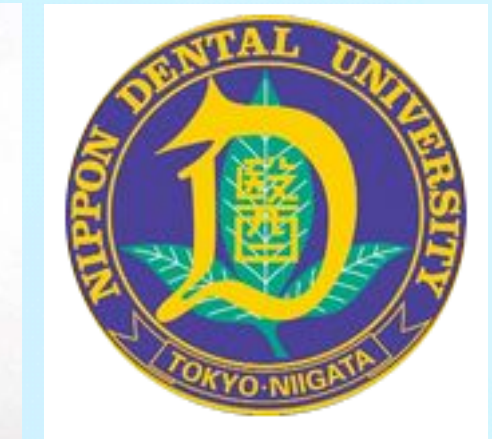


ILD-J calorimeter activities



国立高専機構
長野高専

日本歯科大新潟
生命歯学部

ECAL

Silicon ECAL : T.Suehara (ICEPP)

Scintillator Strip ECAL : W.Otani (ICEPP) & T.Takeshita (Shinshu)

H.Ono (NDU), E.Saito (Nagano TS)

HCAL

Scintillator Tile HCAL : W.Otani (ICEPP) & T.Takeshita (Shinshu)

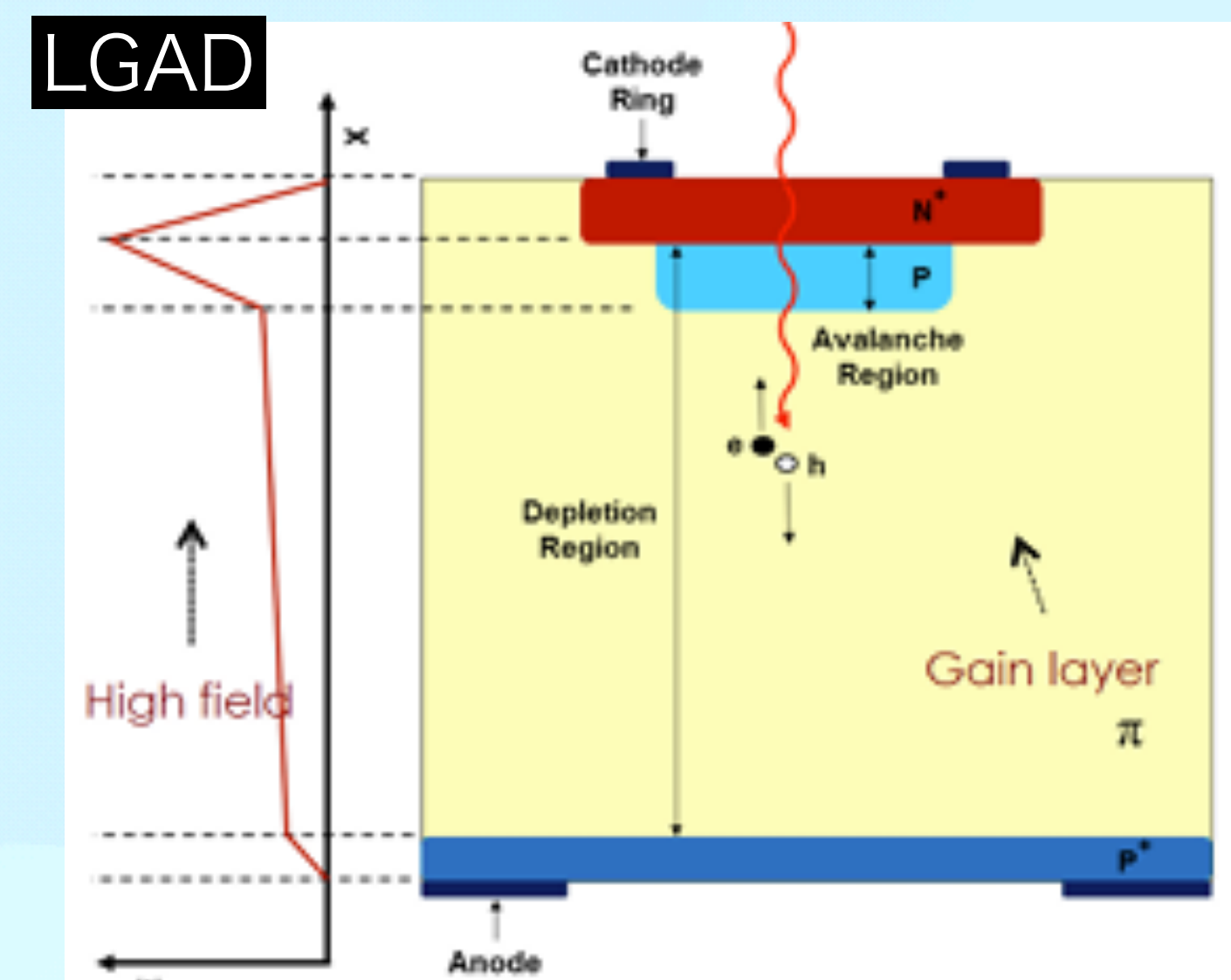
Scintillator Strip HCAL : W.Otani (ICEPP) & T.Takeshita (Shinshu)

T.Takeshita March2024 for ILD-J meet

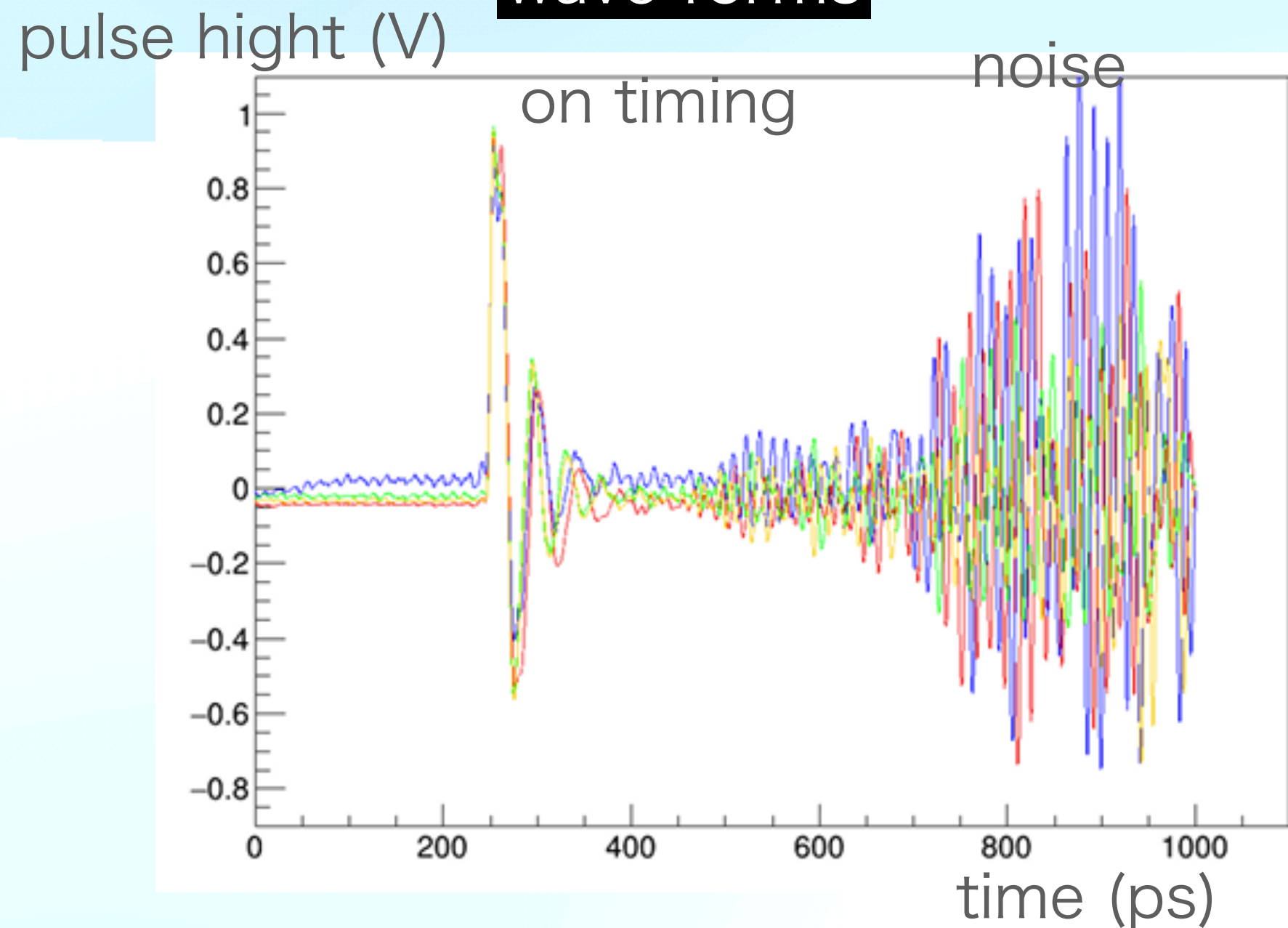
Silicon ECAL

timing resolution : T.Suehara

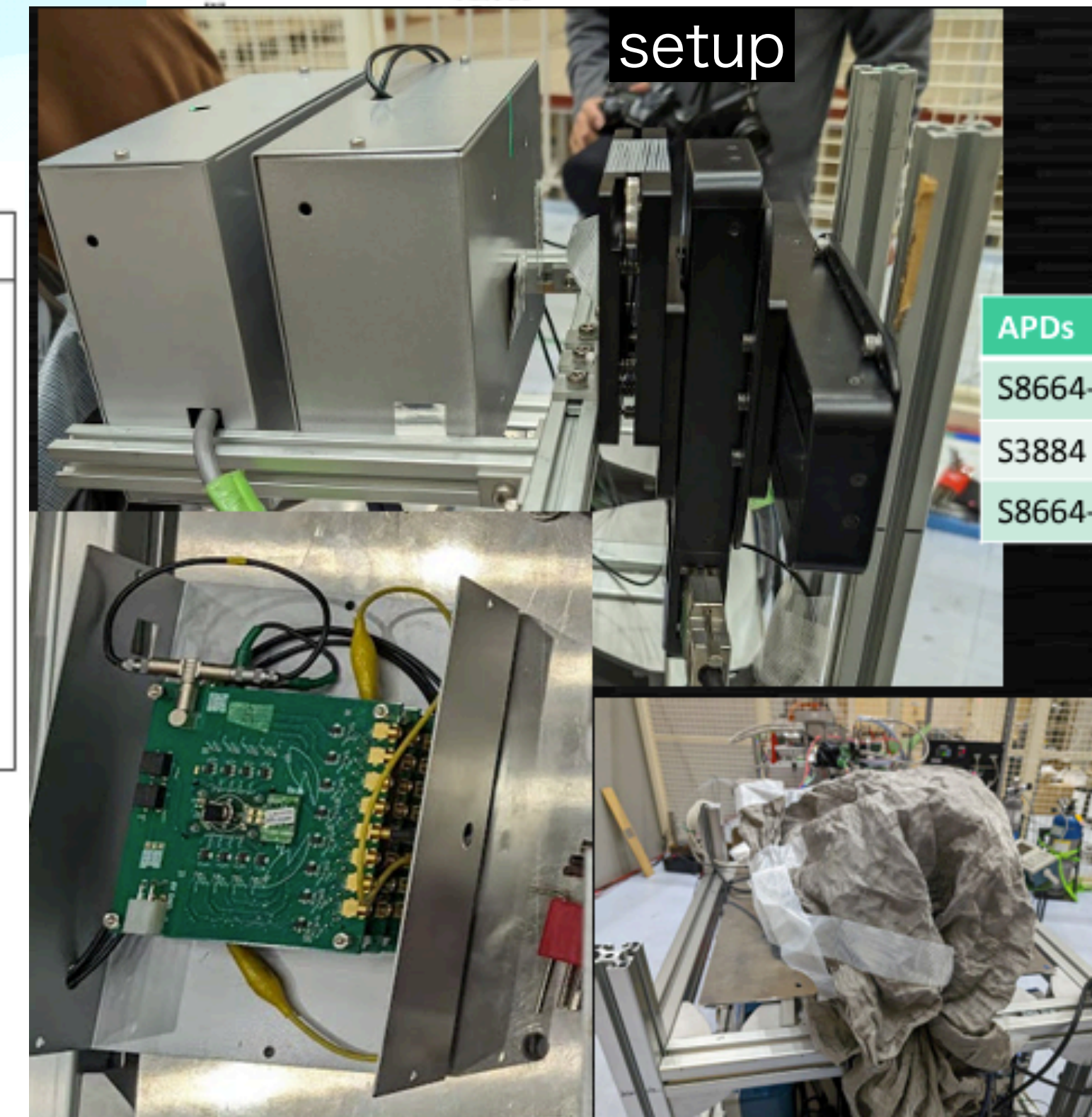
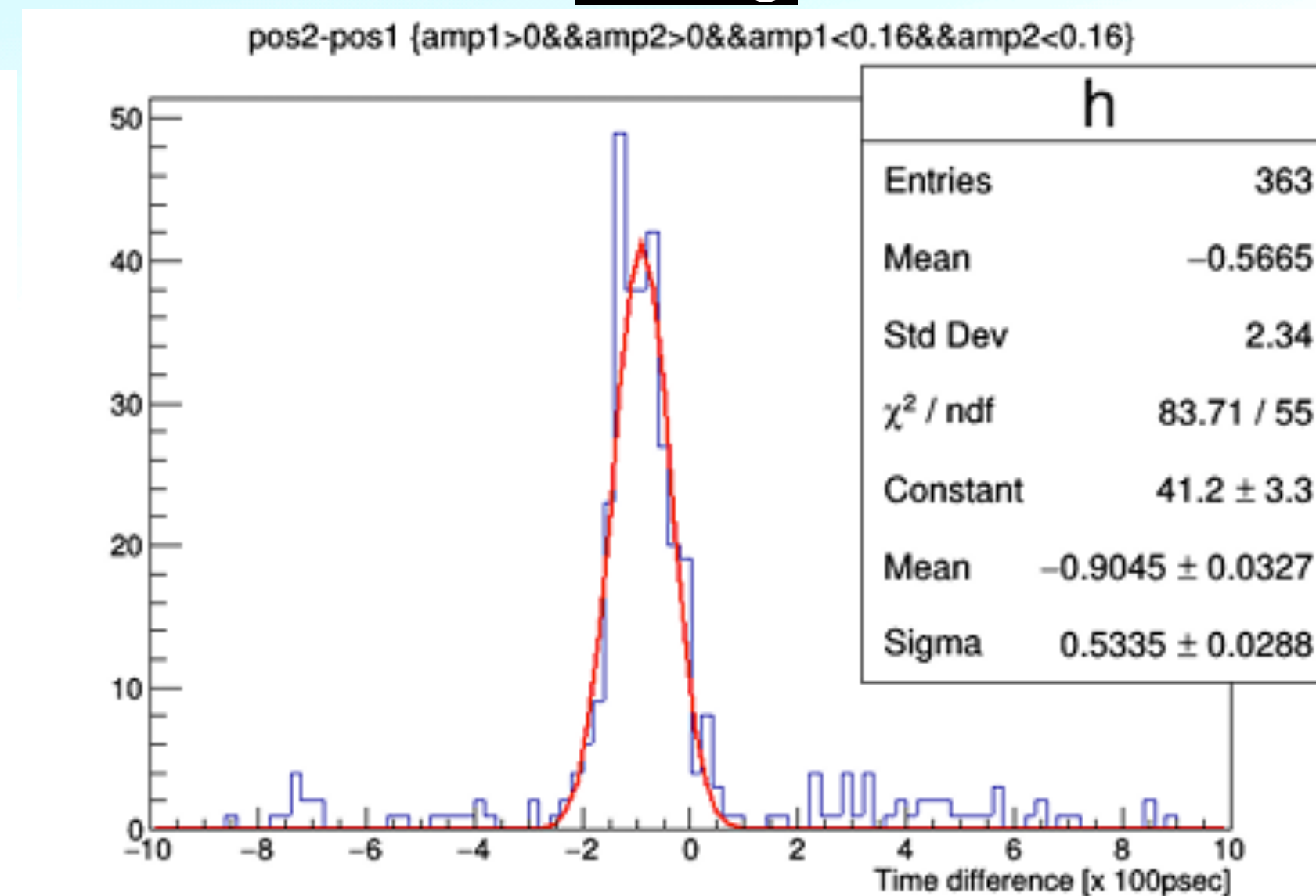
- LGAD : avalanche detector for charged particles
- overall timing resolution ~ 53ps



wave forms



timing



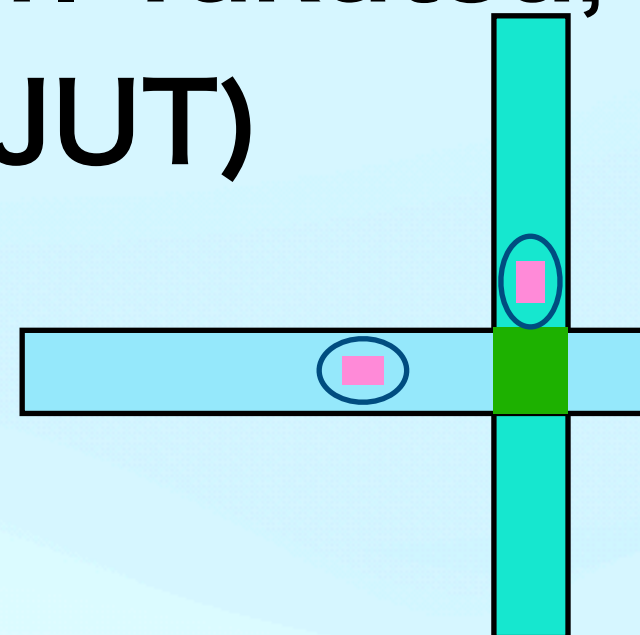
Scintillator strip ECAL

strip ECAL Beam test (W.O + T.Murata, T. Takatsu, T.T)
with CEPC Institutes (USTC, IHEP and SJUT)

