Status of Sc-strip ECAL optimization study

Tau and Ecal analysis Meeting

3rd March 2015

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Sc-strip ECAL optimization study plan

1. Realistic simulation study
   on Structure
      PCB - 1.2 mm and scintillator 1.0 mm thickness,
   Variances by
      saturation curves,
      calibration,
      dead channel,
      photon statistics at SiPM,
      # of pixels,
   - seeing single particles and jets.

by using Daniel's digitizer

2. Optimization
   scintillator thickness, 1.0 - 2.0 mm,
   photon yield ---noise vs. dynamic range.
3. test by some physics modes.

Todays topics,

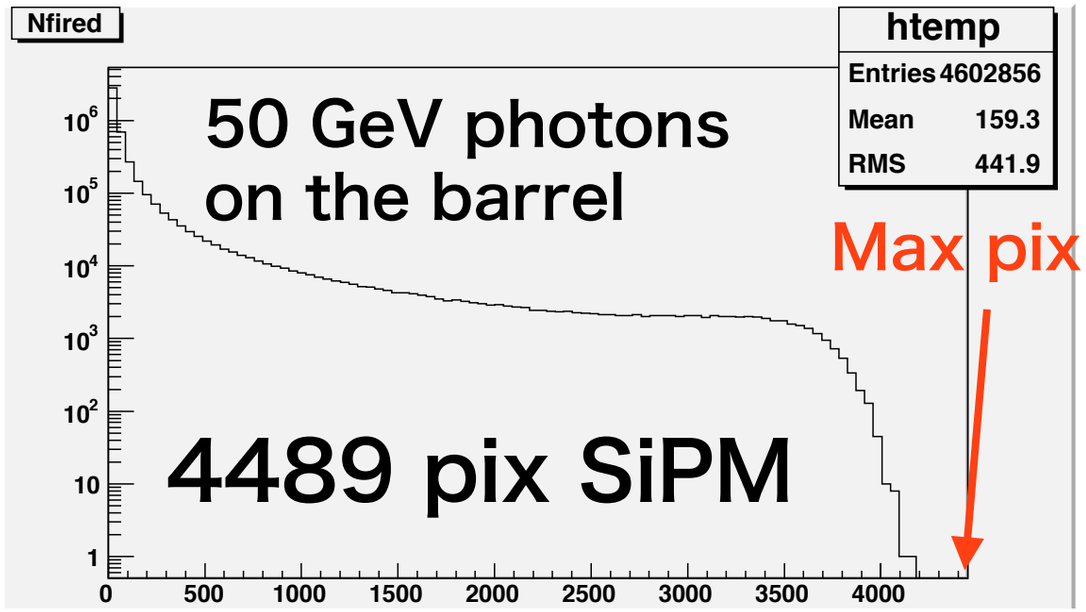
Single particle study

- # of pixels in a SiPM vs. high energy events.
- Energy measurement on Stave boundaries.

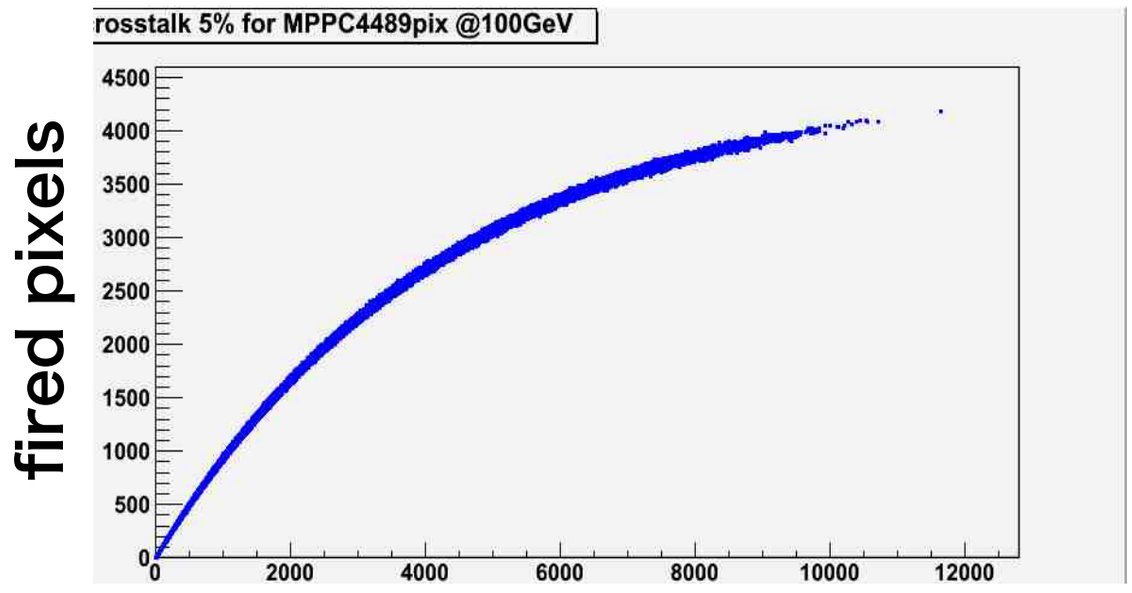
High energy saturation on a strip.

