

Status of ScECAL At Shinshu

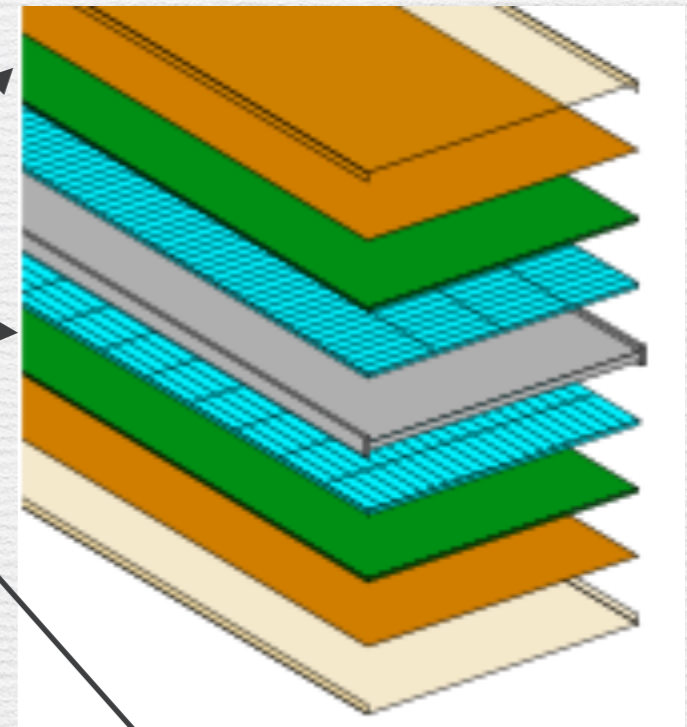


Tohru Takeshita (Shinshu) March 2021

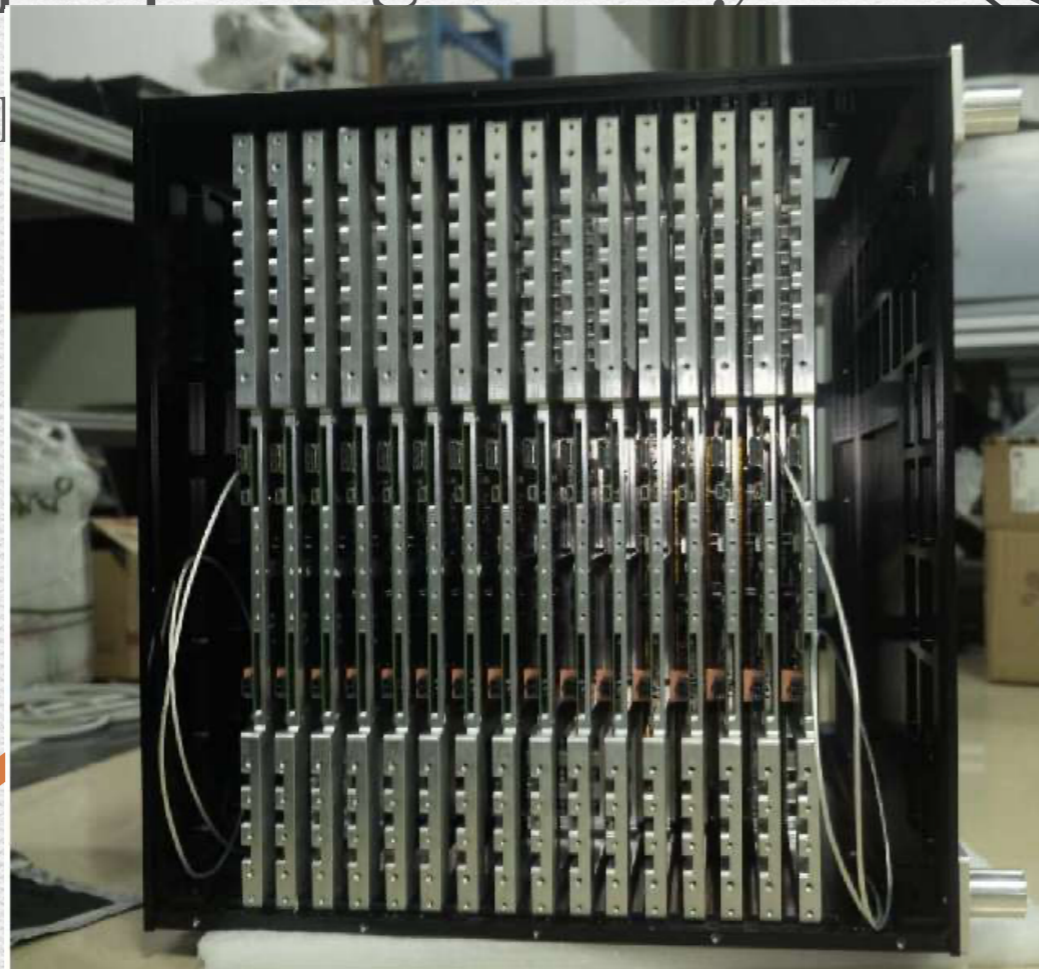
- two scintillator strip layers for beam test with China-Japan SC-ECAL project
- Strip uniformity study with simulation to be compatible with measurements

CALICE Tech. prototype

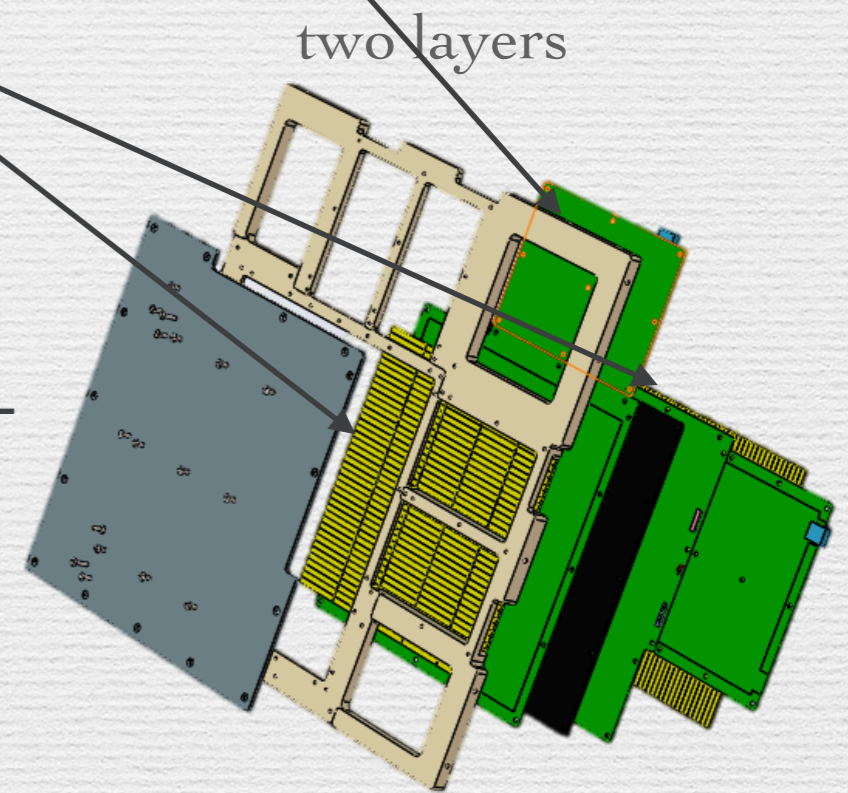
- scintillator strip ECAL < Physcs. proto.
- embedded electronic-read out board
- stacking 32 layers with China & Japan
- Shinshu is preparing two layers



SCECAL technological



electron
beam



Layer preparation at Shinshu

- preparing two layers with orthogonal set up

wedged trip

- strip scintillator

- bottom readout with wedged shape strip

- center dimple read out

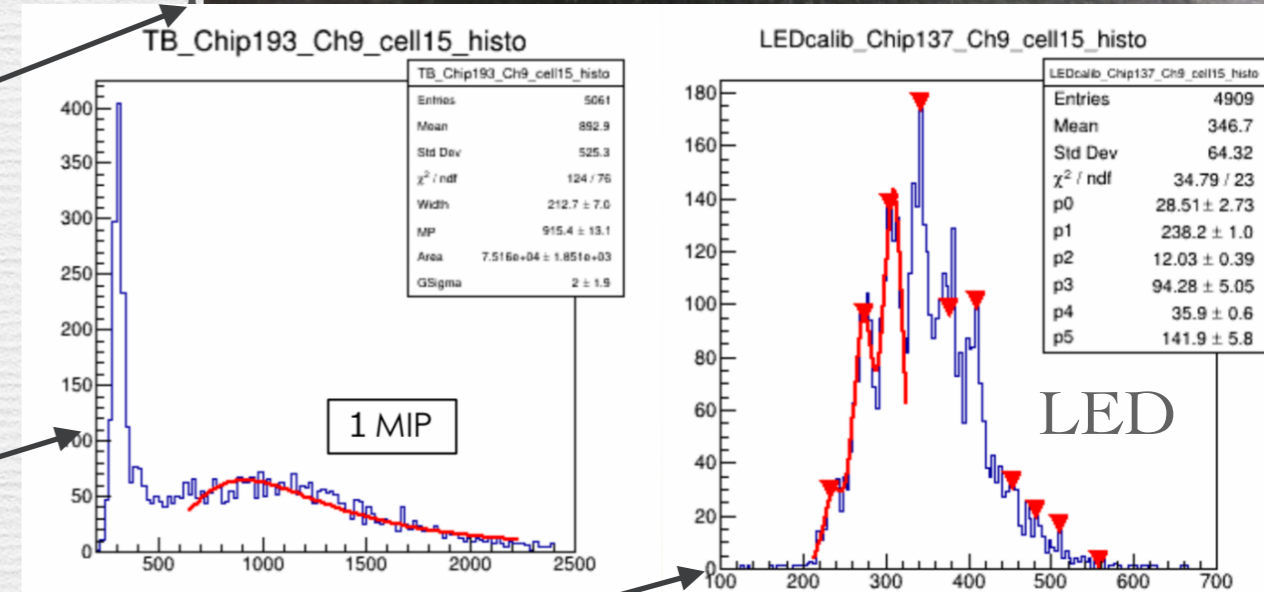
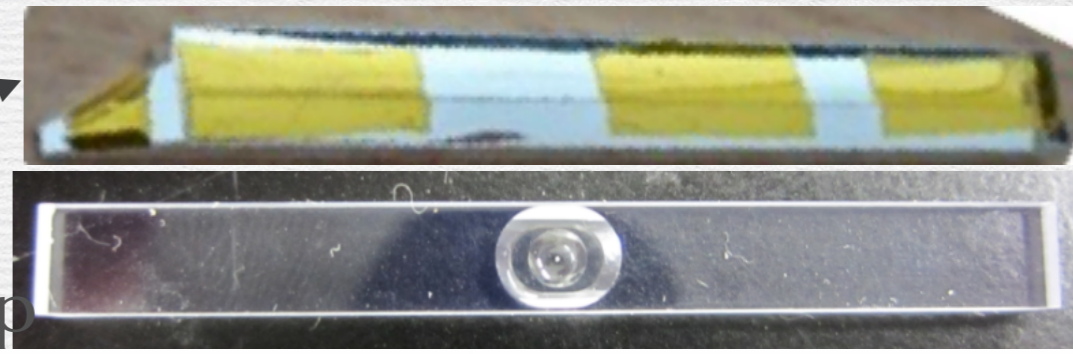
- tuning

