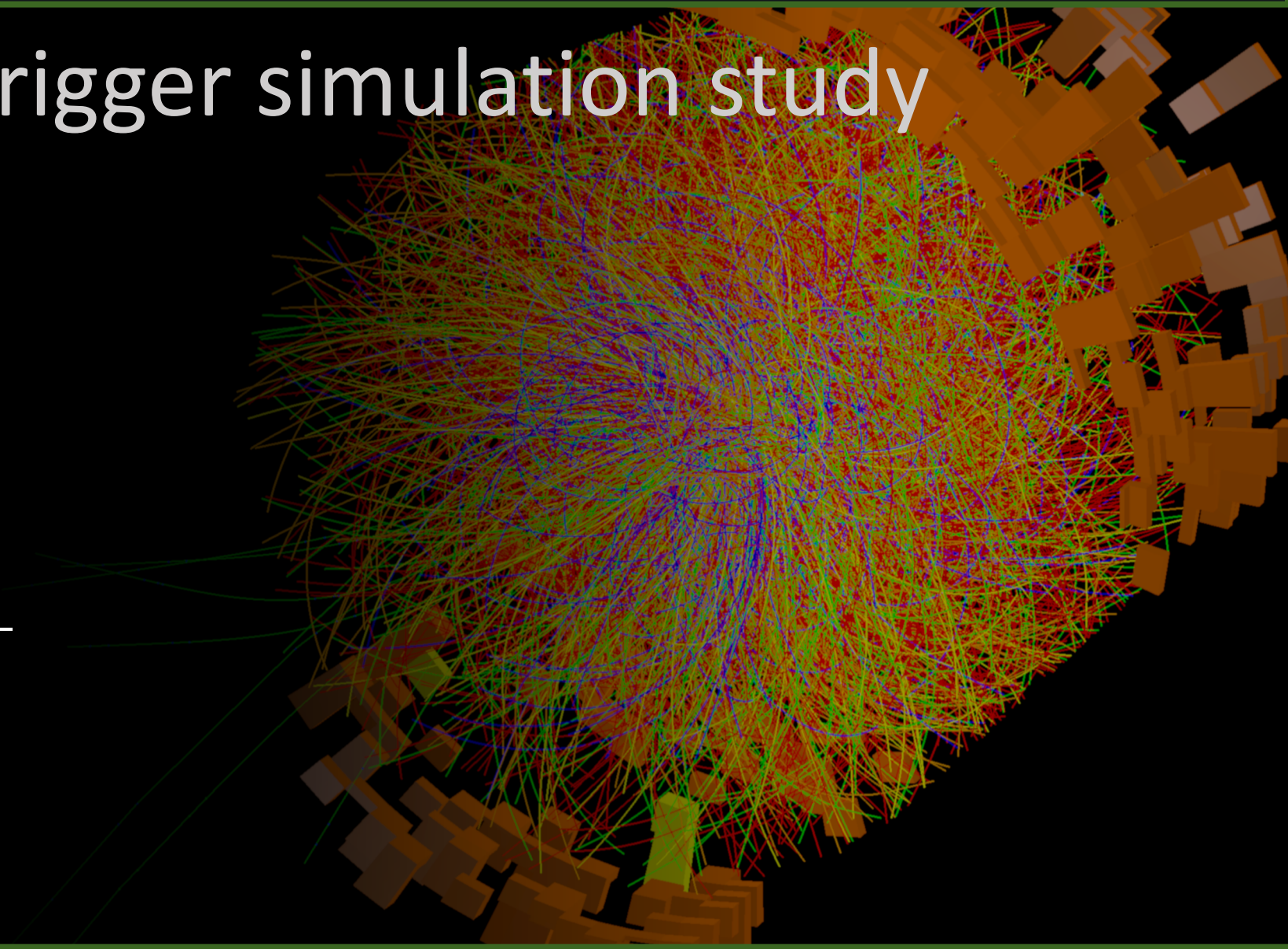
FoCal Geant 4 trigger simulation study



Tsukuba University
Takuya Kumaoka

FoCal trigger study plan

- install Geant4 and understand the output (Done)
- prepare the data for trigger development
- make a trigger to distinguish gamma and neutron.

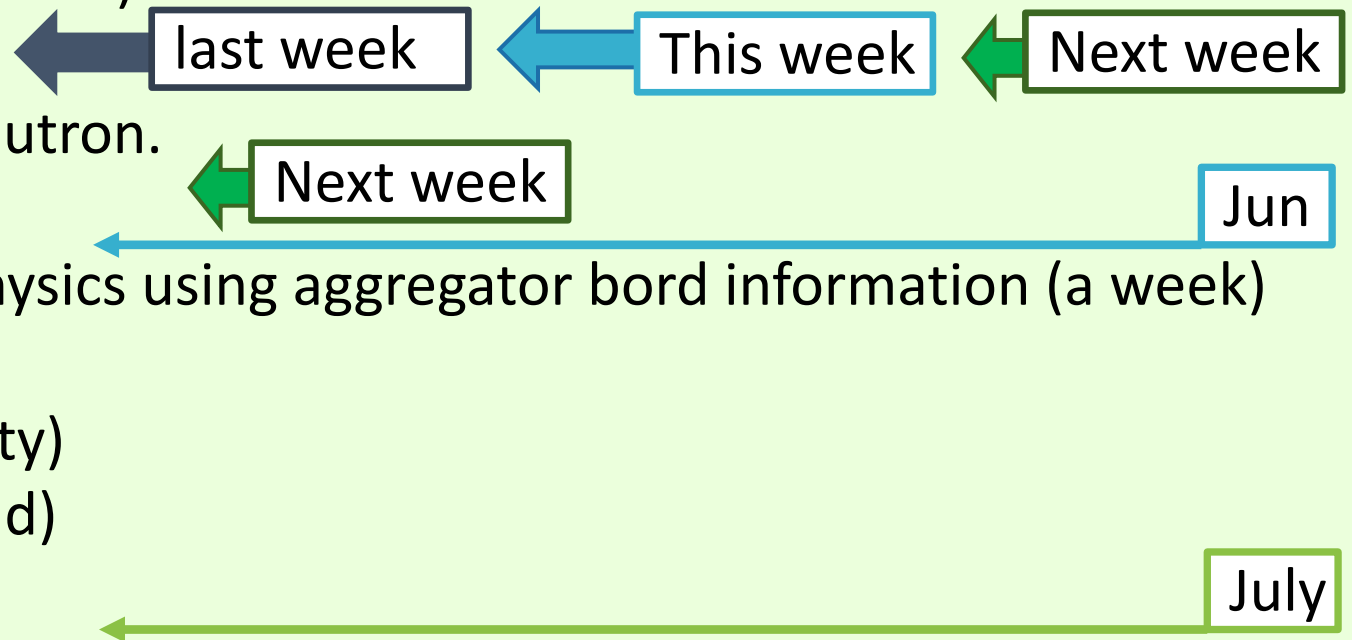
(consider energy, depth, expansion, and etc…)