Scintillator: 1mm thickness,
photon yield: 7 p.e. / MIP

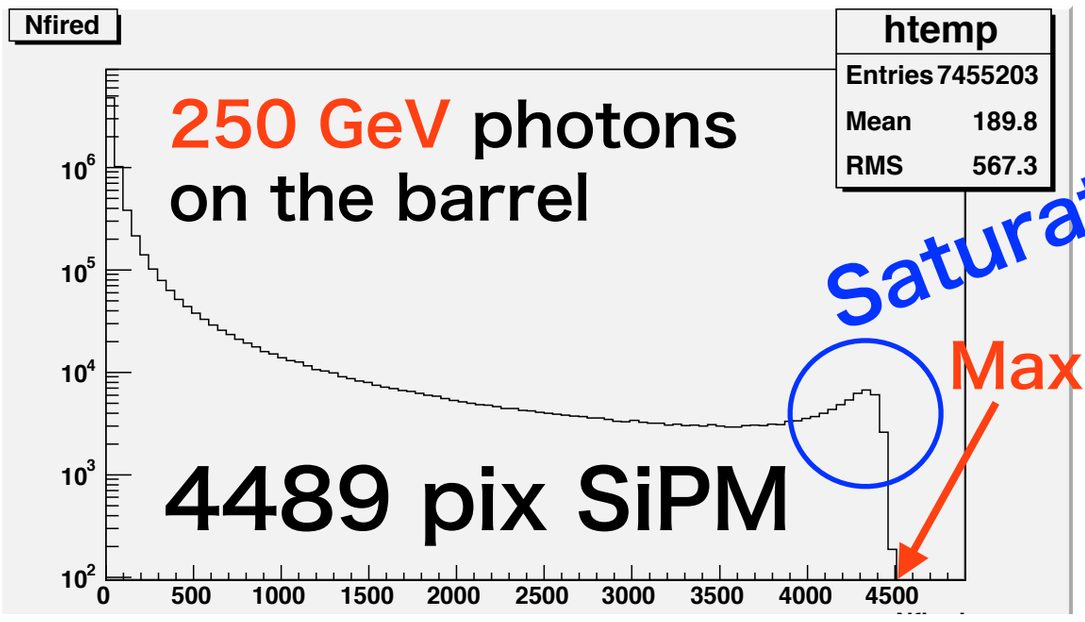
By A. Murasame



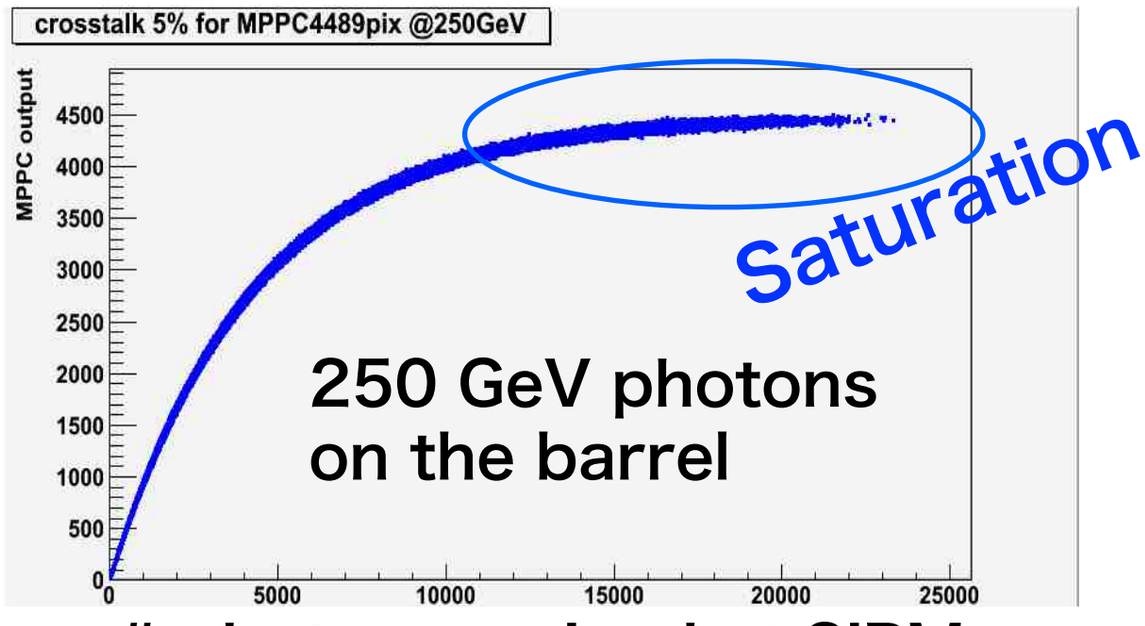
fired pixels



photons arrived at SiPM



fired pixels



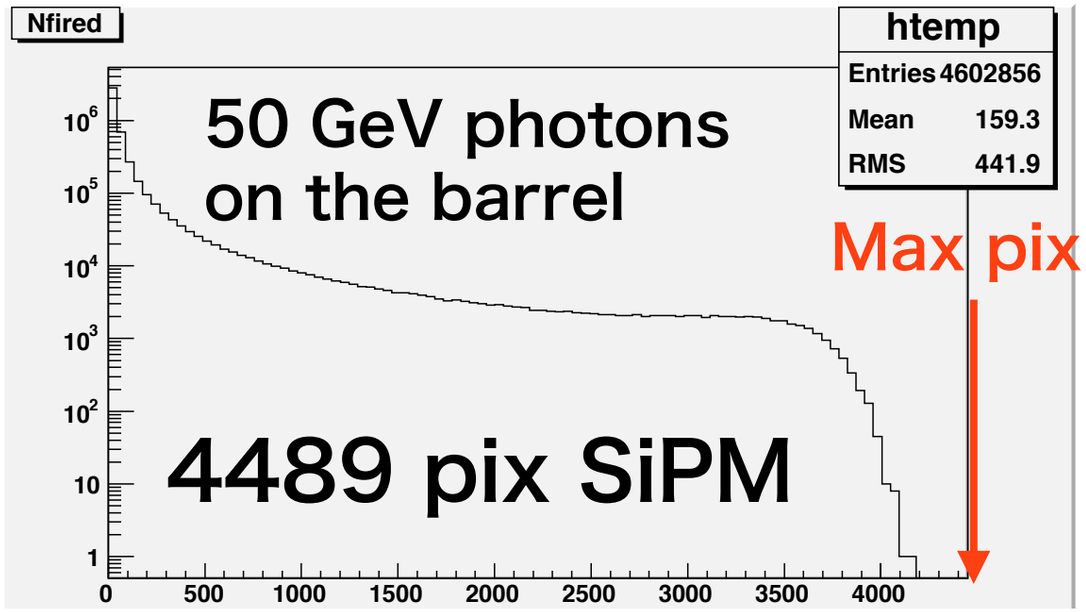
photons arrived at SiPM

4489 pixel is not enough for 250 GeV.