- MIP calibration with beta ray

- photo-sensor gain calibration by photo-electron peaks with LED

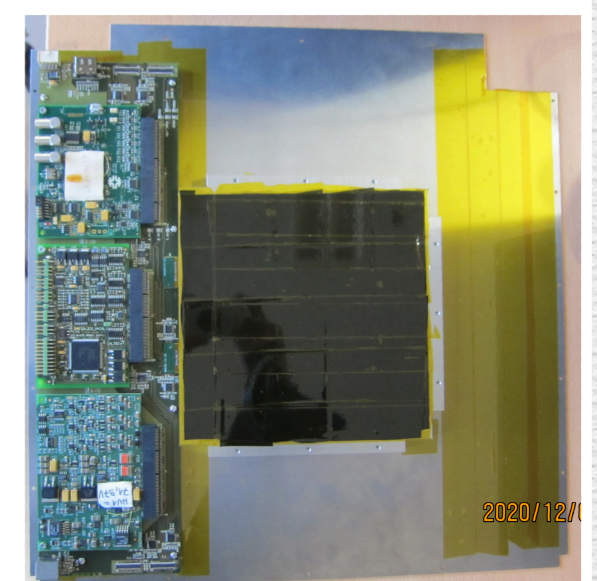
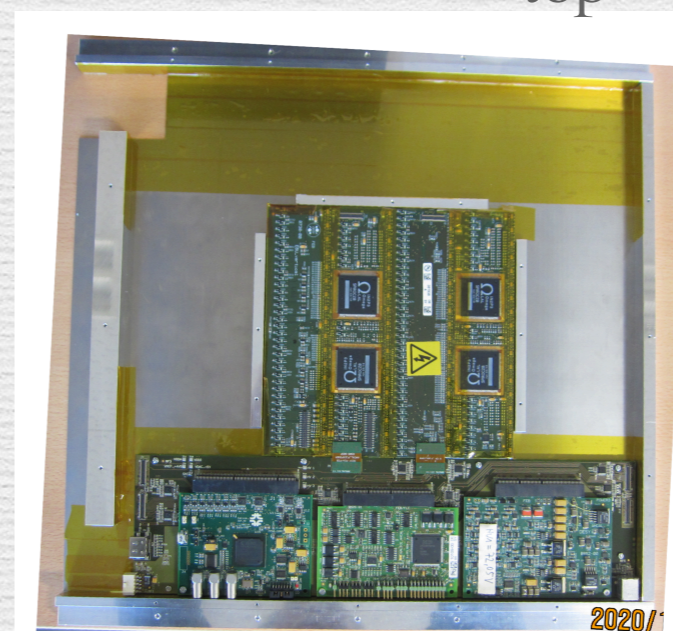
- Cosmic ray test with two layers

- - DAQ & analysis on going



top

bottom



calibration by LED & MIP

Bottom readout

- MIP 138/144 (96%)

- LED 130/144 (90%)

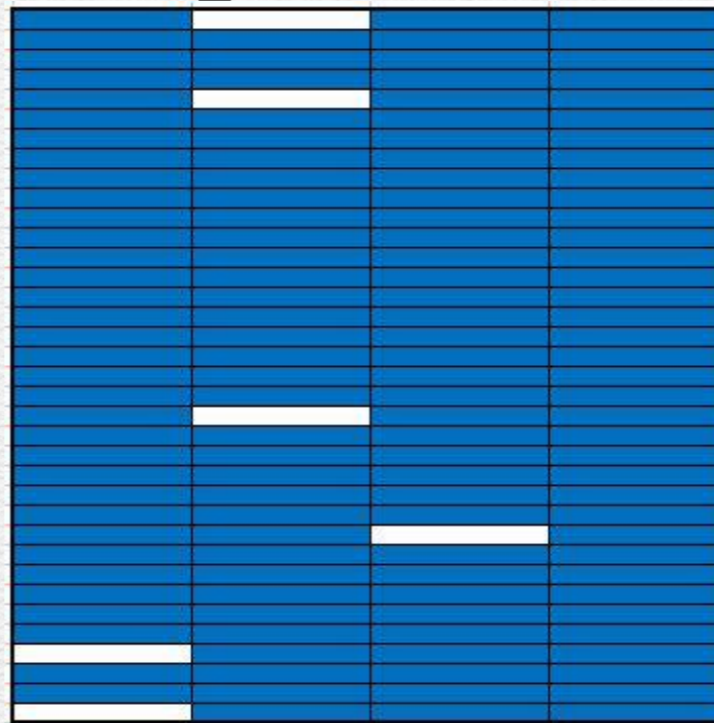
Center readout

- MIP 106/144 (74%)

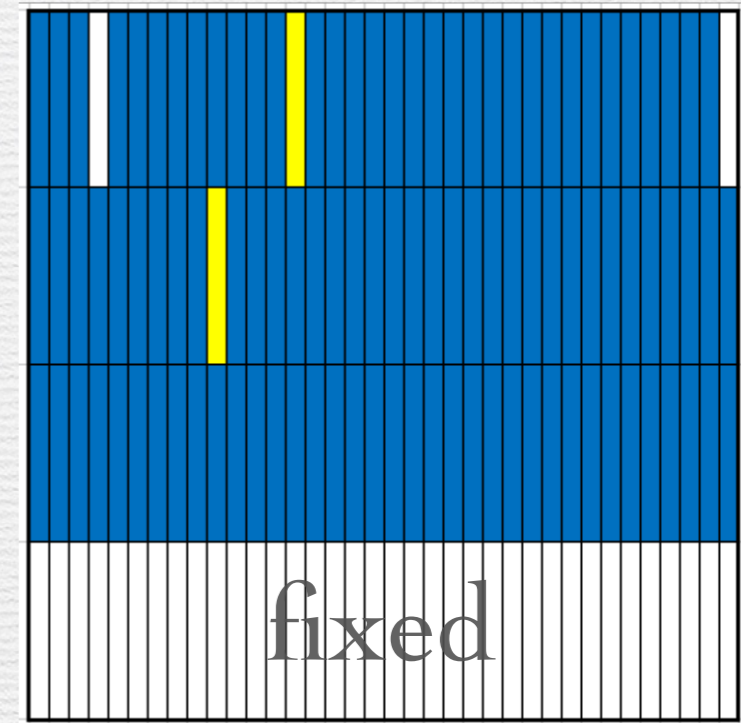
- LED 99/144 (69%)