- plan algorithm how to fire trigger use for physics using aggregator bord information (a week)
- inplement the trigger algorithm (1.5 weeks)
- check trigger performance (efficiency / purity)

(energy/hit position/angle/particle/background)

(a few weeks)

- make a code to convert energy information to real ASIC information (TOT/TOA/AOD) (2 weeks)
- …



Study of the feature of neutral particle

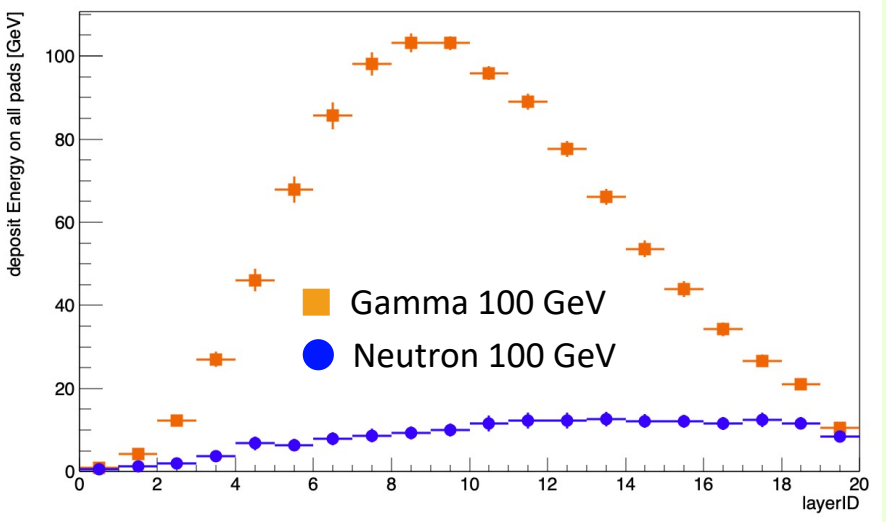
To distiguish neutral particle, I searched for features of Gamma and Neutron.

- set: FoCal-E, 8X9 cells, 1X1 cm^2/cell
- particle: Gamma/Neutron, 100 GeV, 100 Events, angle: 0 degree, position: center

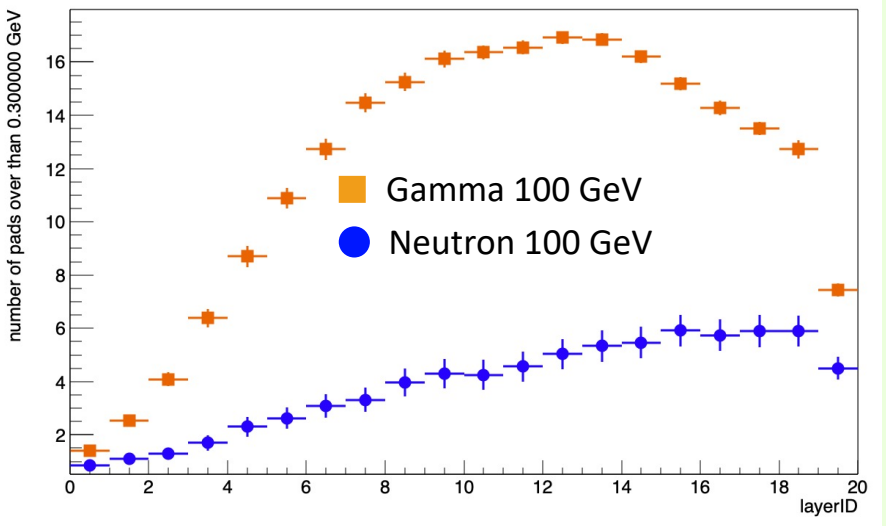
These results show we can separate these particle by using information on the deposit energy and the number of hit cells (shower expanstion)

To detail study, I increased the number of events by using HT-condor.

- To estimate fluctuations of each value on each layer
- To evaluate the only events neutorn interacts with detector