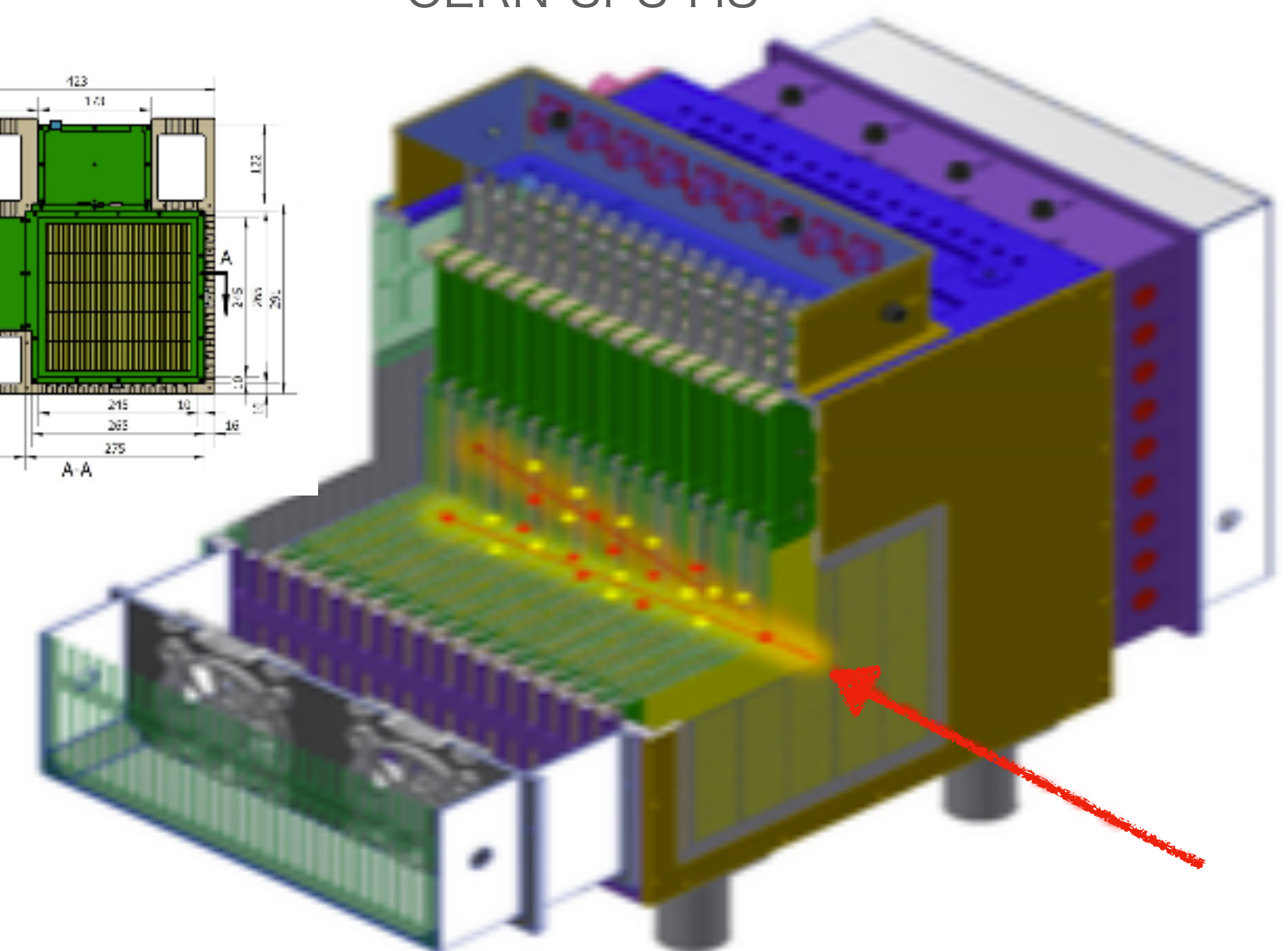
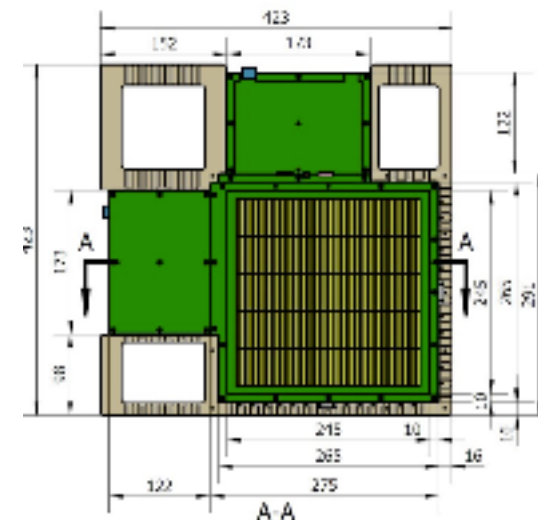
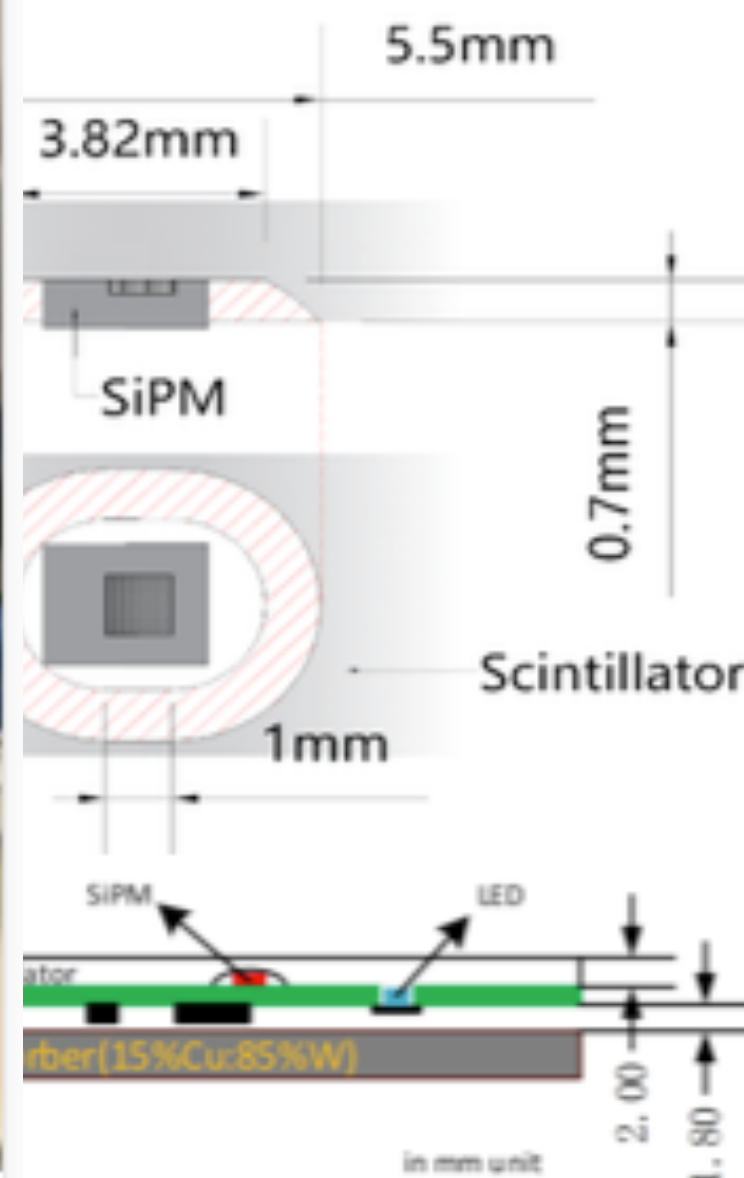
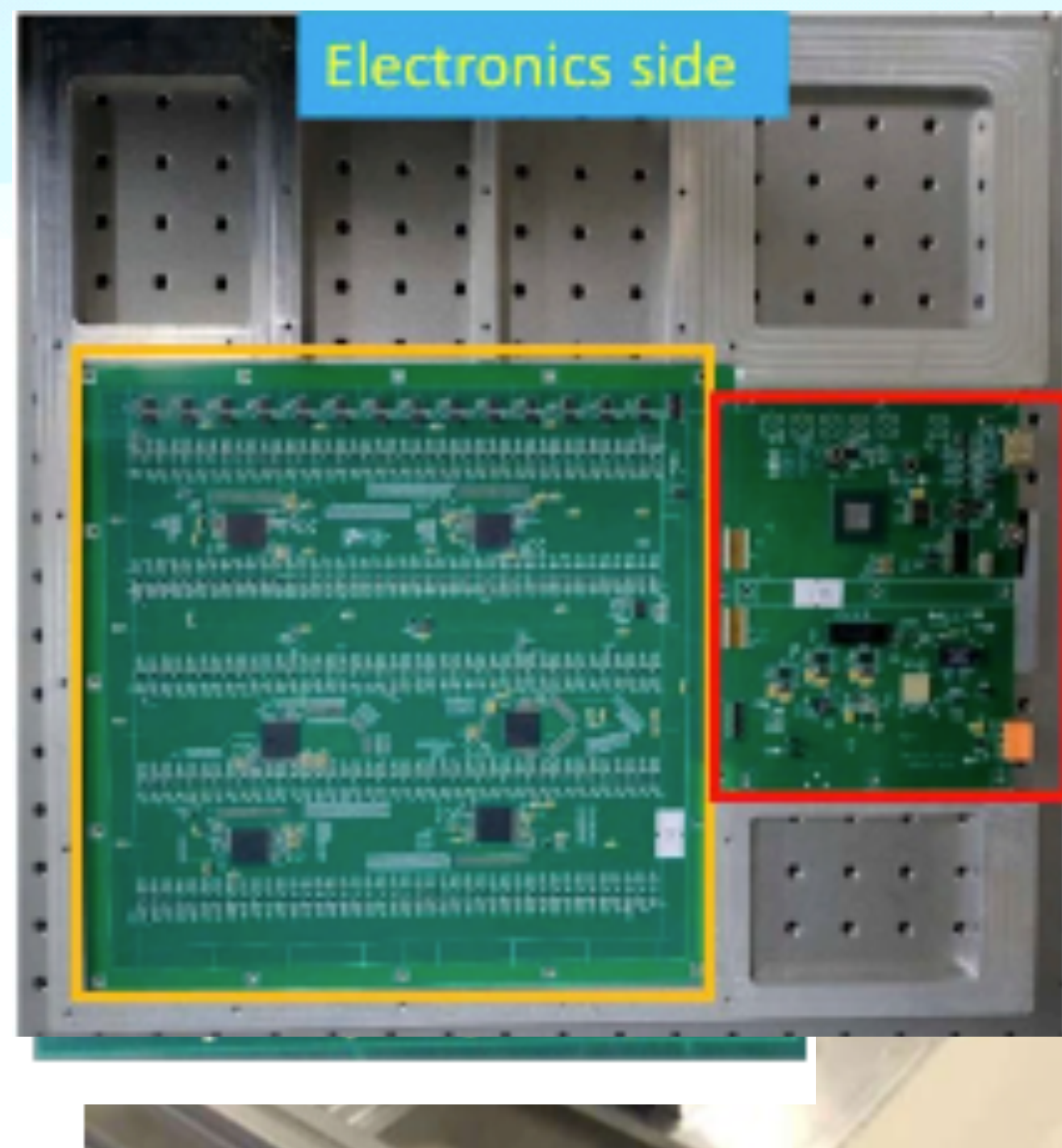
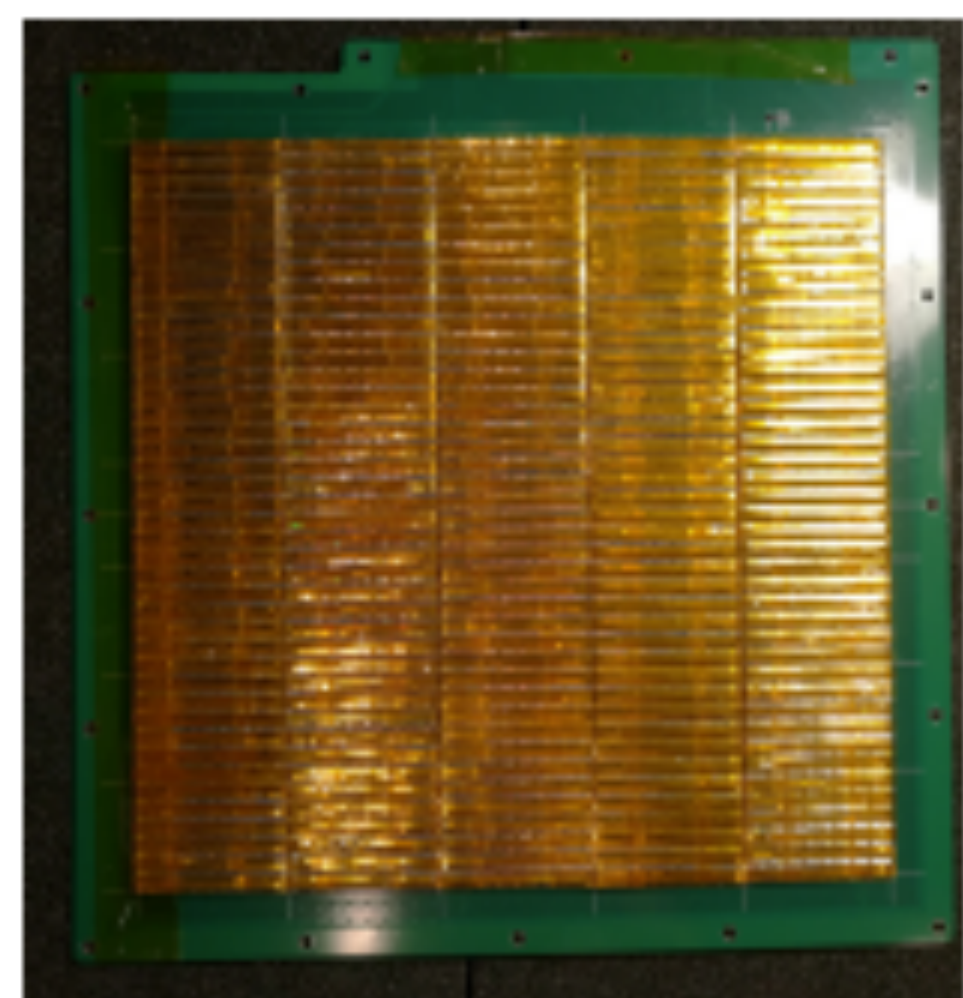
- cosmic test at USTC

42x5x32=6720 ch

- Beam Test at CERN SPS and PS at 2022, 2023)



CERN-SPS-H8



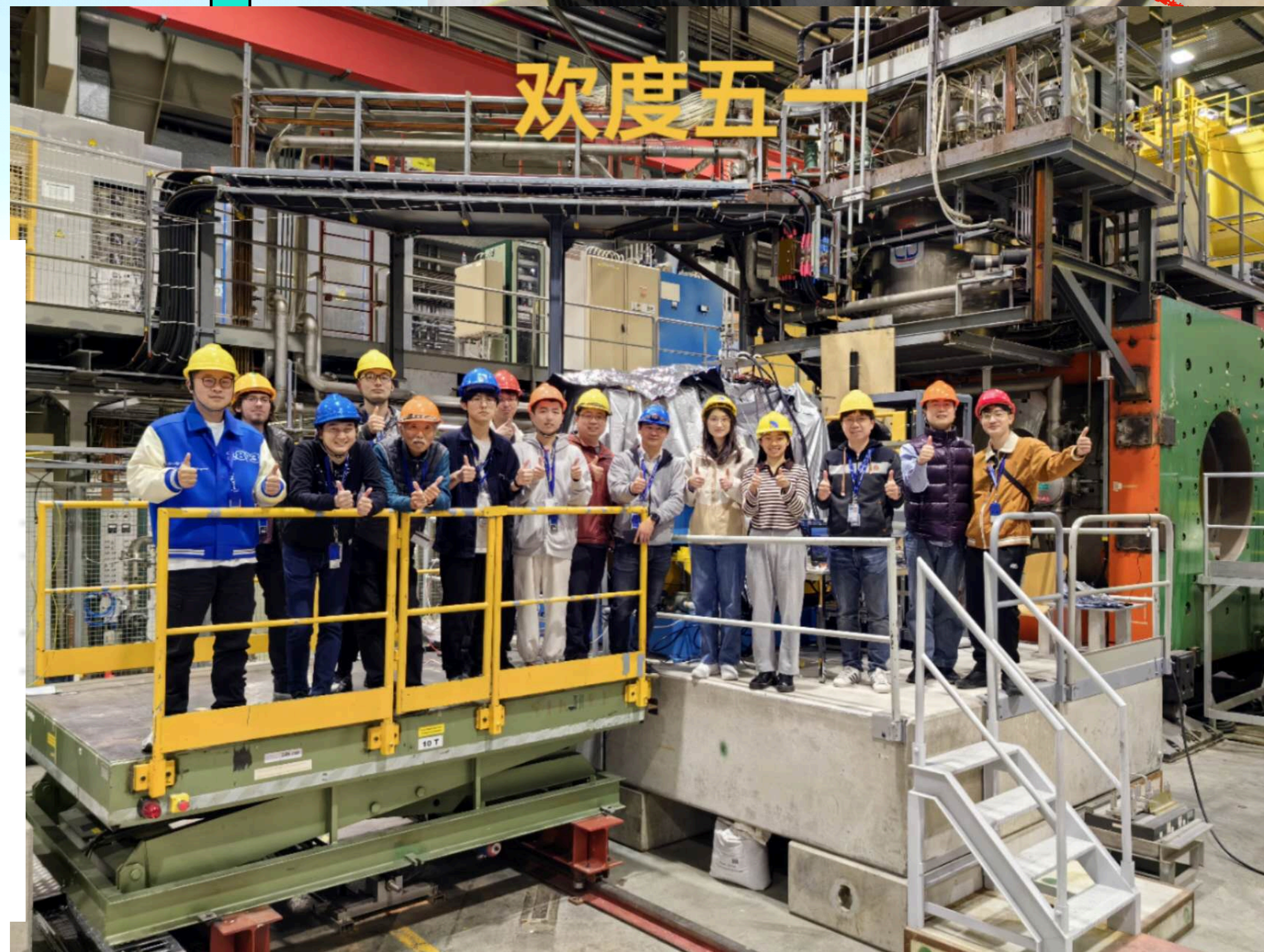
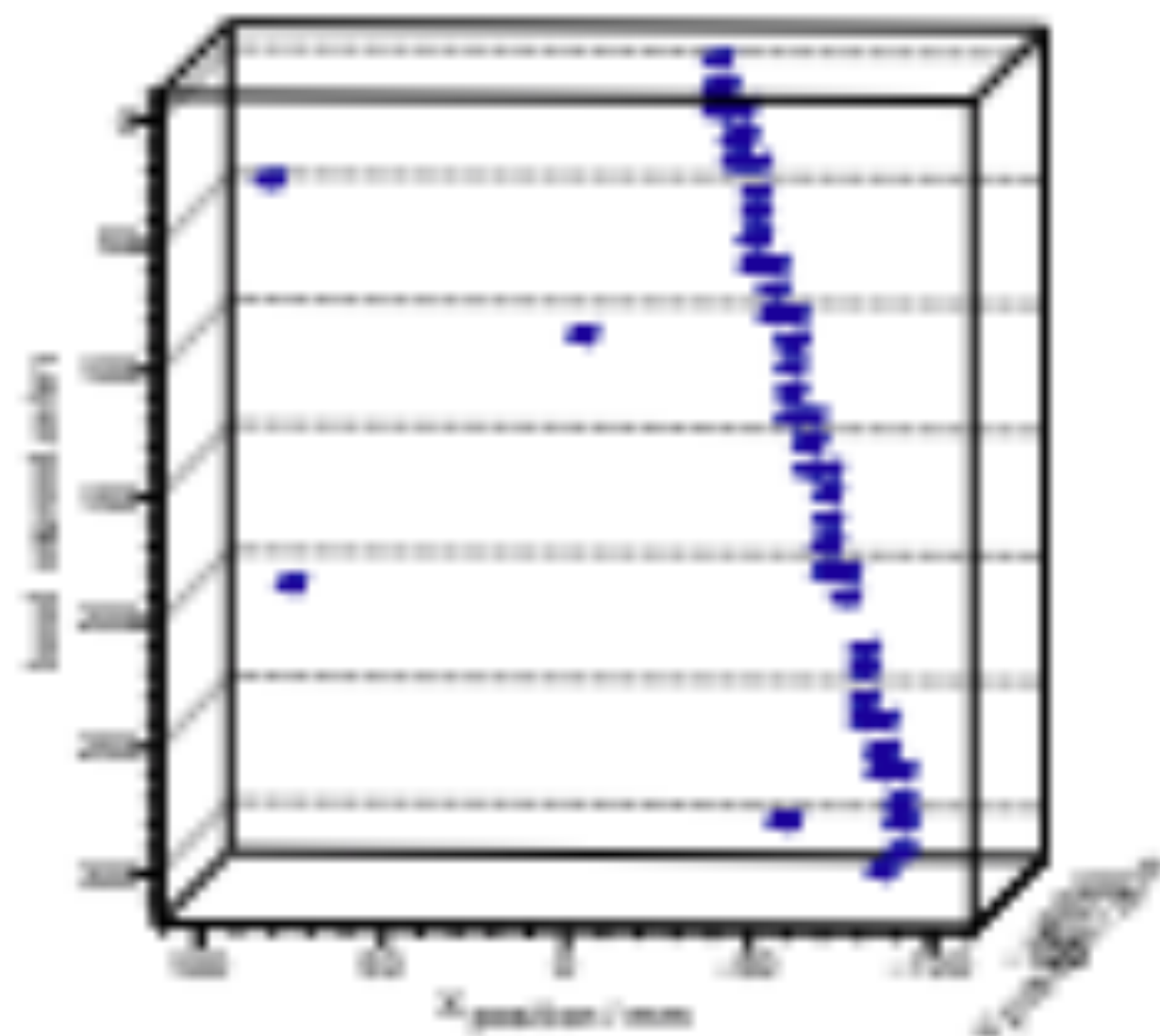
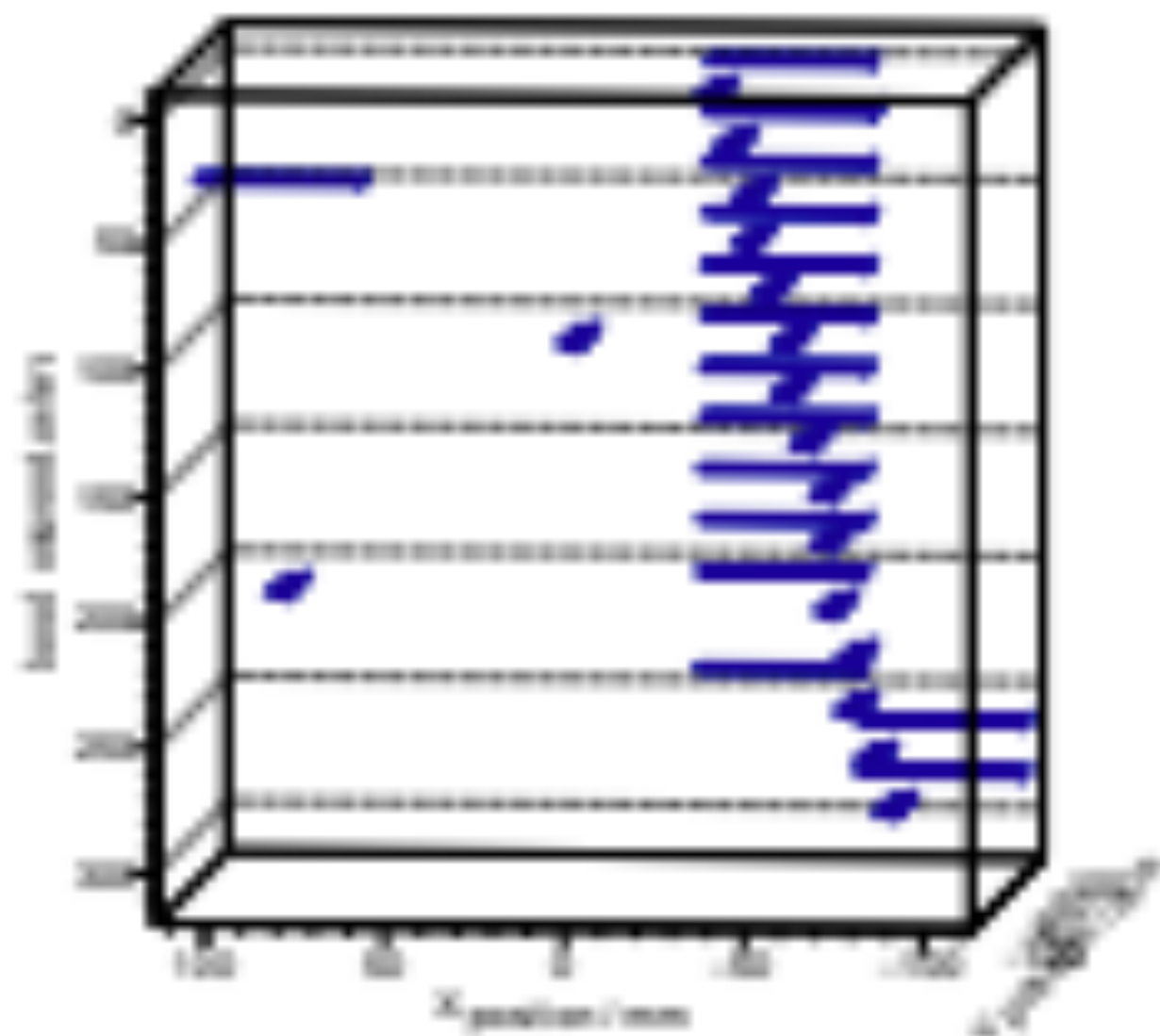
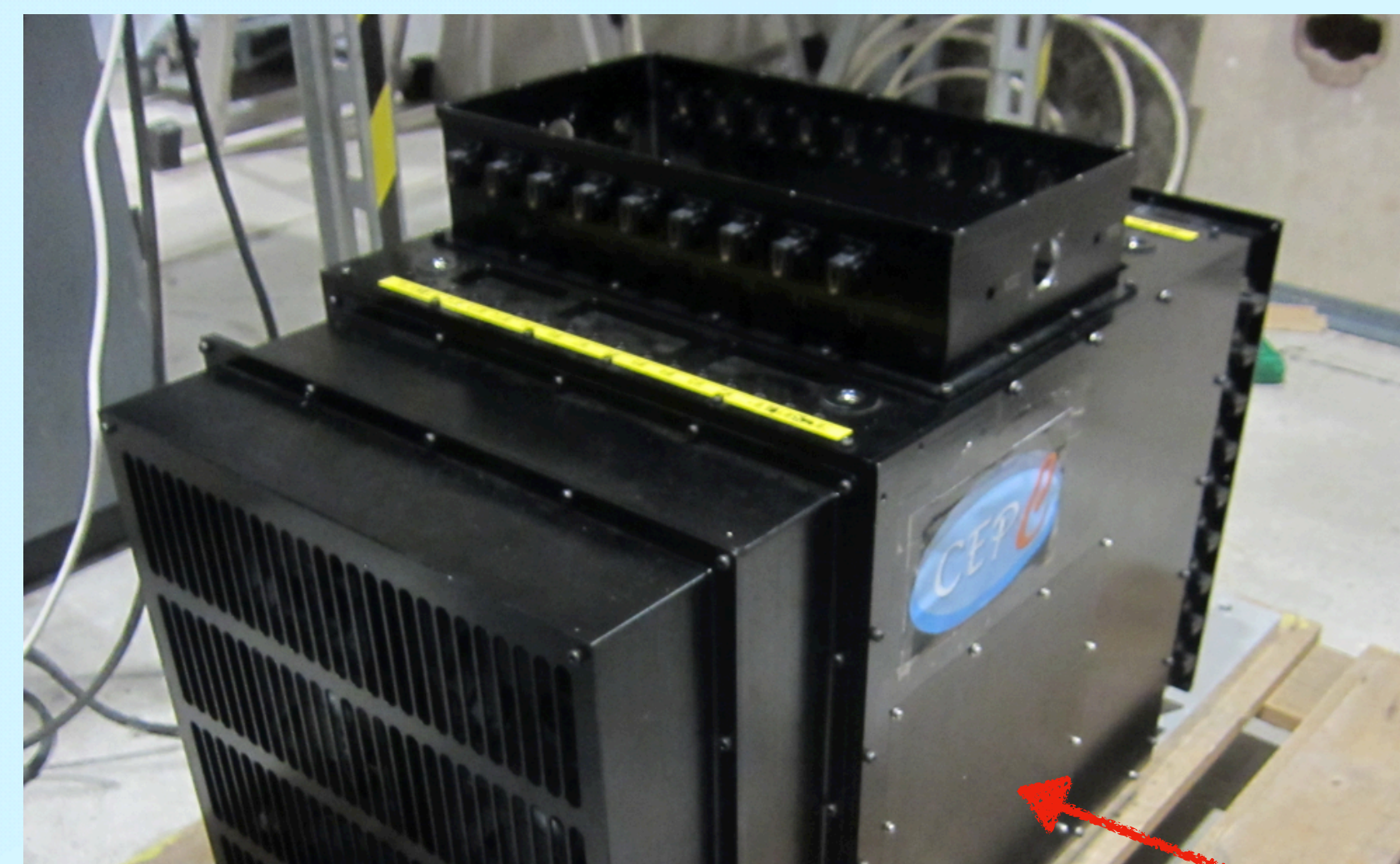
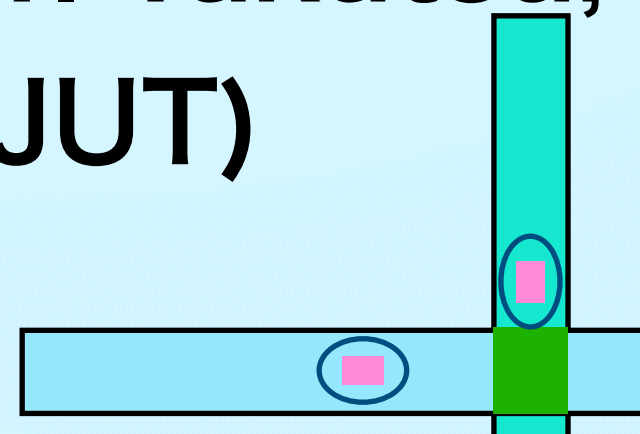
Scintillator strip ECAL

strip ECAL Beam test (W.O + T.Murata, T. Takatsu, T.T)
with CEPC Institutes (USTC, IHEP and SJUT)