Need more effort to finish calibrations

- calibration at fixed area due to missing registers



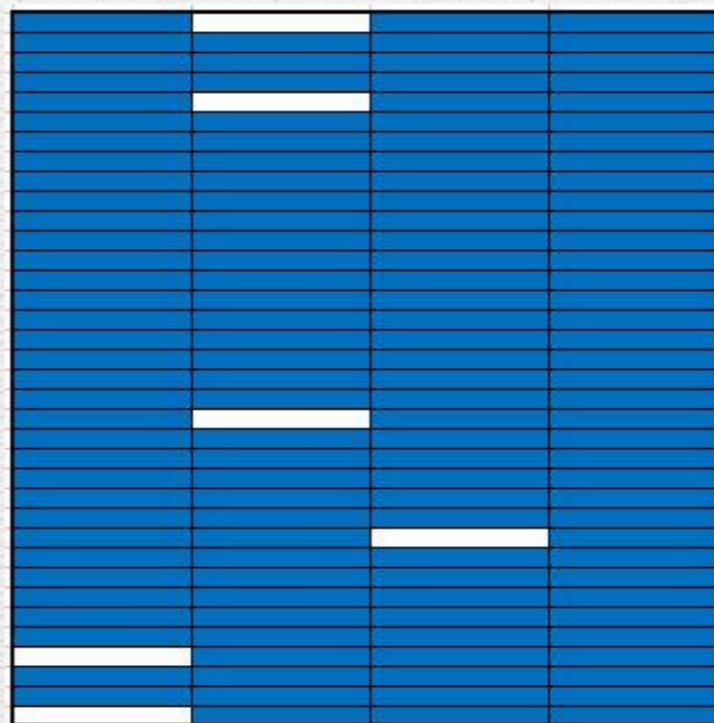
LED



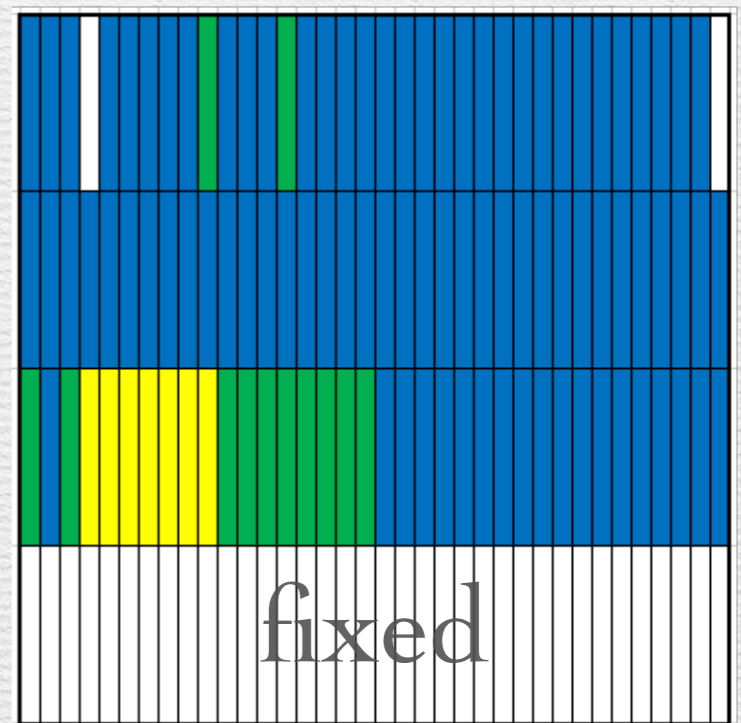
fixed

Bottom

Center



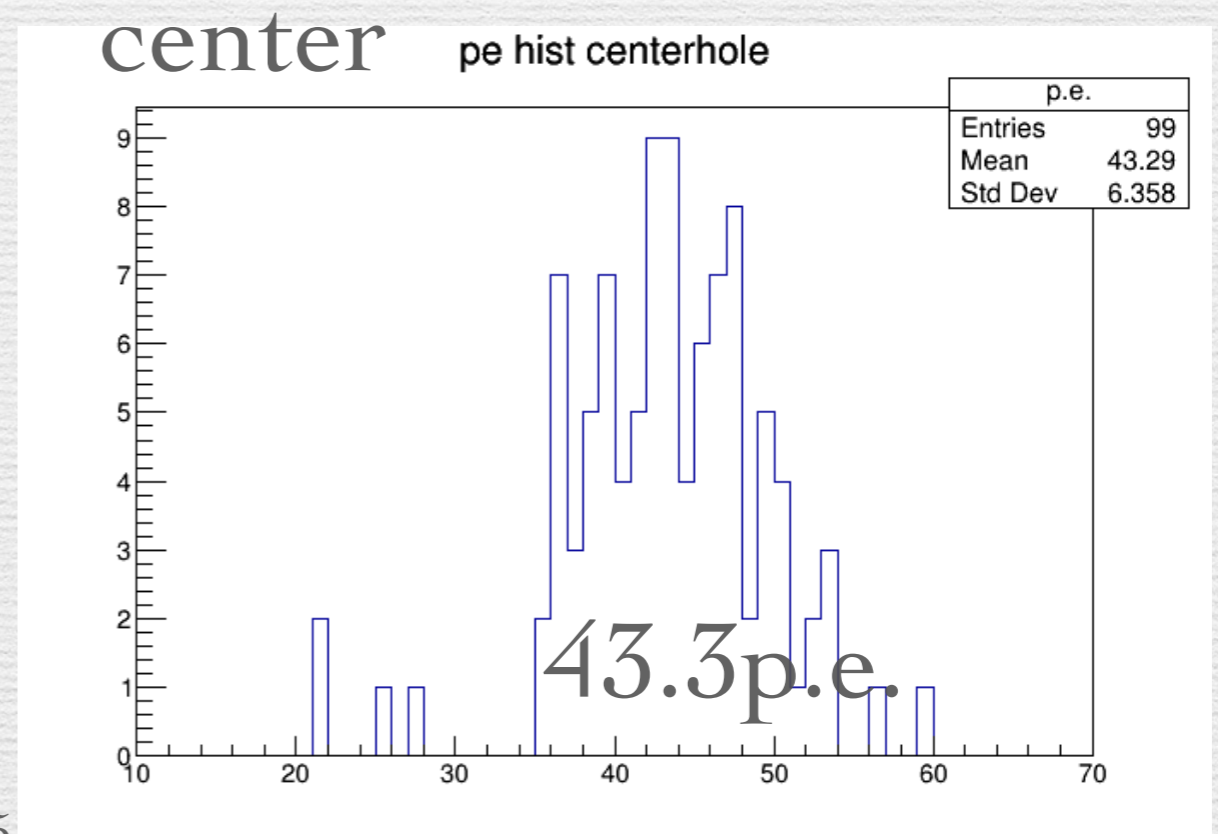
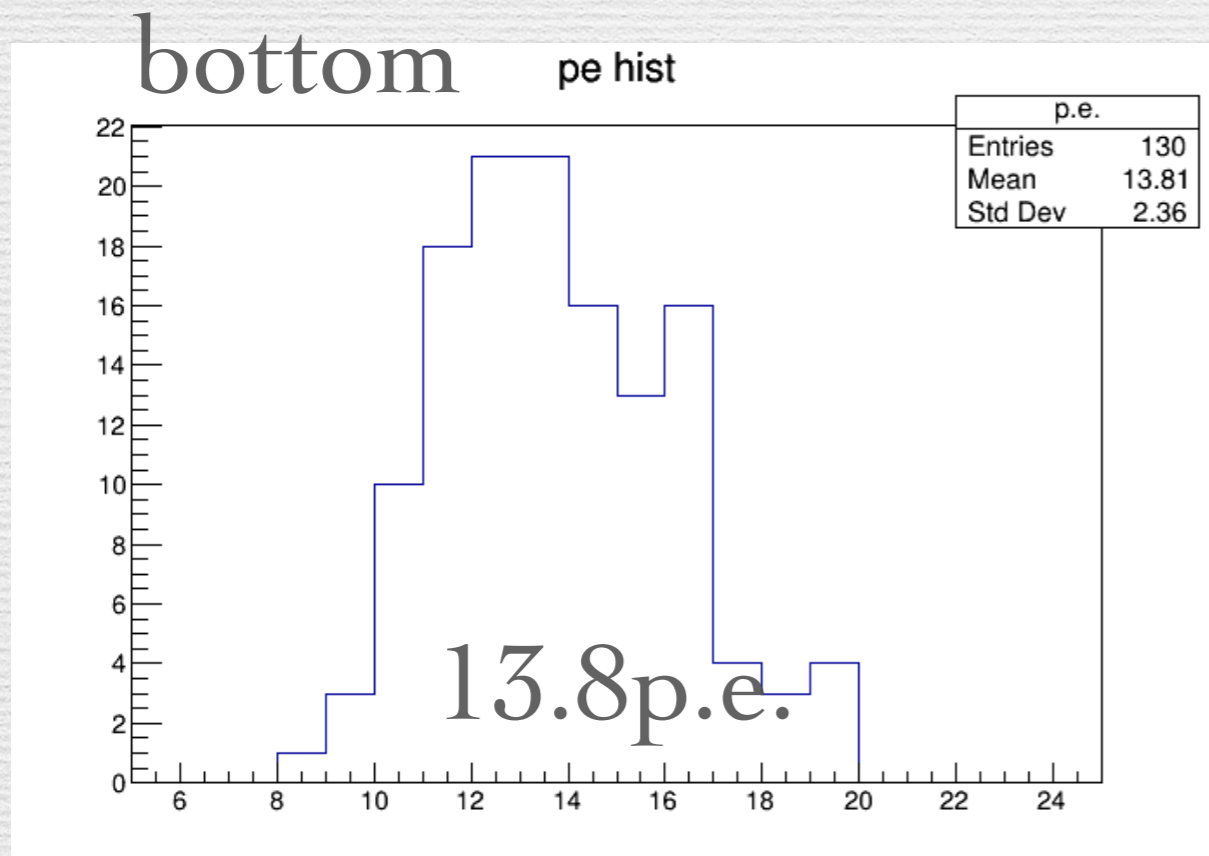
MIP



fixed

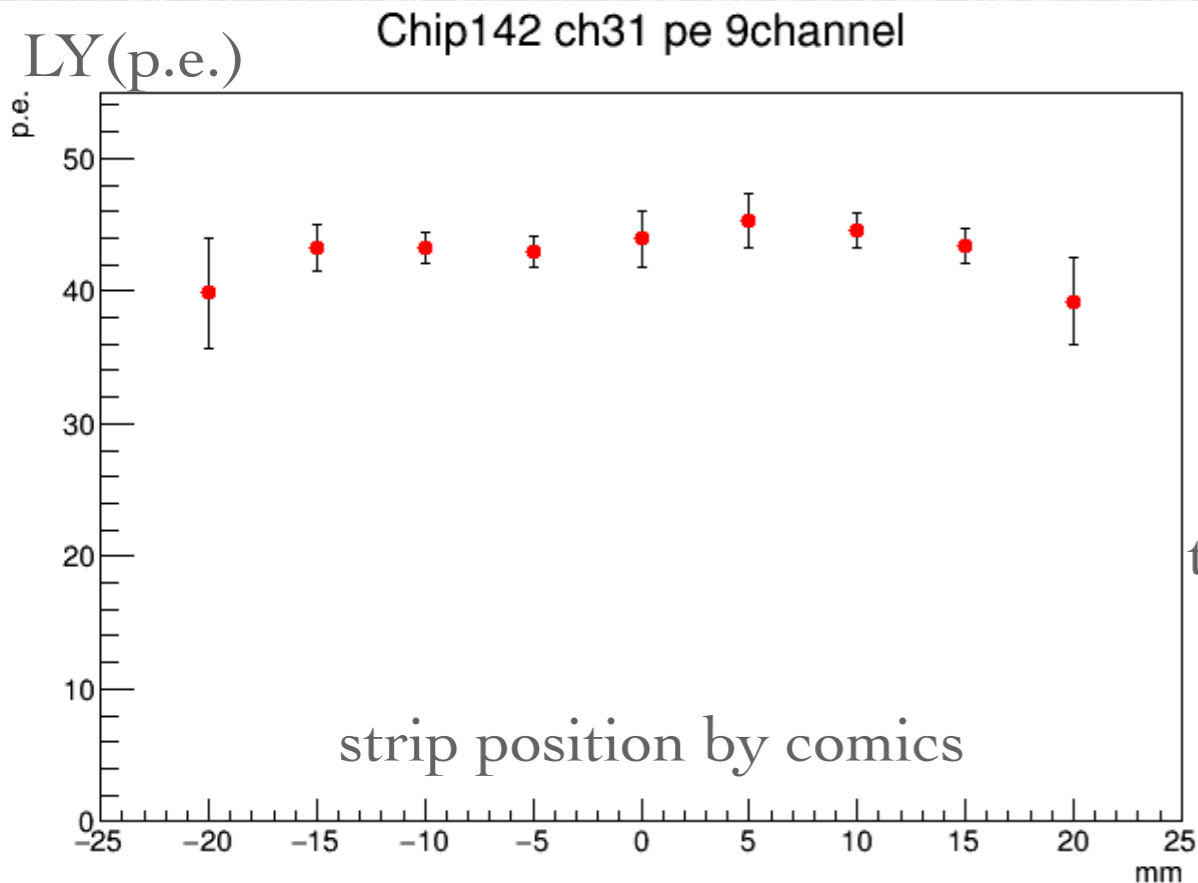
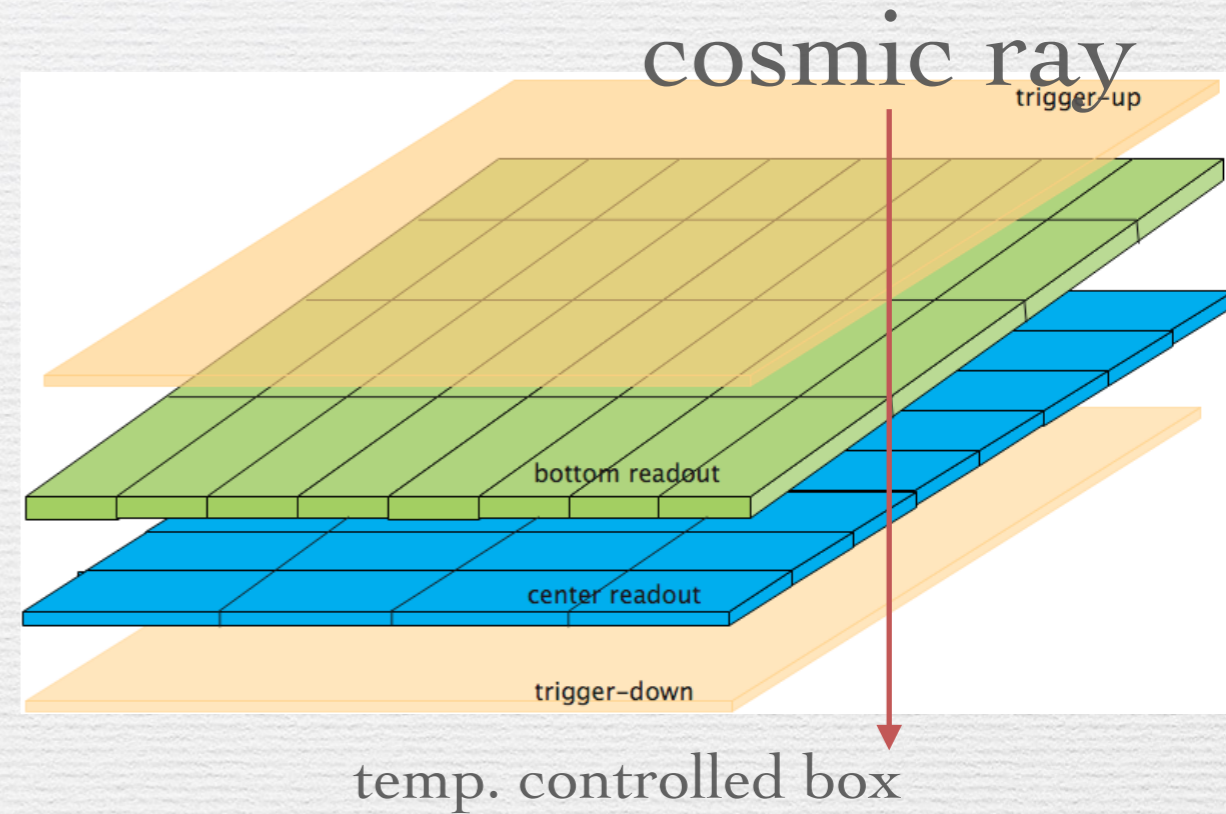
comparison of two layers

