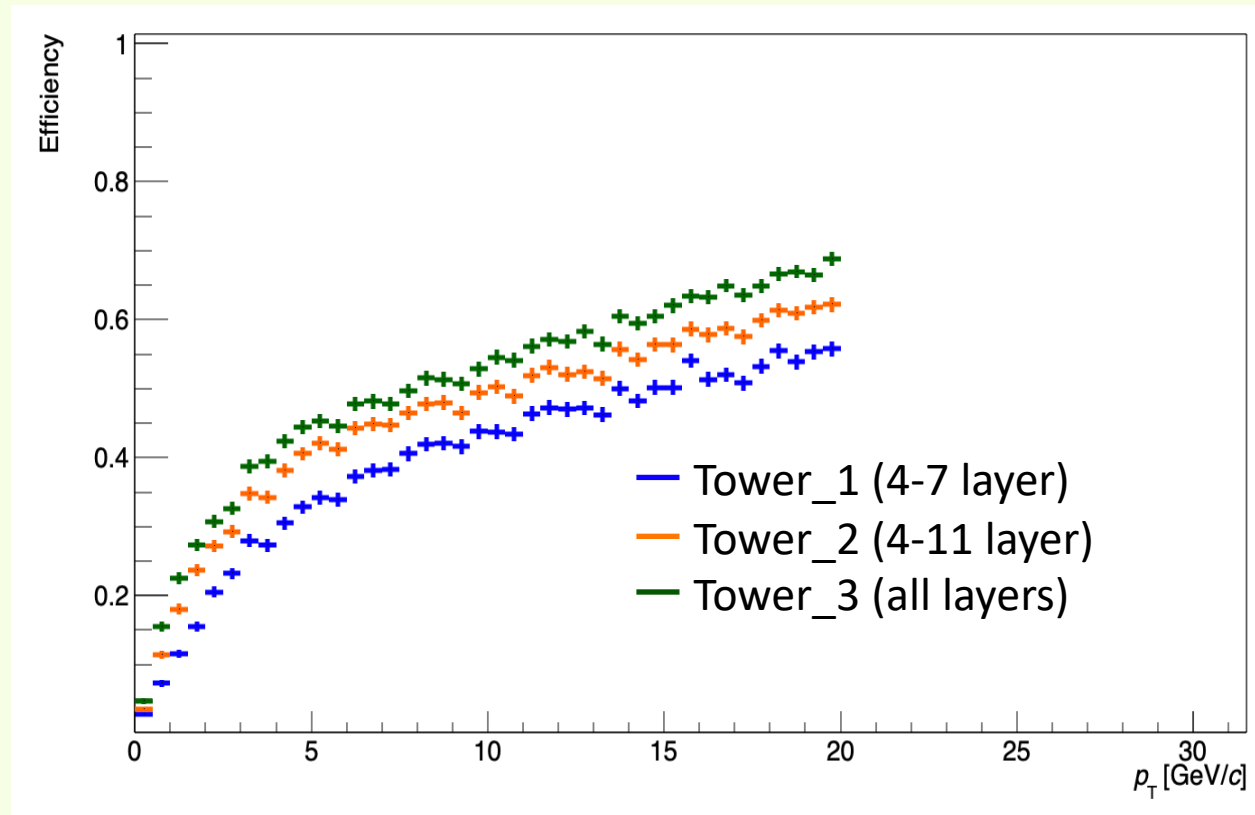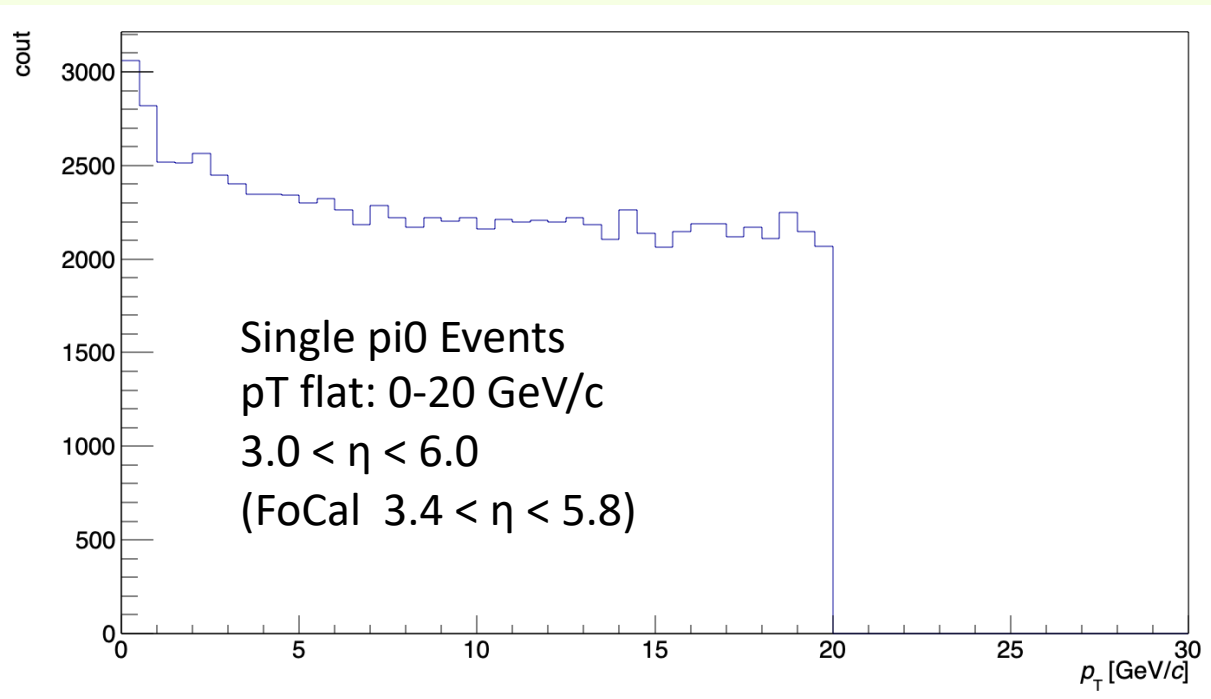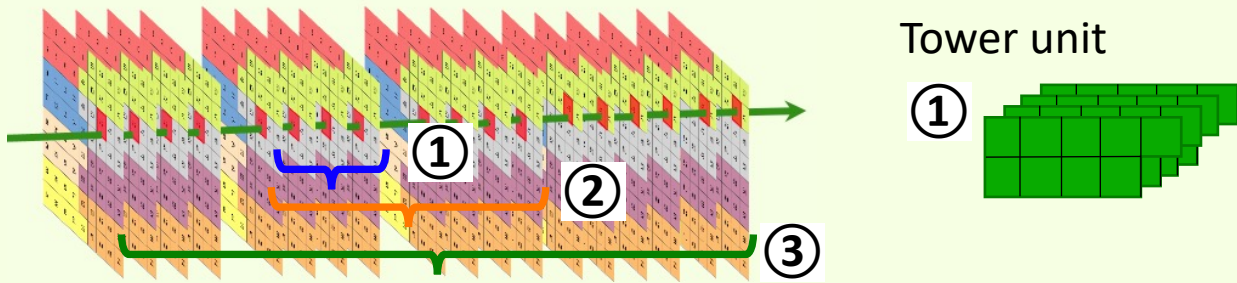
Overwrap Unit Tower
-> We expect to recover the particle that go through out the tower