- cosmic test at USTC

42x5x32=6720 ch

- Beam Test at CERN SPS and PS at 2022. 2023)



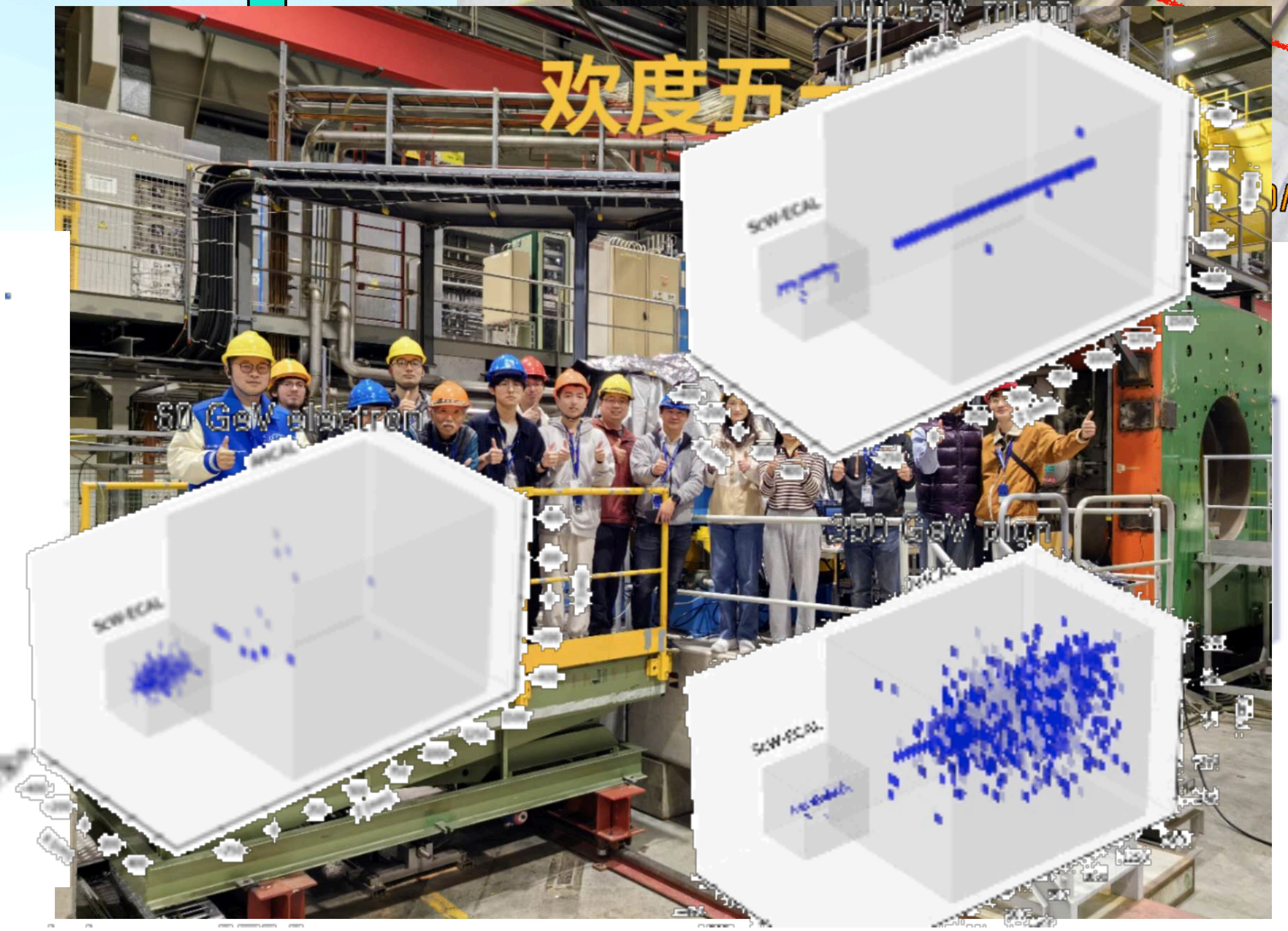
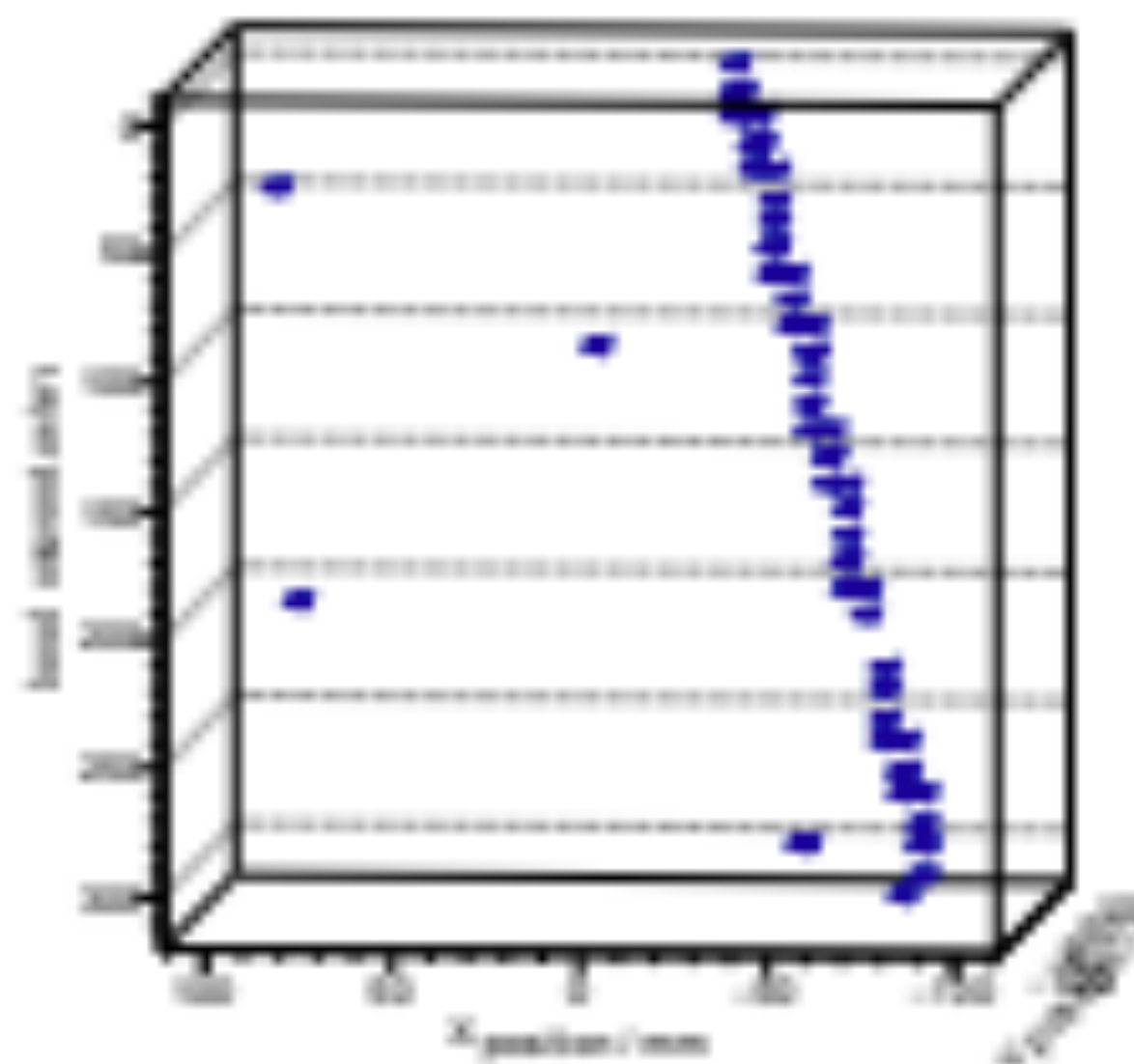
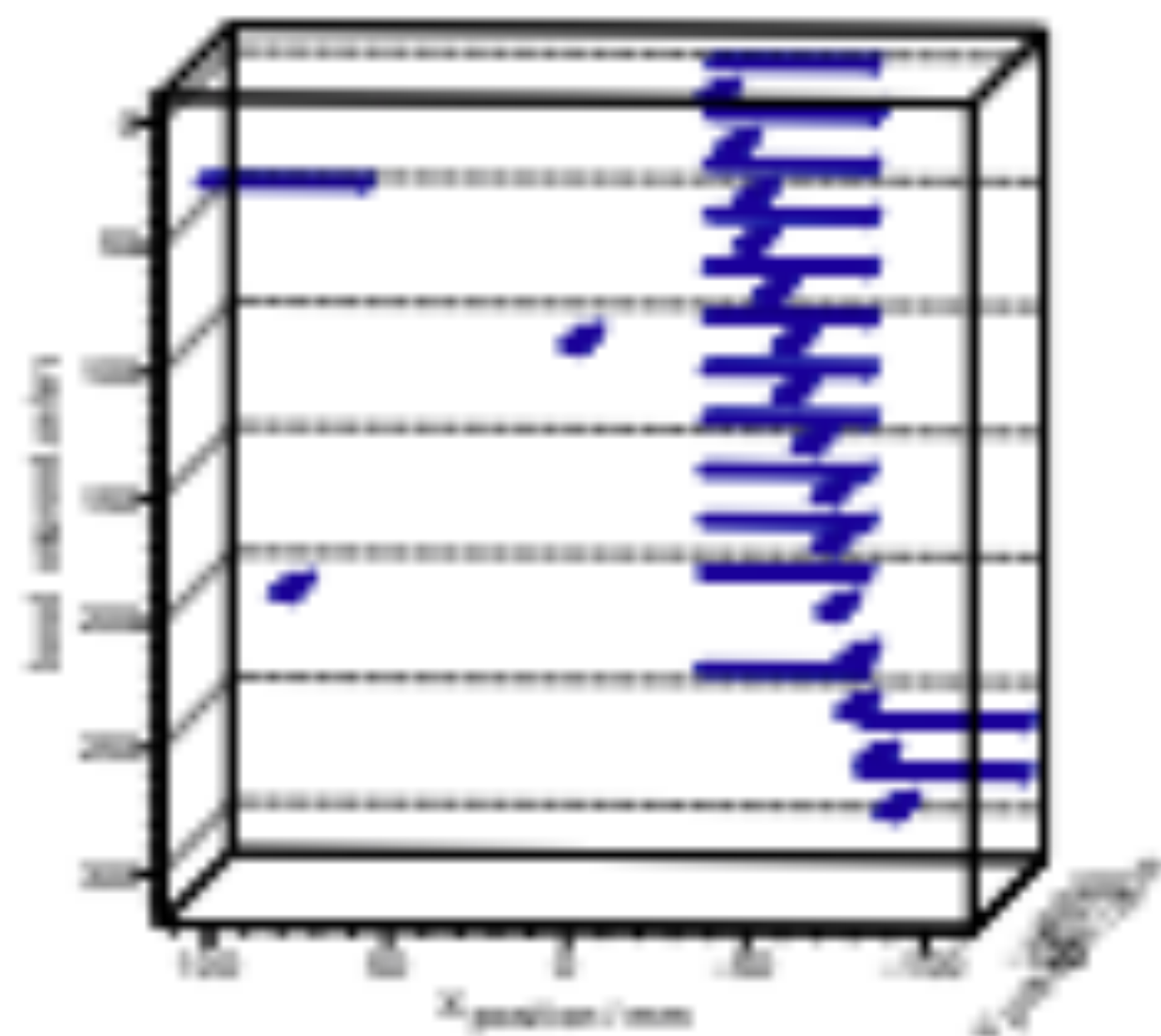
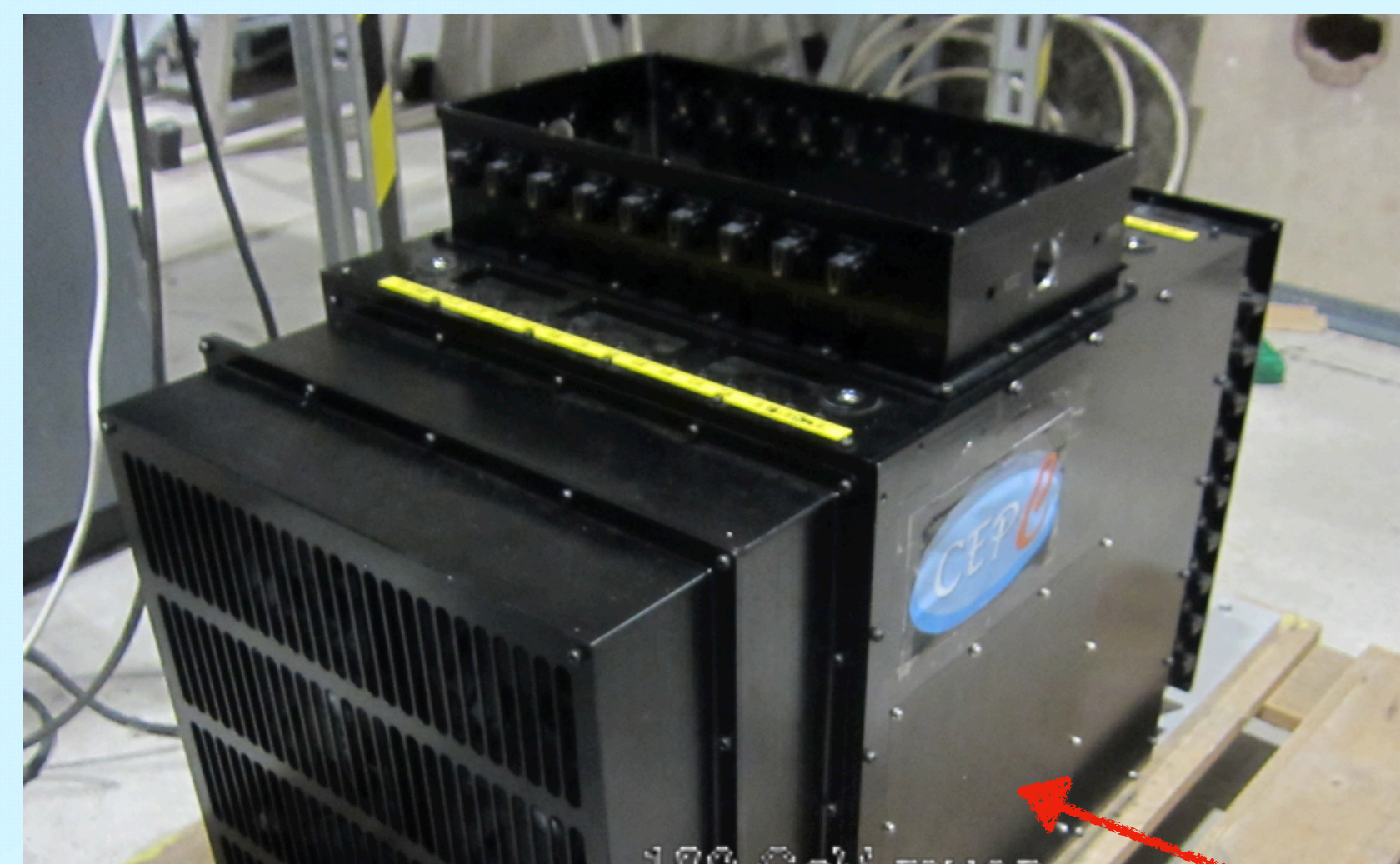
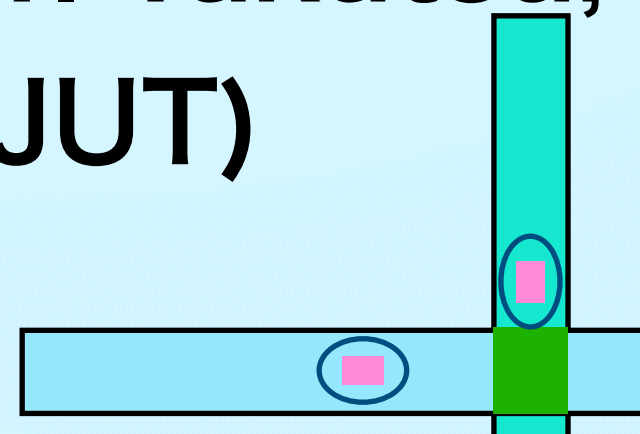
Scintillator strip ECAL

strip ECAL Beam test (W.O + T.Murata, T. Takatsu, T.T)
with CEPC Institutes (USTC, IHEP and SJUT)