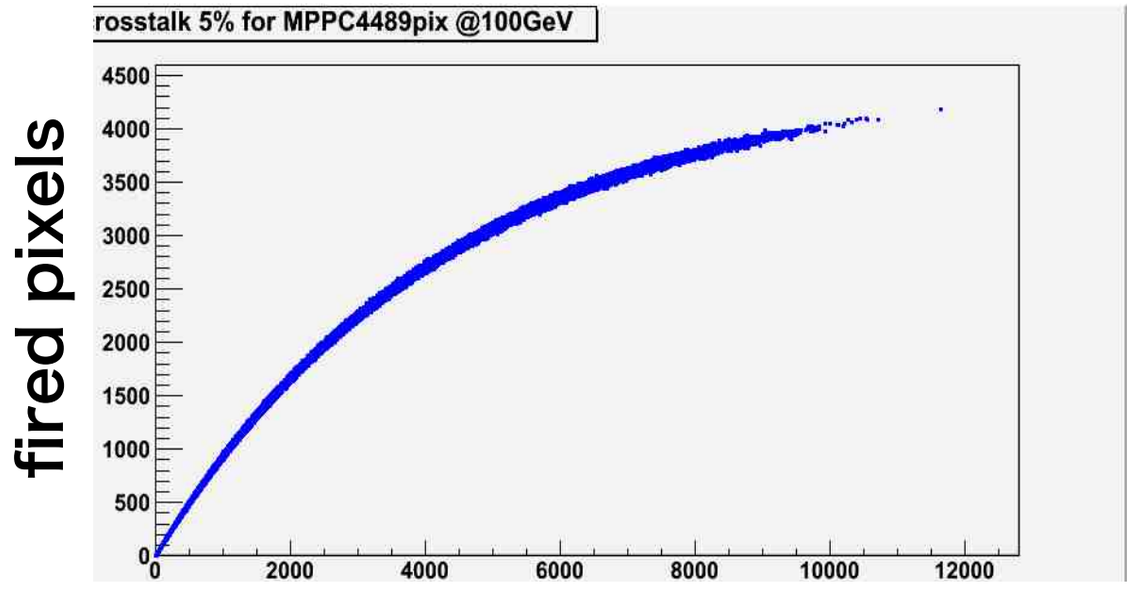
High energy saturation on a strip.

