recent status of Japanese scintillator ECAL development

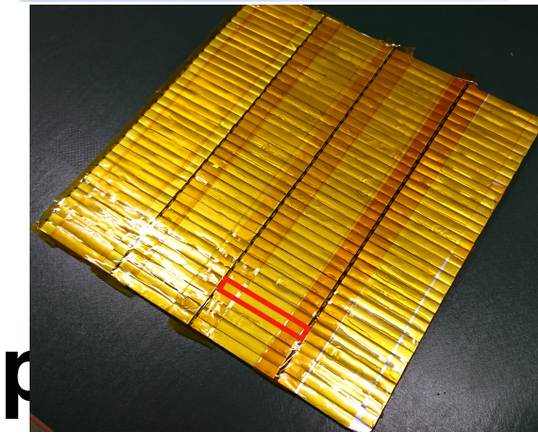
CALICE @ Utrecht 11April2019

T.Takeshita

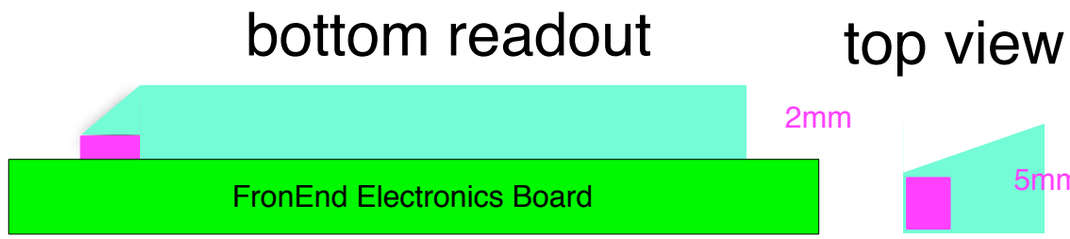
EBU : bench and Test Beam at ELPH
scintillator design with collaboration
Segmented LGs
cosmic calibration

EBU

- EBU : Ecal Base unit by DESY, 144ch.
- four SPIROC2b's : Omega
- 144 strips with bottom read out (wedged shap

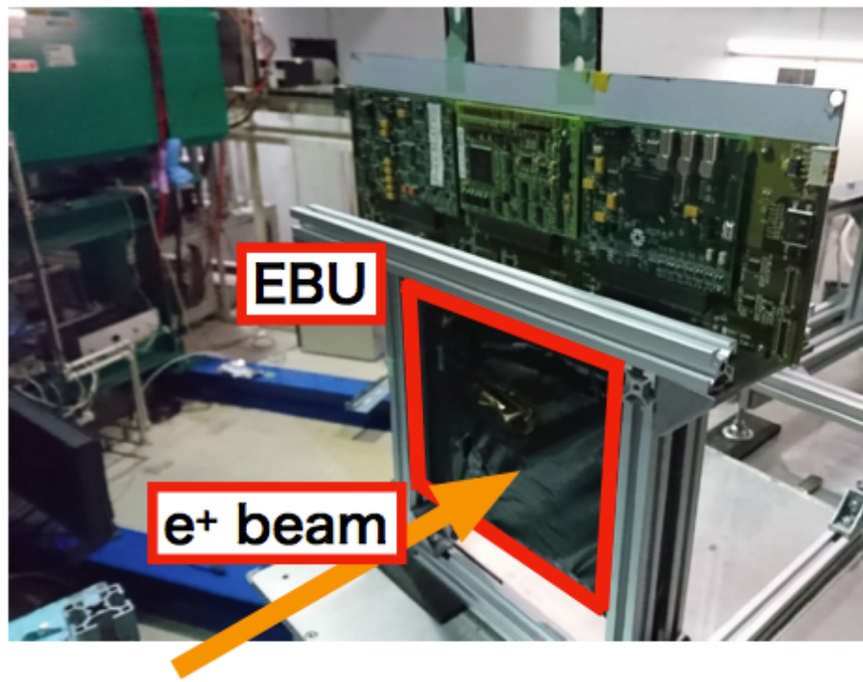


- 15um pitch MPPC
- one layer (lack of DIF)



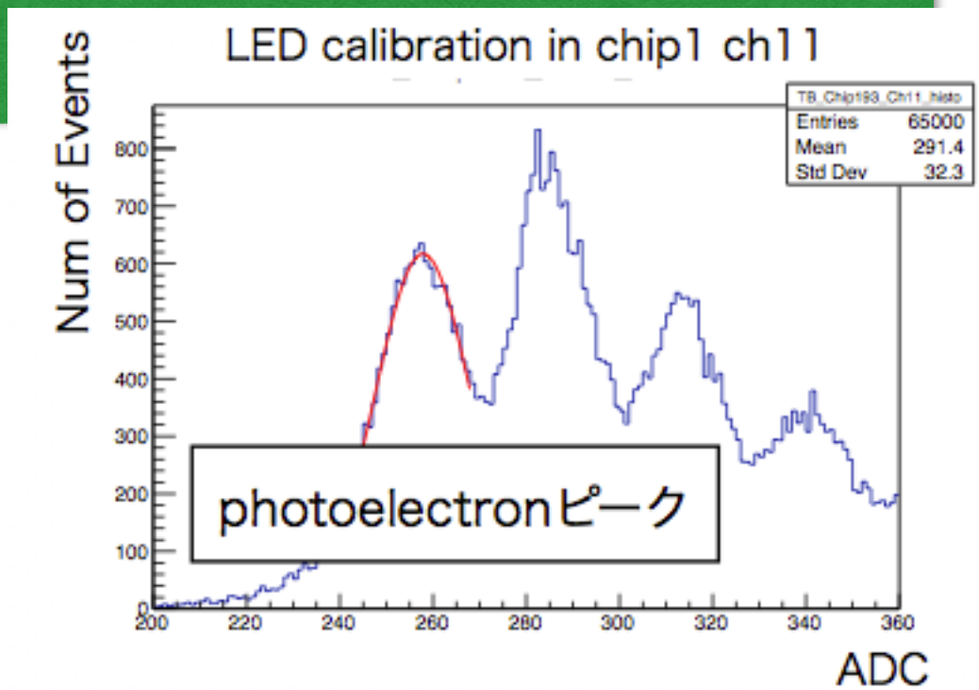
EBU with 15um PPD

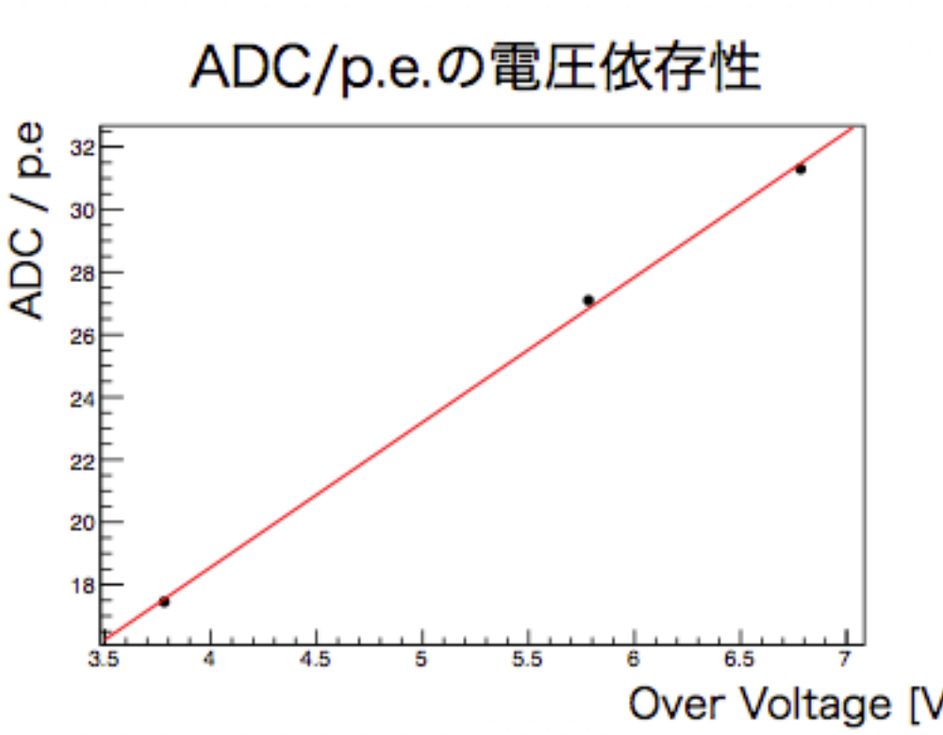
- ELPH is in Tohoku University, Sendai
- Test beam line : <800MeV e+ with enough intensity
- easy to get machine time in two chafes / year
- we carried out BT in Nov.2018
- Segmented Lead glass cal. + EBU,,,



bench test with LED

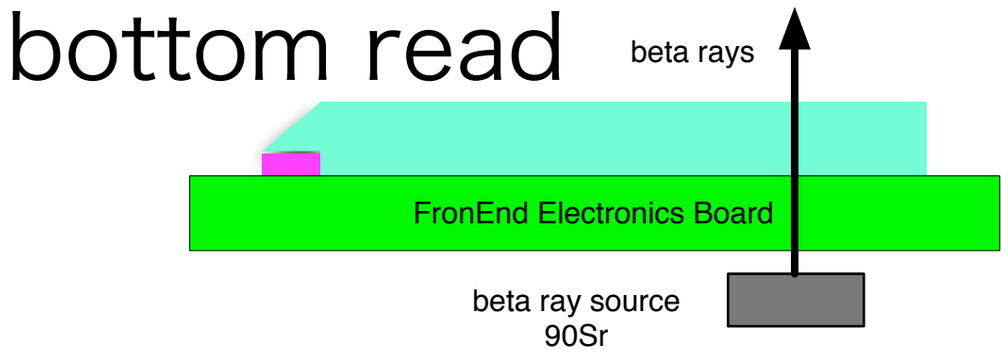
- at Shinshu
- photon separation with LED
  - dV dependent gains
- 116/144 (81%) success
- need fine tuning
- with much effort