- cosmic test at USTC

42x5x32=6720 ch

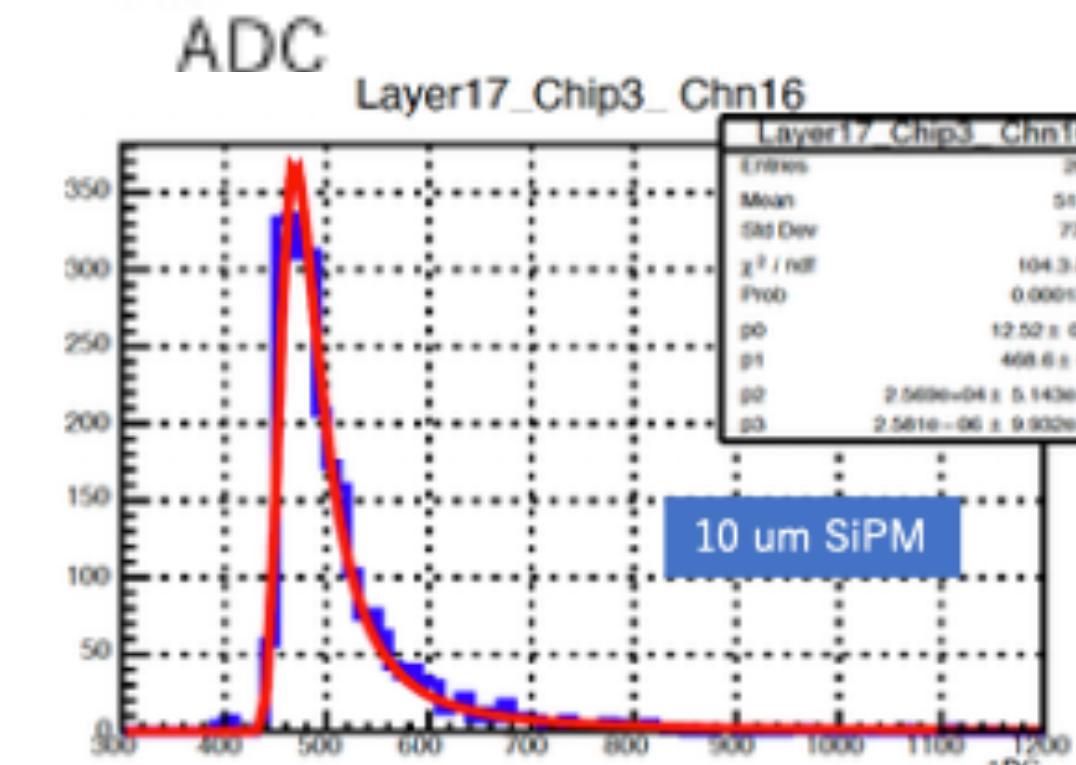
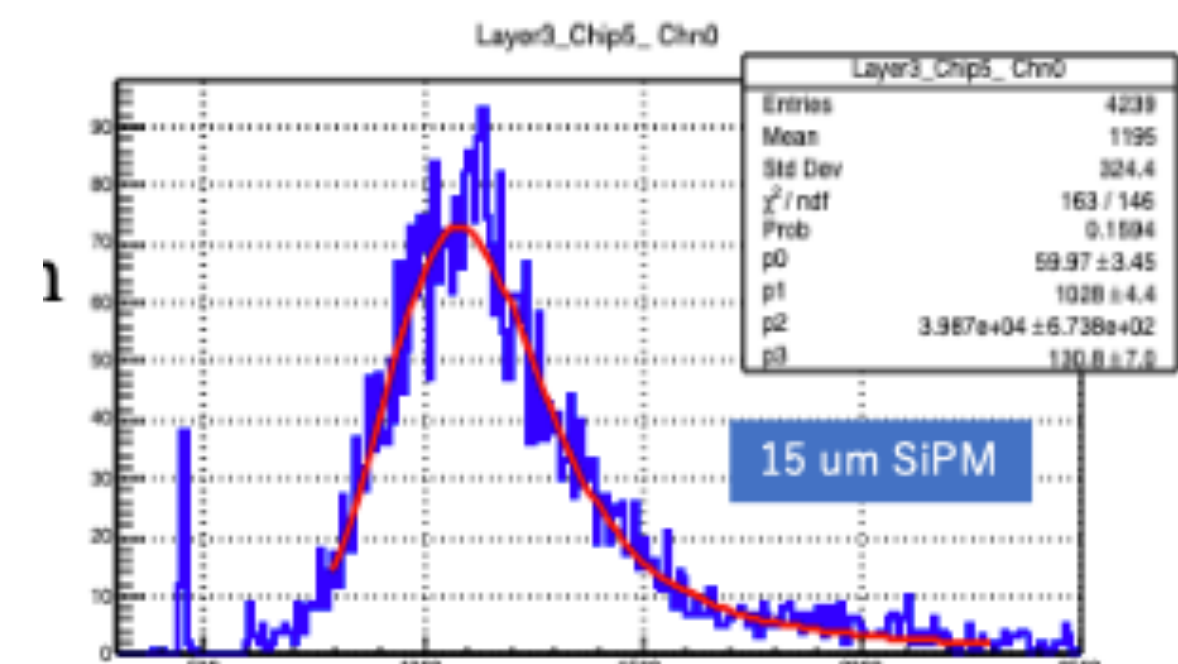
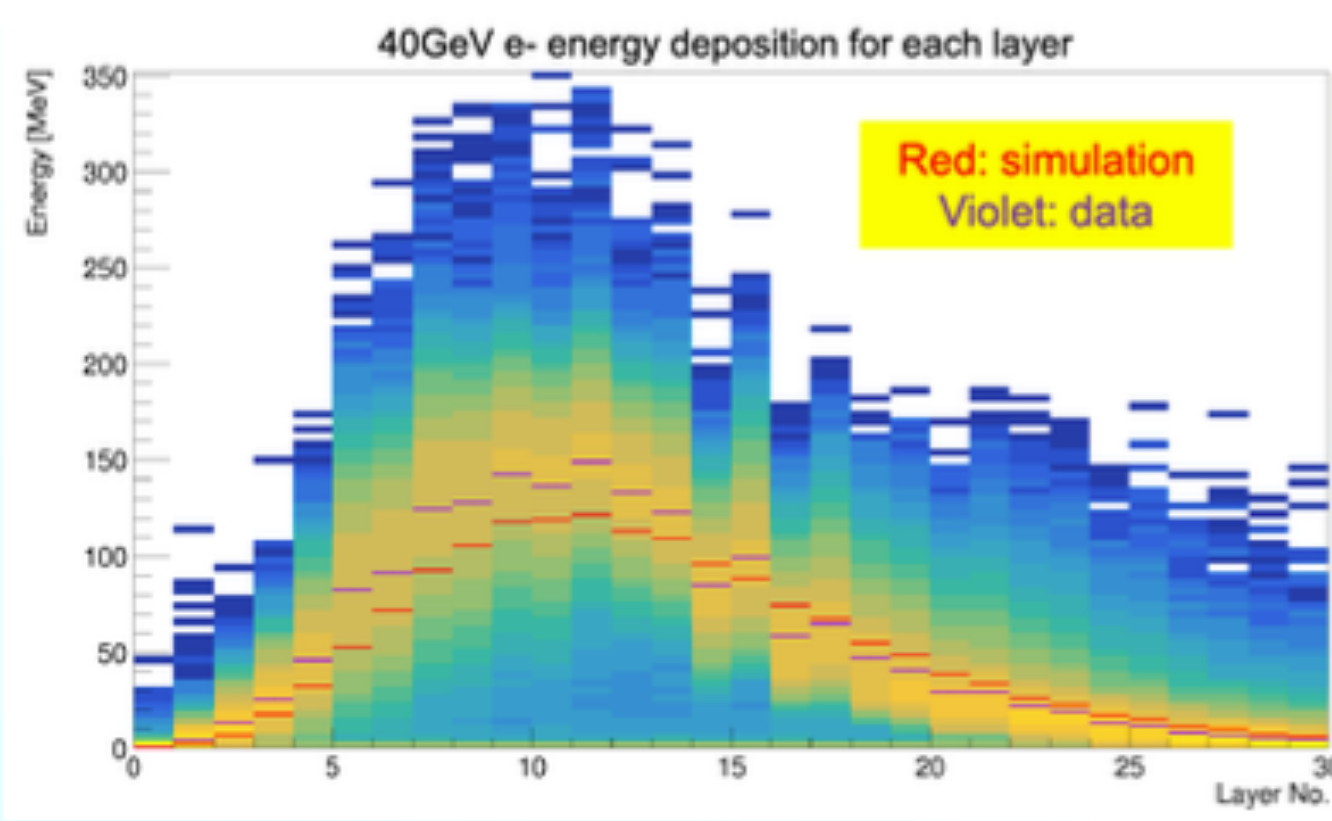
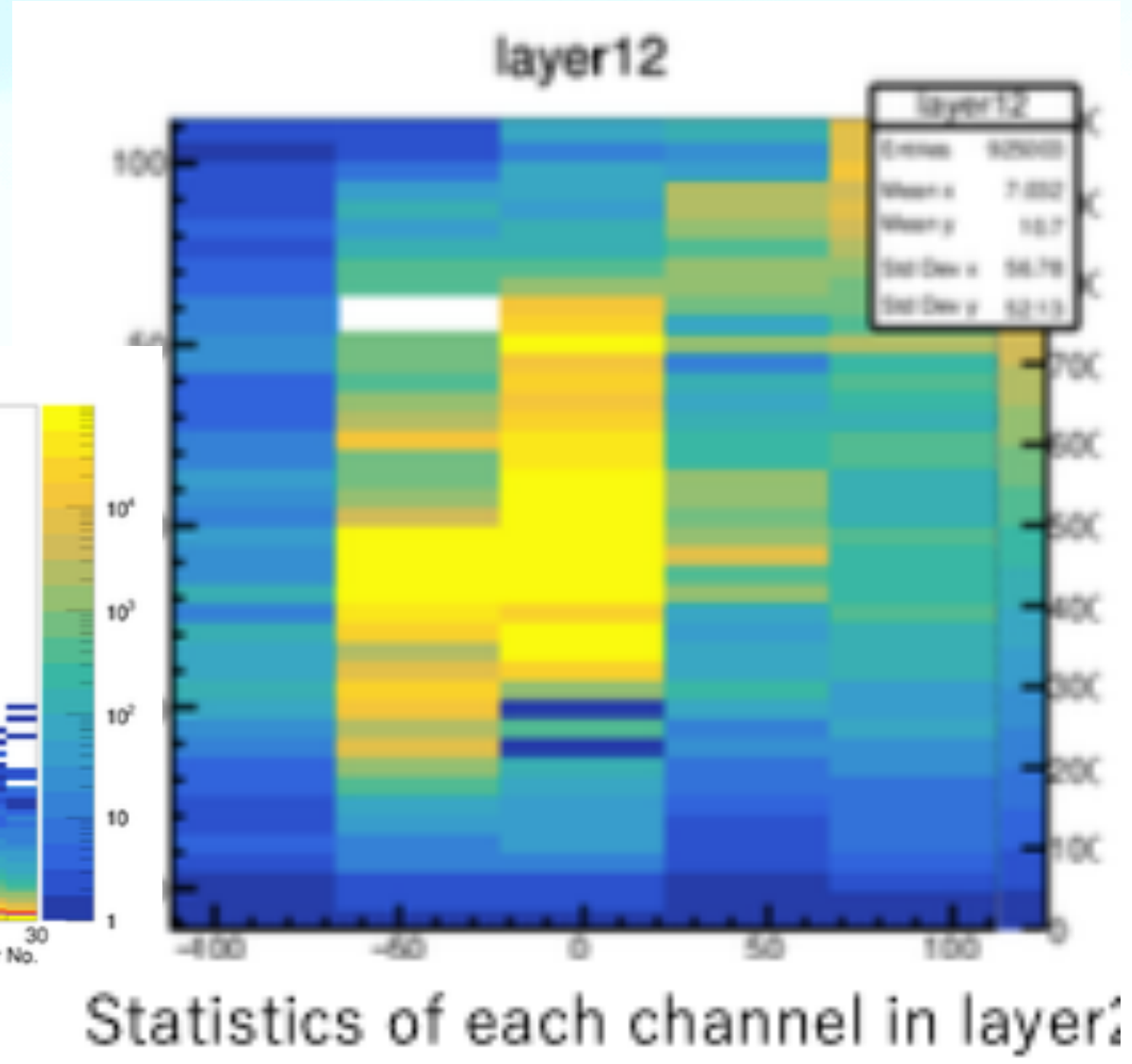
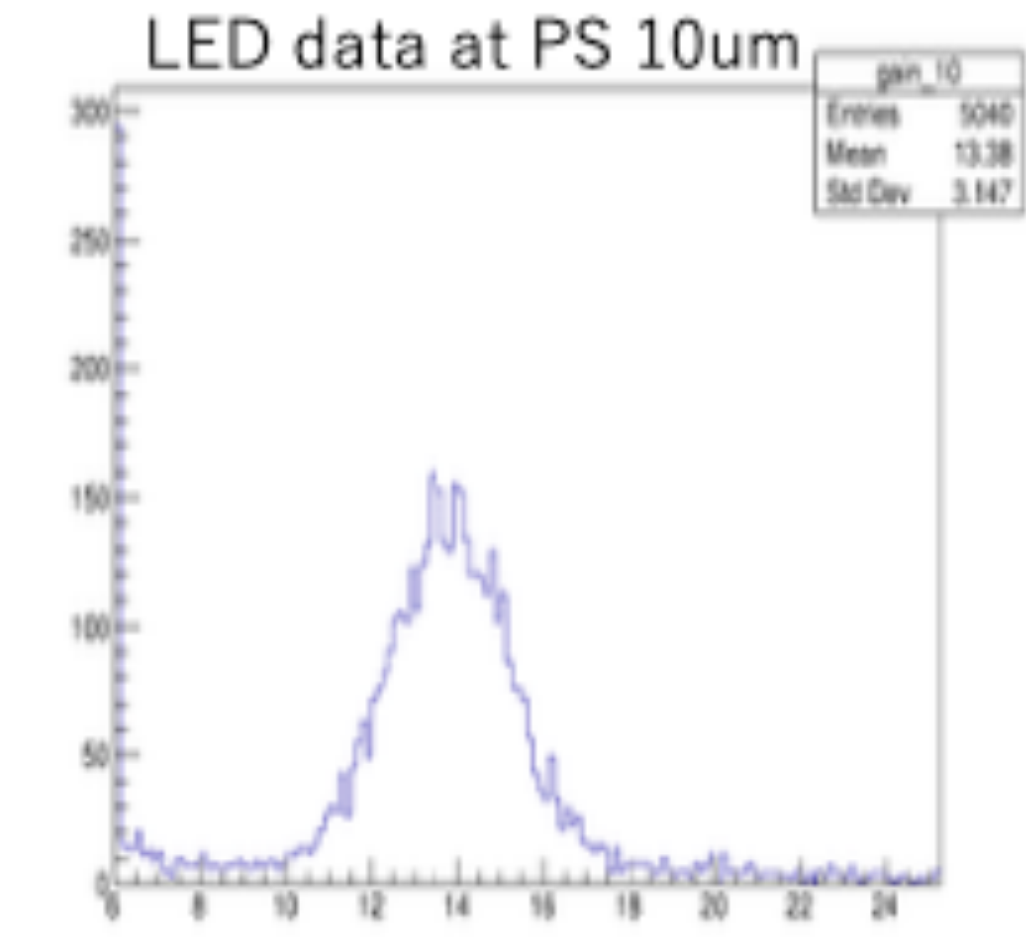
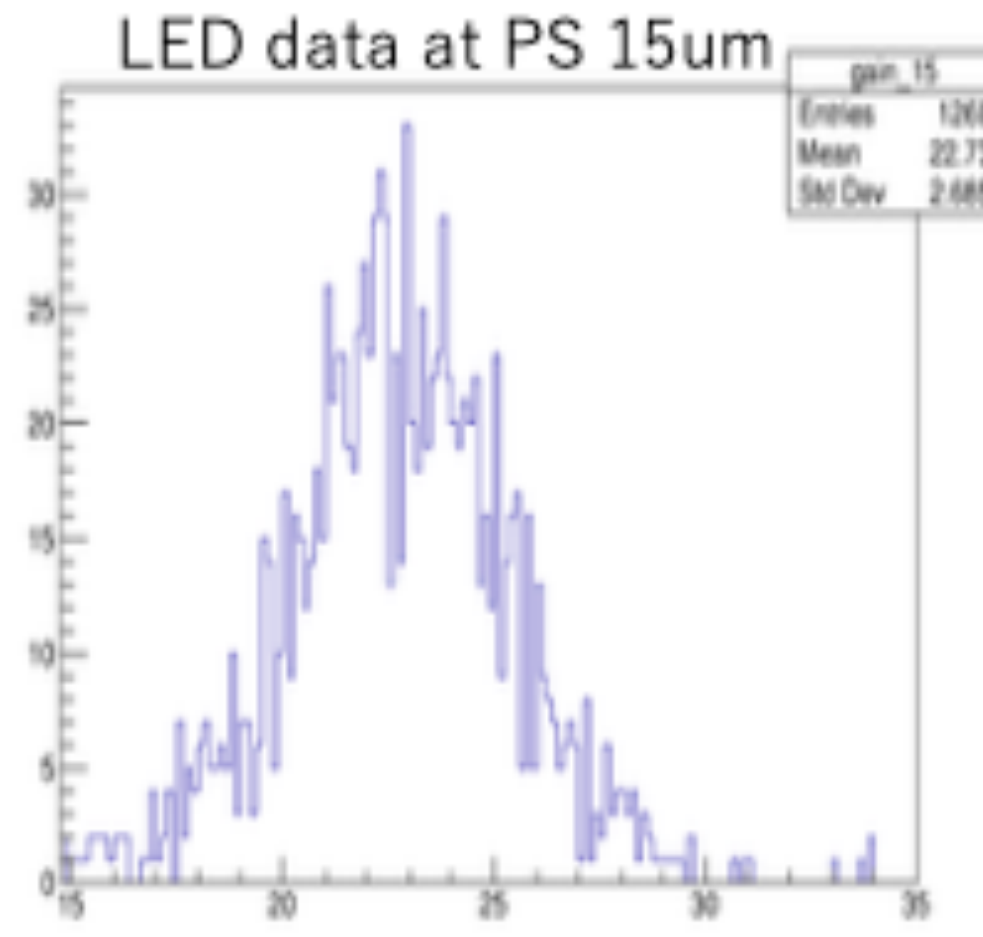
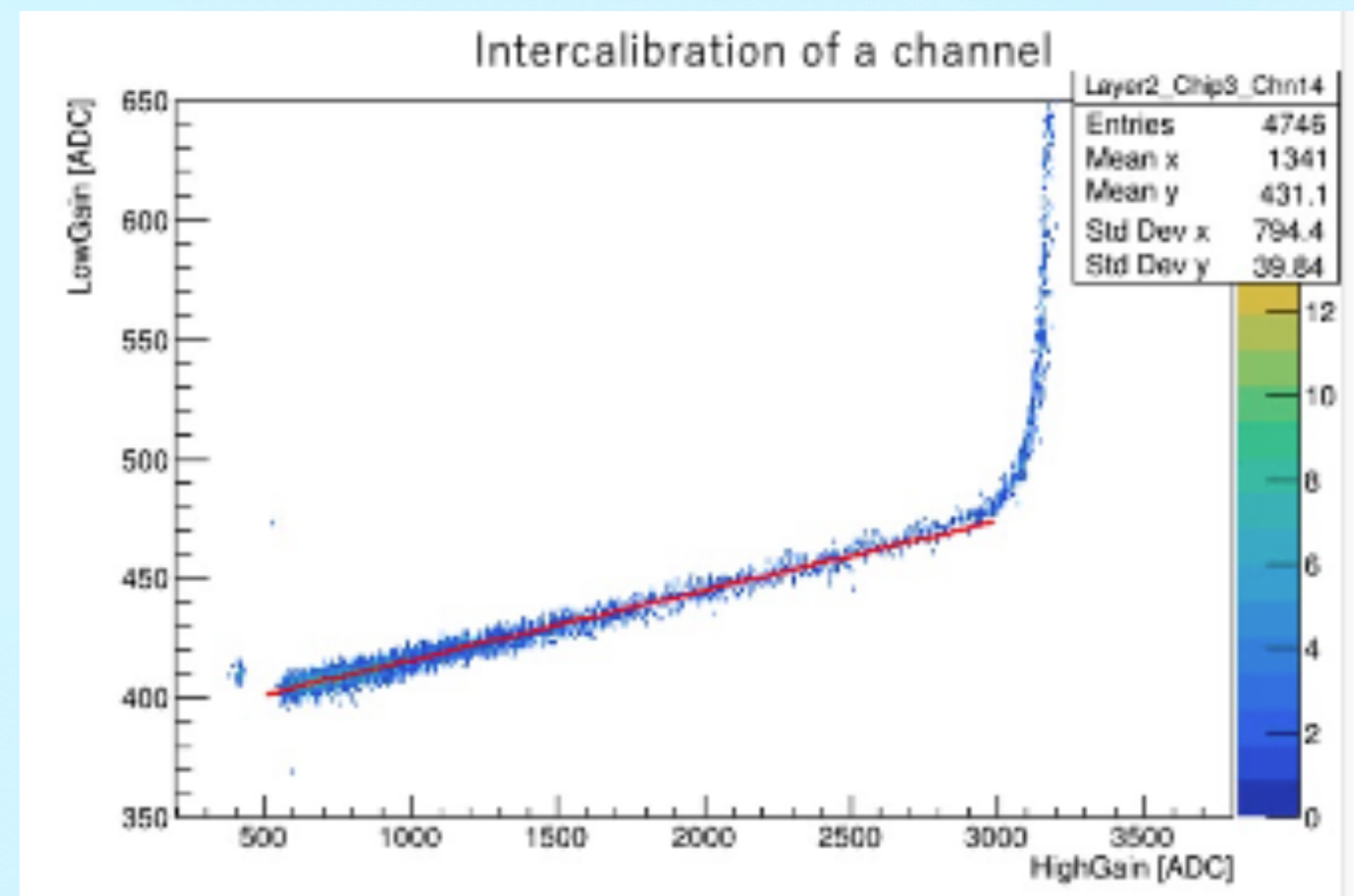
- Beam Test at CERN SPS and PS at 2022. 2023)