deposit energy distribution for each layer



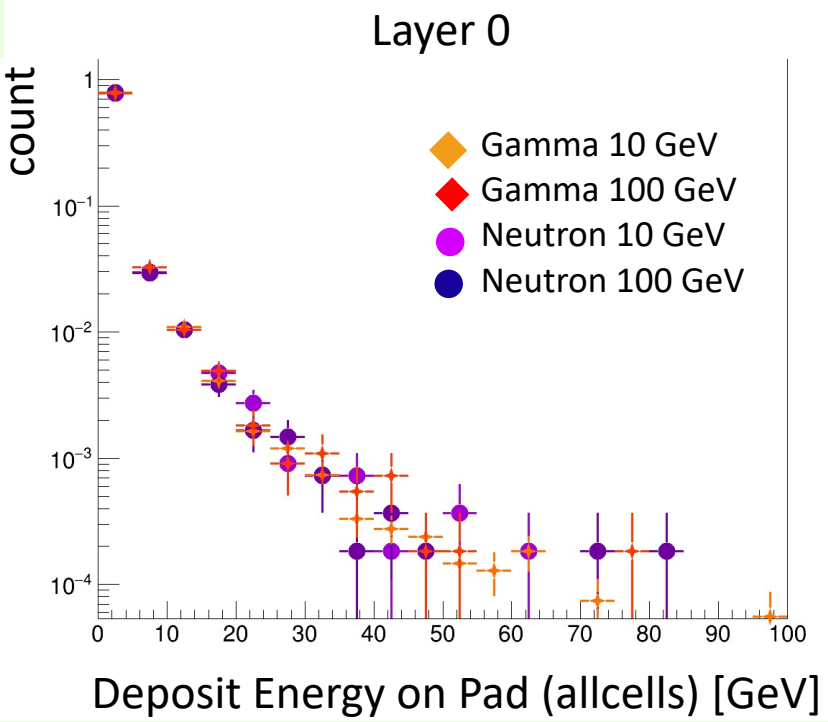
# of cells distribution for each layer

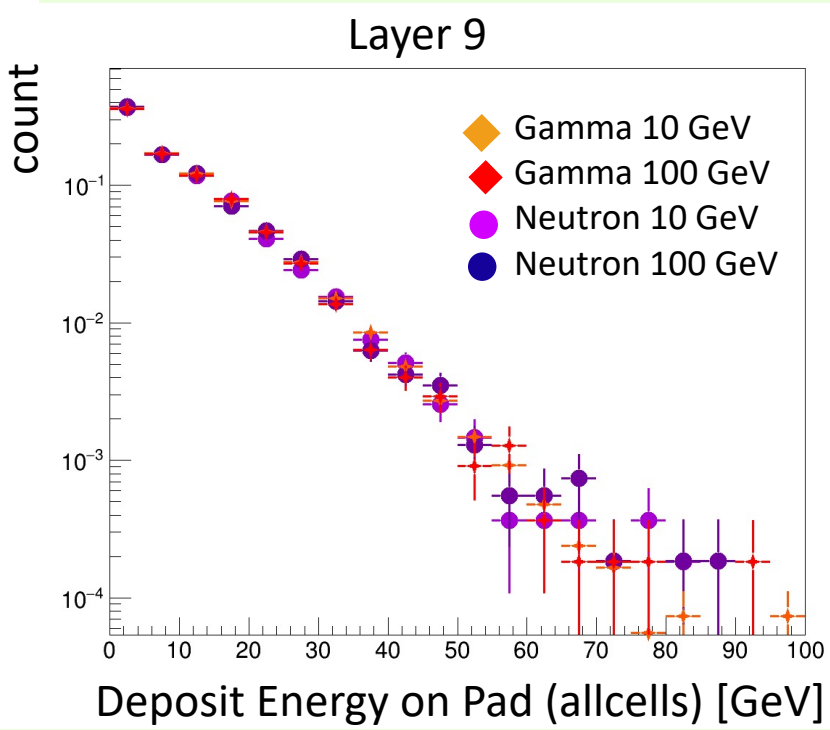
New test setting

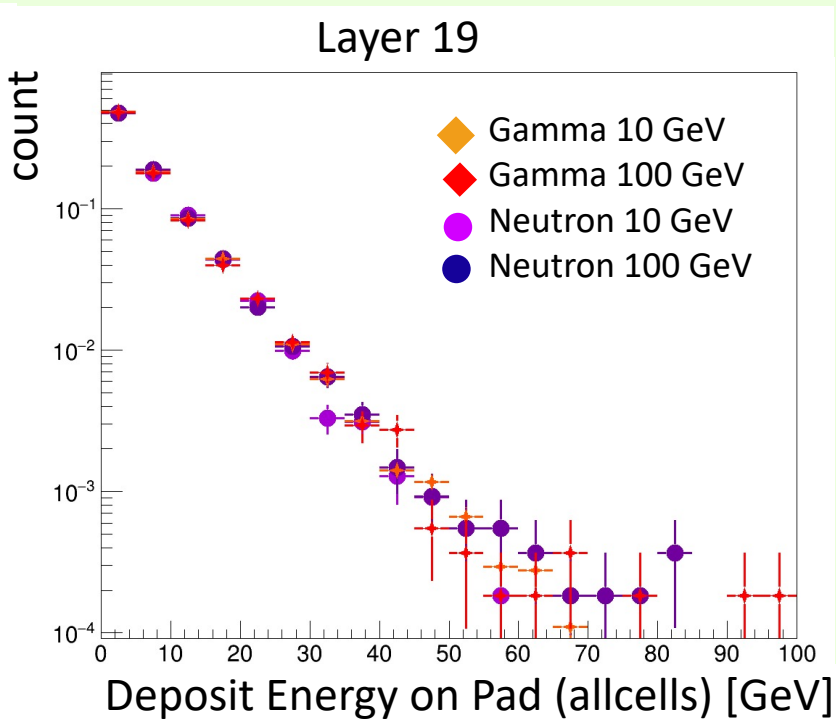
- set: FoCal-E, 8X9 cells, 1X1 cm^2/cell
- particle: Gamma/Neutron, 100/10 GeV, **10000 Events**,
angle: 0 degree, position: center

Select the events having the over than layers with the deposit energy.
(Many Neutron events not interact with detector)