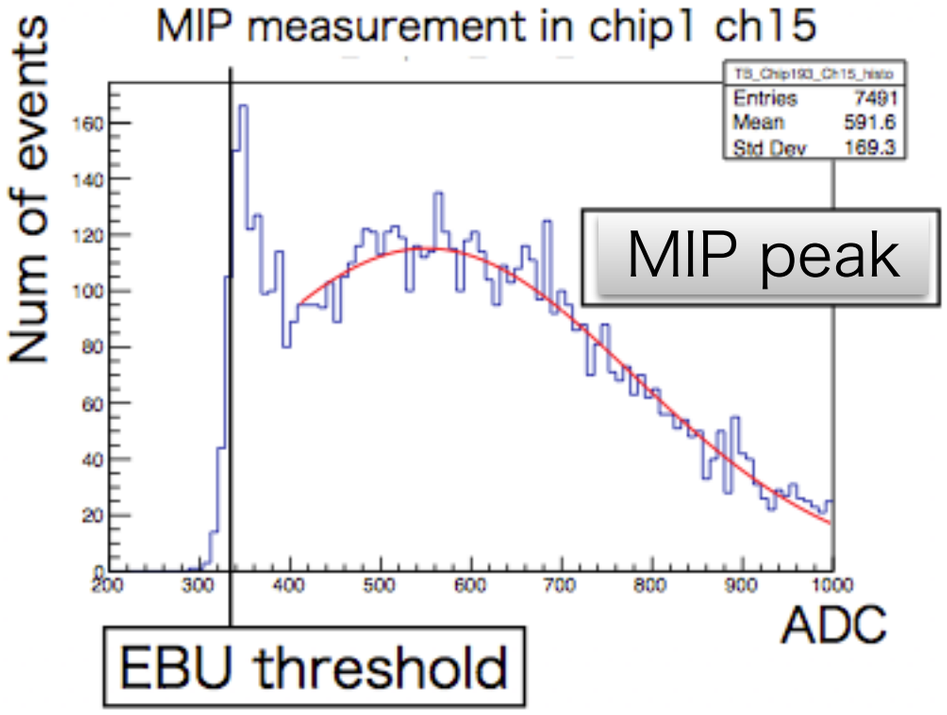


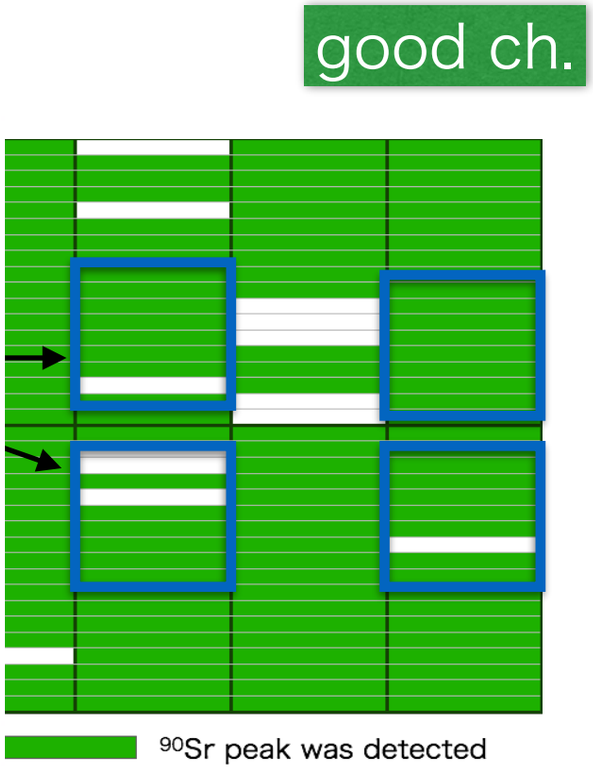


bench test with βray

- **MIP separation from noise**
  - **131/144 (91%) success**
  - **<LY> ~15p.e.**