Scintillator strip ECAL BT

some results

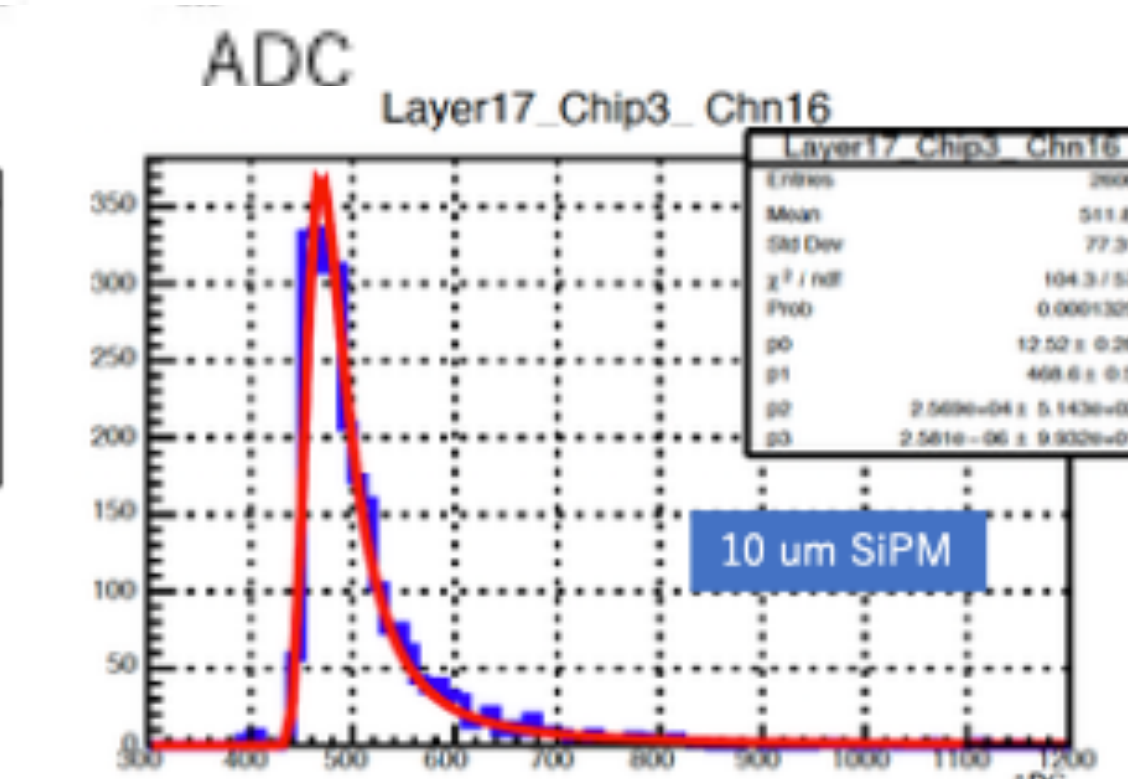
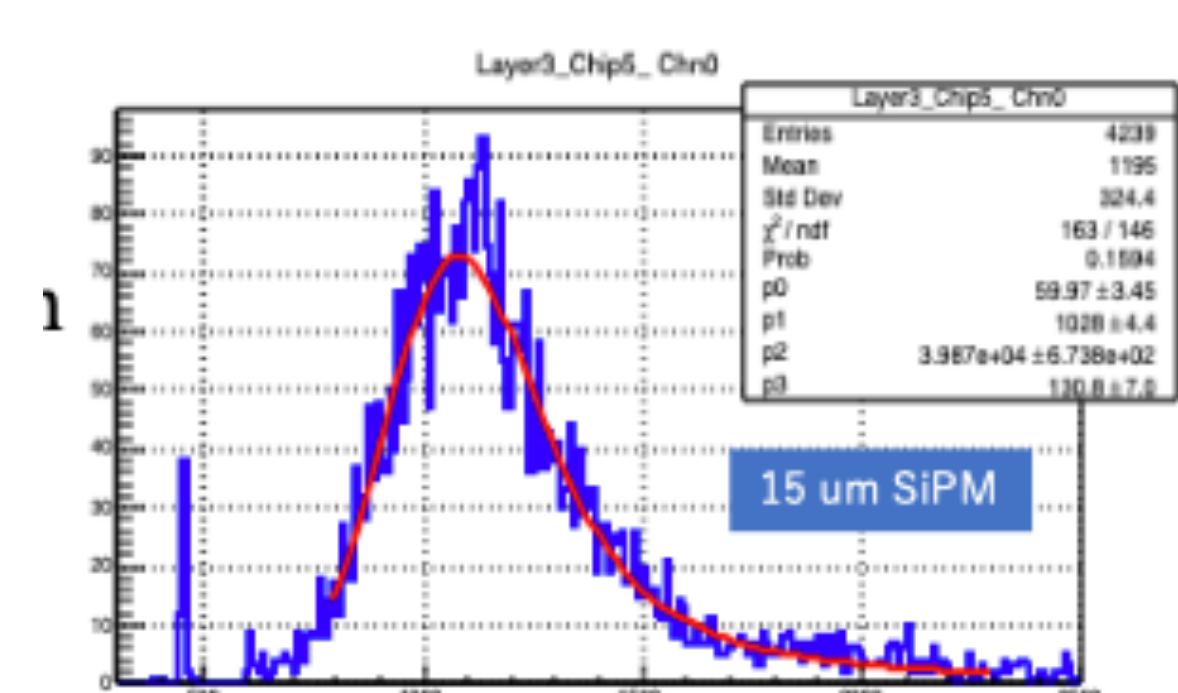
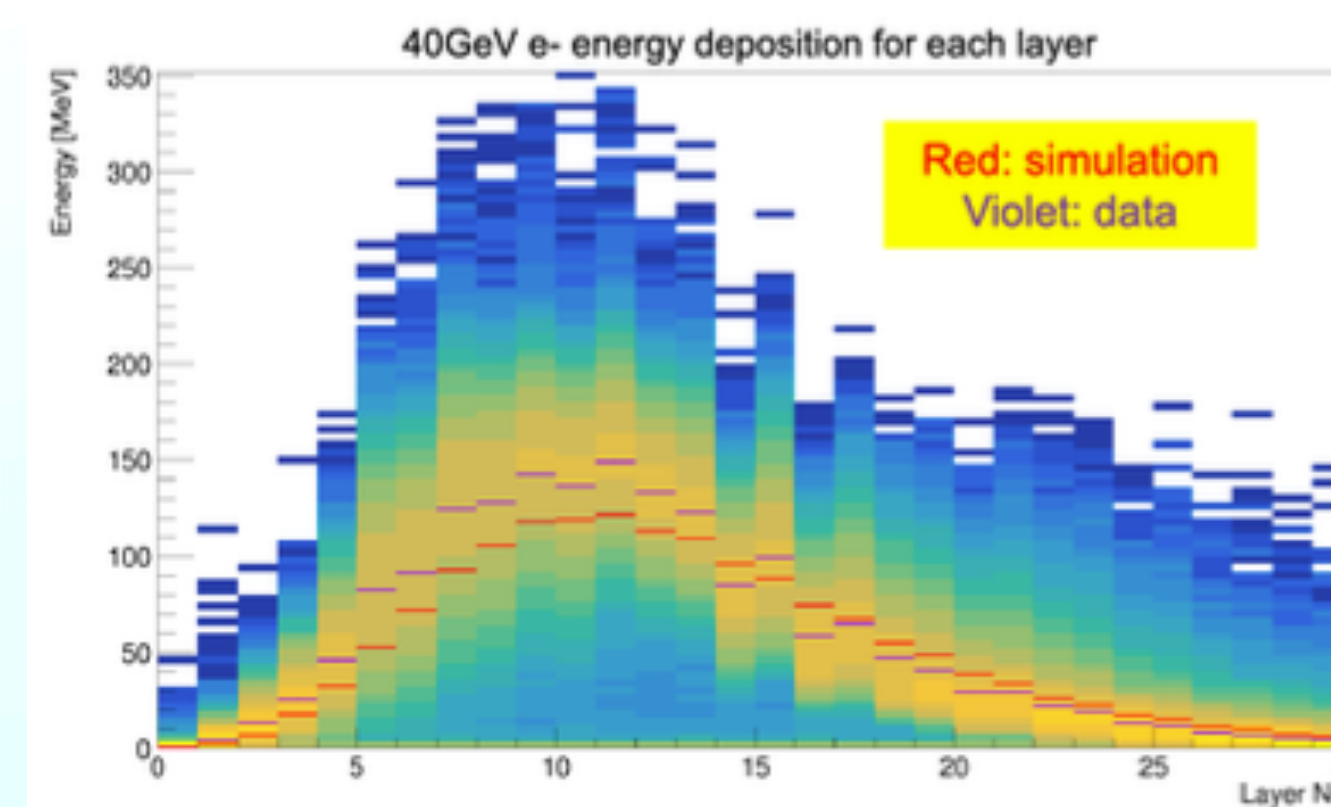
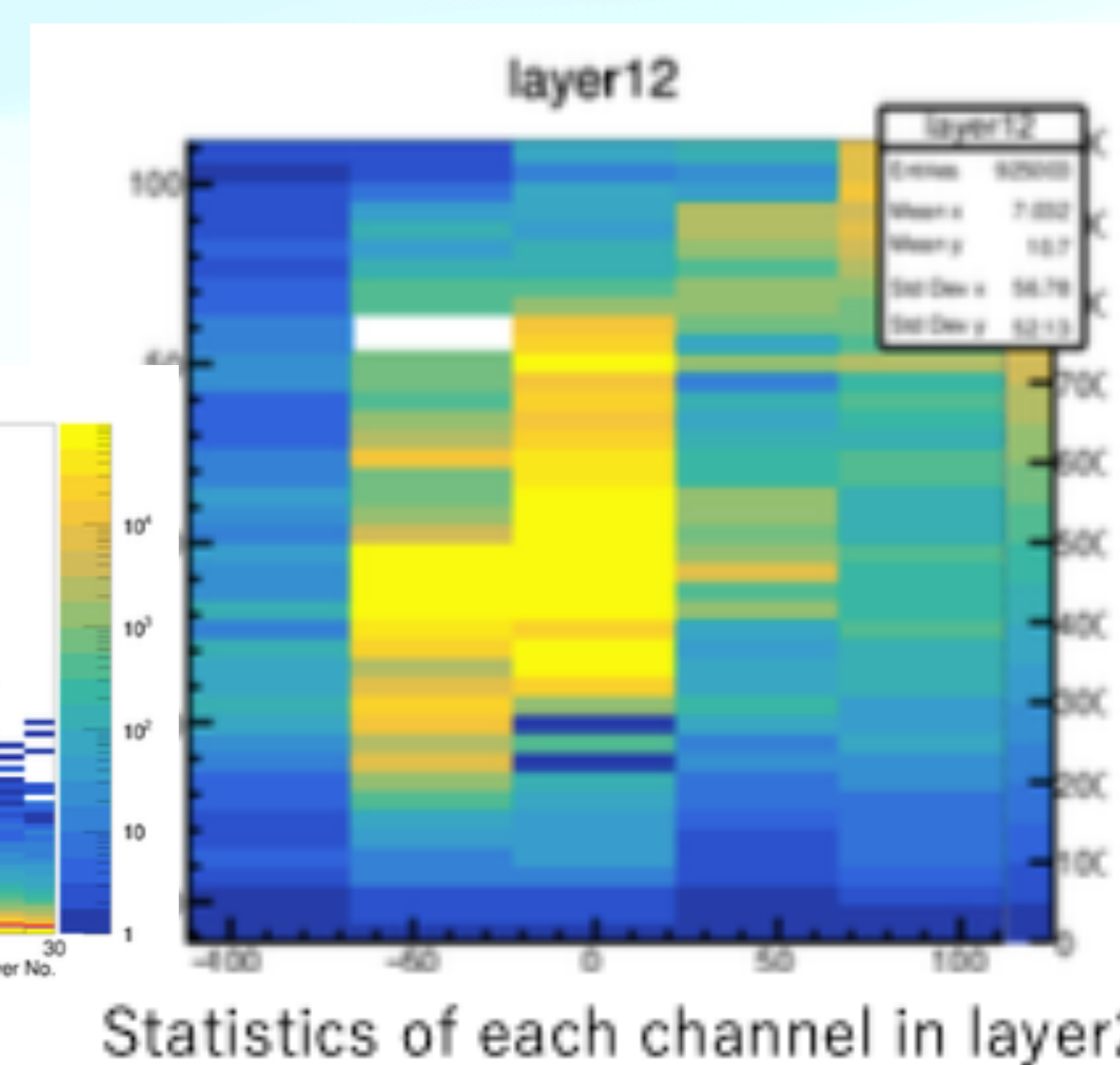
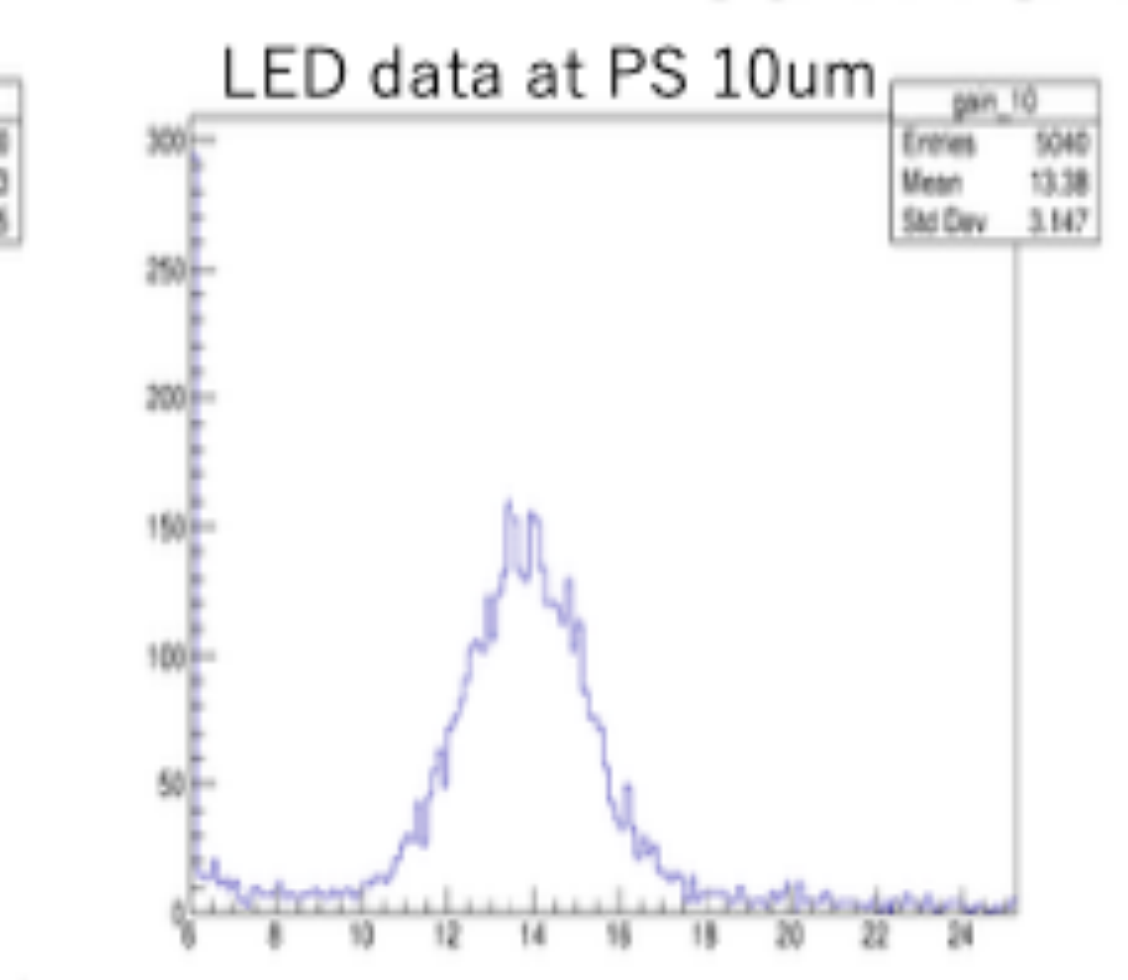
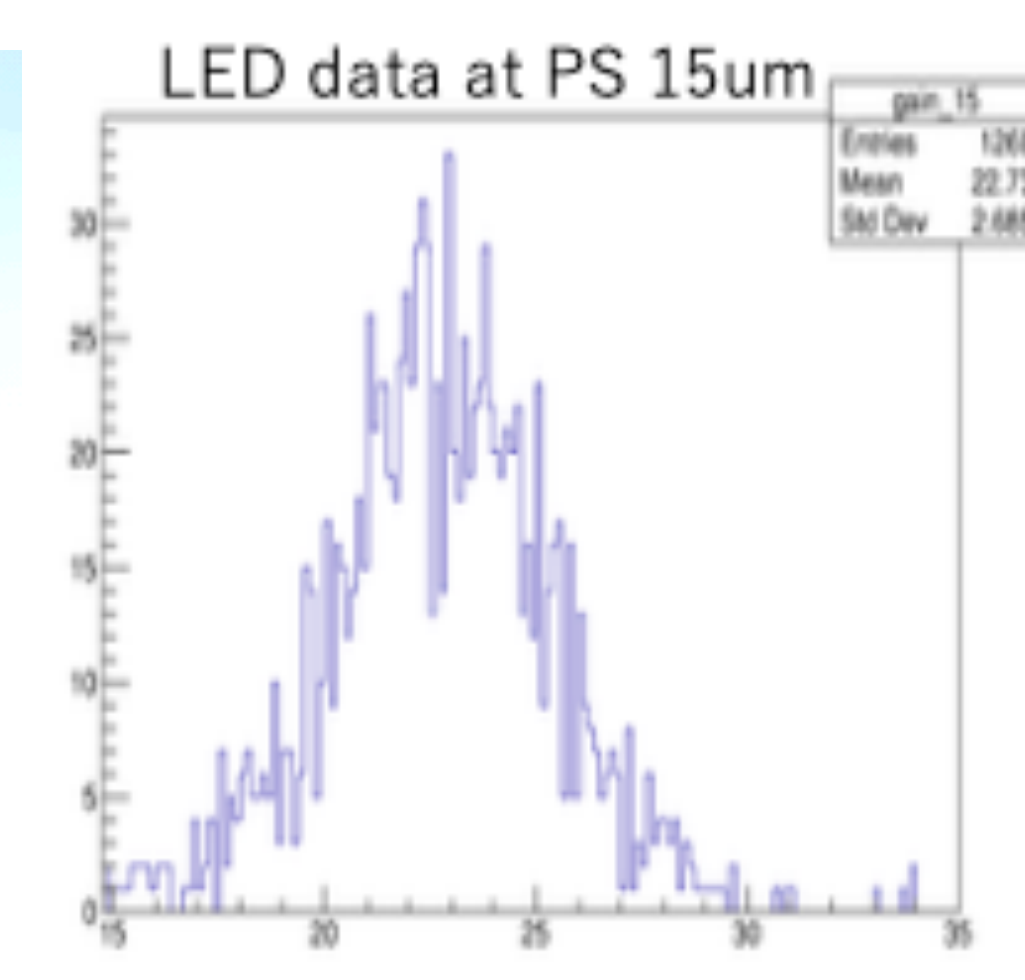
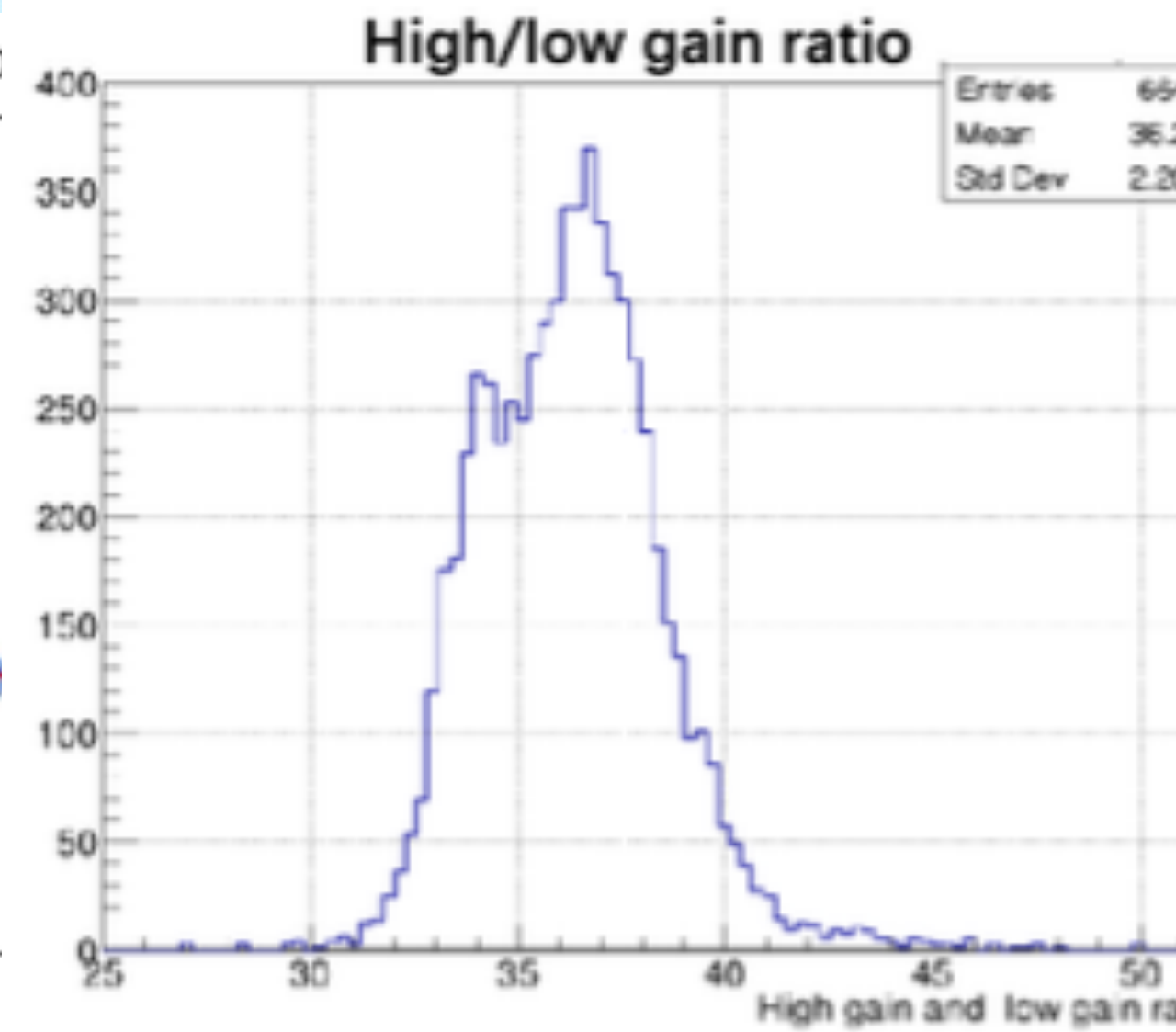
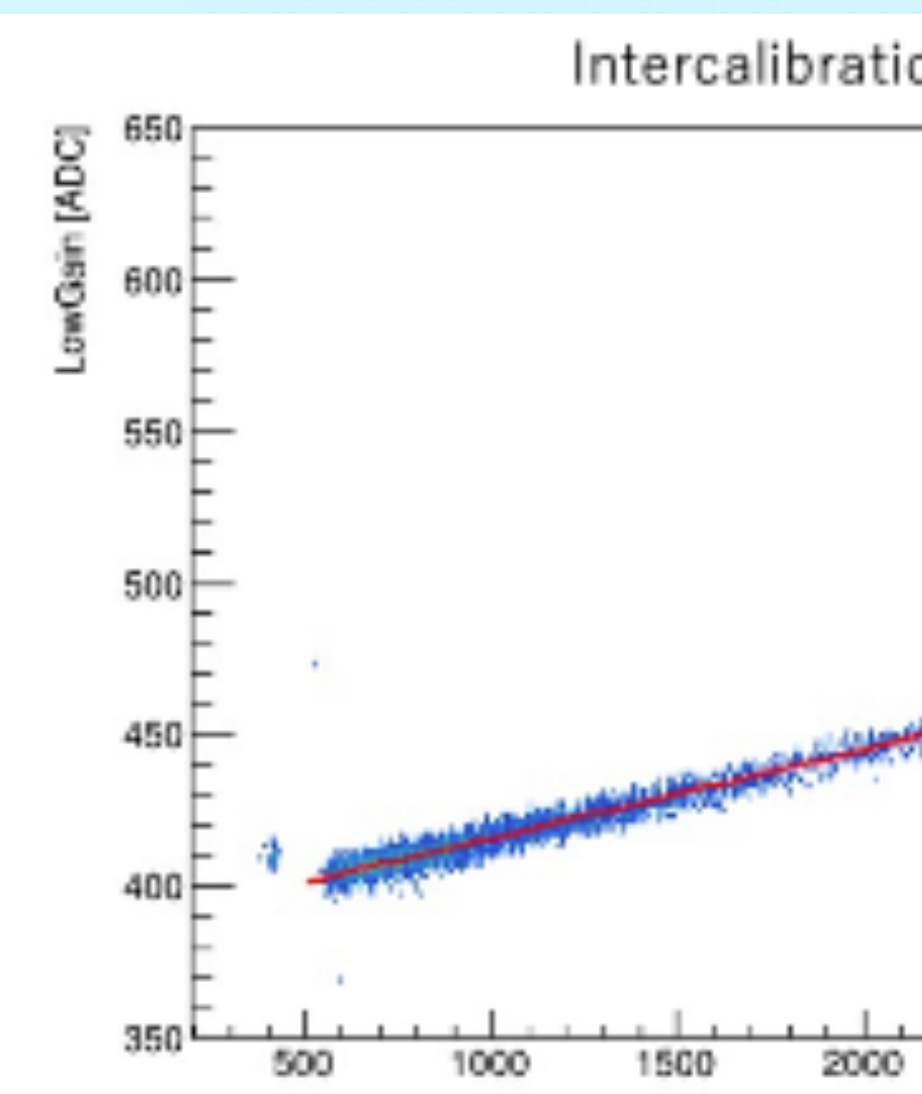
- High & Low gain amp.
- LED calibration
- MIP calibration
- sim vs data