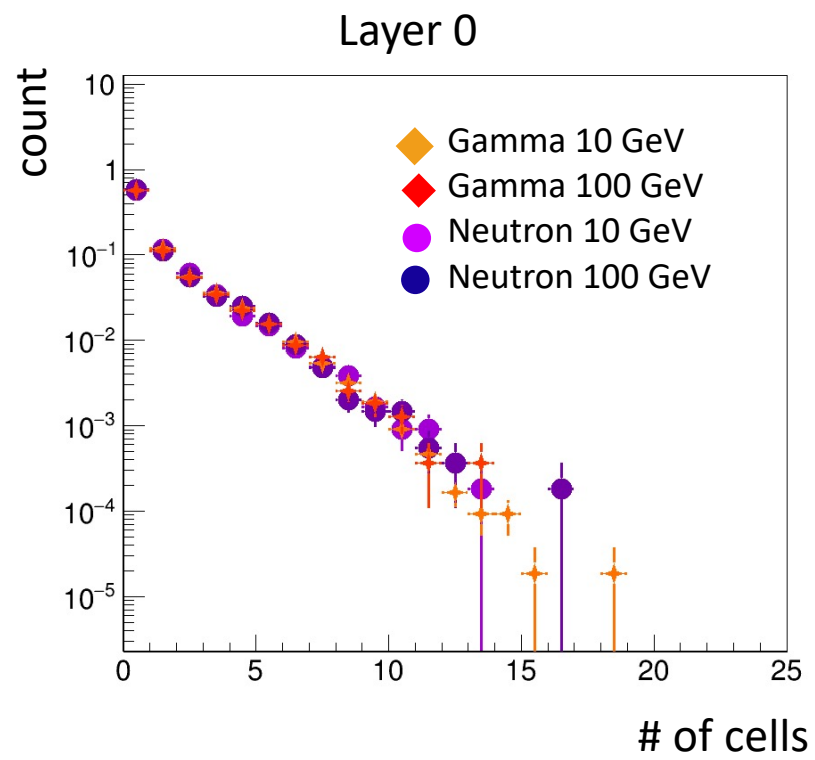
Deposit energy difference

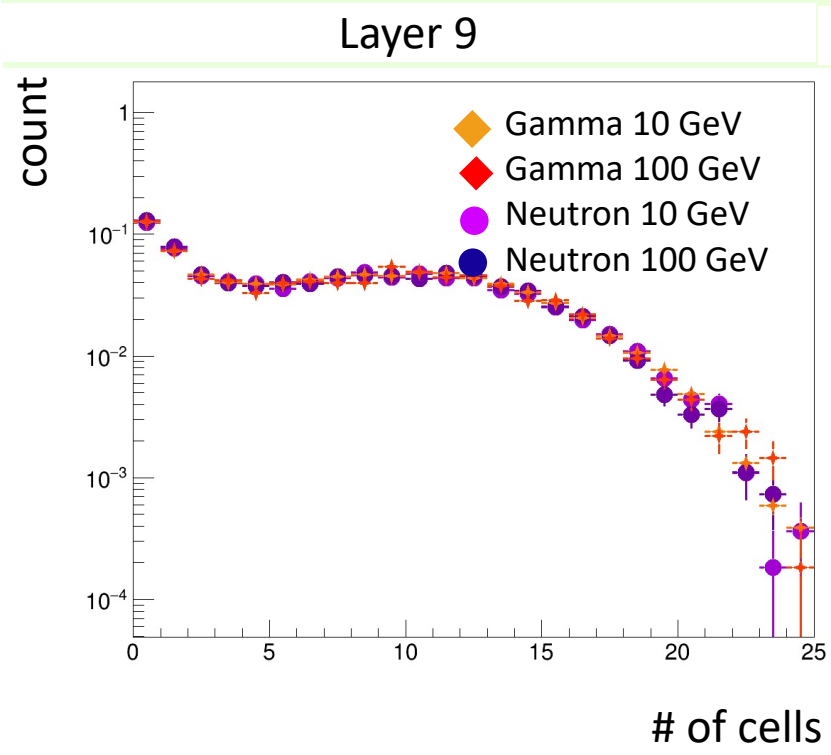


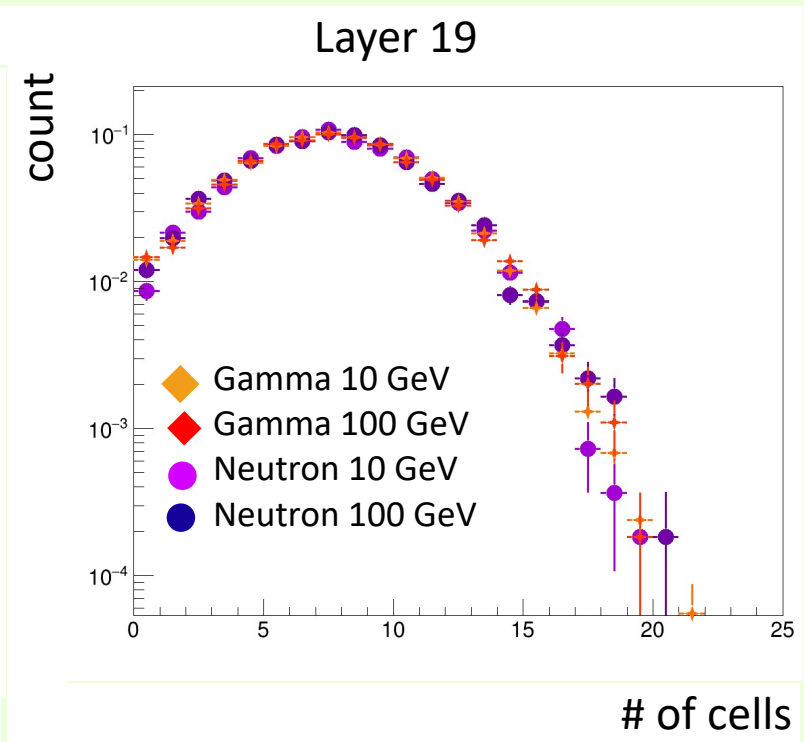




of cells


Layer 0
count
Gamma 10 GeV
Gamma 100 GeV
Neutron 10 GeV
Neutron 100 GeV
# of cells


Layer 9
count
Gamma 10 GeV
Gamma 100 GeV
Neutron 10 GeV
Neutron 100 GeV
# of cells


Layer 19
count
Gamma 10 GeV
Gamma 100 GeV
Neutron 10 GeV
Neutron 100 GeV
# of cells

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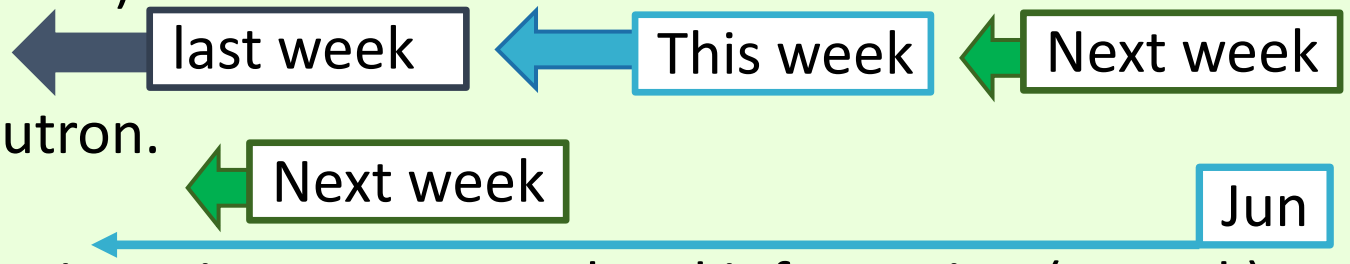
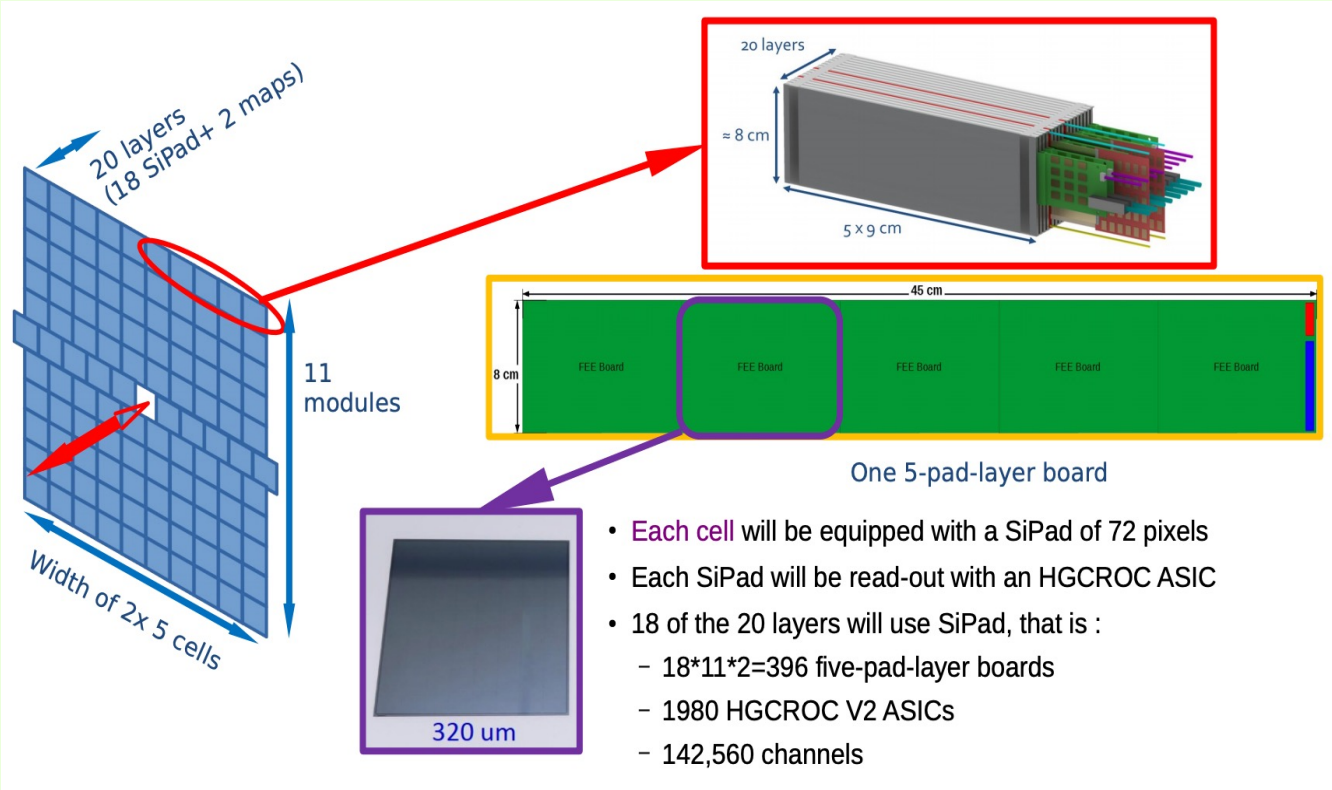