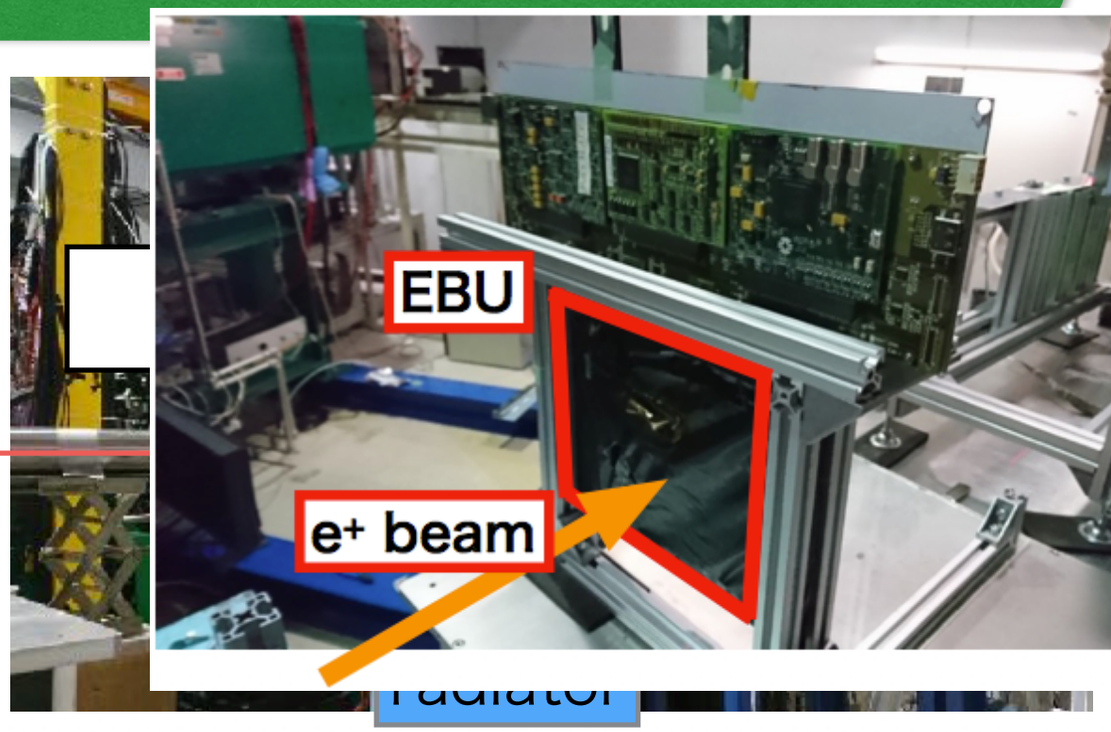


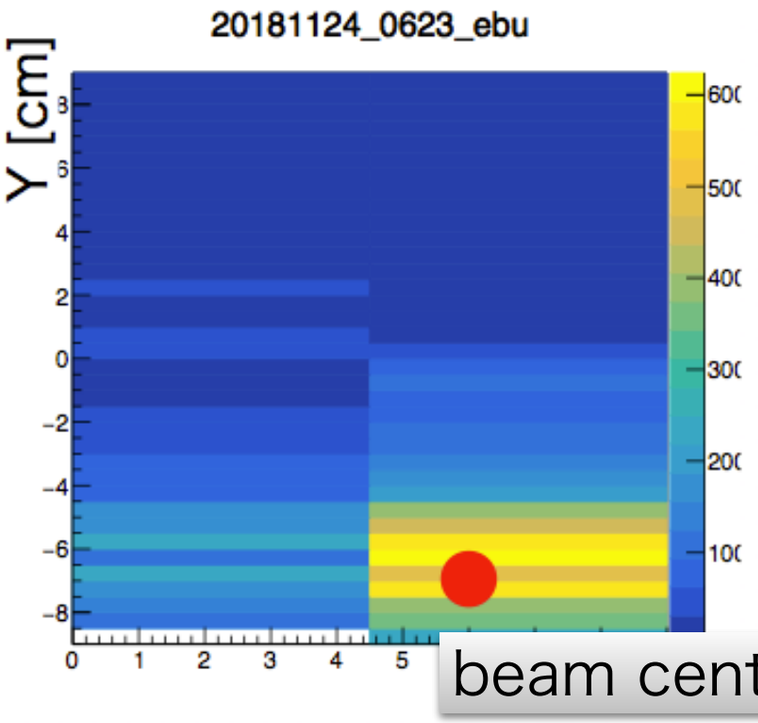


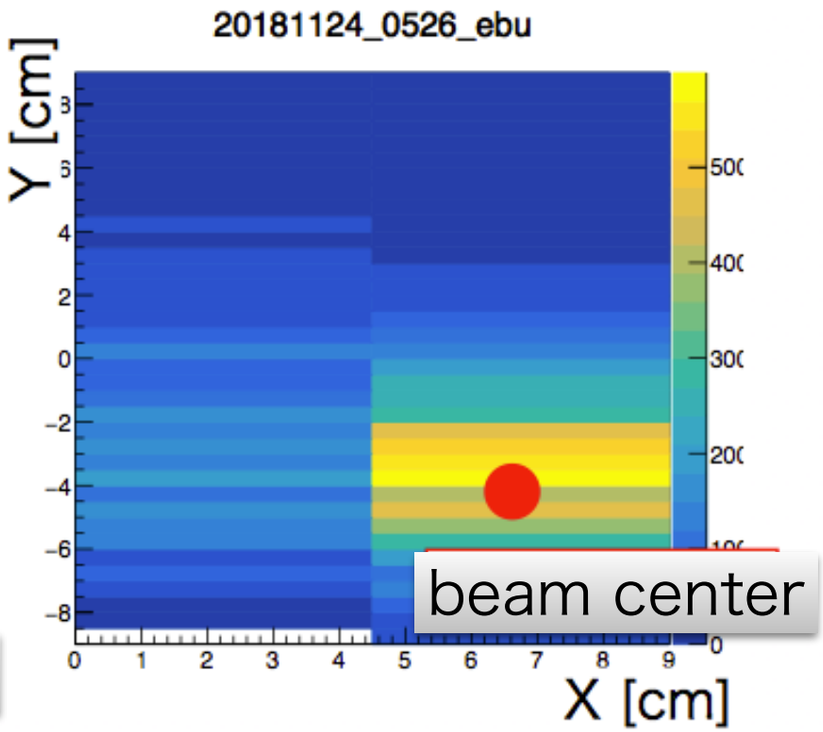


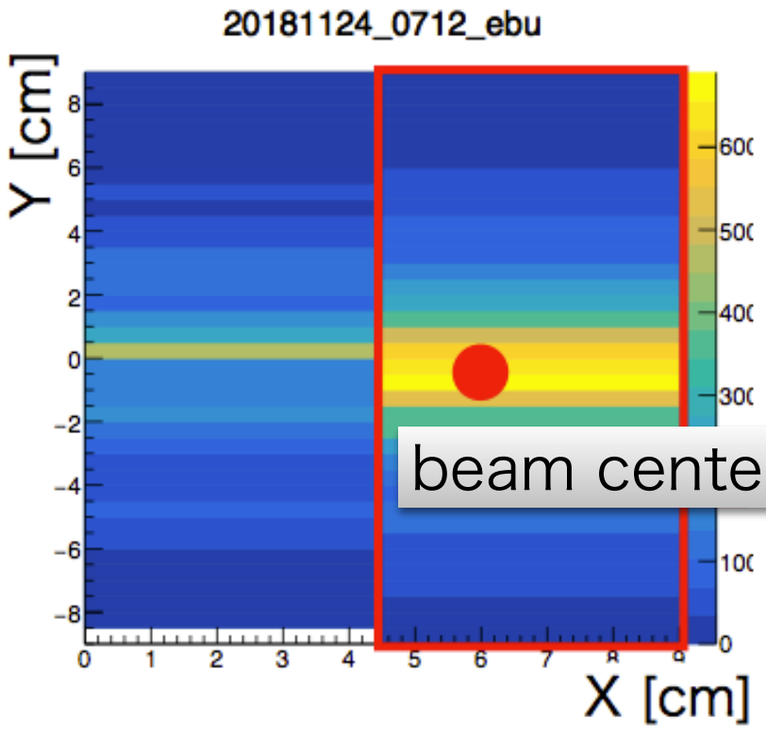
MIP - hit map at TB

- MIP separation from noise
  - a radiator at up stream
  - move EBU



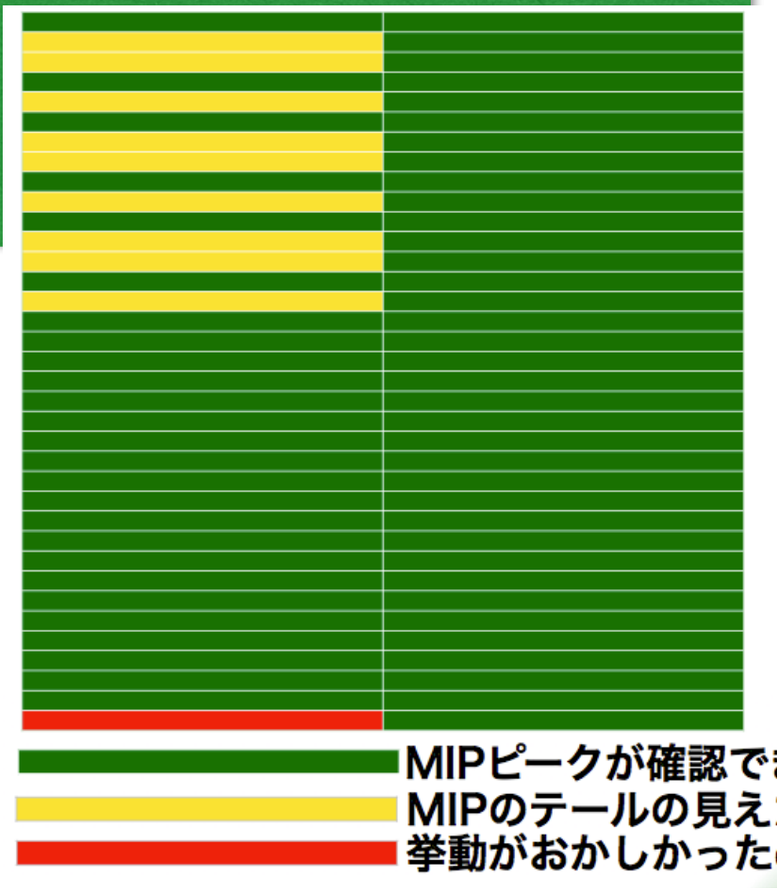


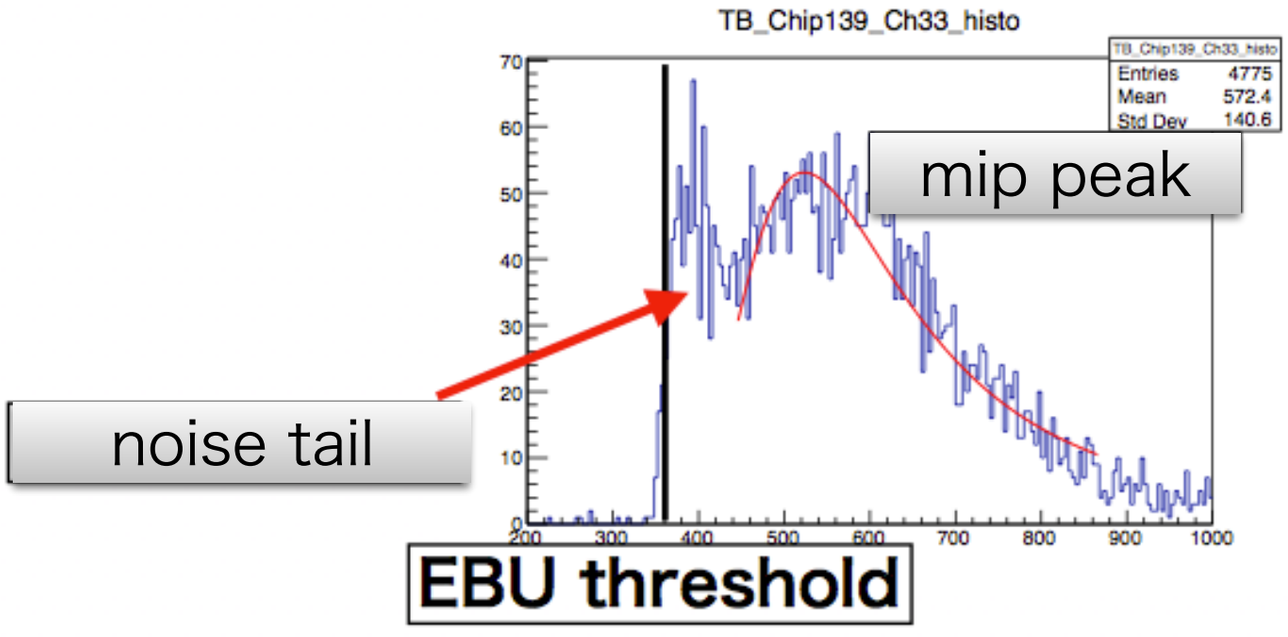


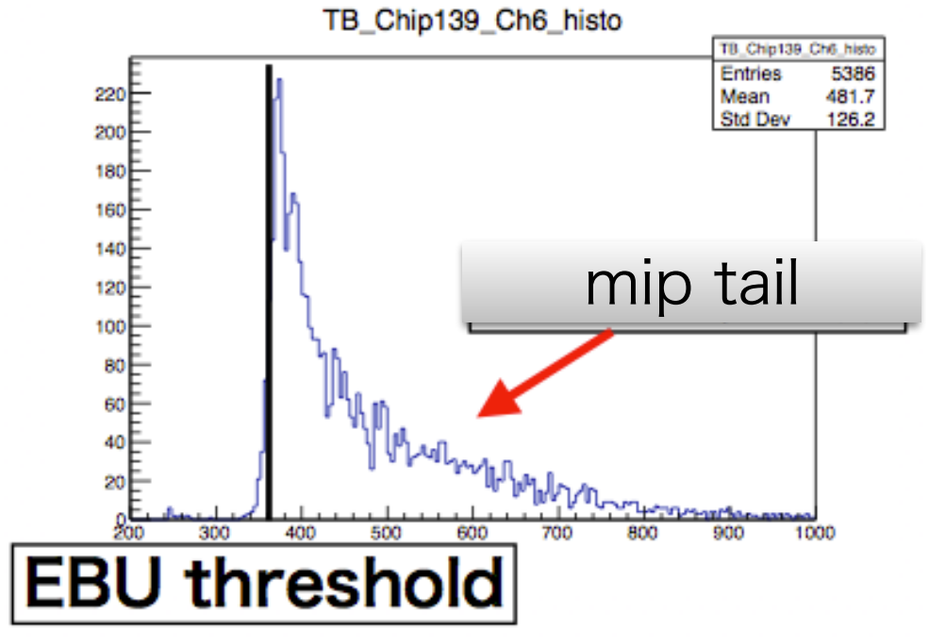


MIPs in EBU

- MIP separation from noise
  - 60/72 (83%) success
  - difficulty for setting common threshold with SPIROC2b
  - HD-MPPC with trench : reduce noise rate