Scintillator strip ECAL BT

some results

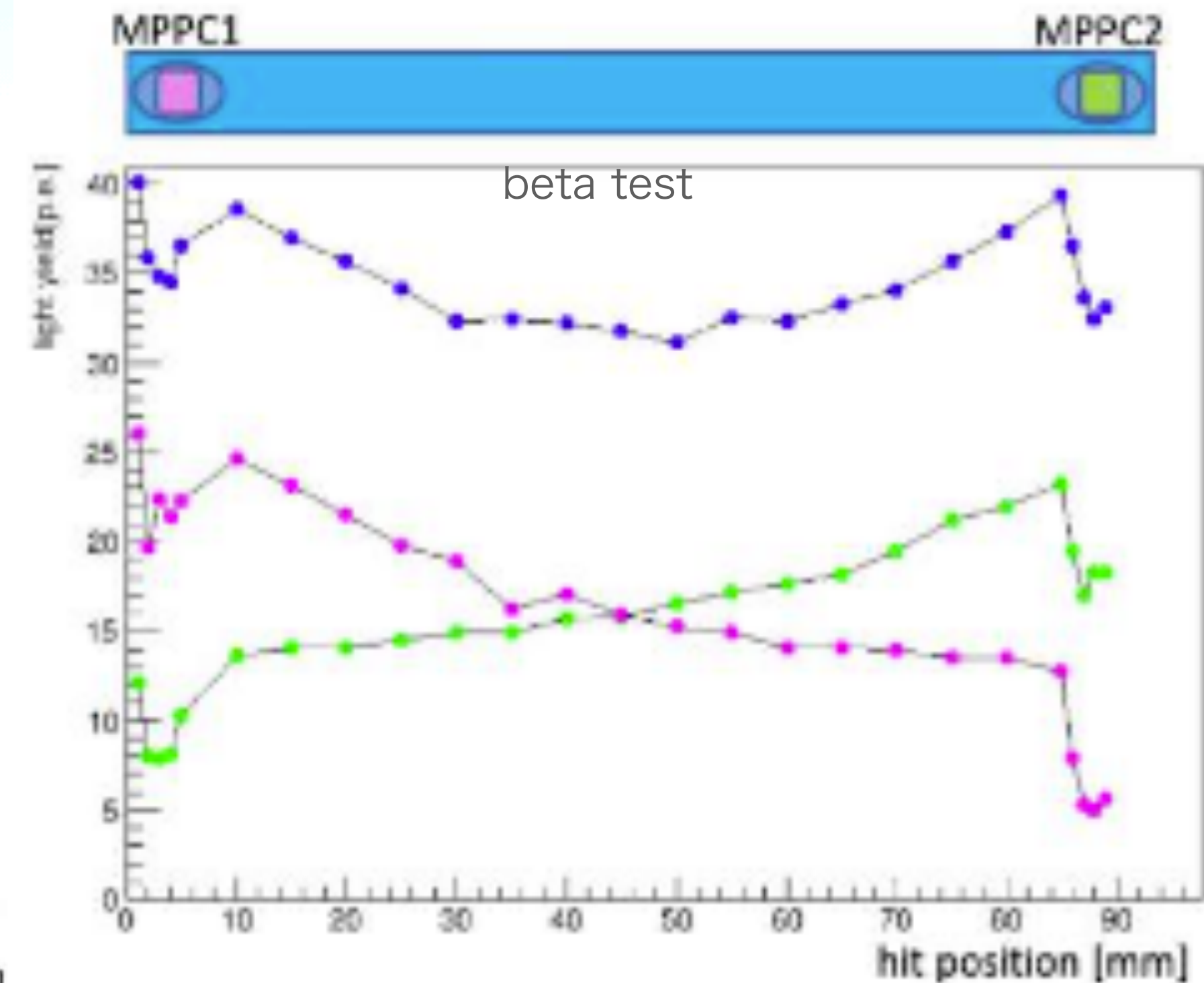
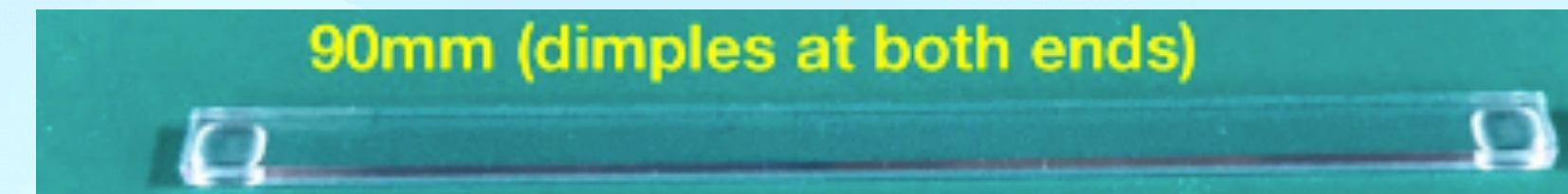
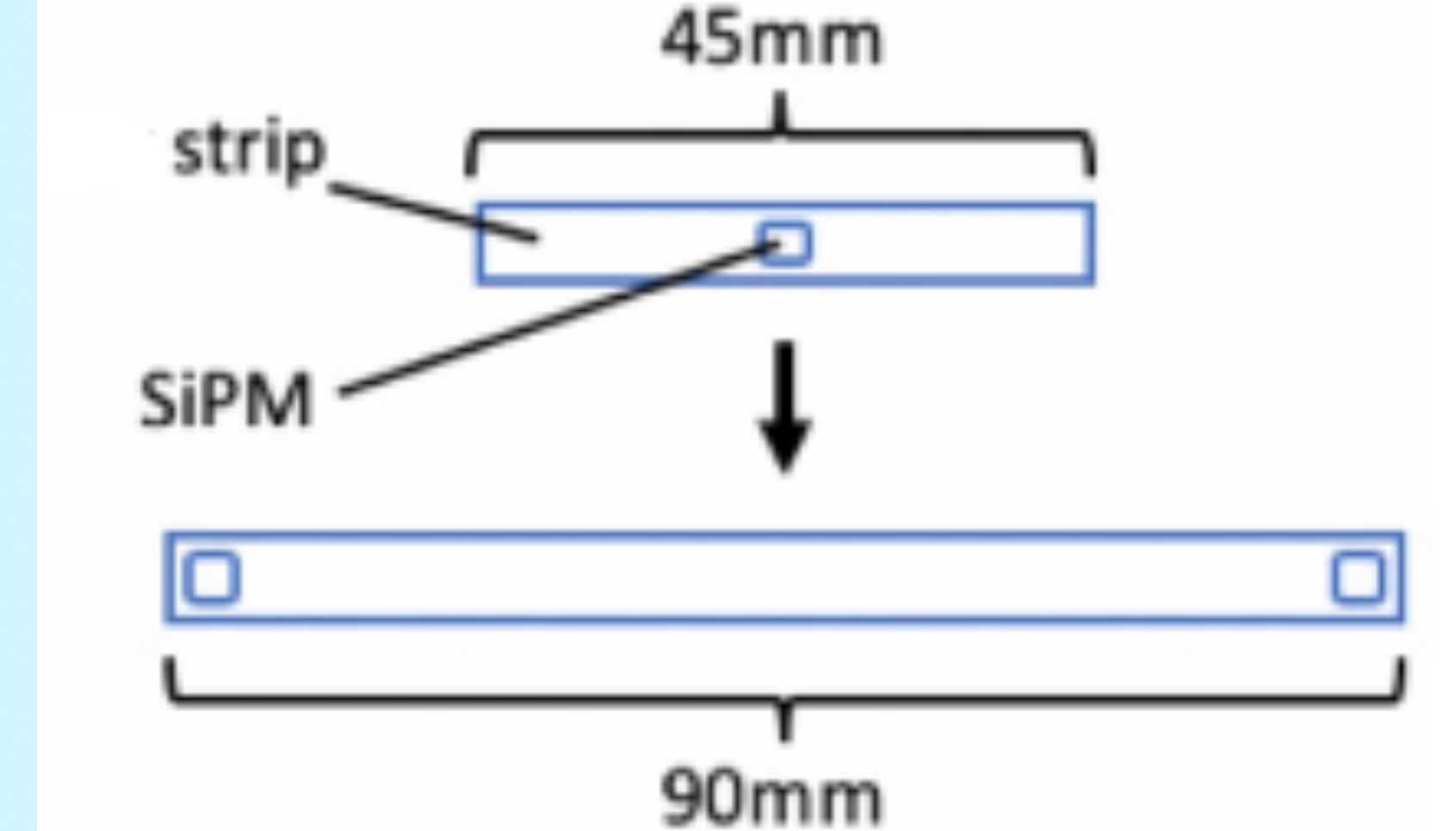
- High & Low gain amp.
- LED calibration
- MIP calibration
- sim vs data



Scintillator strip ECAL

Long strip option (W.O + ???)

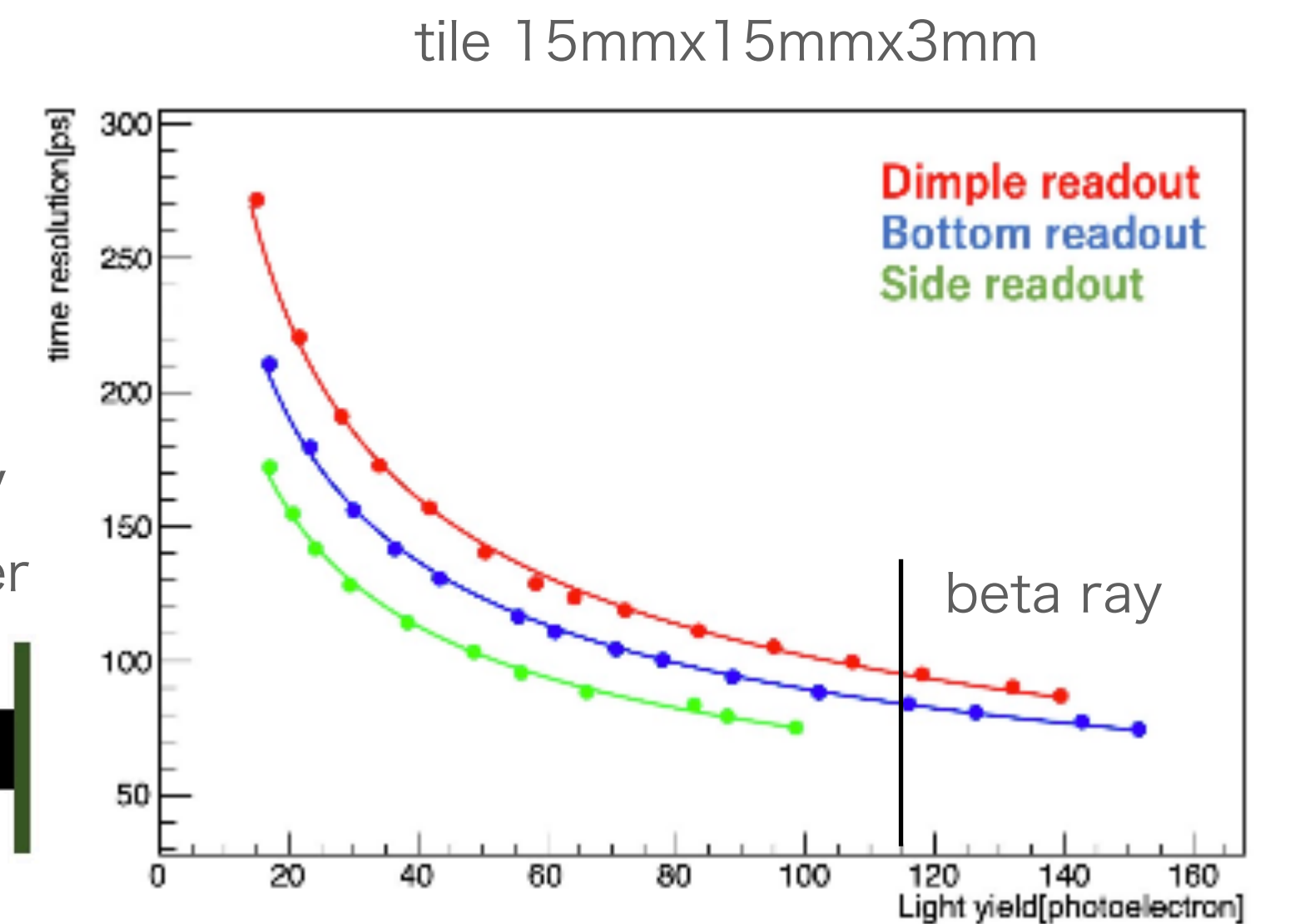
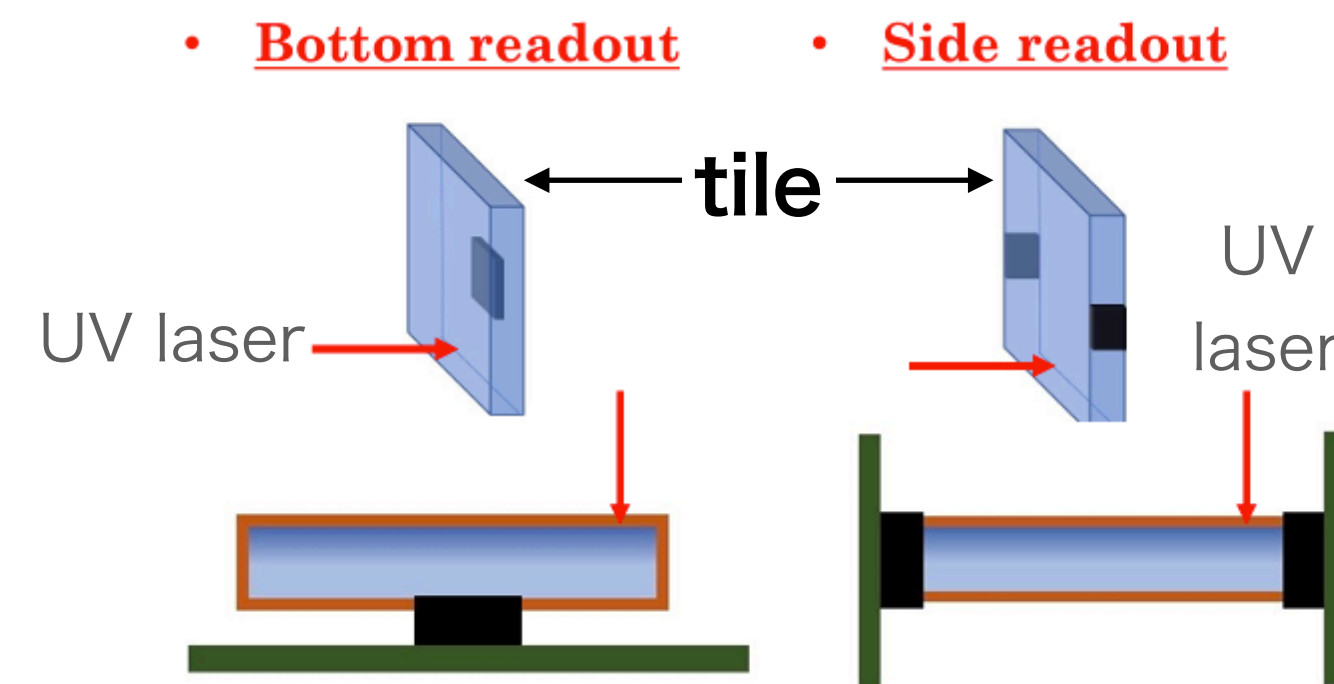
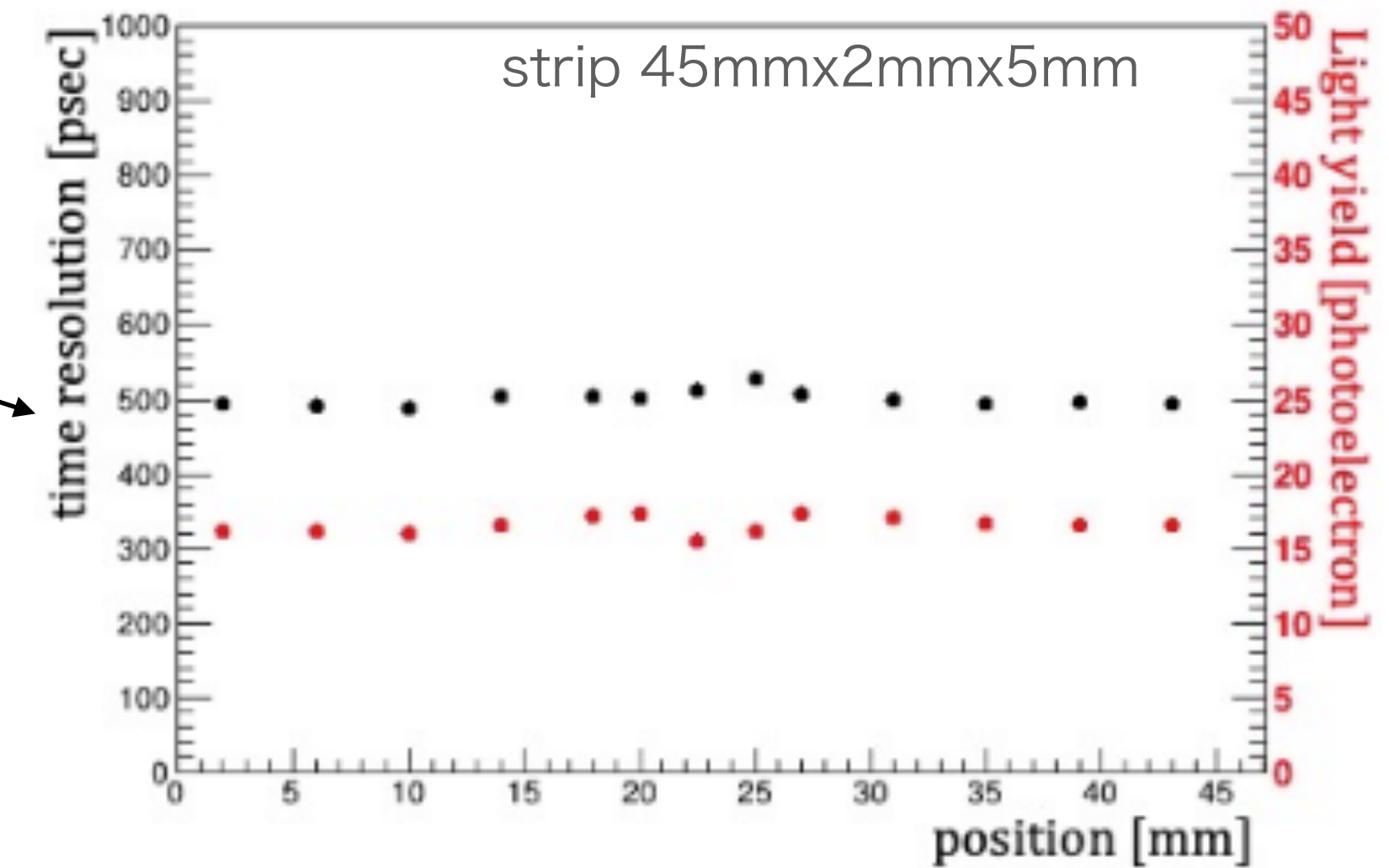
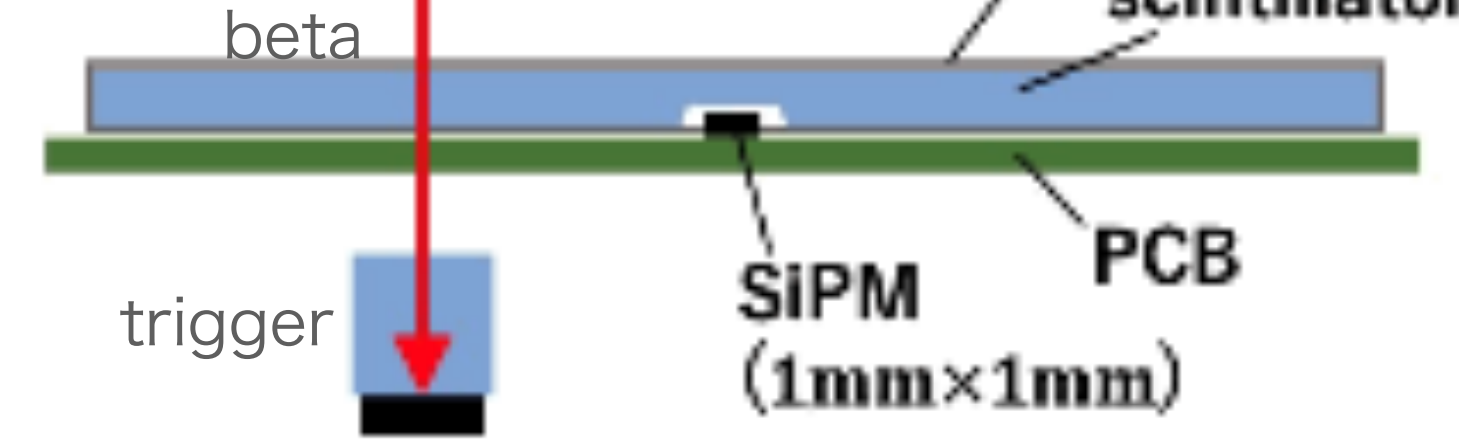
- installed scECAL at the last 2 layers in X&Y
- Beam test data analysis on going
- remove accidental data by taking coincidence with two sensors.
- remove ghost hits by chase division.
- position resolution=2cm
- improve timing resolution ?