Scintillator: 1mm thickness,
photon yield: 7 p.e. / MIP

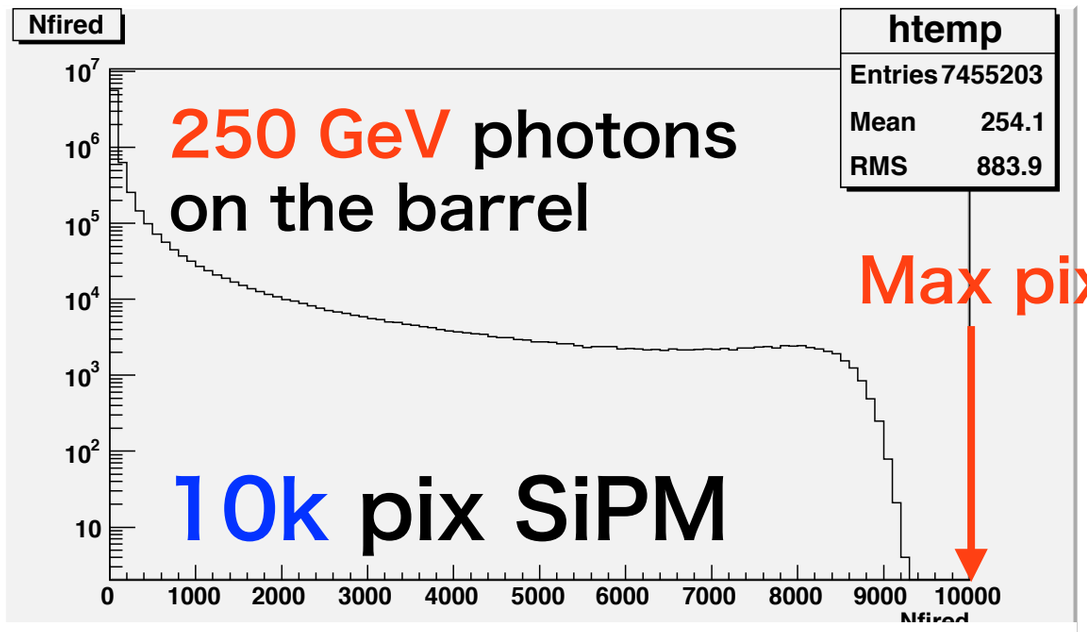
By A. Murasame



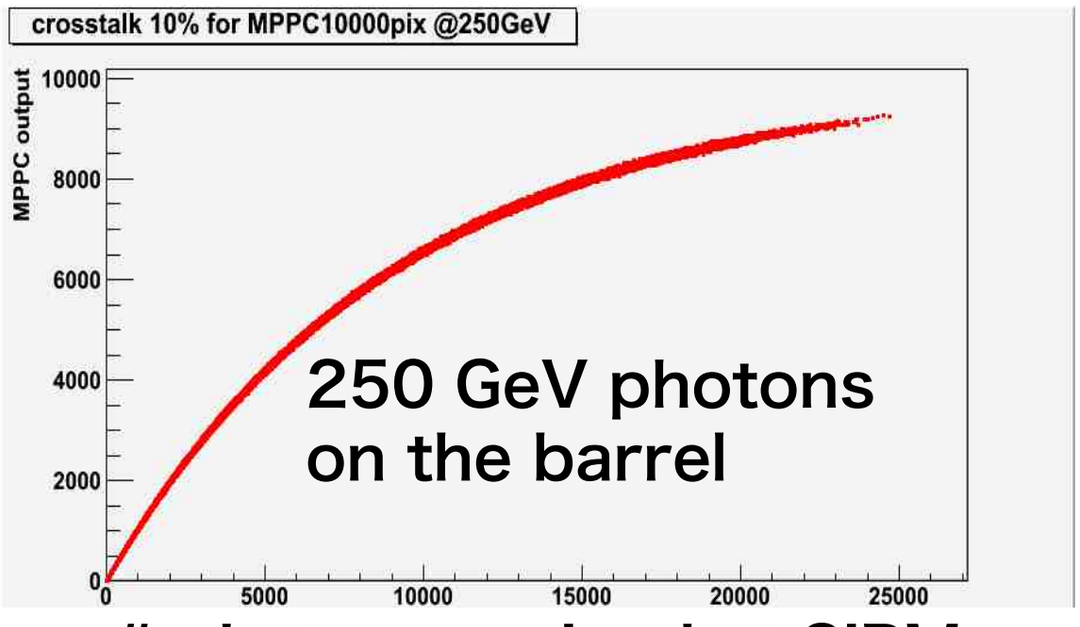