- one photon gain(1 p.e.) from LED calib. in ADC unit
- one MIP gain from MIP Calib. in ADC unit
- Light Yield for each strips by p.e. unit for MIP
- bottom readout layer with wedged strip : 13.8 p.e. with 1mmx1mm PPD
- center readout layer with center dimple strip : 43.3 p.e. 1.3mmx1.3mm

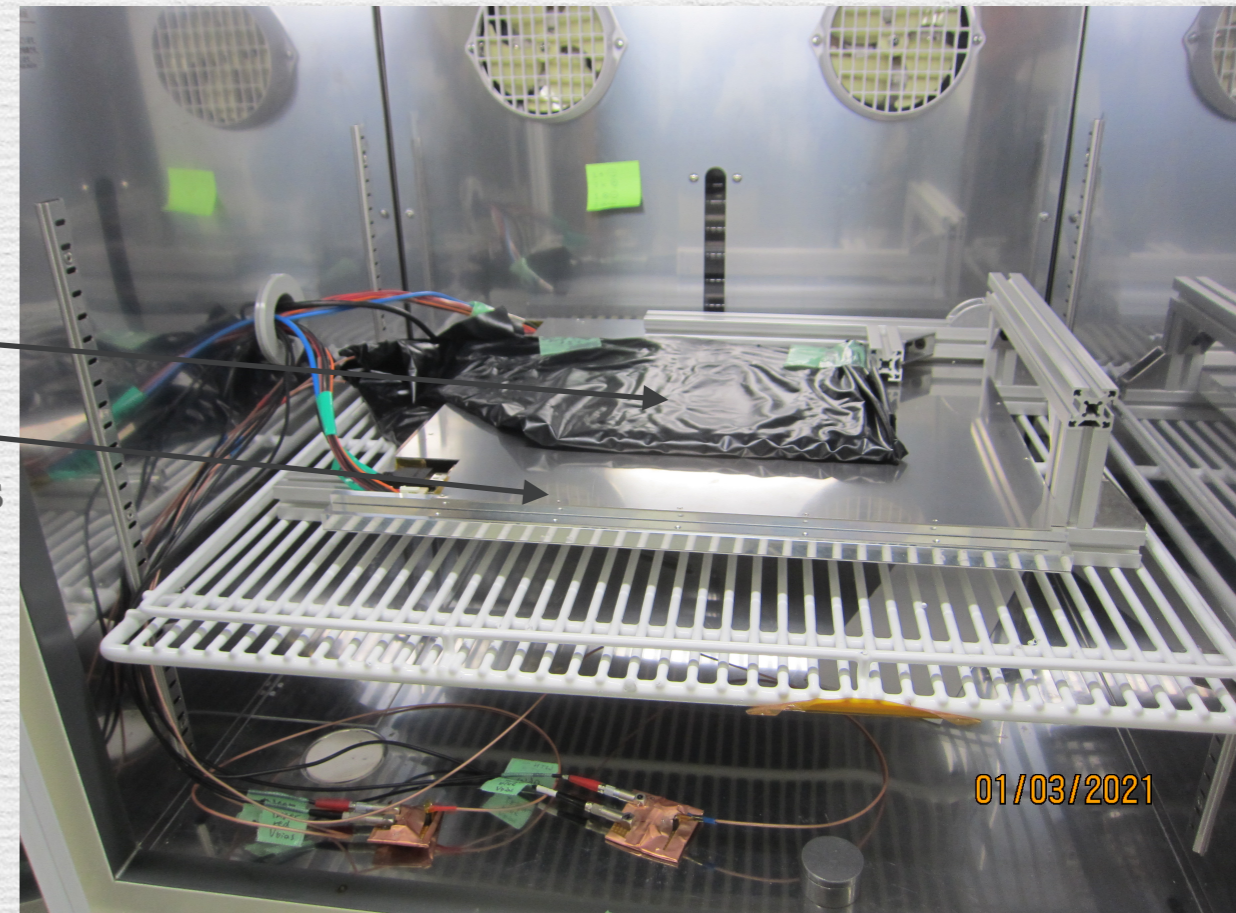


cosmic ray test

- set up with combined two layers
- taking data as much as possible with 2Hz
- uniformity by cosmic
- temperature coefficients will be measured

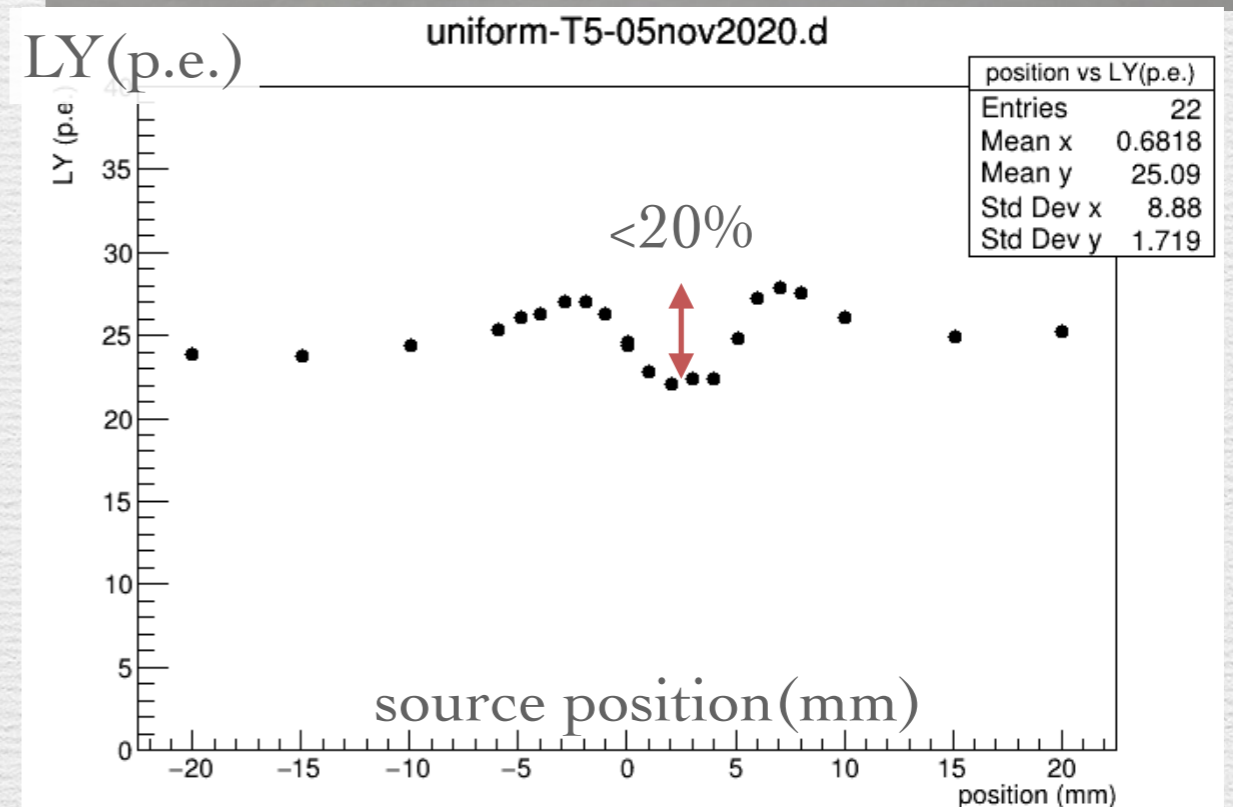
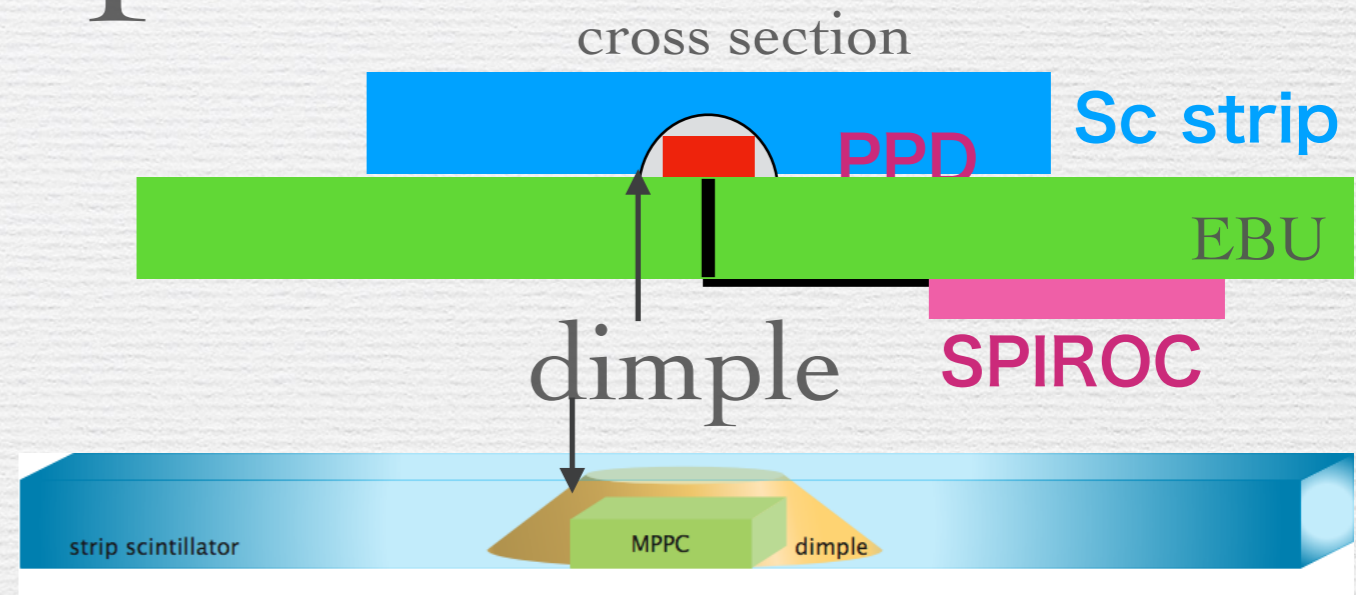