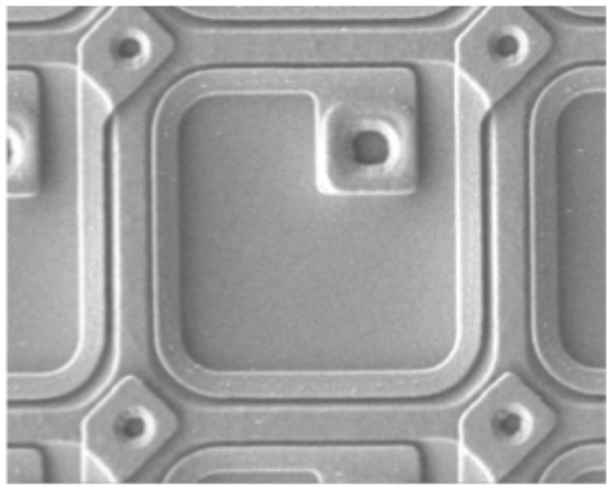
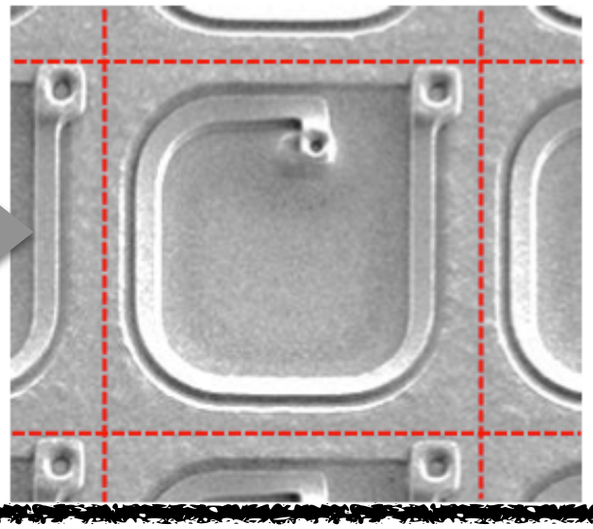
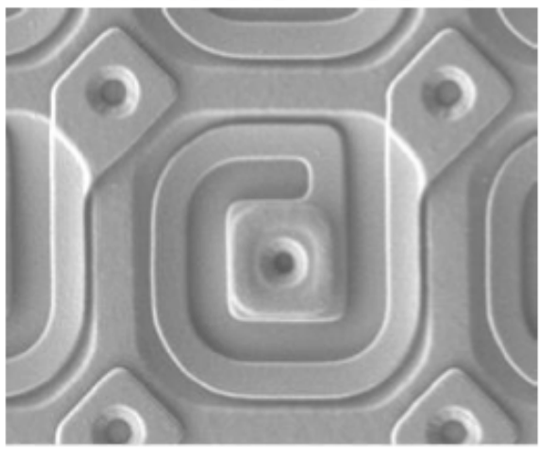
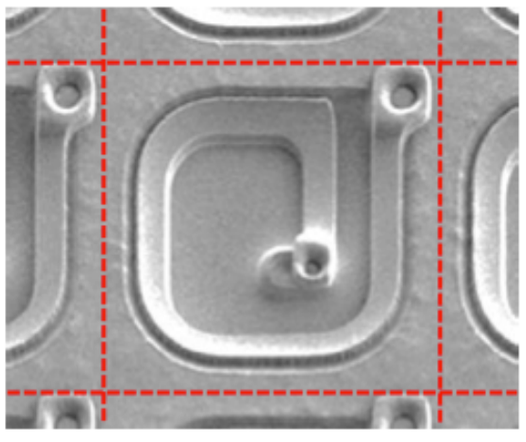
MPPC with trench

- **Hamamatsu announced at PD18**

- **HD-MPPC with trench : reduce noise**

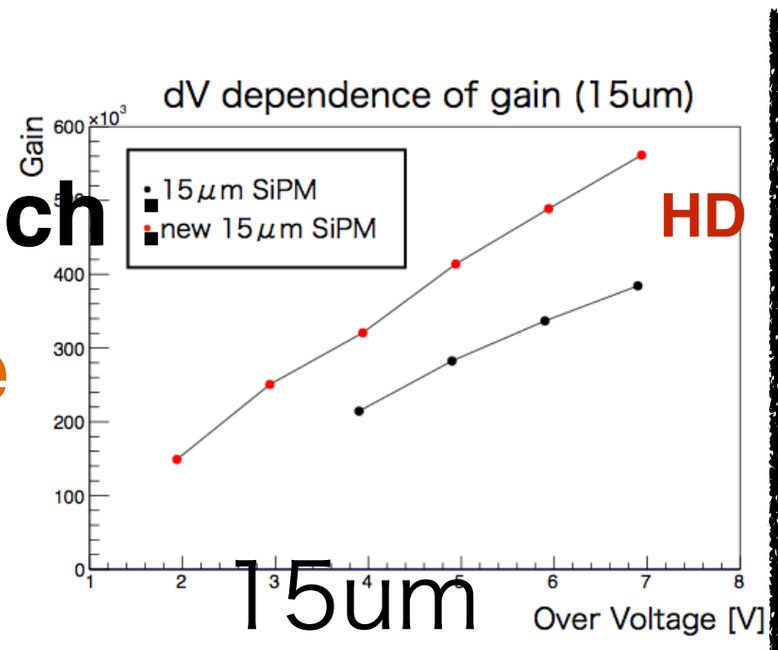
Micro-cell design of new MPPCs

HAMAMATSU
PHOTON IS OUR BUSINESS

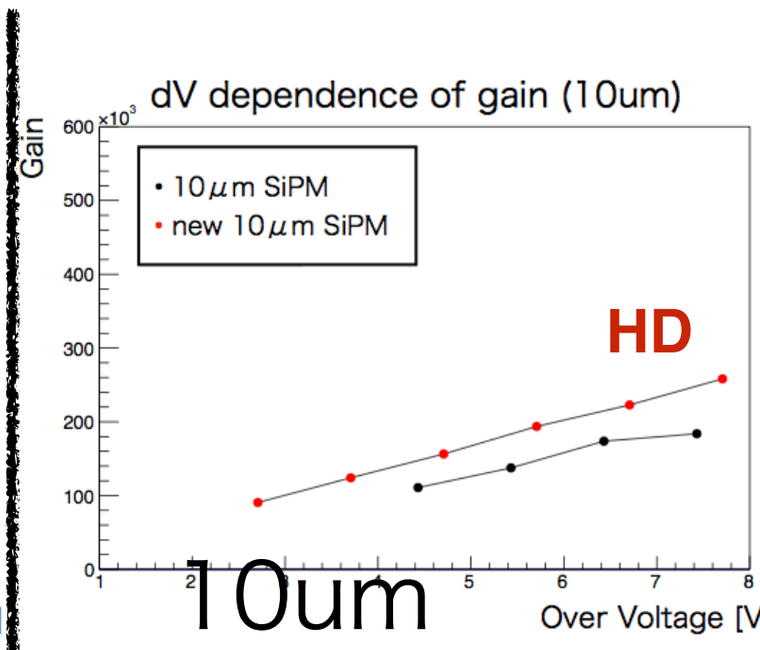
	Old design (w/o trench)	New design (w/ trench)
	we're testing	we'll test this year
15 µm	● Fill factor: 53% 	● Fill factor: 49% 
10 µm	● Fill factor: 33% 	● Fill factor: 31% 

MPPC with trench

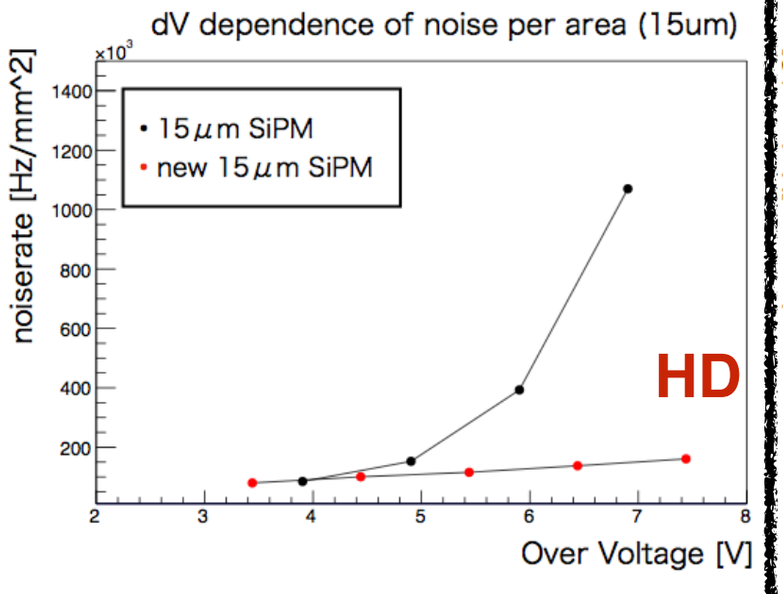
- Hamamatsu announced at PD18
  - higher gain
  - HD-MPPC with trench :
  - reduced noise rate