Scintillator Strip/Tile CAL

Tile timing option (W.O+ Y.Ueda)

- timing by waveform digitizer at 25%
- ECAL ScStrip with dimple (single MPPC) :
~500ps
- tile layer (smaller, four MPPCs, side RO) :
15x15x3mm³
~70ps
- timing resolution $\propto 1/\sqrt{LY}$

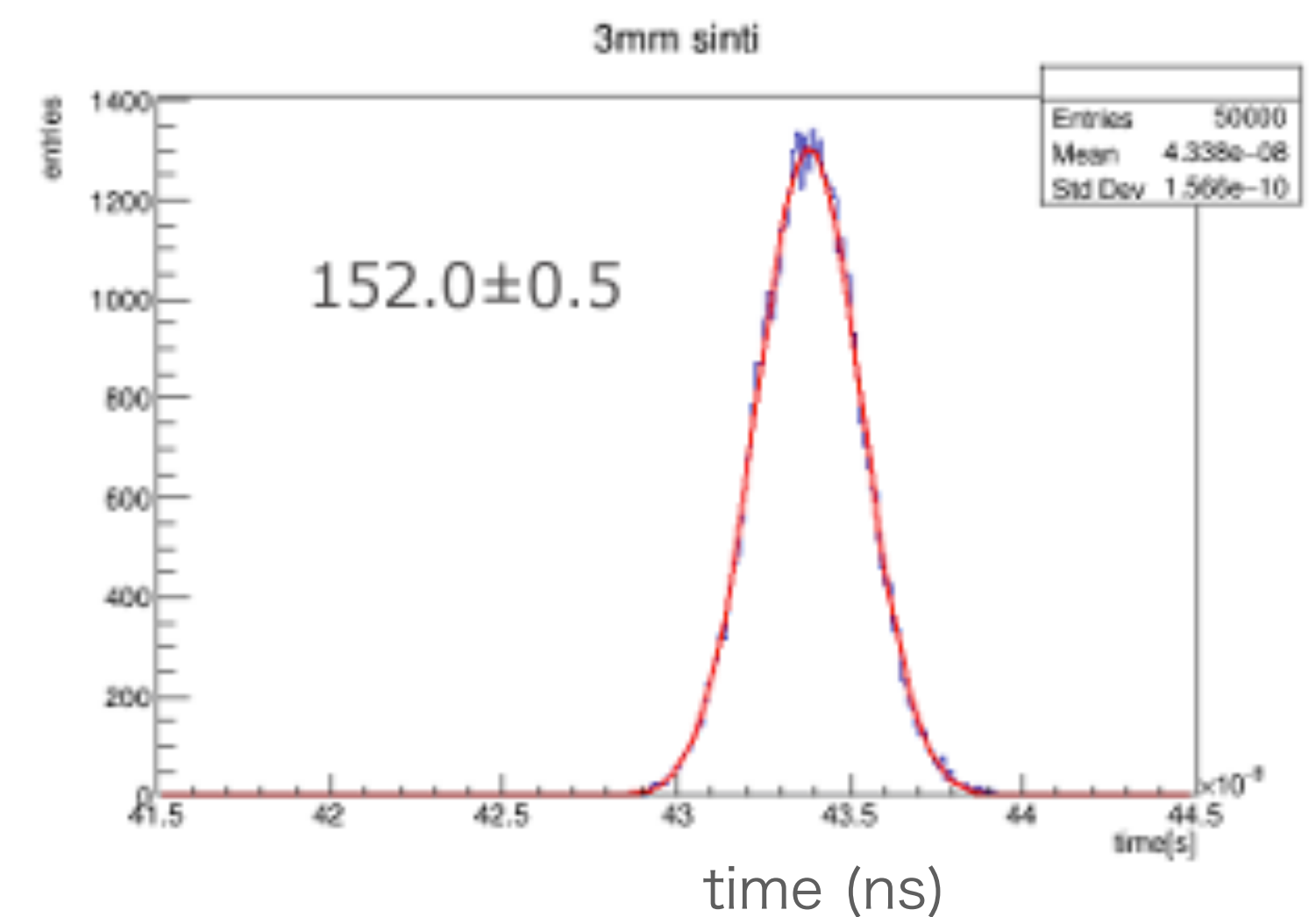
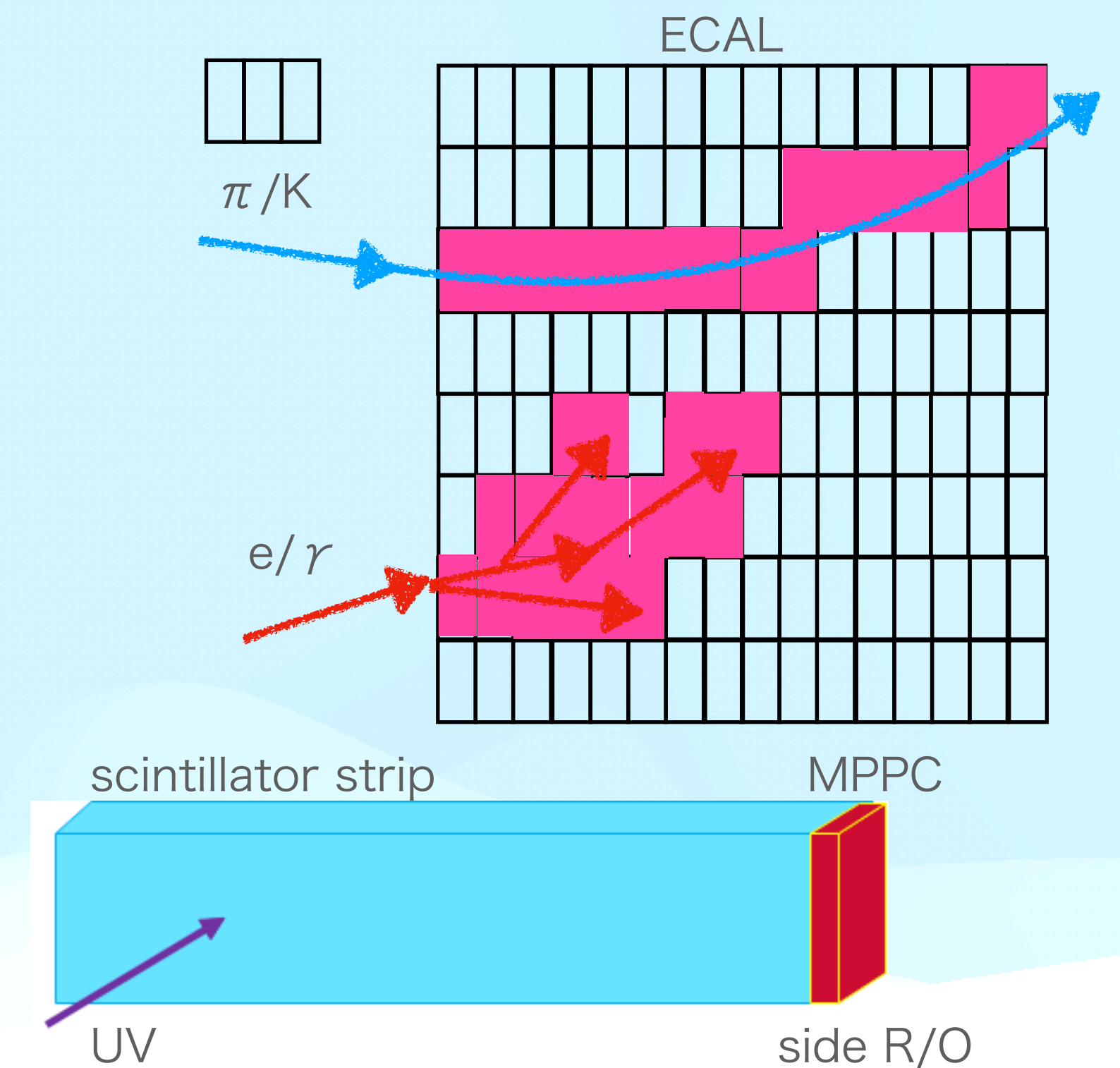


by UV Laser light

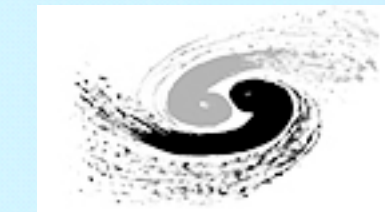
Scintillator strip ECAL

strip timing option (T.T+ M.Ishitani)

- timing resolution $\propto 1/\sqrt{Npe}$: increase LY
- UV 375um laser
 - MPPC : large # photons : 9ps
 - a few photons : 90ps
 - strip one side R/O : 152ps
 - beta ray test
 - >> strip single/double sides R/O
 - >> planning EM shower to increase LY >> better timing



Scintillator Tile HCAL

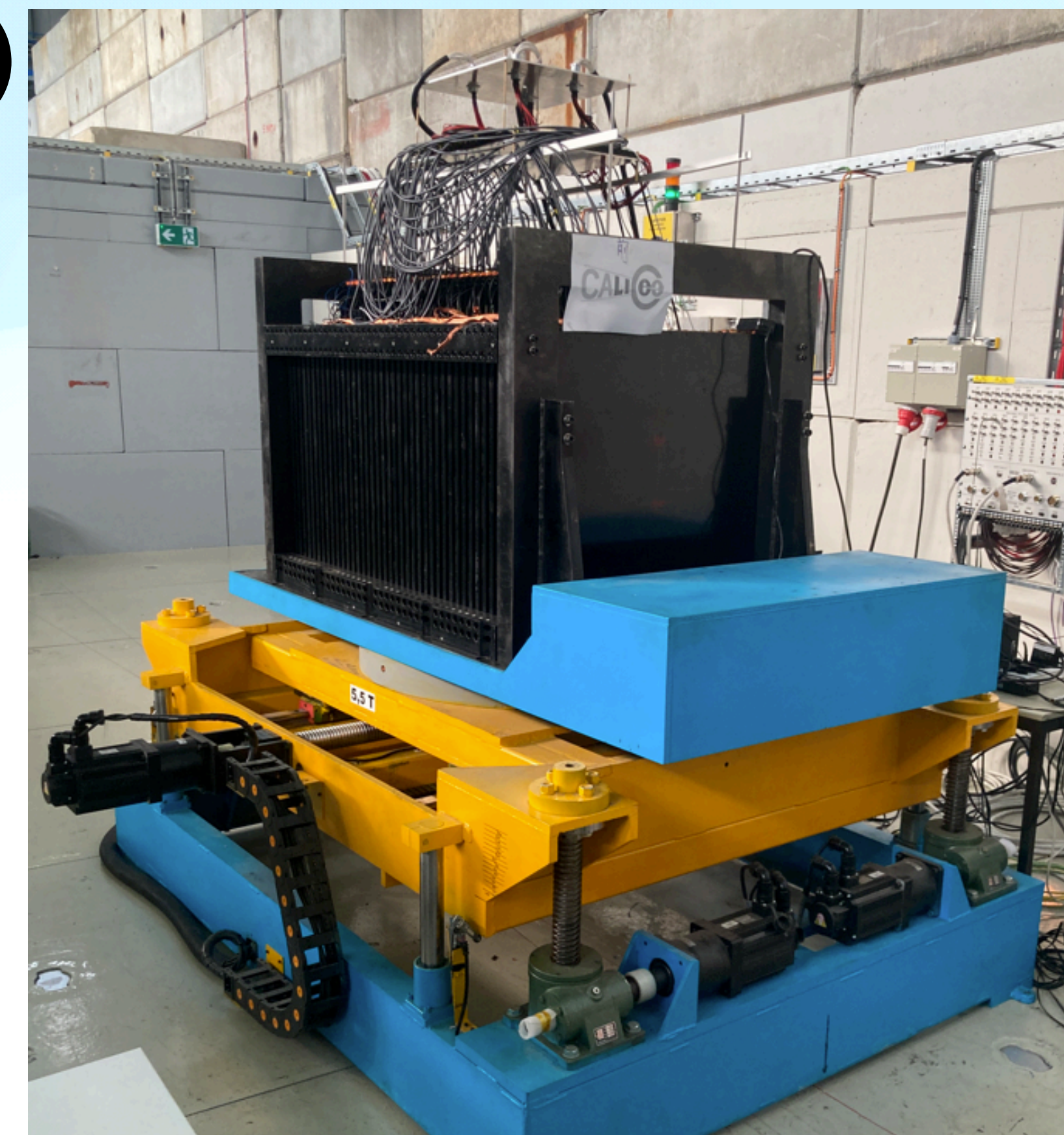


Institute of High Energy Physics
Chinese Academy of Sciences

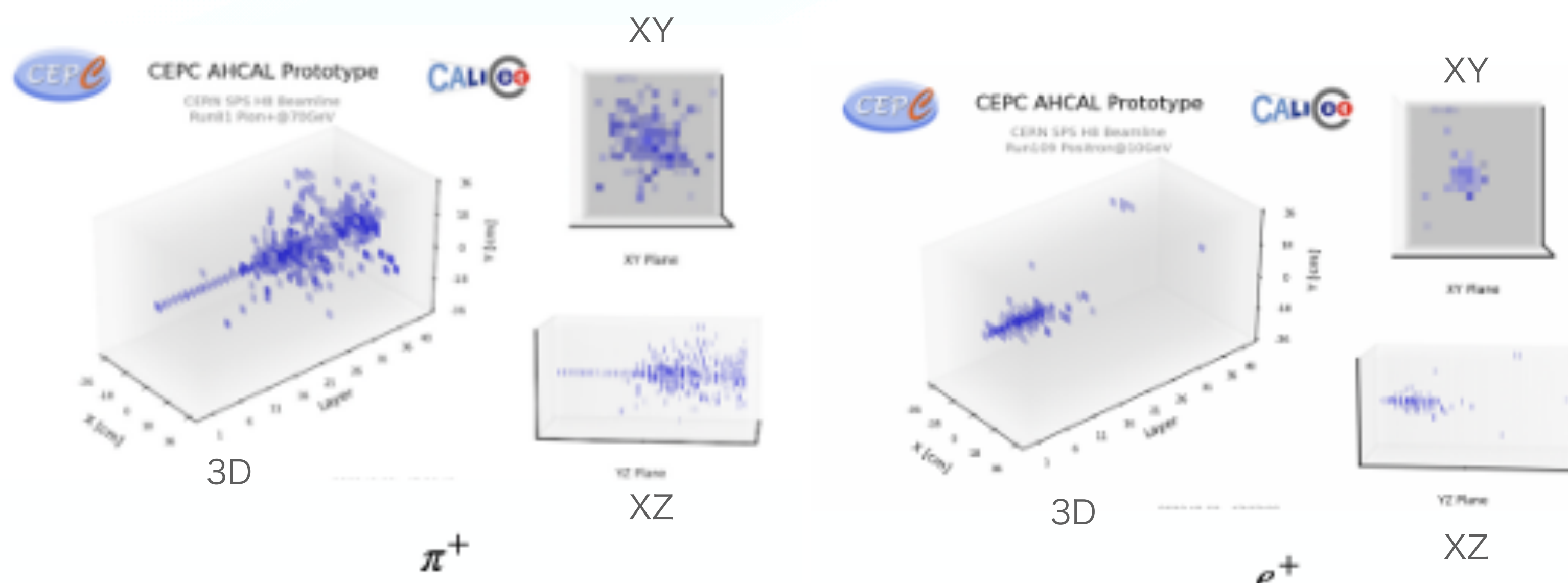


Tile HCAL Beam test (W.O + R.Masuda, T. Takatsu)
with CEPC Institutes (USTC, IHEP and SJTU)

- Beam Test at CERN SPS and PS at 2022, 2023)
- 4x4x0.3cm³: 18tile x18tile/layer * 40 12960ch



CERN-PS-T10

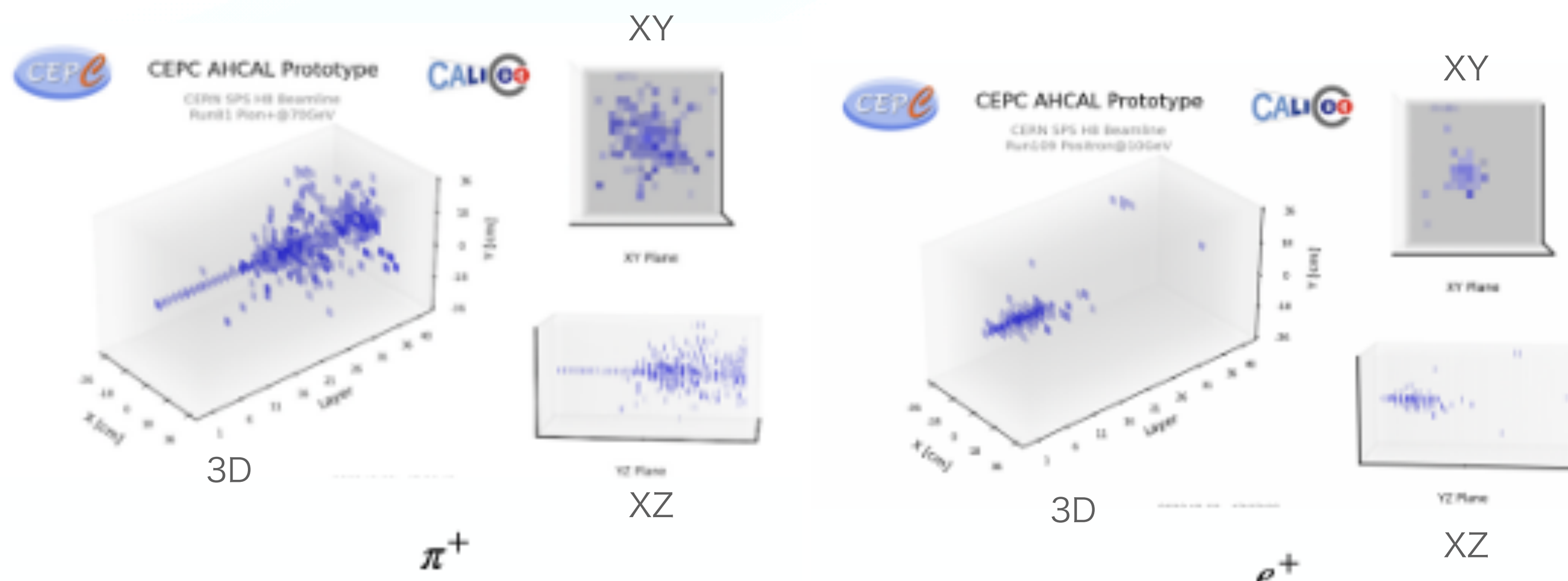
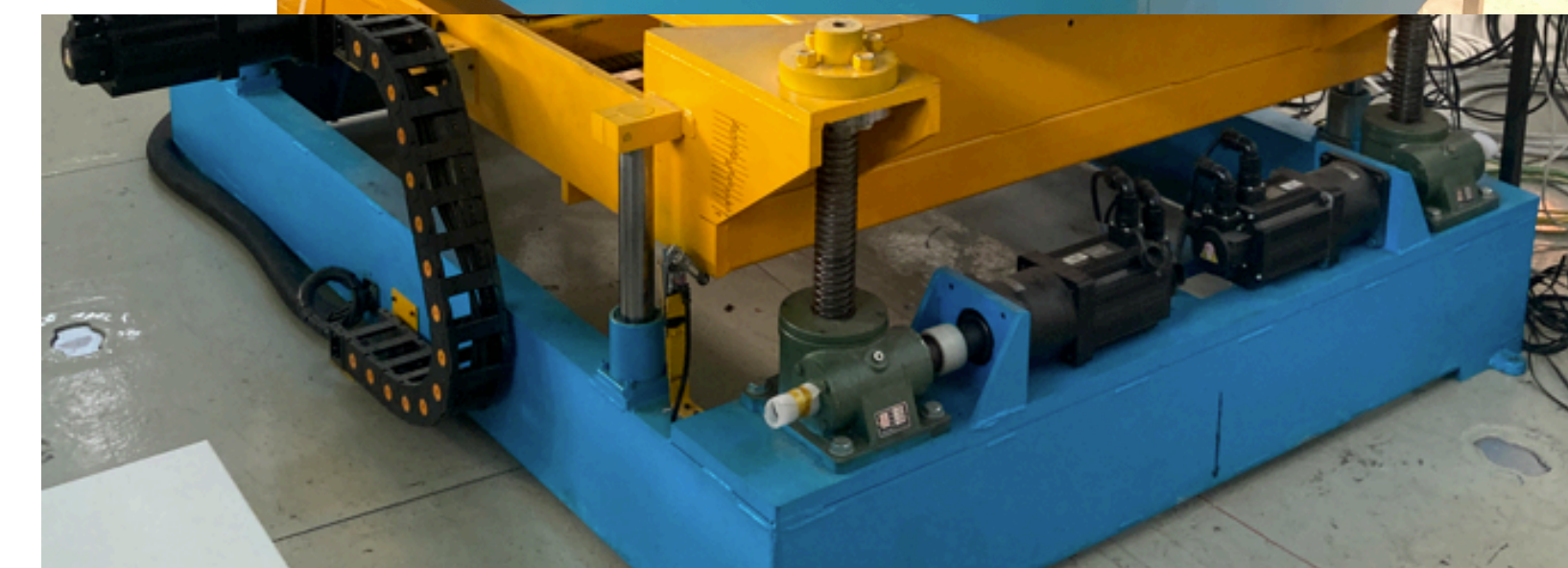


Scintillator Tile HCAL



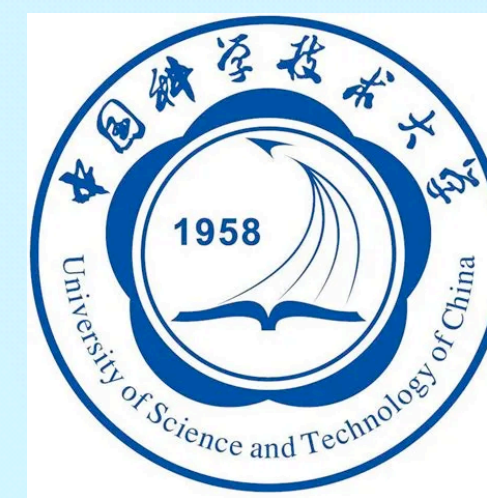
Tile HCAL Beam test (W.O + R.Masuda, T. Takatsu)
with CEPC Institutes (USTC, IHEP and SJTU)

- Beam Test at CERN SPS and PS at 2022, 2023)
- $4 \times 4 \times 0.3 \text{ cm}^3$: 18tile x18tile/layer * 40 12960ch



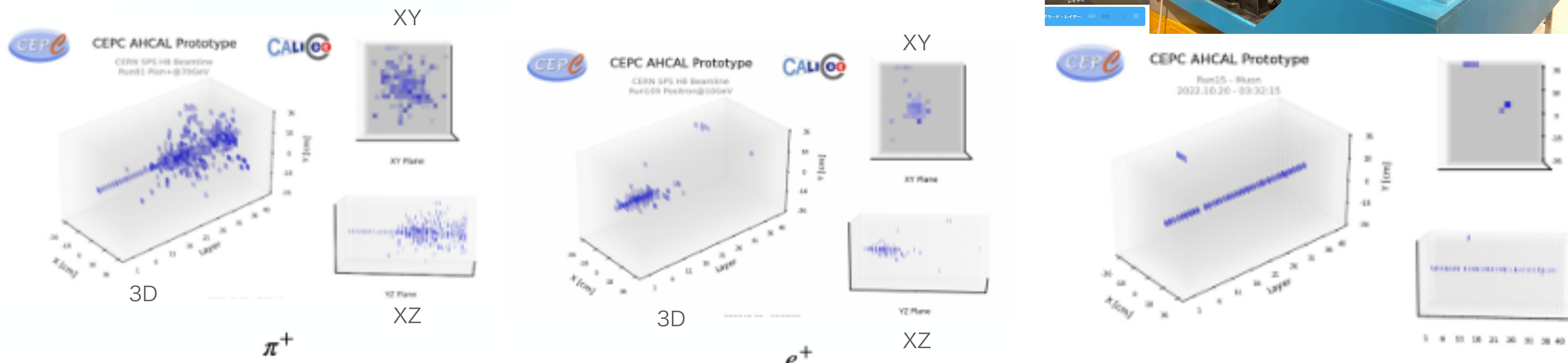
CERN-PS-T10

Scintillator Tile HCAL



Tile HCAL Beam test (W.O + R.Masuda, T. Takatsu)
with CEPC Institutes (USTC, IHEP and SJTU)

- Beam Test at CERN SPS and PS at 2022, 2023)
- 4x4x0.3cm³: 18tile x18tile/layer * 40 12960ch