trigger
two layers



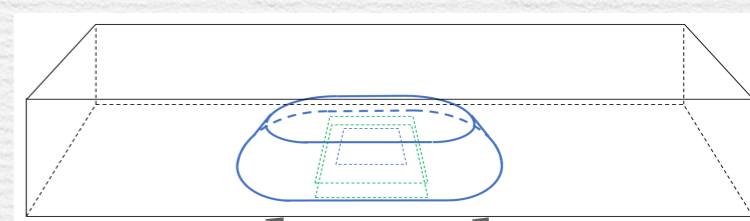
scintillator strip and PPD

- dimple at strip center
- where a PPD is set to collect scintillation lights efficiently
- dip and bump structure
- uniformity along the strip



strip uniformity

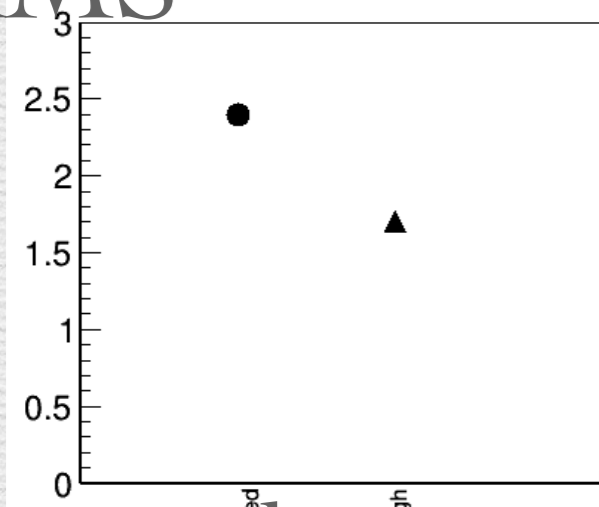
- uniformity measurement results show
- **polished** dimple is NOT good
- than unpolished
- simulation study with rough surface at dimple



dimple

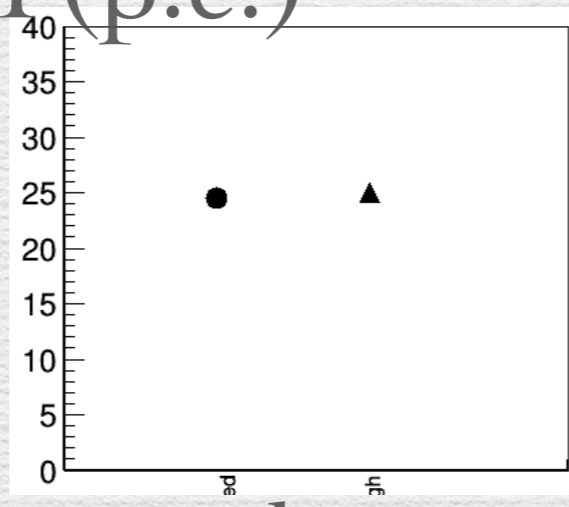
- UNIFIED model in G4

RMS



pol. unpol.

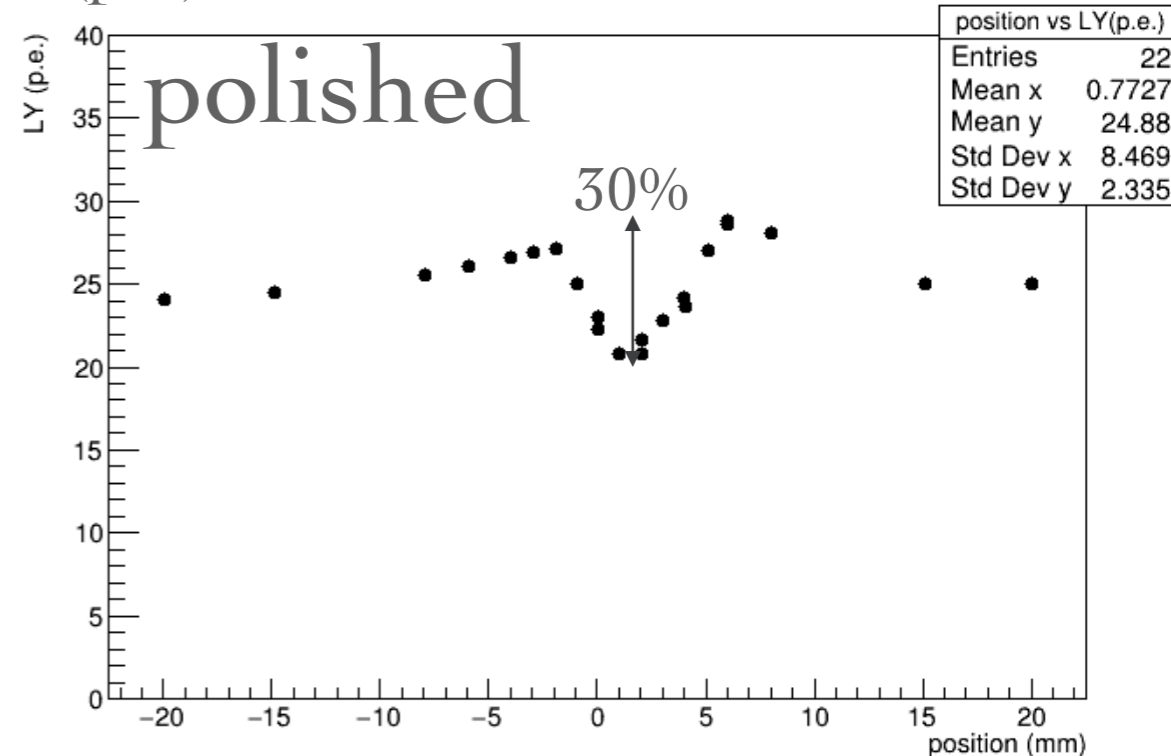
LY(p.e.)



pol. unpol.

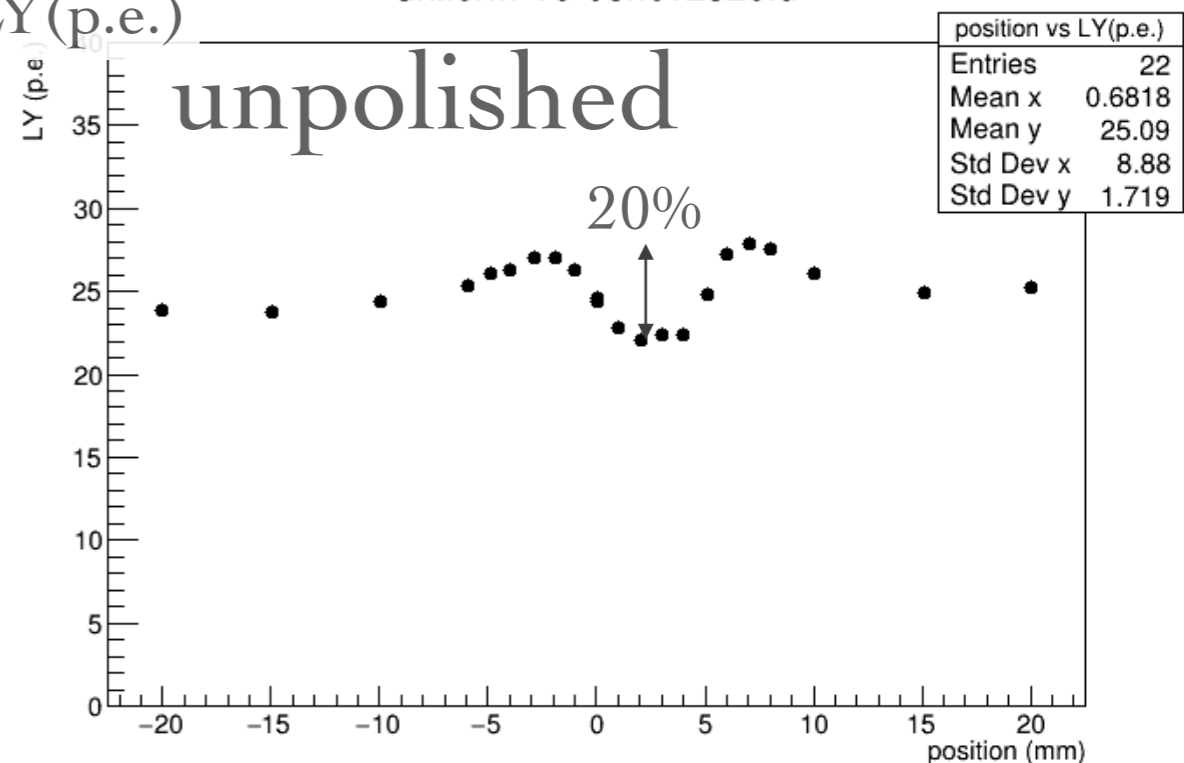
LY(p.e.)

uniform-T0-06nov2020.d



LY(p.e.)

uniform-T5-05nov2020.d



UNIFIED model

- parameters

- α : surface angle with ^{micro}

- σ_α : gaussian

- reflection probability

- normal reflection (C_{sl})

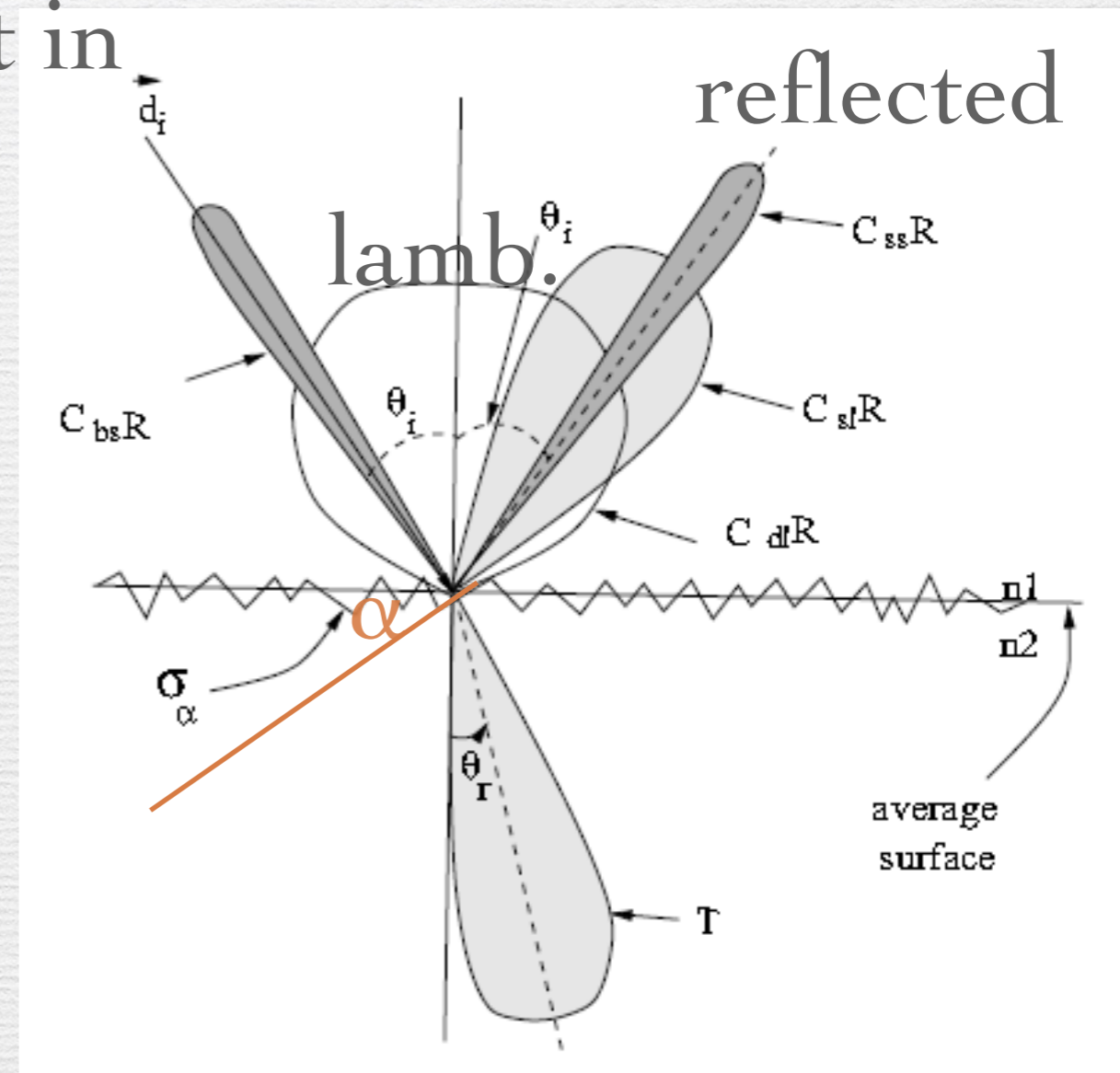
- Lambert reflection (C_{dl})