Overwrap large tower
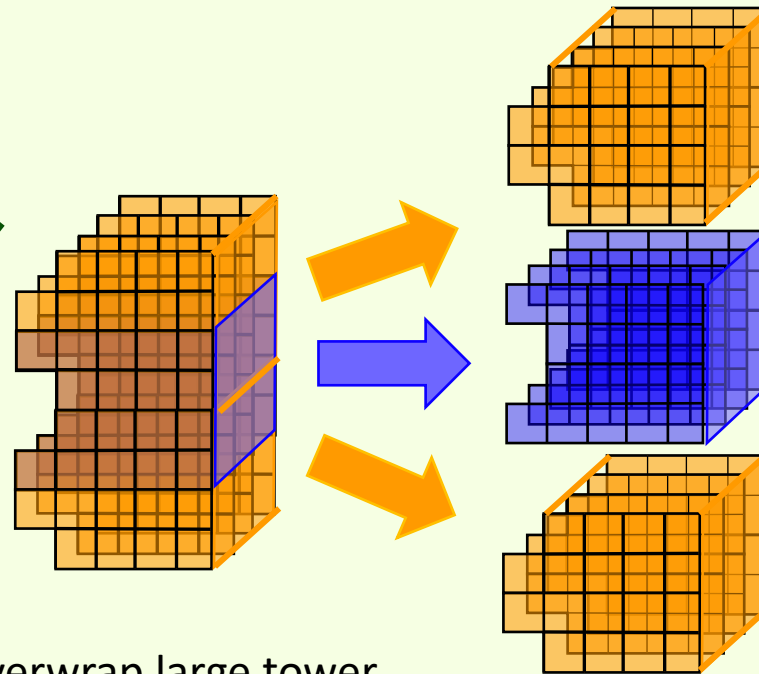
Unit: Sum of cells on a layer
Tower: Sum of units for z direction
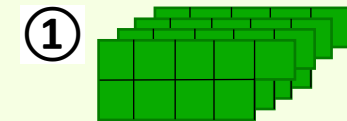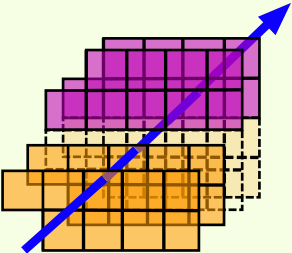
Felxible:
- Merge highest unit not fix x-y direction
- ❌ : not over 1 HGCROC