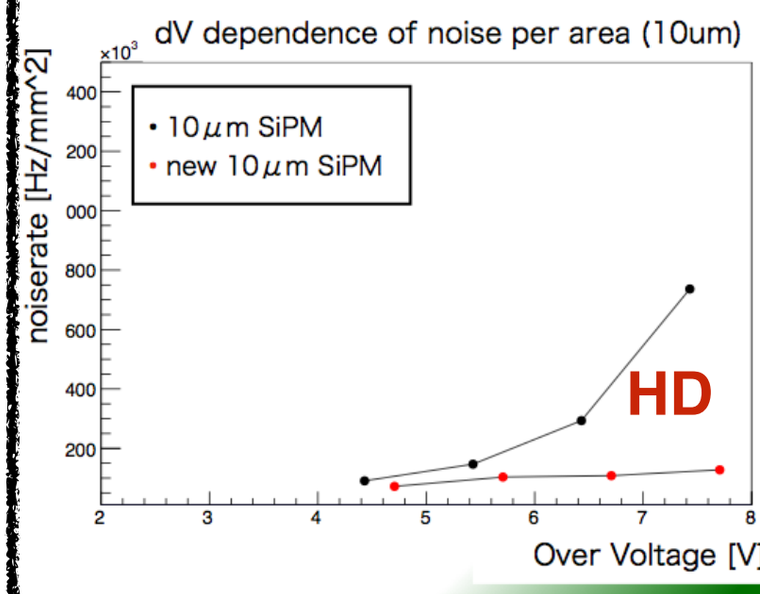


15um



10um

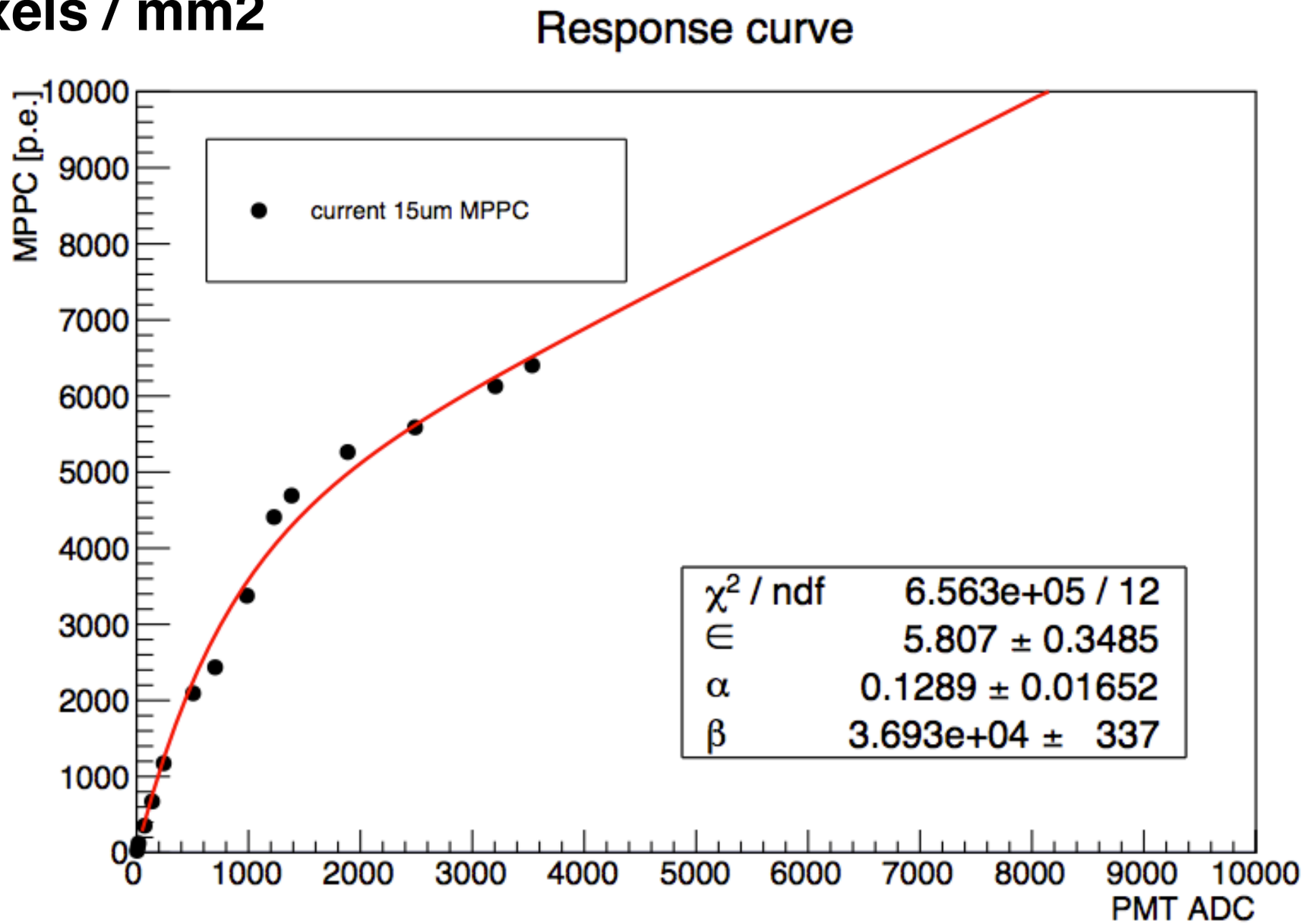




Measured with CAMAC readout

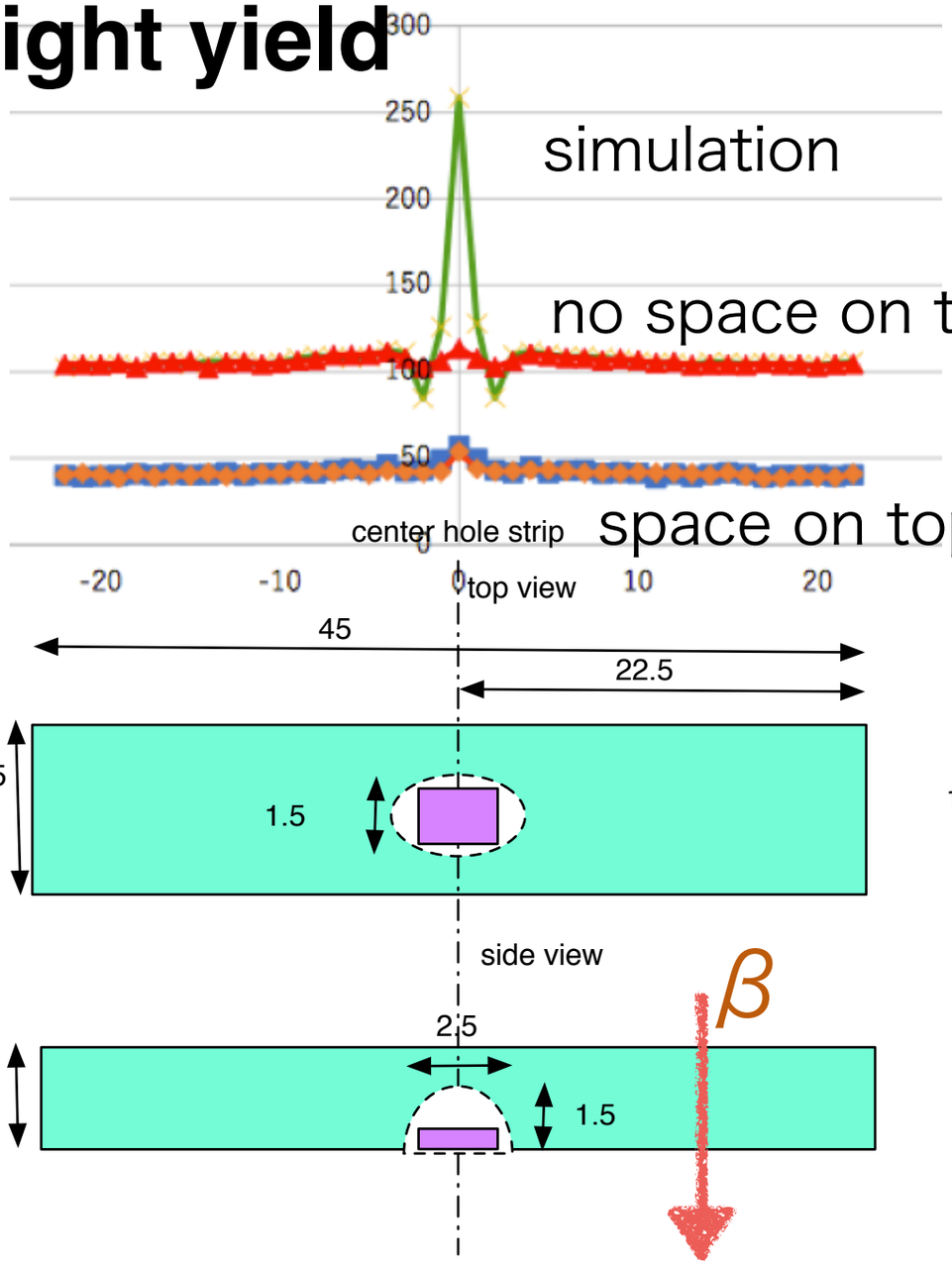
saturation curve

- saturation of 15um pitch ~5000pixels/mm2 by pico sec laser
- could reach 10k pixels / mm2
- fitted curve is
- arXiv:1510.01102

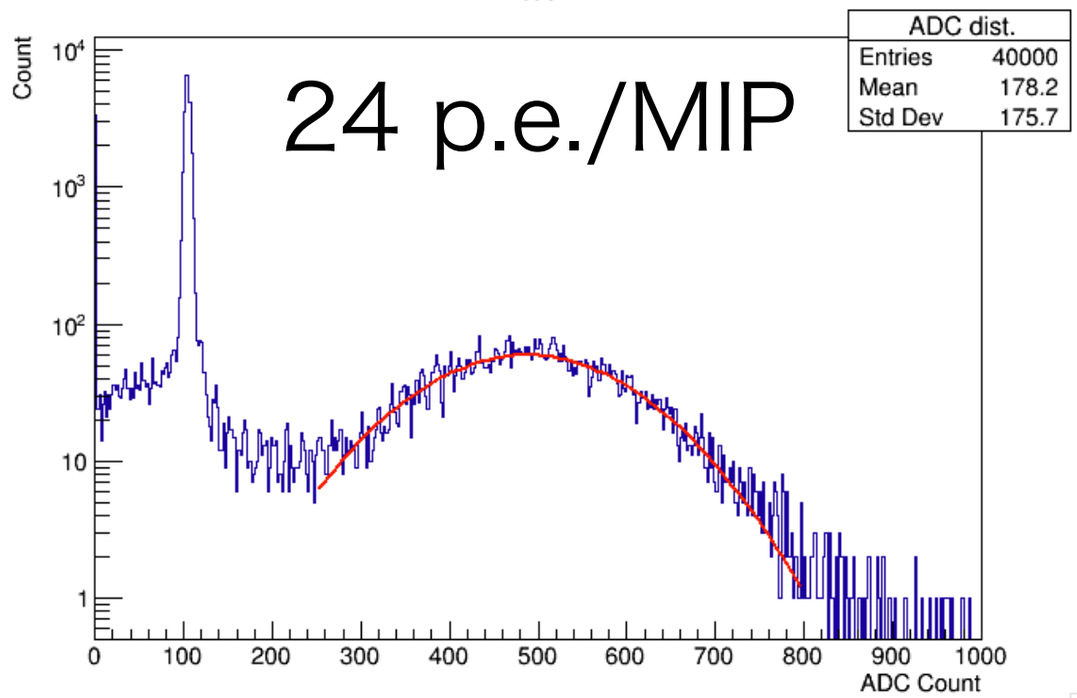


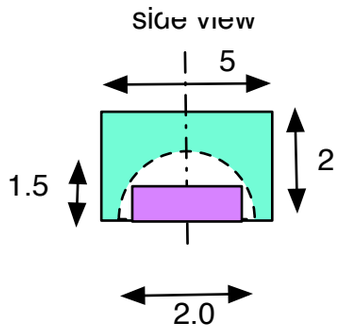
strip with central hole

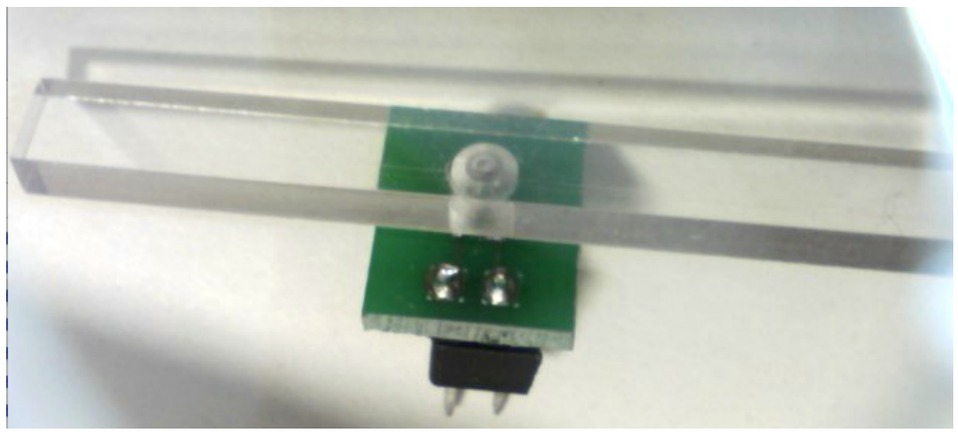
- **with Chinese collaboration**
- **light yield**