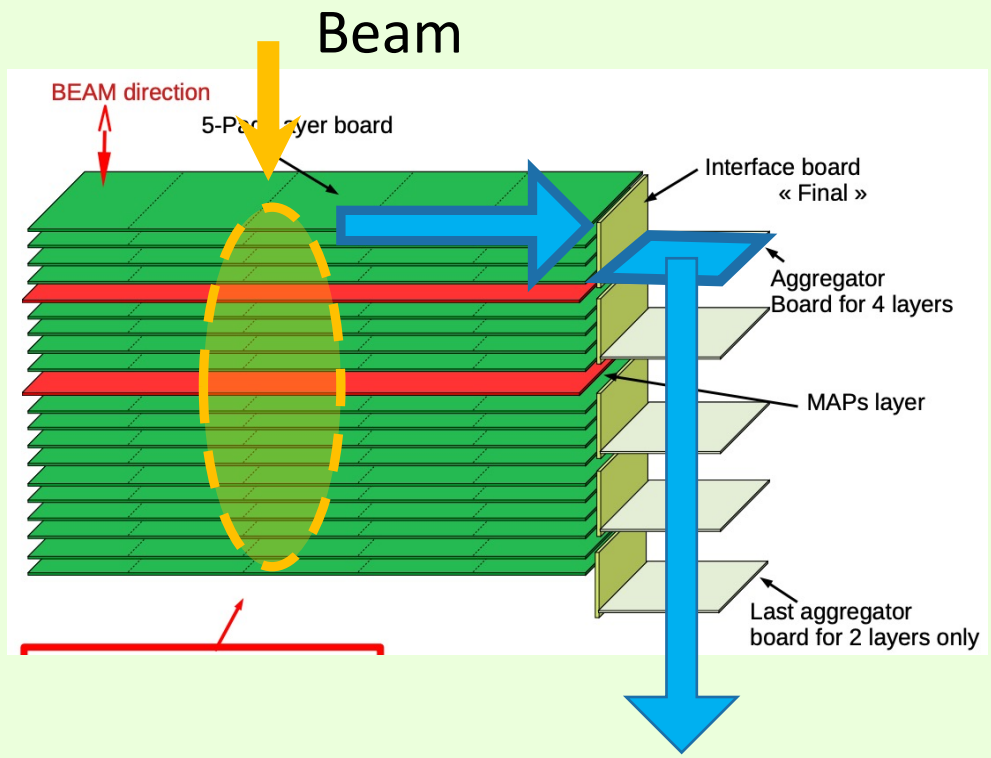
Backup Slides

Study Motivation

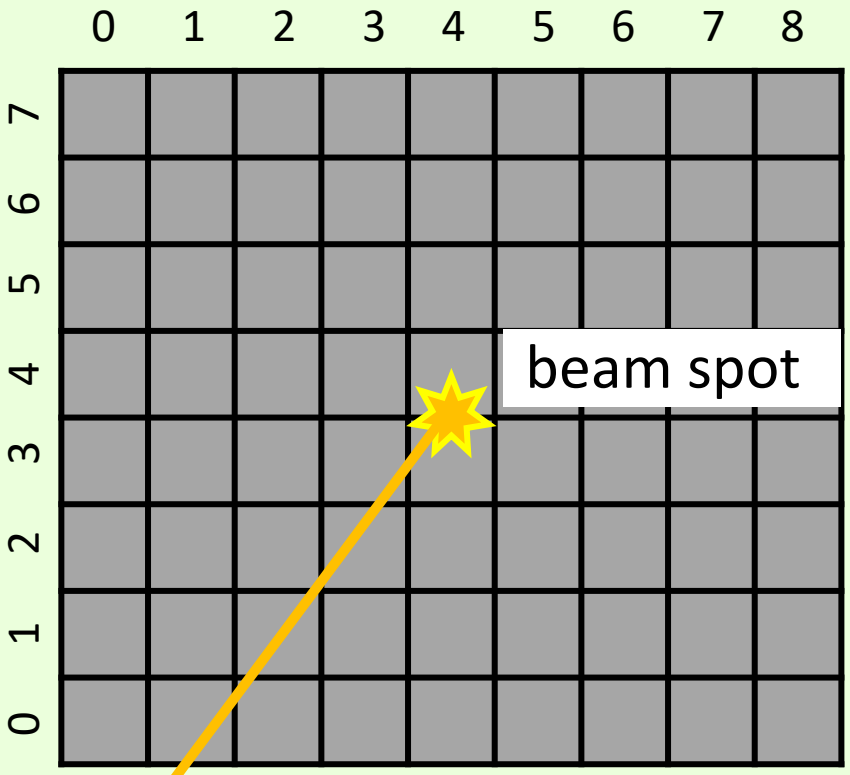
Development of FPGA Frontend trigger of FoCal-E (ALICE / RHICf)

Grenoble group mainly contribute to this study, but I cannot go there because of Covid-19.
-> I started planning how to make the trigger by using GEANT4 simulation.