1 HGCROC

- Motivation: (n)PDFs at low x
  - Window to the unexplored regime of $x \sim 10^{-6}$ and low $Q \sim 4\,\mathrm{GeV}/c$
    - Non linear evolution due to high gluon densities
  - Access 2–3 orders of magnitude smaller x at low Q^2 than fRHIC and EIC
  - Unique opportunity in the foreseeable future (well before LHeC and FCC)

Efficiency vs p_T [GeV/c]

— ① 4 layers tower (9 cells)
— ② 8 layers tower (9 cells)
— ③ all layers tower (9 cells)
— ④ all layers tower (18 cells)
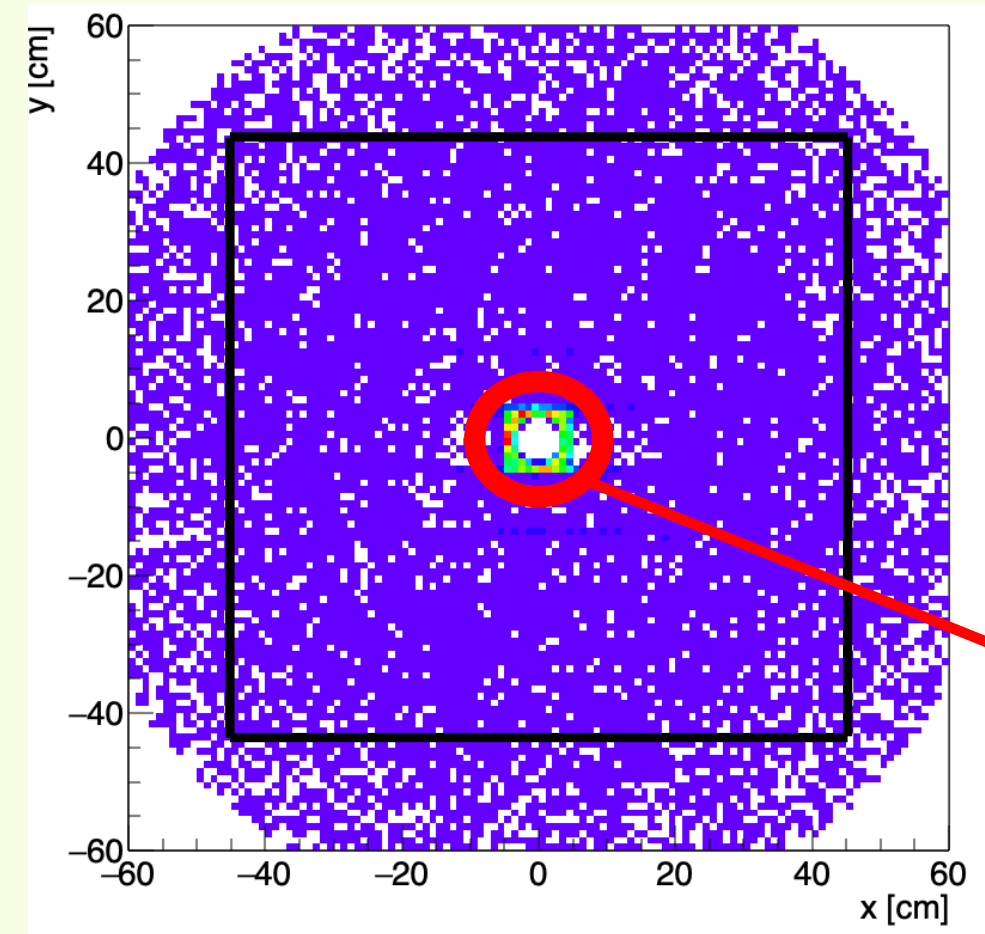— ⑤ all layers tower (72 cells)
— ⑥ all layers combine (9 cells)