round hole 6mmΦ



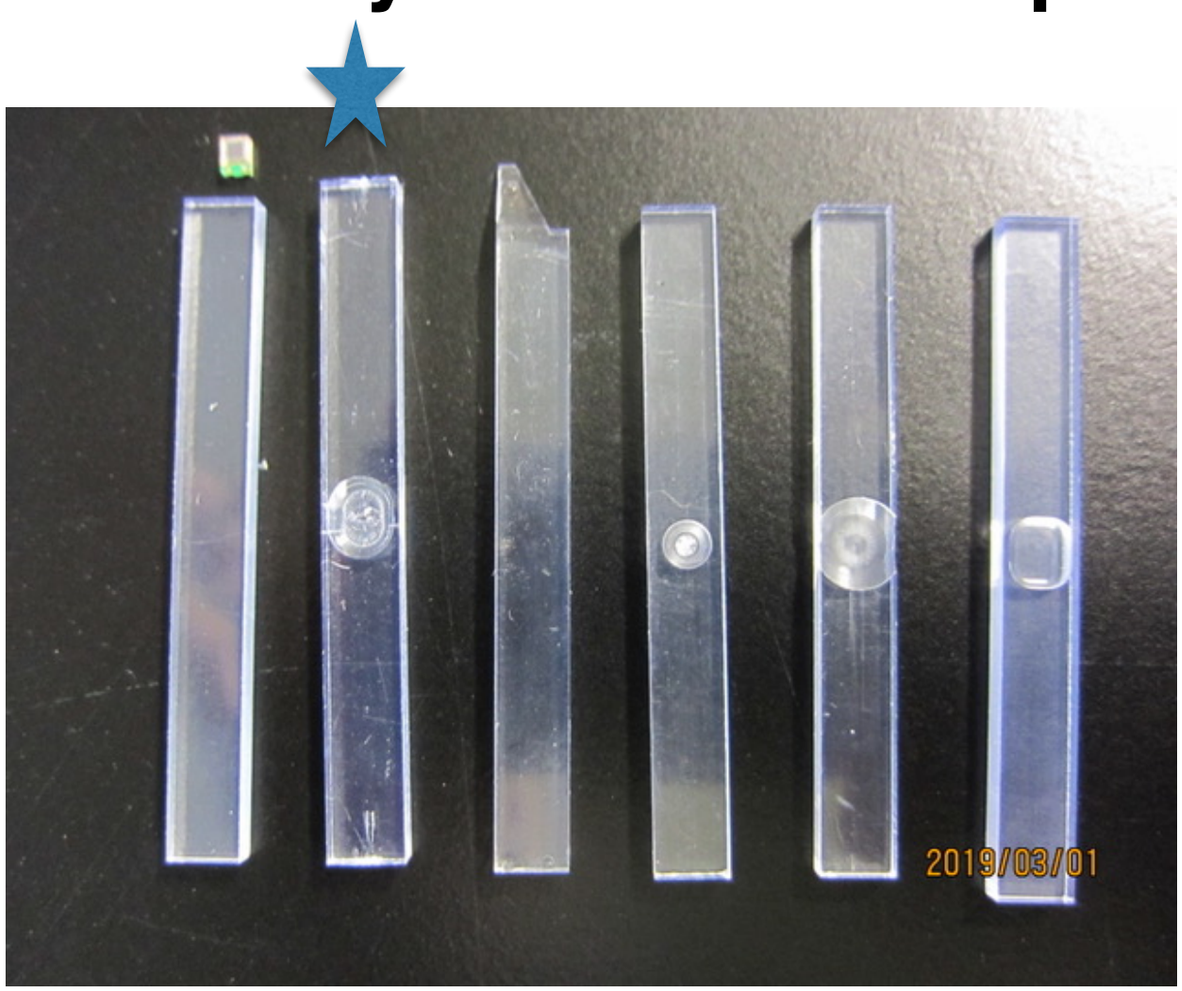


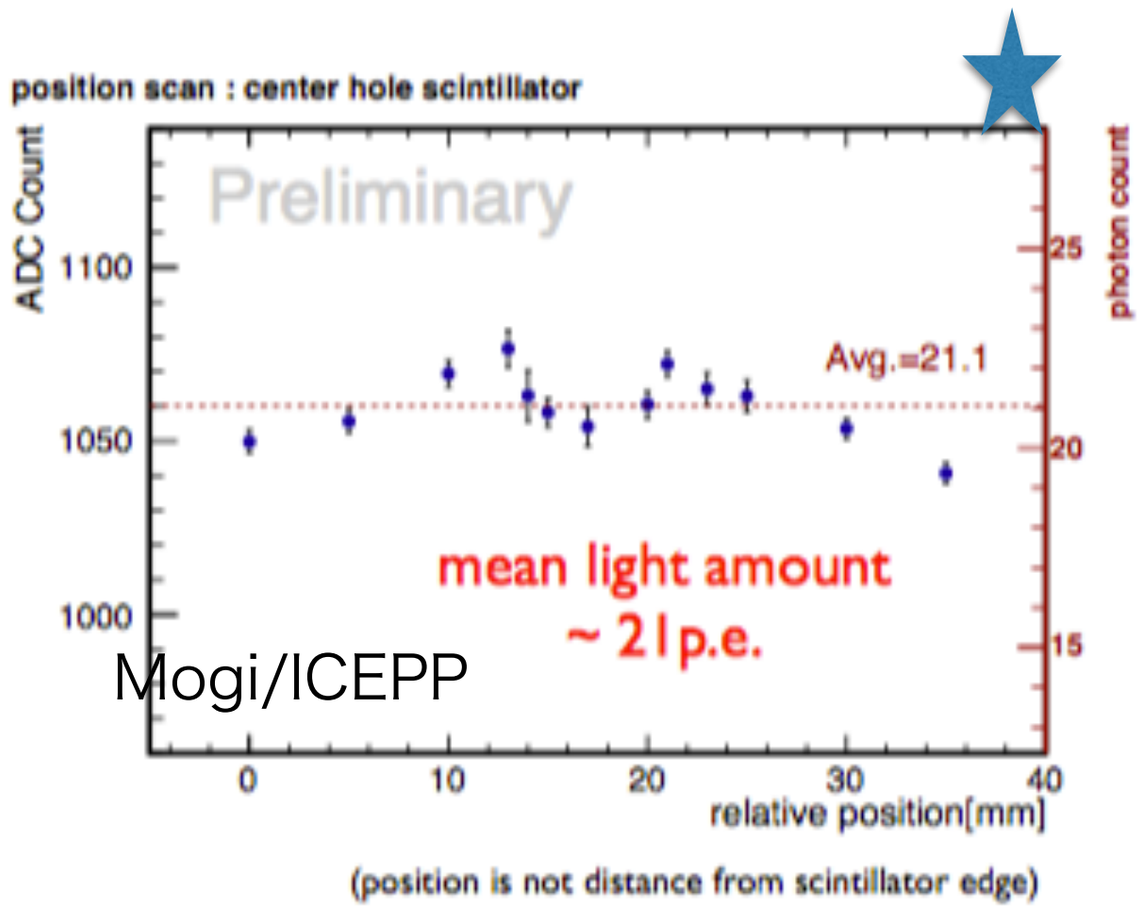


round hole 3mmΦ

strip with central hole

- with Chinese collaboration
- uniformity is good
- many candidate strips



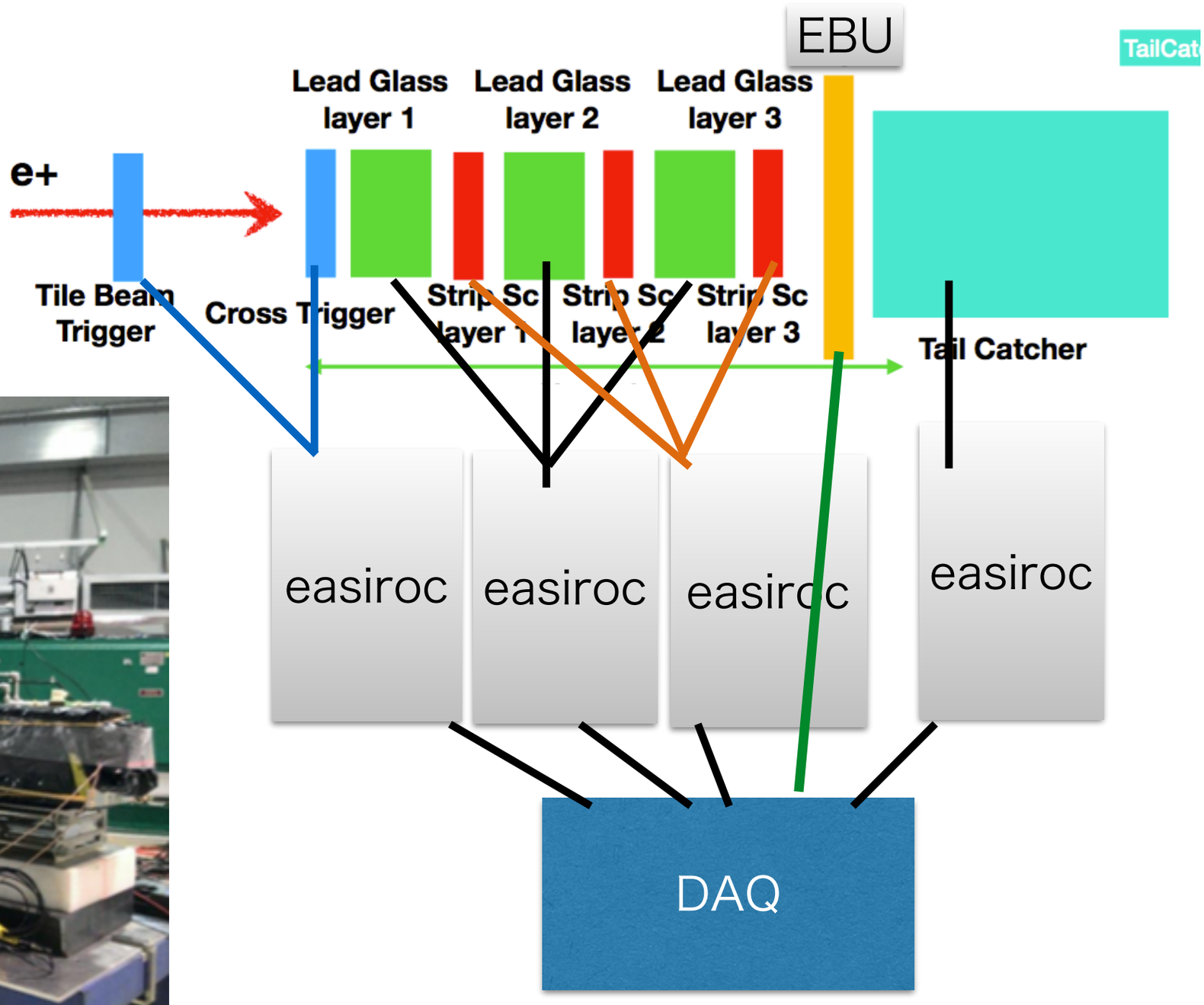


Mogi/ICEPP

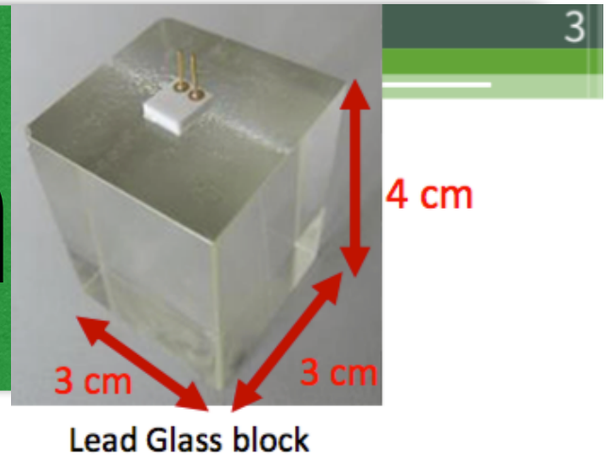
Chinese hole

segmented absorber cal.