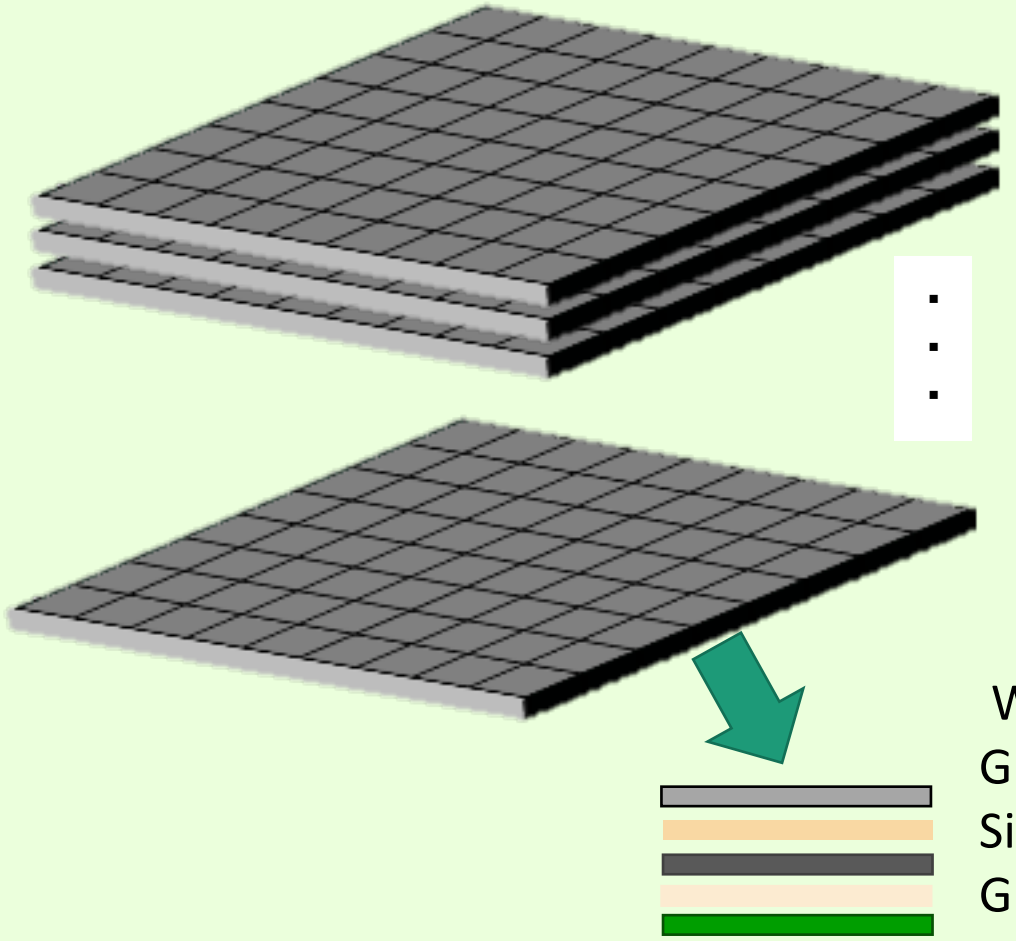


Default FoCal-E Setting



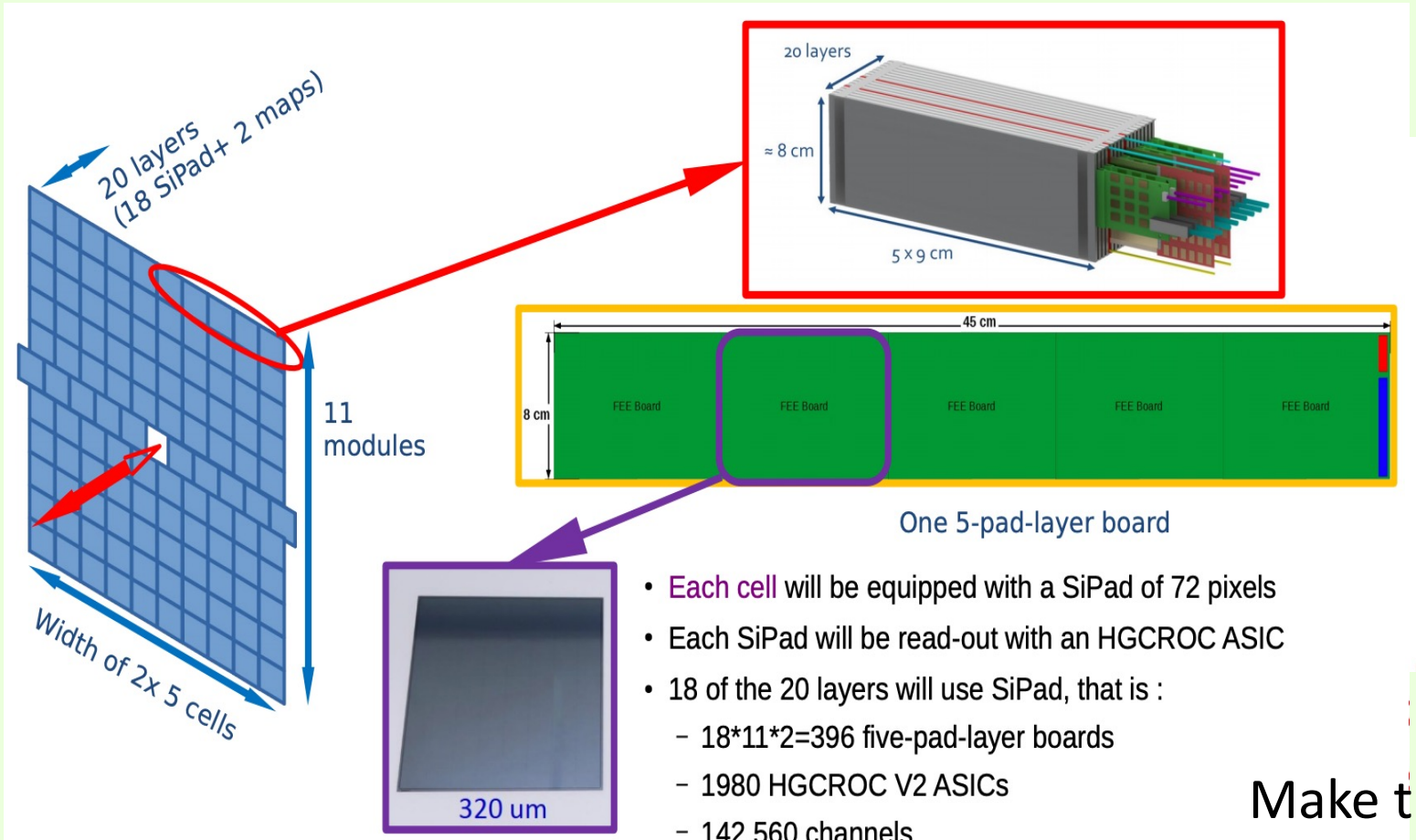
particle, energy, position, angle

we can easly add layer / replace to PIX

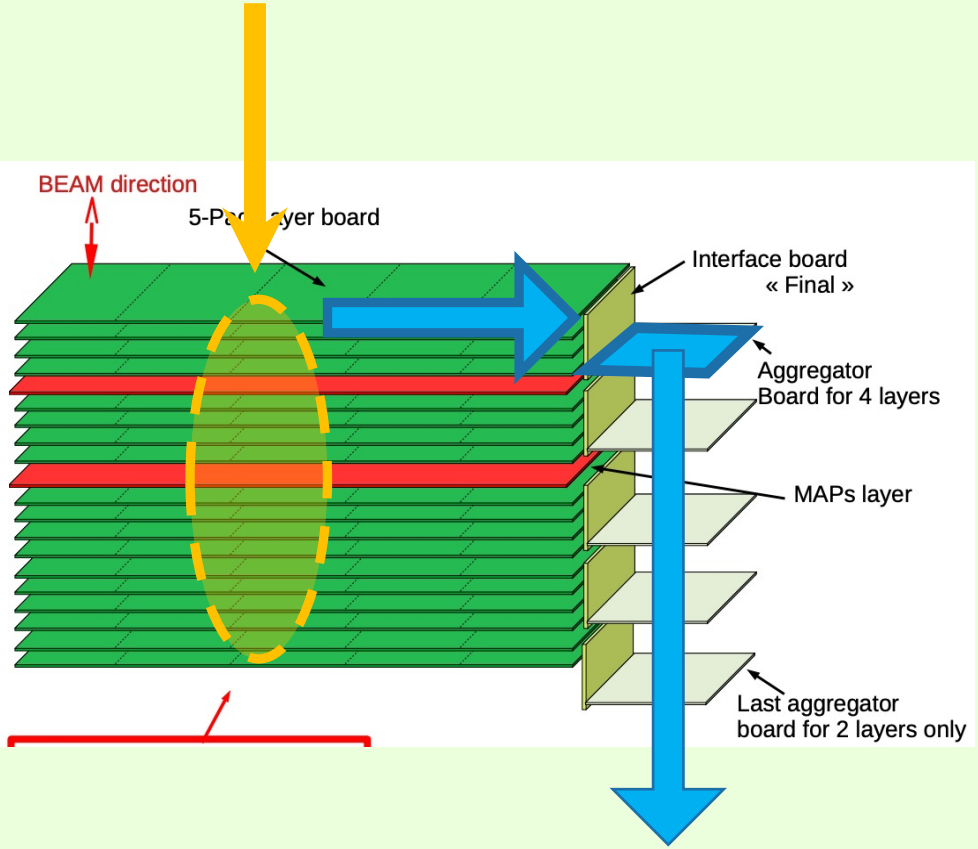


W: 3.5 mm
Glue: 0.11 mm
Silicon: 0.32 mm
Glue: 0.13 mm
PCB: 0.28 mm