fired pixels



photons arrived at SiPM



fired pixels

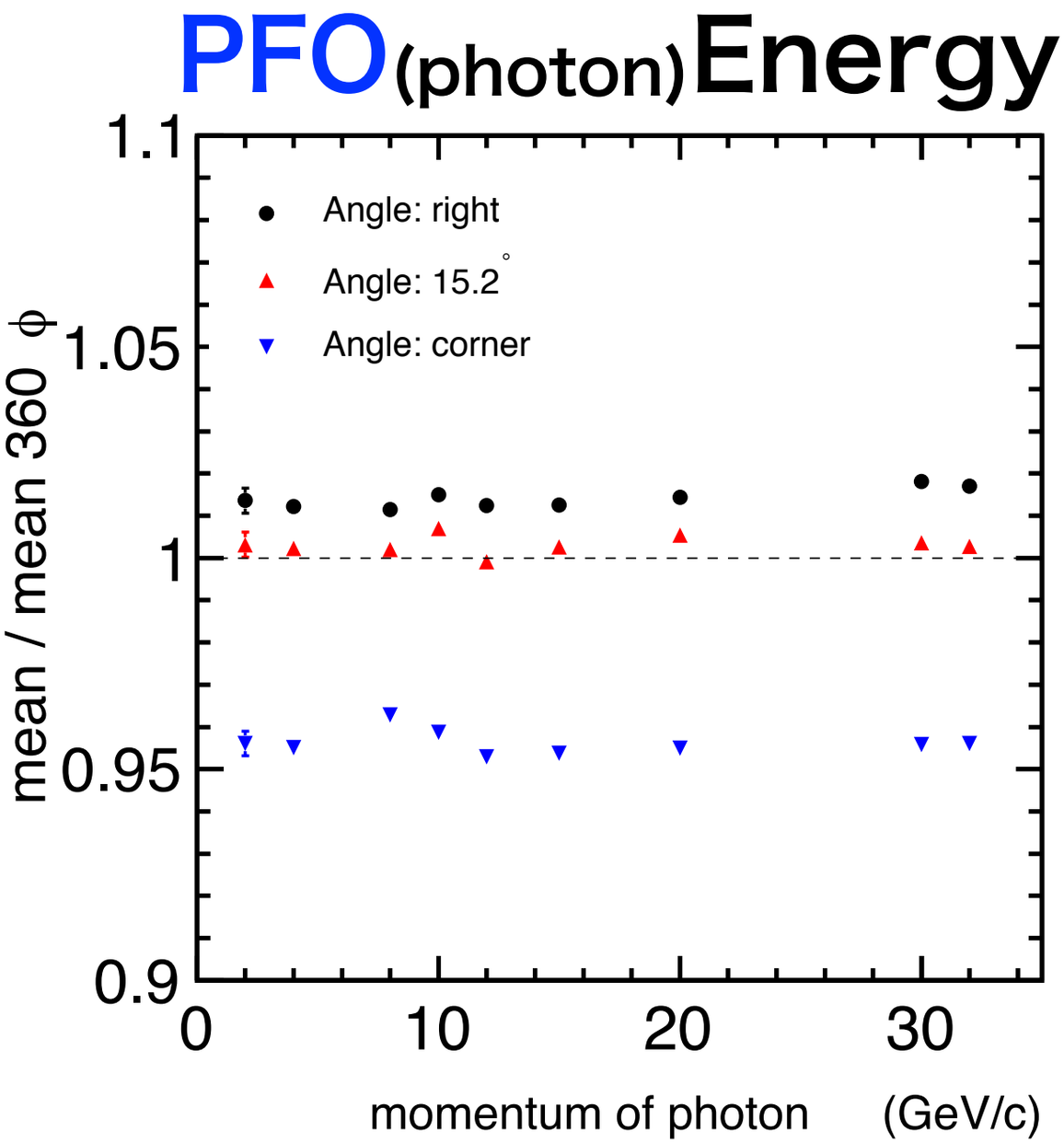


photons arrived at SiPM

10 k pixel is enough for 250 GeV cluster.