- PFA manageable active absorber calorimeter

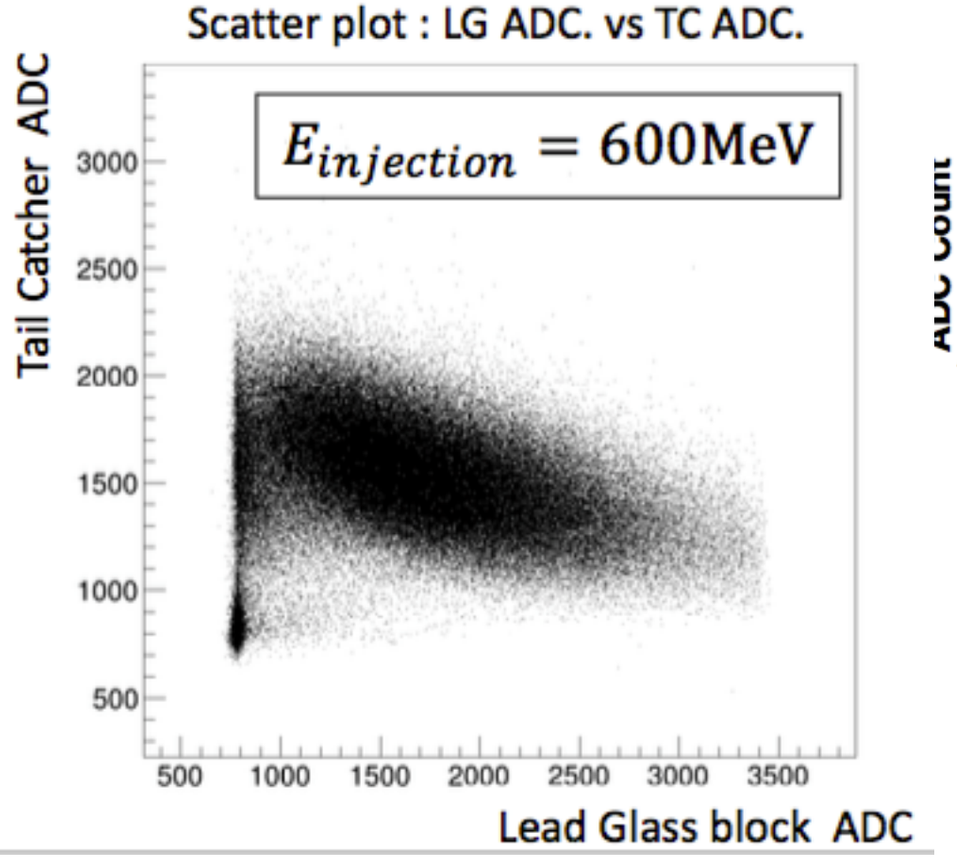


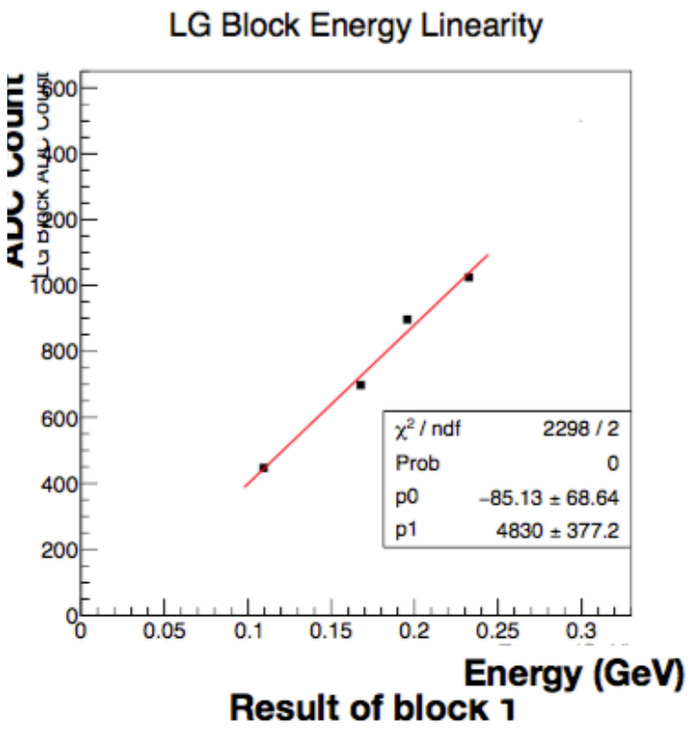
LGBlock calibration

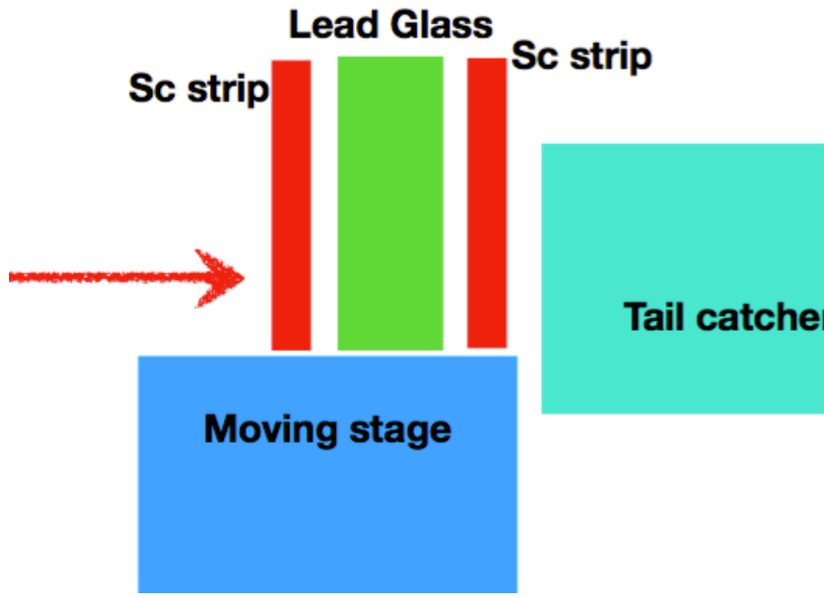


- segmented absorber calorimeter
- tail catcher is calibrated alone
- a LG block + TC(calibrated) event by event basis changing Einject

Einject(MeV)=ELG+ETC(MeV)