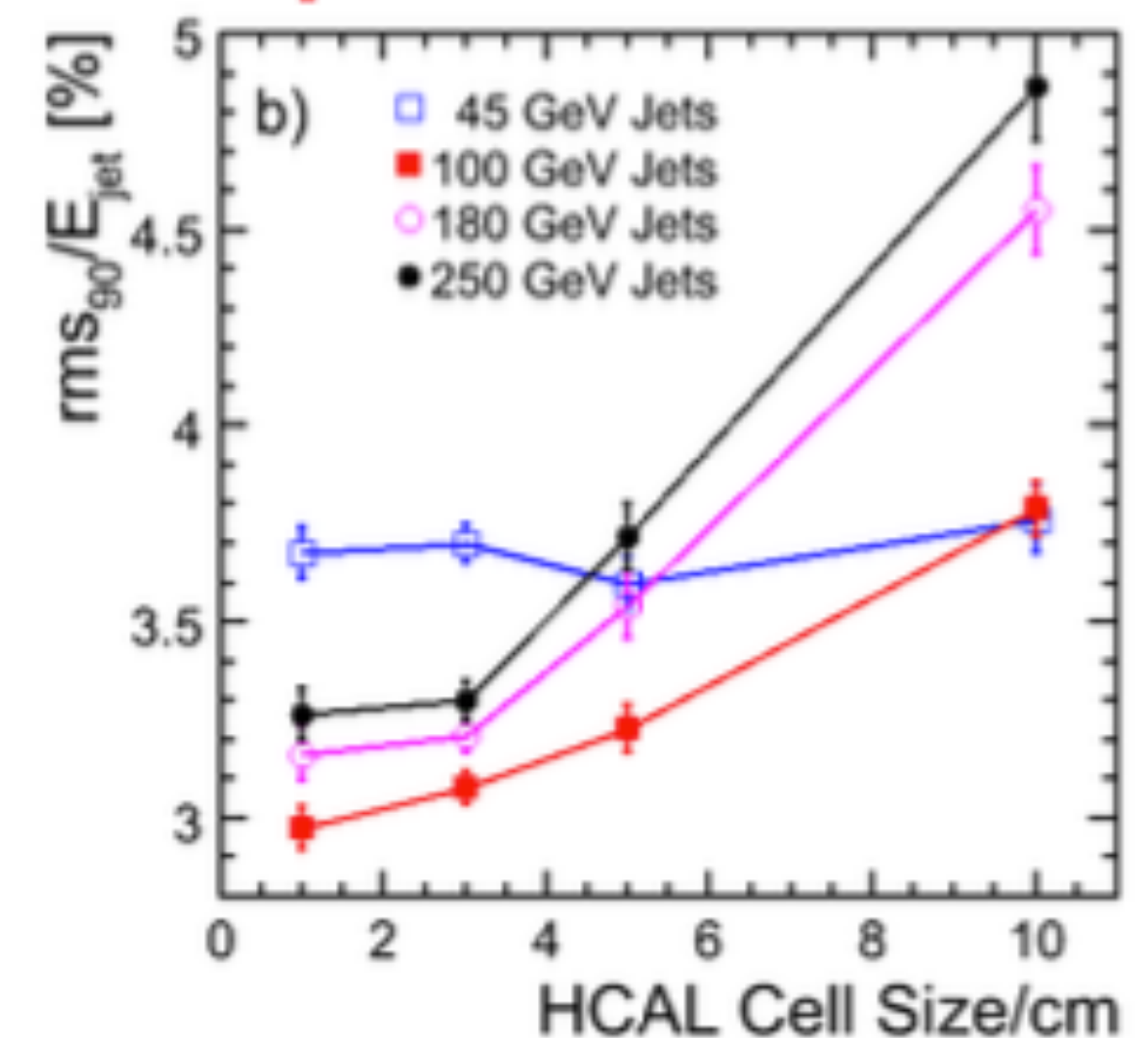
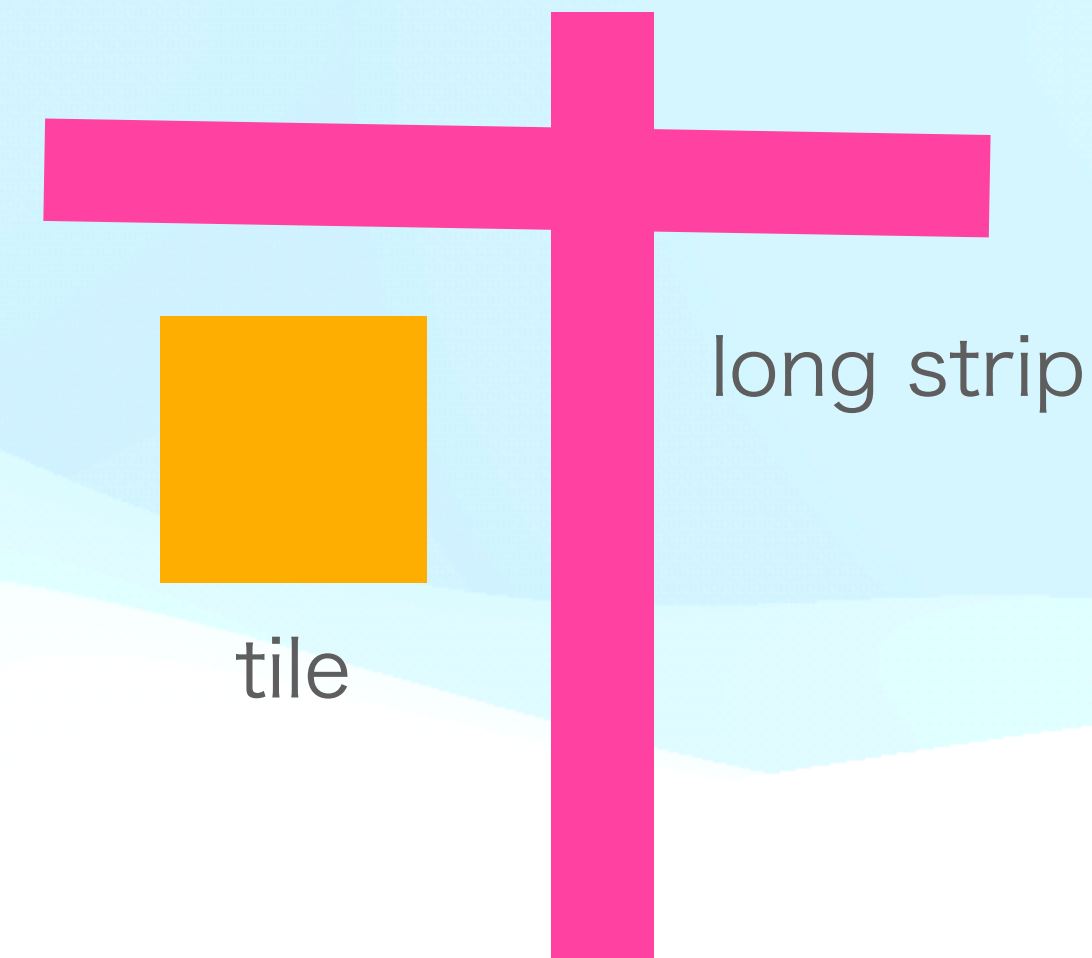
Scintillator Strip HCAL

long strip HCAL (W.O, T. Takeshita)

- improve timing for π/K separation
 - need modified ASIC from SPIROC
 - keep the same number of channel
 - $3 \times 3 \text{cm}^2$ tile $>$ $1 \times 9 \text{cm}^2$ strip with double readout
- no-gain for Jet Energy resolution



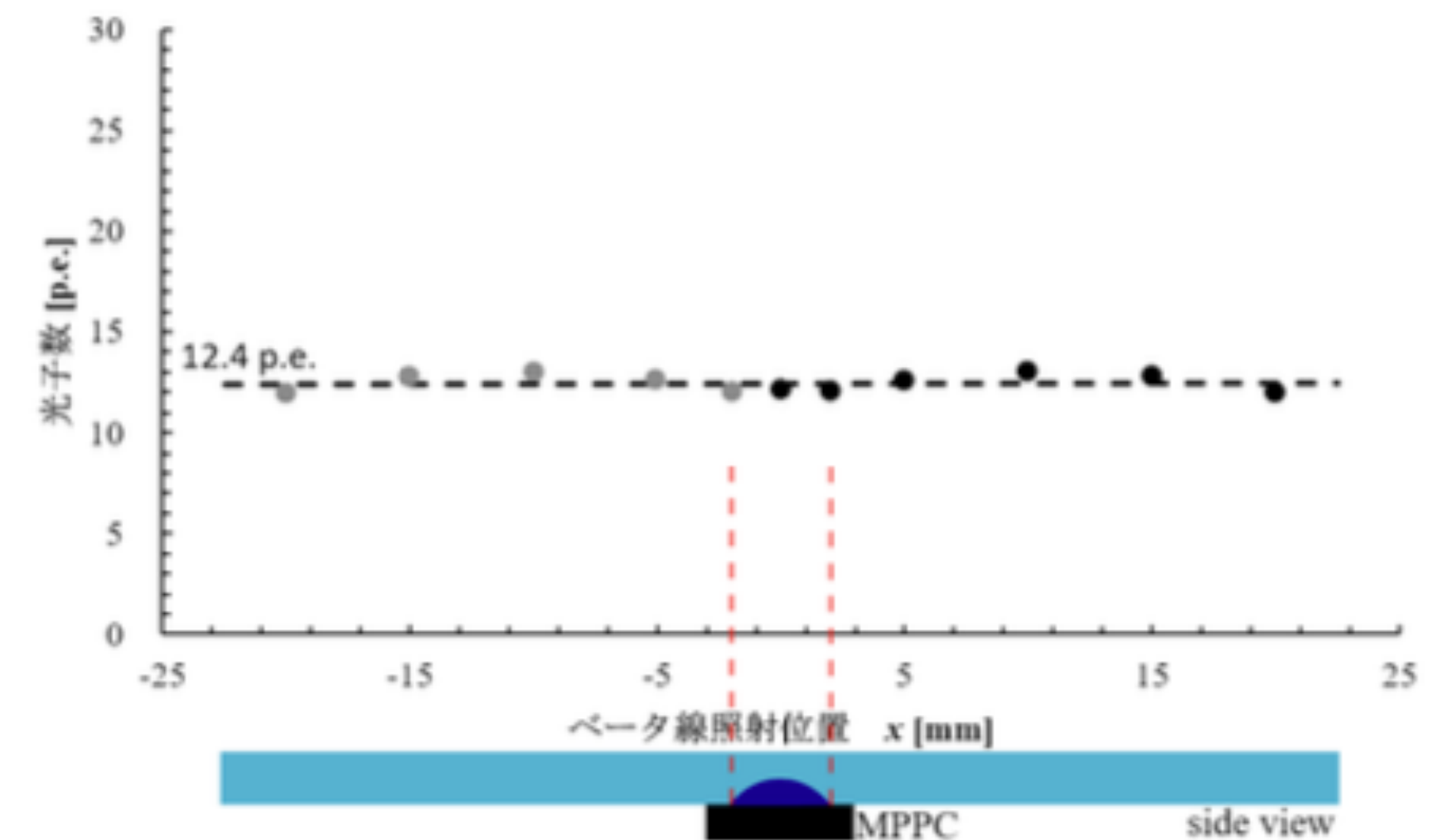
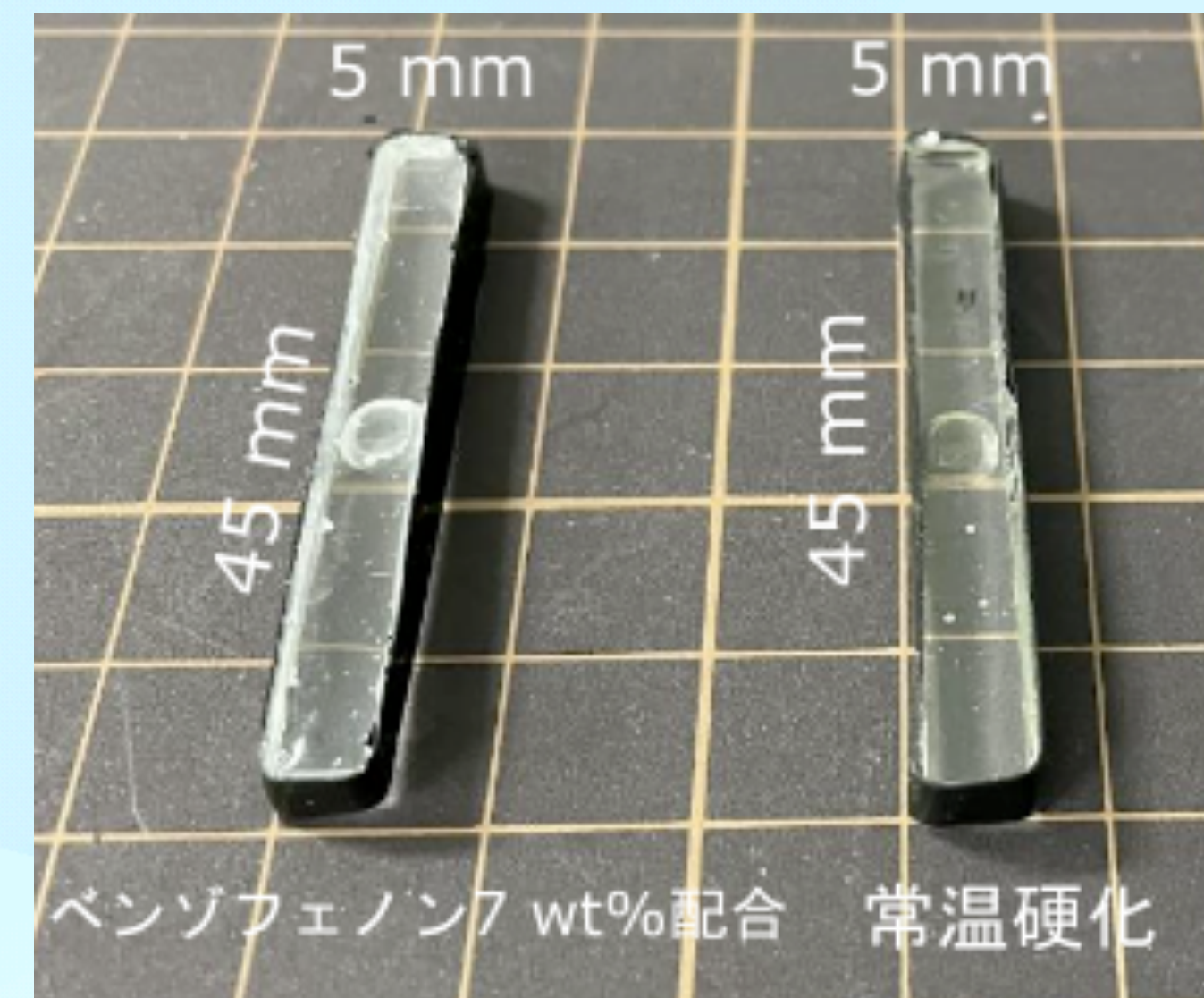
Institute of High Energy Physics
Chinese Academy of Sciences



scintillator production

Cured at room temp. (E.Saito, Nagano TS,
H.Ono, NDU)

- handmade from scratch
- LY ~ 1/2 of EJ204
- good uniformity



Summary and outlook

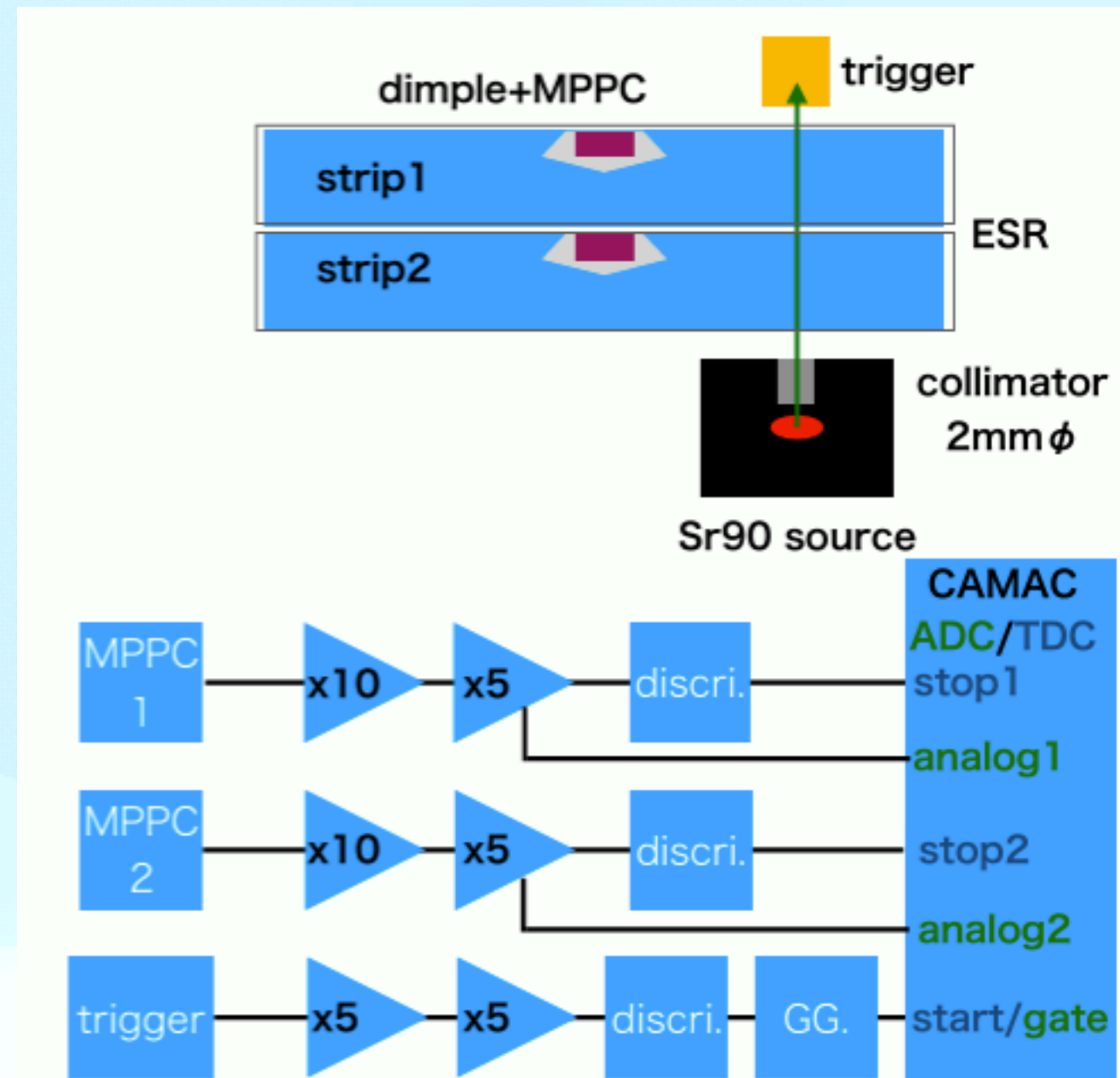
For ILD-cal toward Fccee

- Improvement current ILD- e^+e^-
 - timing layer(s) ECAL - LGAD, strip-double readout
 - timing layer(s) HCAL - long strip-double readout
- Improvement/modification to ILD-Fcc
 - RDR6 / US collaboration

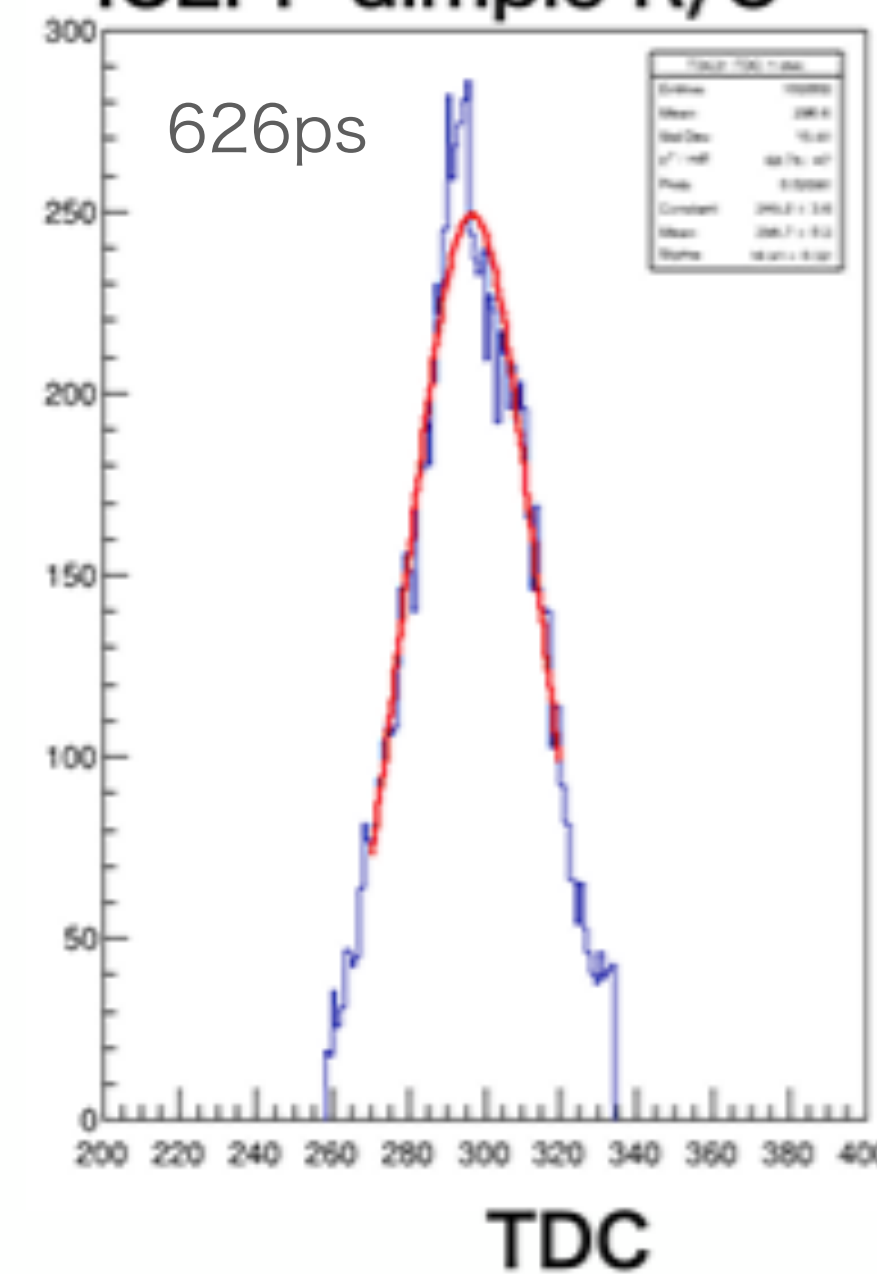
Scintillator Strip ECAL

timing measurement

- with two strips
- time resolution is divided by $\sqrt{2}$
- dimple readout : 626ps (33p.e.)
- side readout : 316ps (~50p.e.)



ICEPP dimple R/O



EJ204 side R/O