① 4 layers

② 8 layers

③ 18 layers

④ 18 layers

⑤ 18 layers

⑥ 18 layers
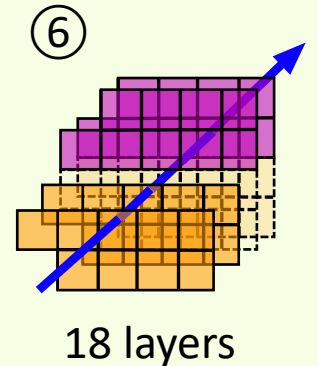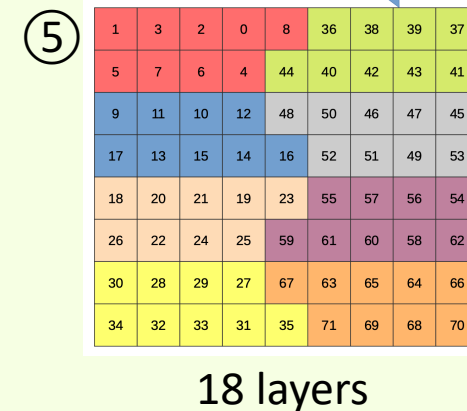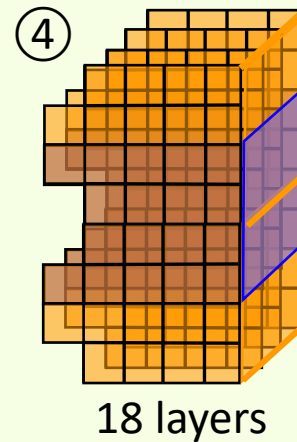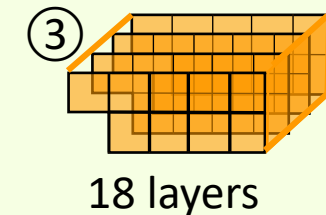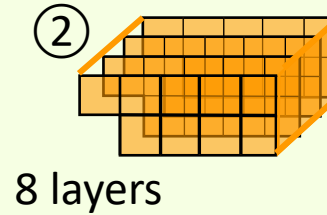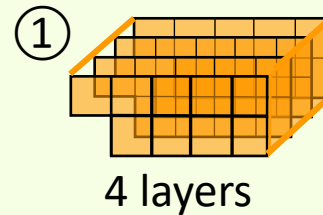
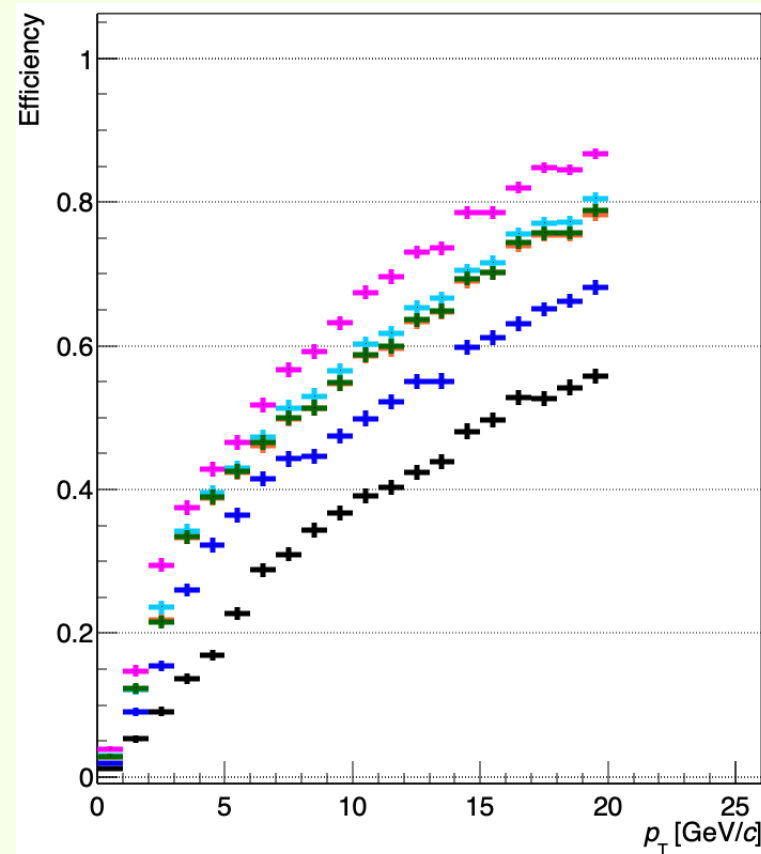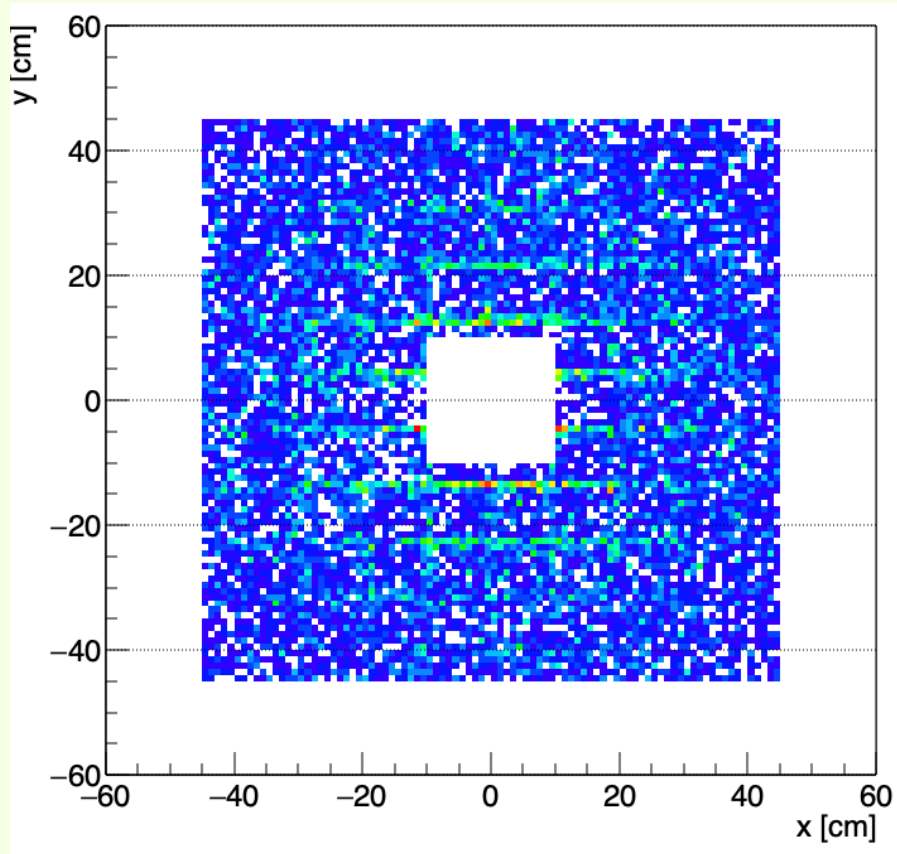- Unit size is not so large effect.
- Layer depth mainly contribut.

Fill a position gammas in miss event at 7000 mm
(x = 7000. * (px/pz), y = 7000. * (py/py))

(Every event has a hit point on FoCal.
So even if the point is on the out of FoCal region at 7000 mm, the particle has hit inner or outer layer.)

Edge Effect

The efficiency is recoverd but it still very low and we cannot see threshold curve