- mirro scat. (C_{ss})

- back scat. (C_{bs})

$$C_{sl} + C_{dl} + C_{ss} + C_{bs} = 1$$

light in

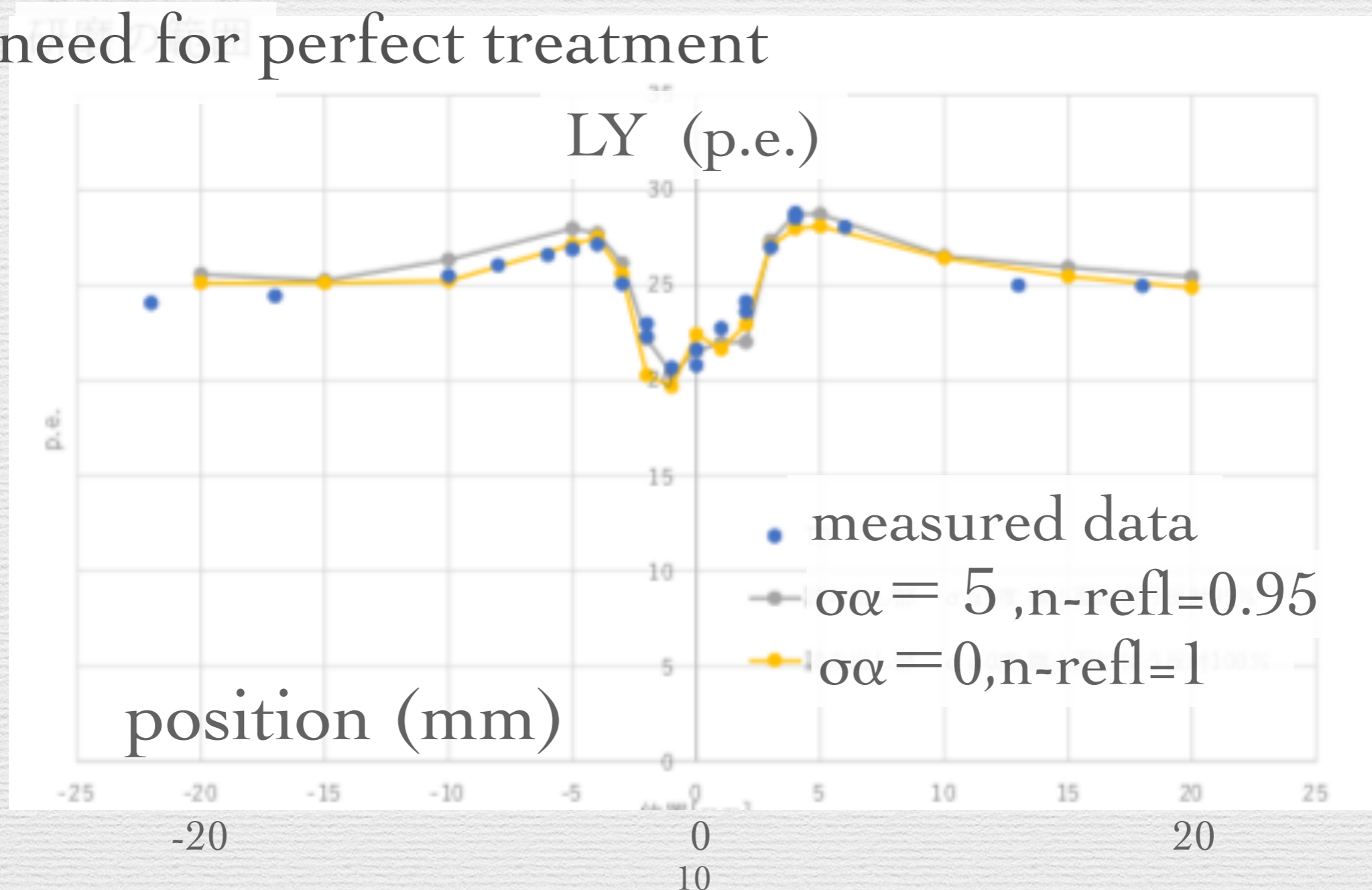


reflected

refracted

fully polished strip

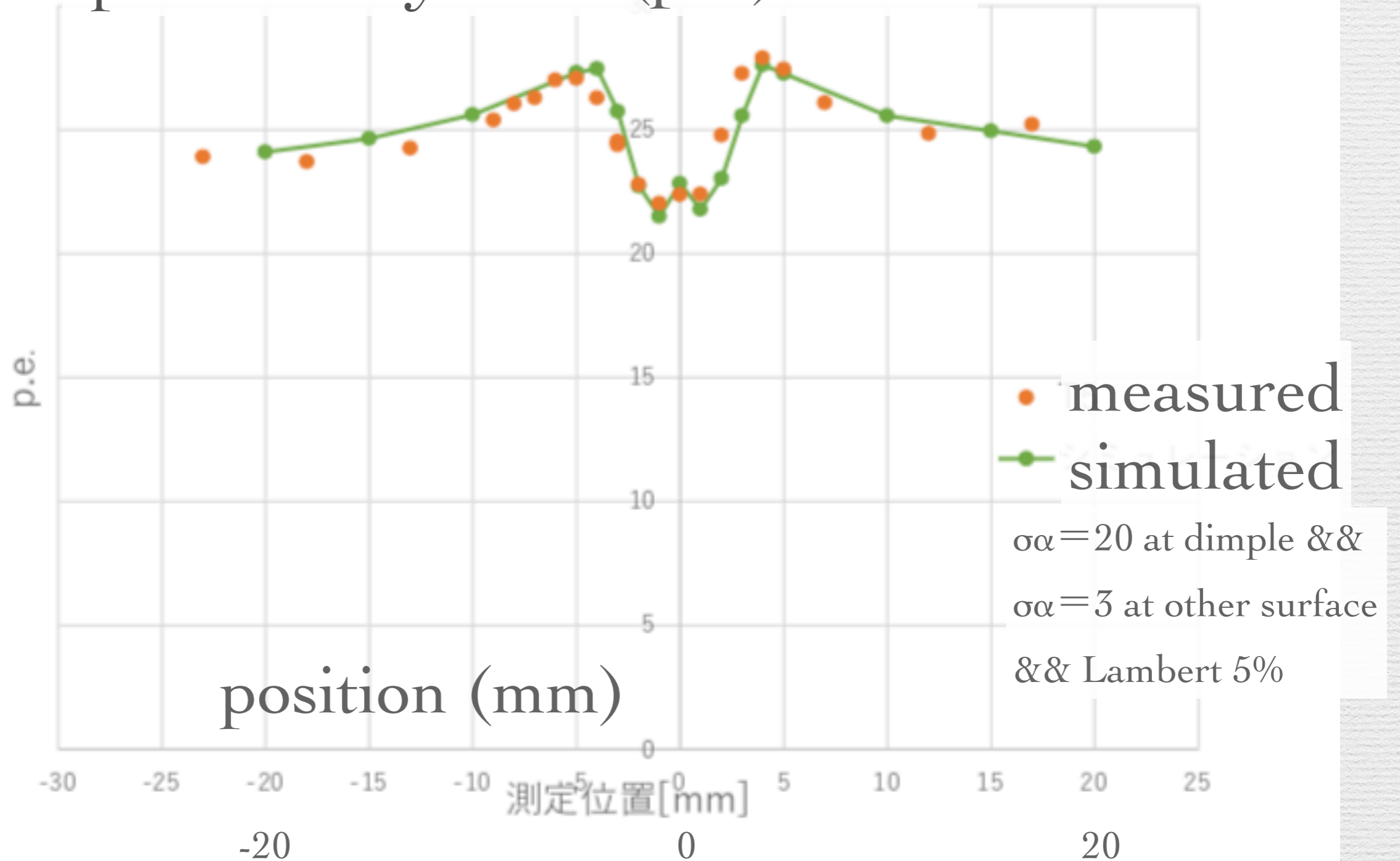
- tuning parameters for fully polished strip
- polished : $\sigma\alpha = 0$ and normal reflection = 1 ? at dimple
- no need for perfect treatment