Next My work



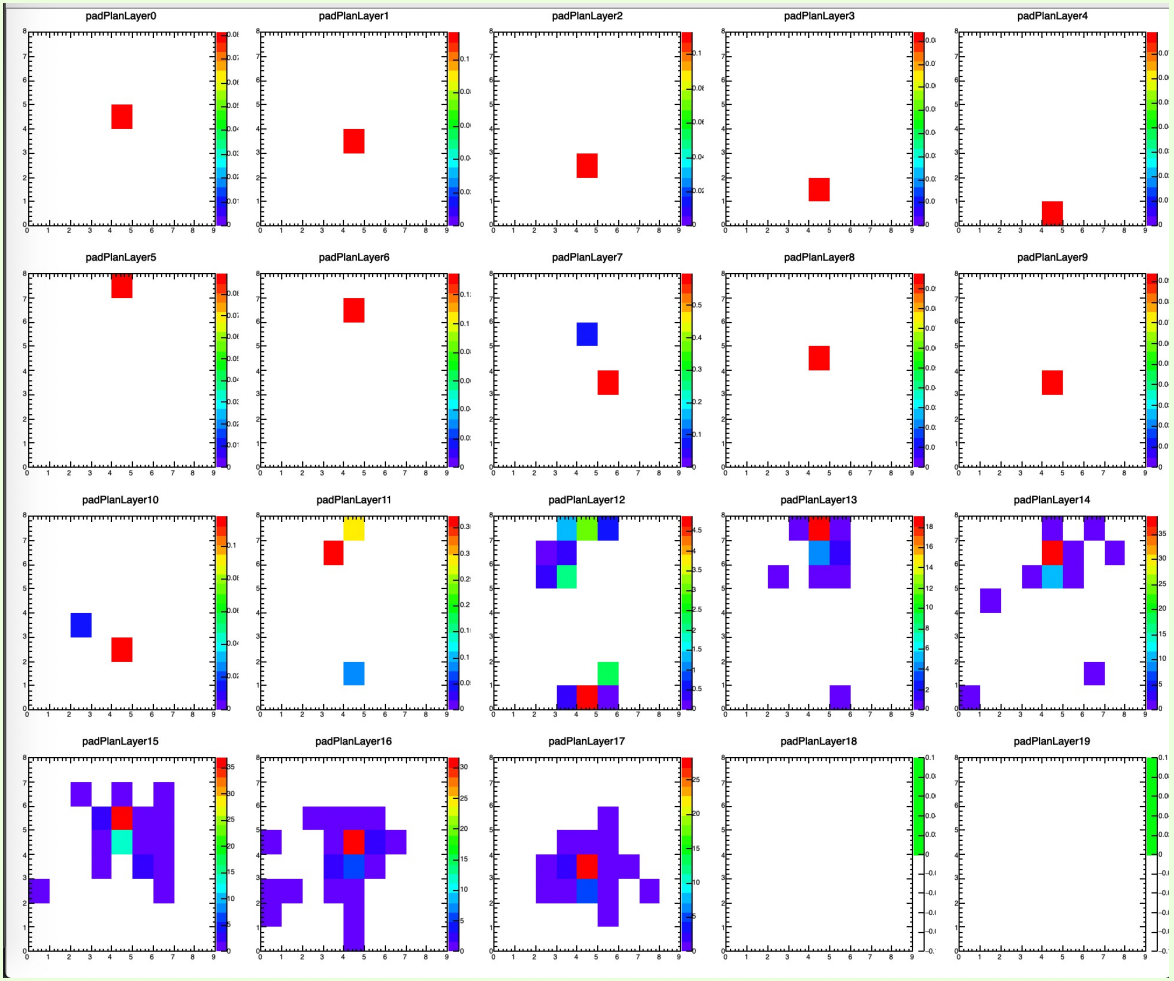
- Each cell will be equipped with a SiPad of 72 pixels
- Each SiPad will be read-out with an HGCROC ASIC
- 18 of the 20 layers will use SiPad, that is :
  - 18*11*2=396 five-pad-layer boards
  - 1980 HGCROC V2 ASICs
  - 142,560 channels