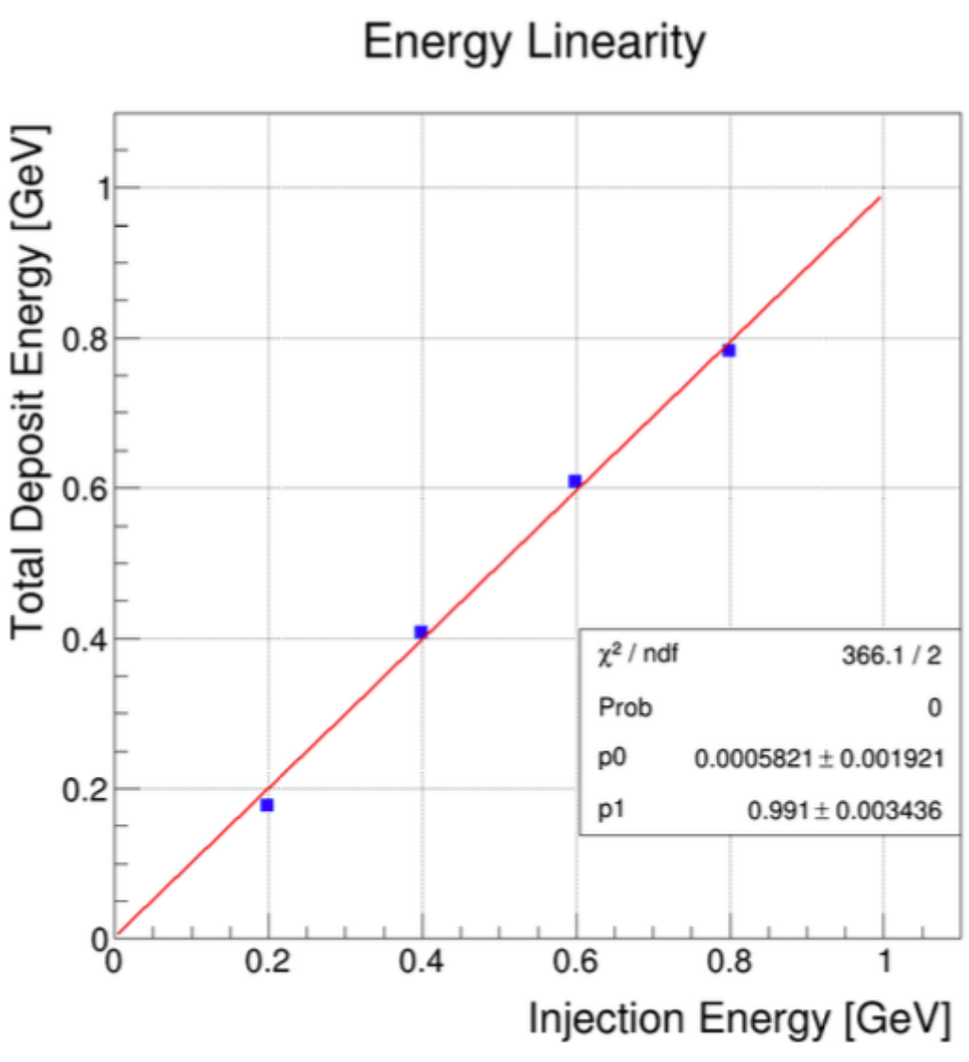




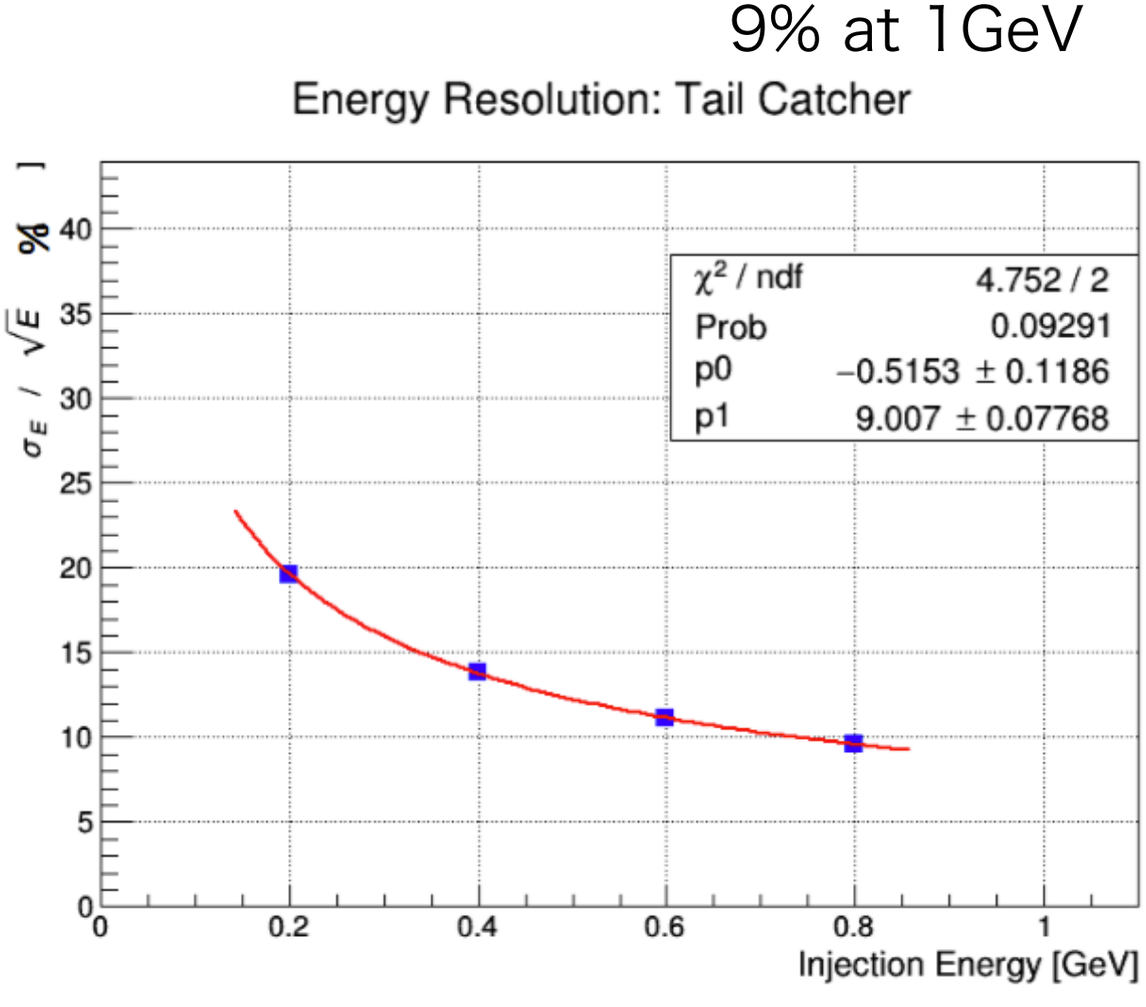


calorimeter performance

- **segmented absorber calorimeter**
- **good linearity**
- **resolution is dominated by Light correction by small MPPC**



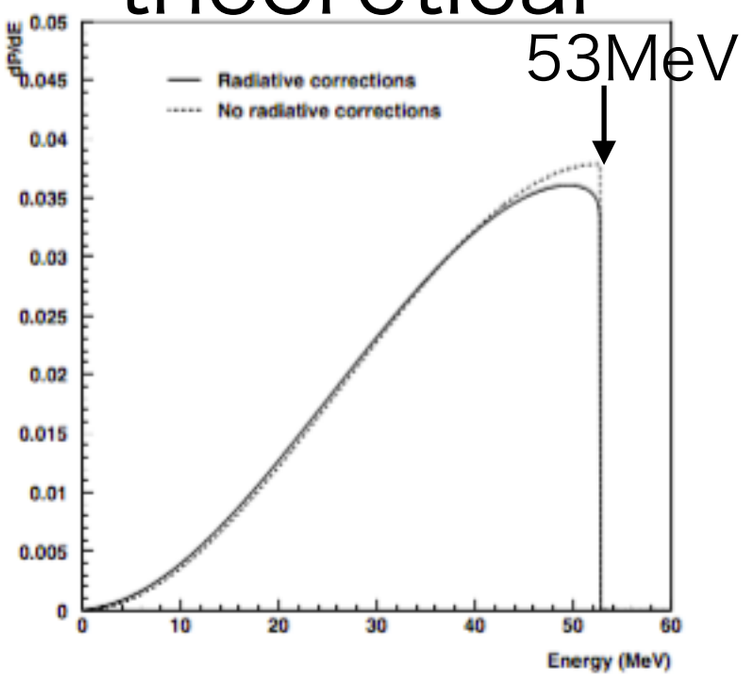
9% at 1GeV

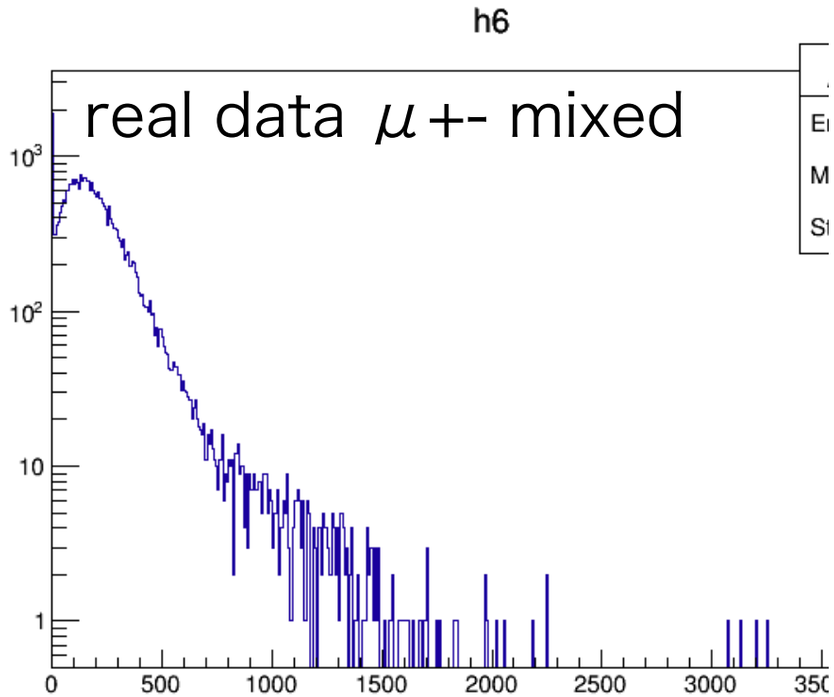


another calibration

- **segmented absorber calorimeter**
- **calibration with cosmic muon decaying to electrons：μ->evv**
- **μ+ acts simply, μ- interacts with nucleus**

$\mu+$ theoretical





summary and outlook

- **EBU with 15um pitch HD-MPPC will be tested**
- **with center hole strips promising performance**
- **have enough light yield**
- **and good uniformity**
- **optimize the shape of hole at the center**
- **segmented Lead Glass cal. development**

trench