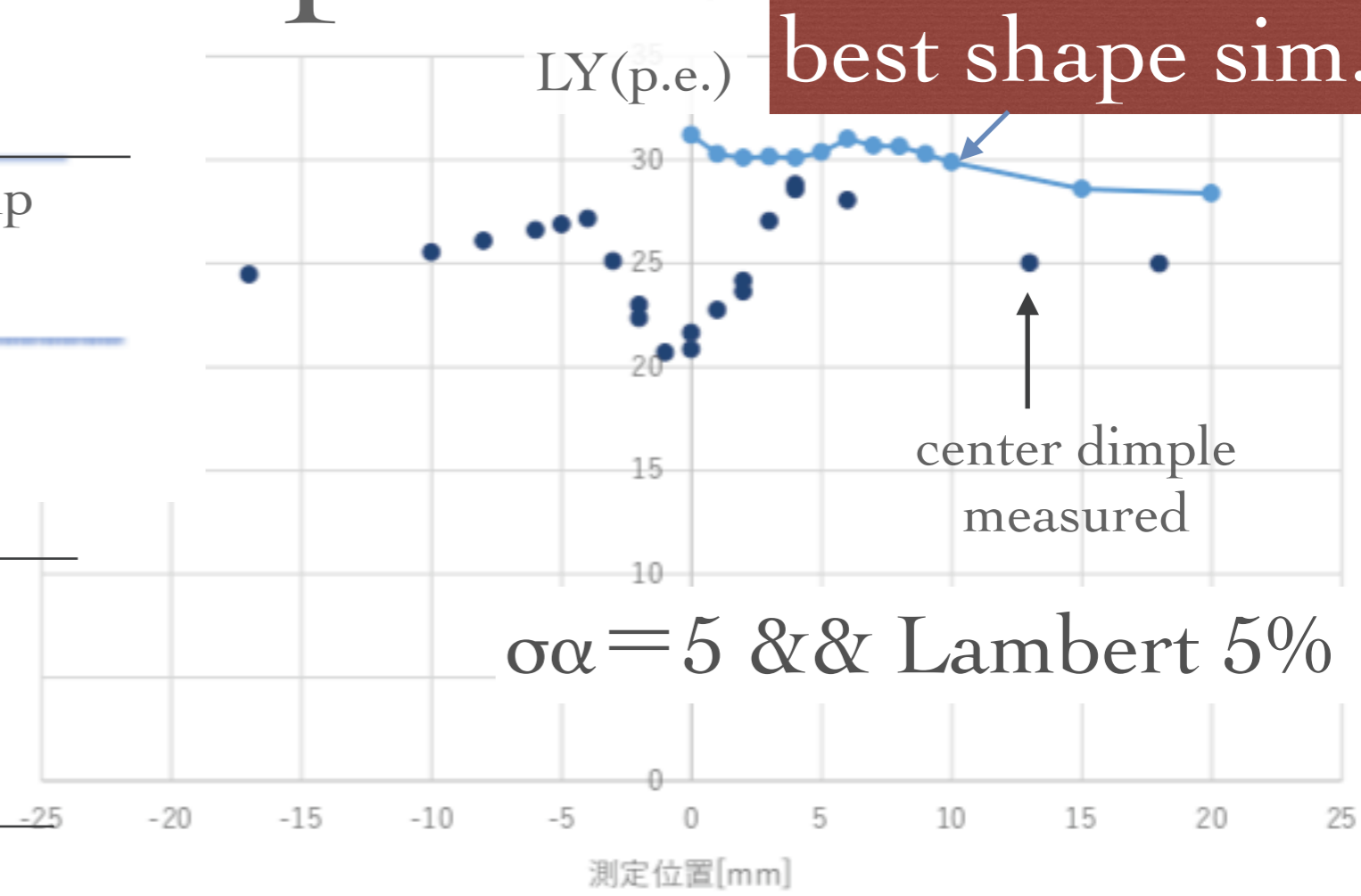
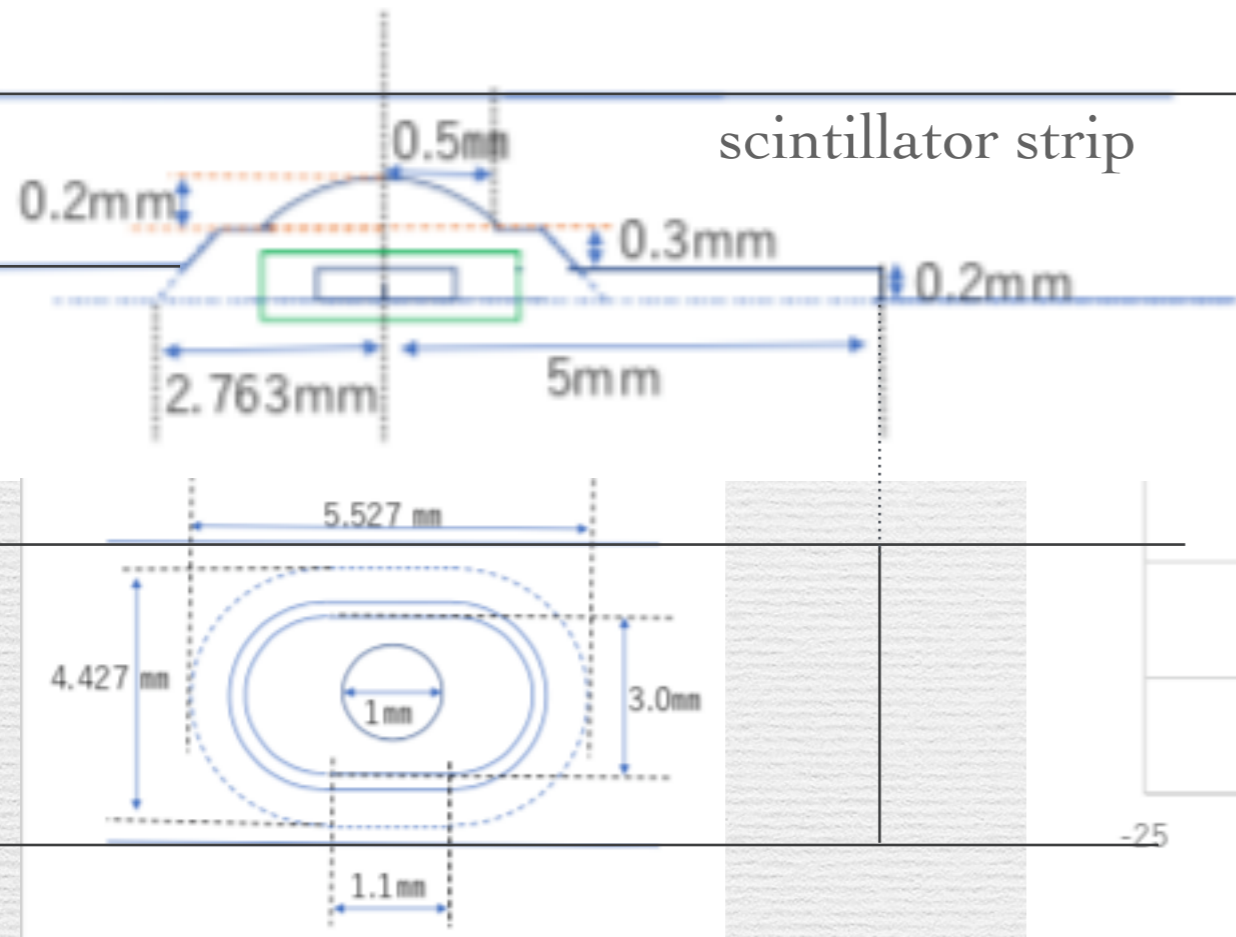
roughness at dimple

- keeping almost smooth surface at other surface

- good reproducibility LY (p.e.)



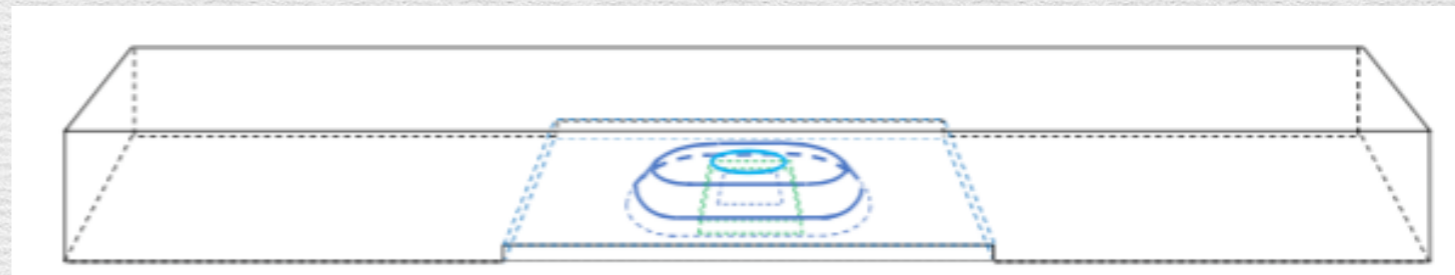
Best dimple shape idea



● 切削部 $\sigma\alpha 5$ Lambert 5% \square パート散乱5% ● T0

position

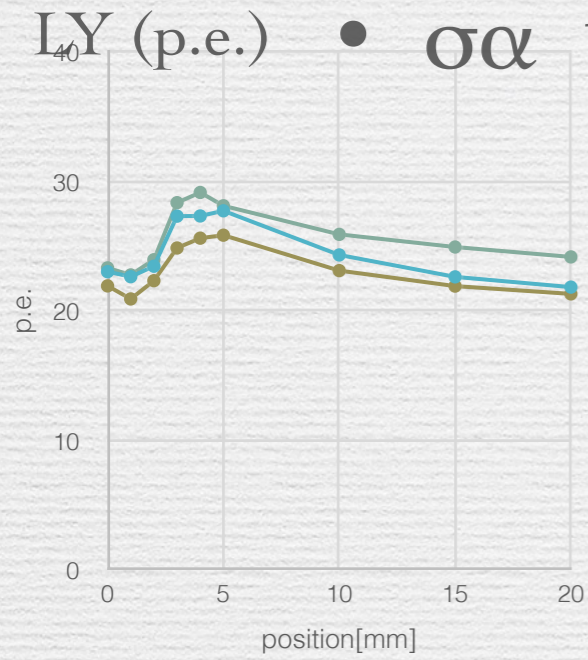
much better uniformity
and
slightly increased LY



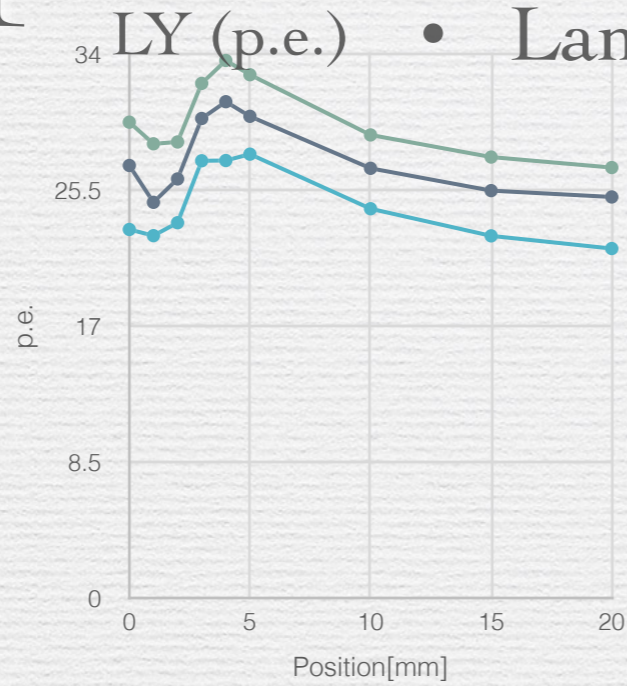
summary and outlook

- two layers of scintillator strips have been almost ready to go to beam test at DESY in 2021
 - LED and MIP calibrations > Bias voltages and threshold are determined as well as other common parameters
 - cosmic ray data taking is on going
- scintillator uniformity is well understood with G4 simulation together with surface treatment
 - better uniformity strip may be produced