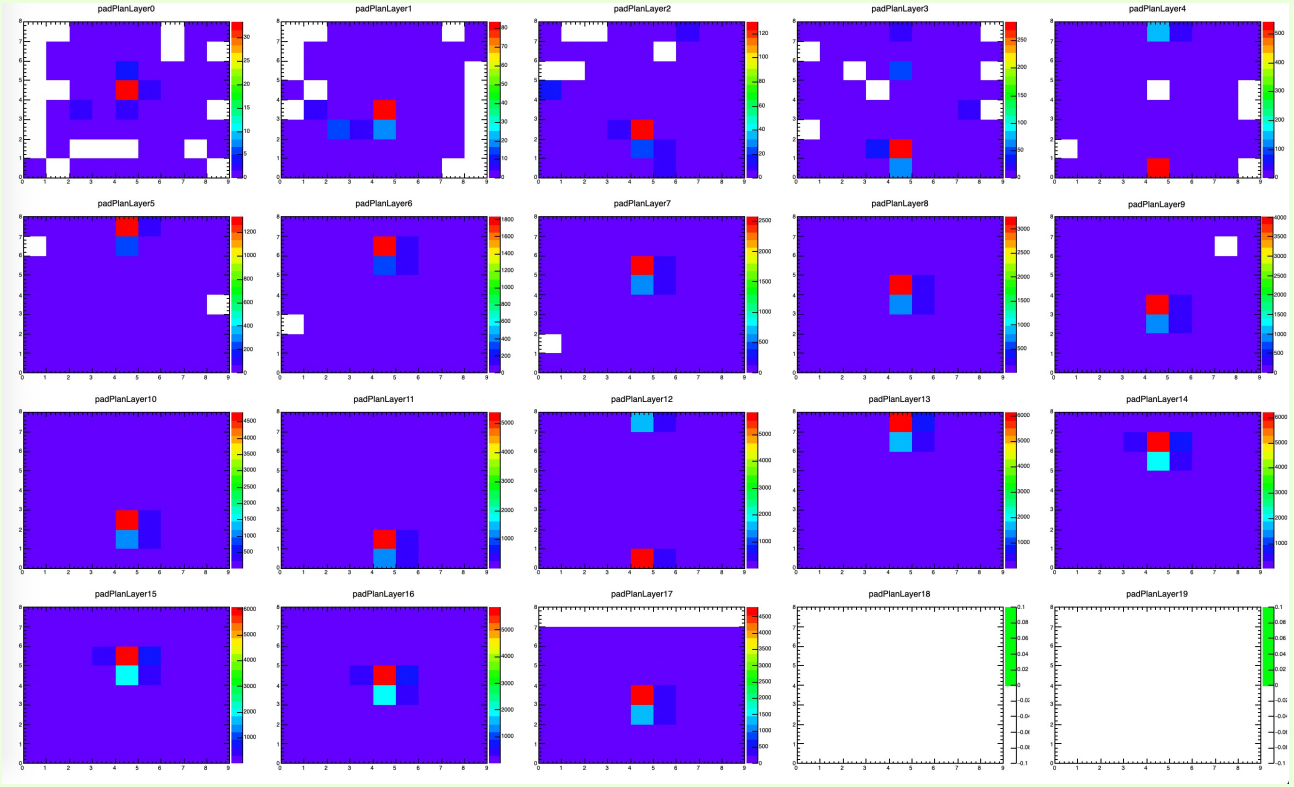
Make trigger by using 4 layer information (5 X 4 pads)

→ As Next step I will understand the pad ID layout and its location.

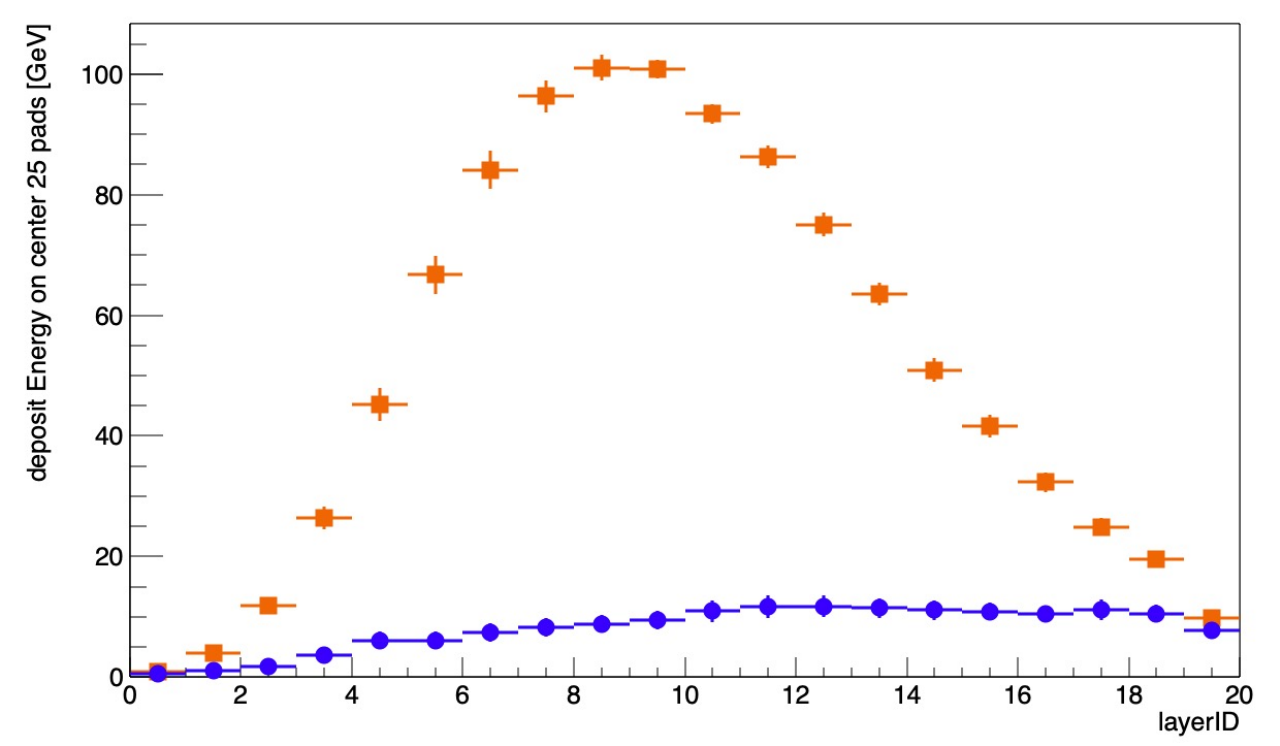
Pi- 1000 GeV, 1 event



Pi- 1000 GeV, 100 event



If I made mistake the location of pads, I will face segmentation vioration


deposit Energy on center 25 pads [GeV]
100
80
60
40
20
0
0
2
4
6
8
10
12
14
16
18
20
layerID

- Photon/Neutoron tirggger (Minho)

# of layer, energy dep, spread

- 2 photon -> pi0 candidate

- sPHENIX -> stream read-out

Old (RIHCf)
High energy tirgger (w/o deep) photon energy dep
Shower tigger (low energy)

To do

1. Grenoble Mail -> Hardware (emulater board)-> program, how to test, injection
2. pi0
3. Hadron shower (extract events)
4. Read Minho Thesis
5. Radiation length
6. Trigger (L90, L20)

Neutron