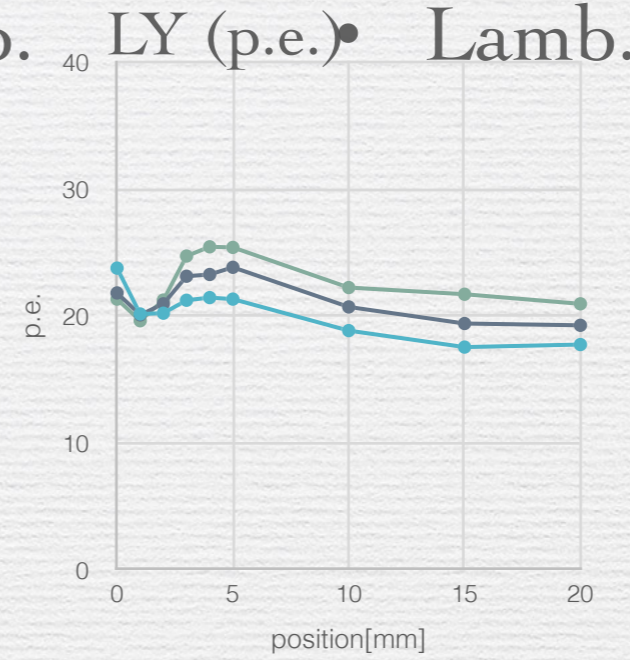
parameter scan



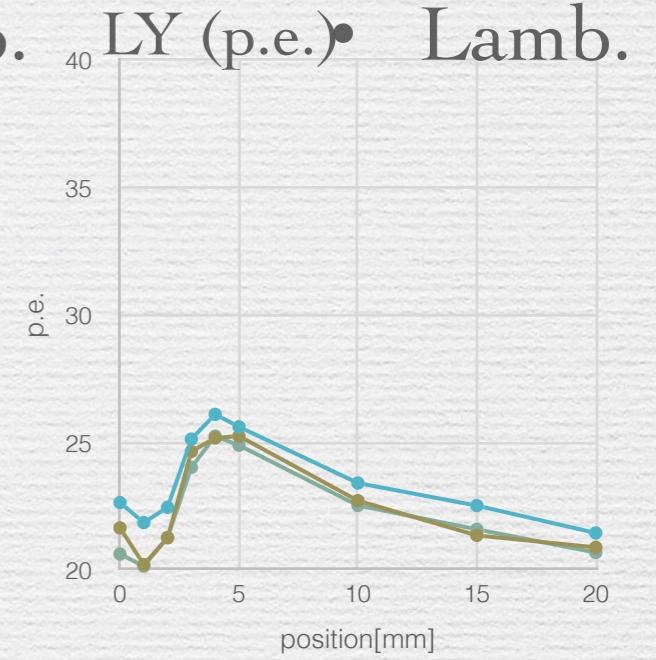
85deg 45deg 0deg



Lambertian 0.0
Lambertian 0.6
Lambertian 1.0



bsc1.0 bsc0.4 bsc0.1



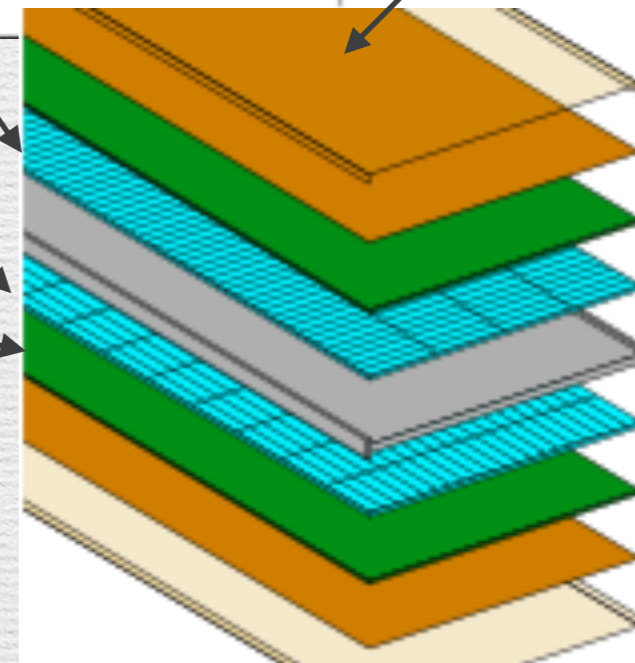
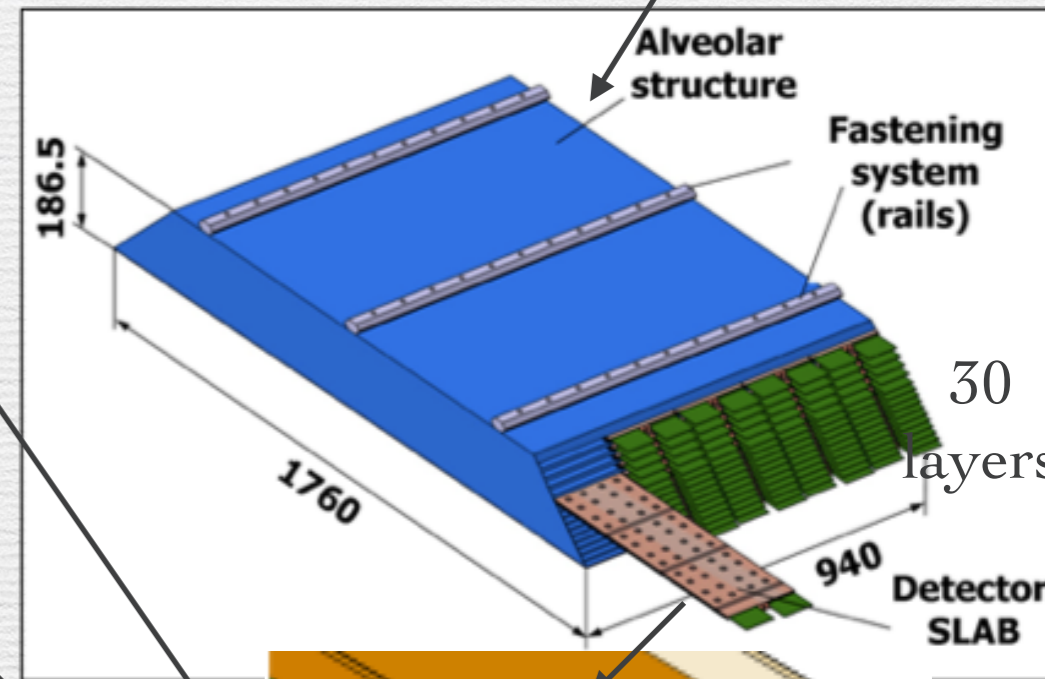
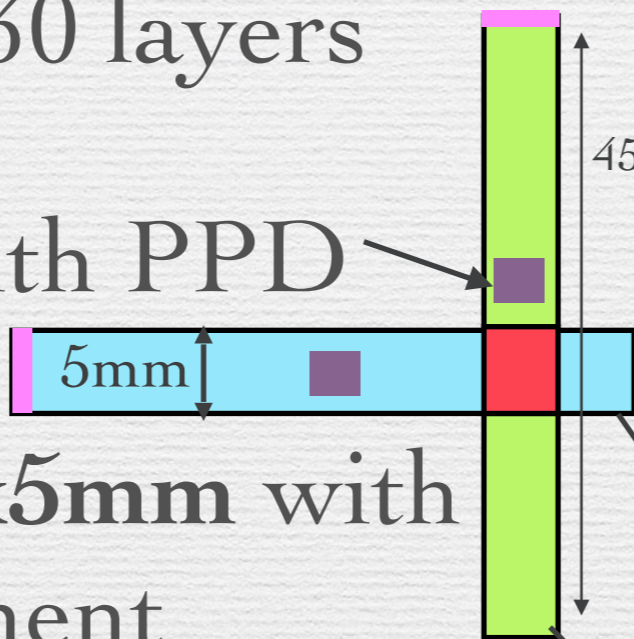
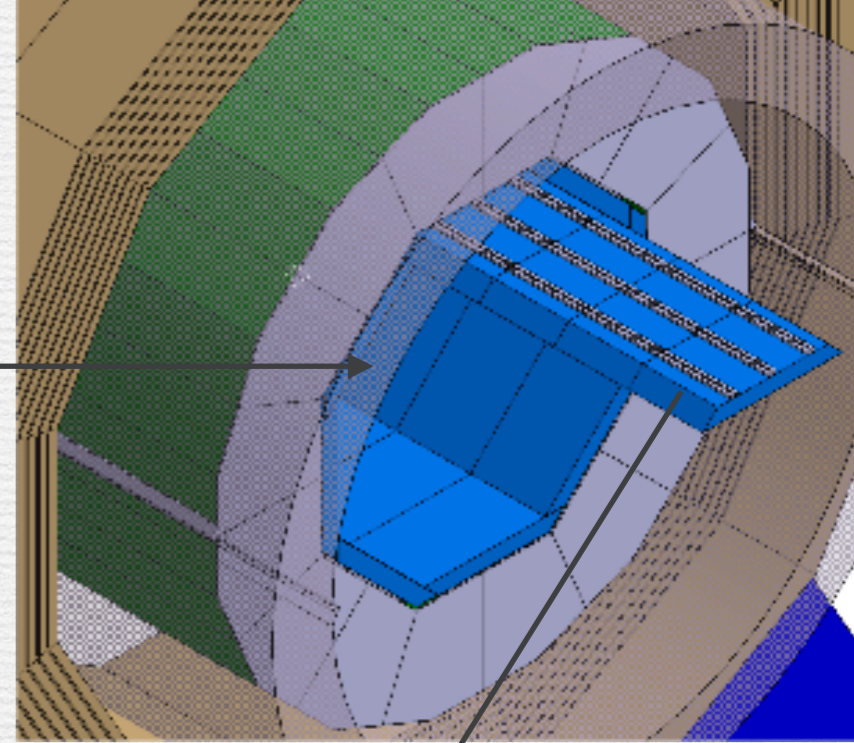
ssc1.0 ssc0.06 ssc0.01

look for the best parameter set

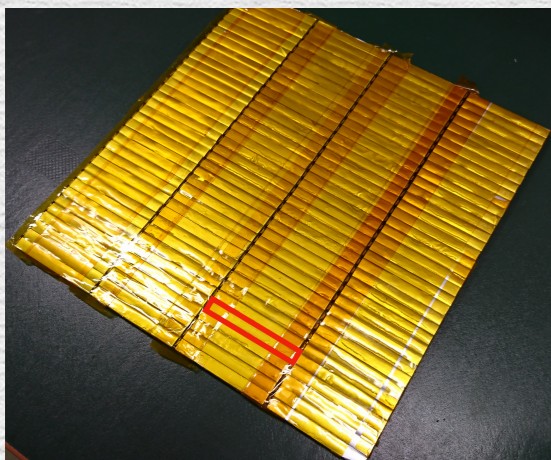


ILD SCECAL

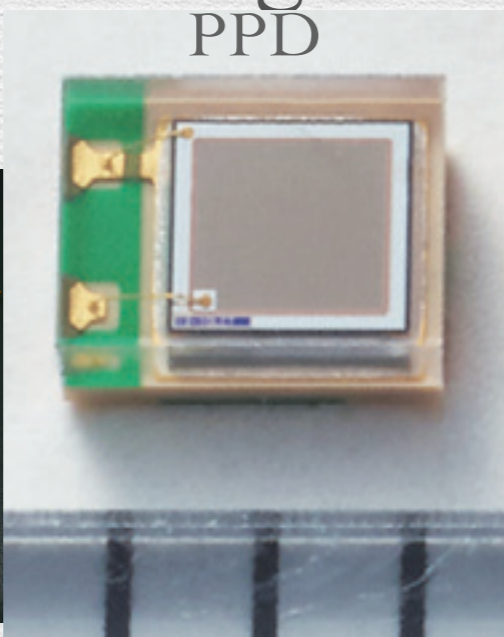
- scintillator strip Electro-Magnetic Calorimeter to fit PFA
- tungsten absorber : 30 layers
- scintillator sensor with PPD
- strips achieve 5mmx5mm with orthogonal arrangement



sc-strip layer



PPD



EBU