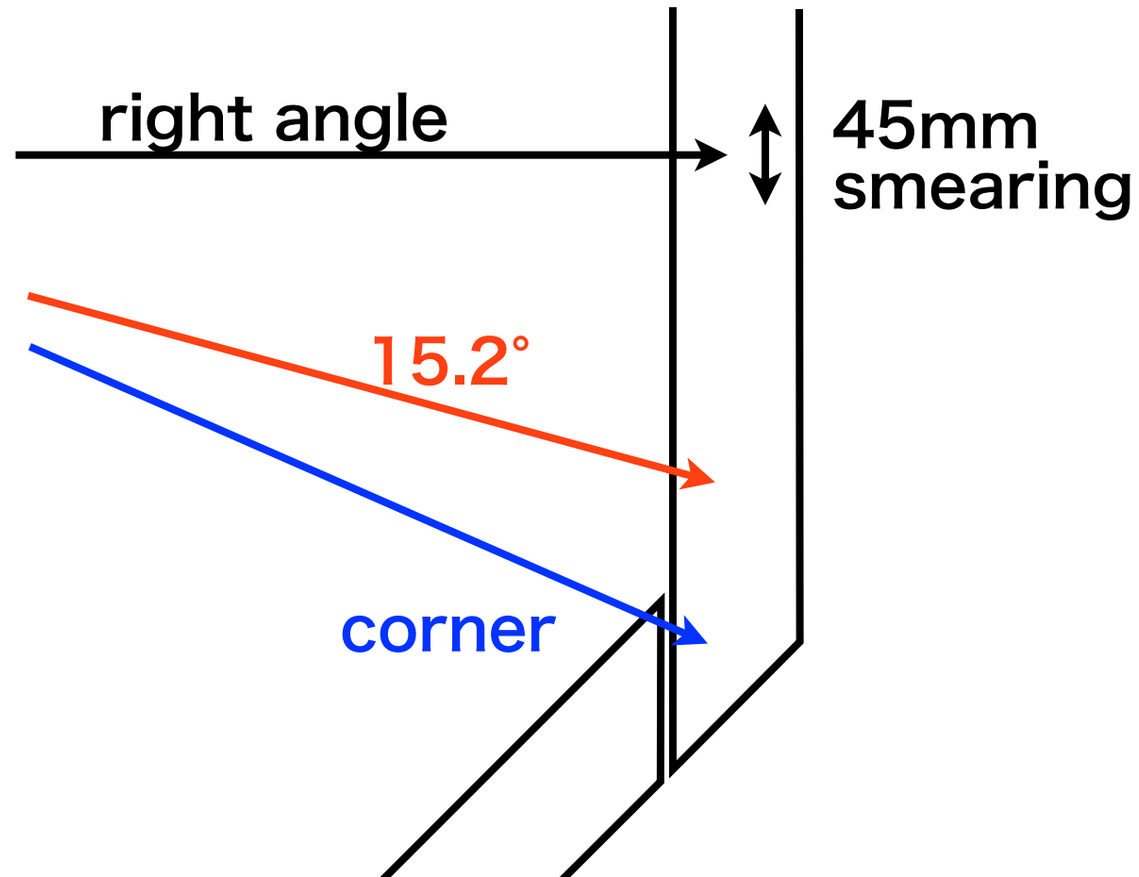
Stave boundary

Difference of E_{mean}s in three incident positions comparing to 360° smearing case



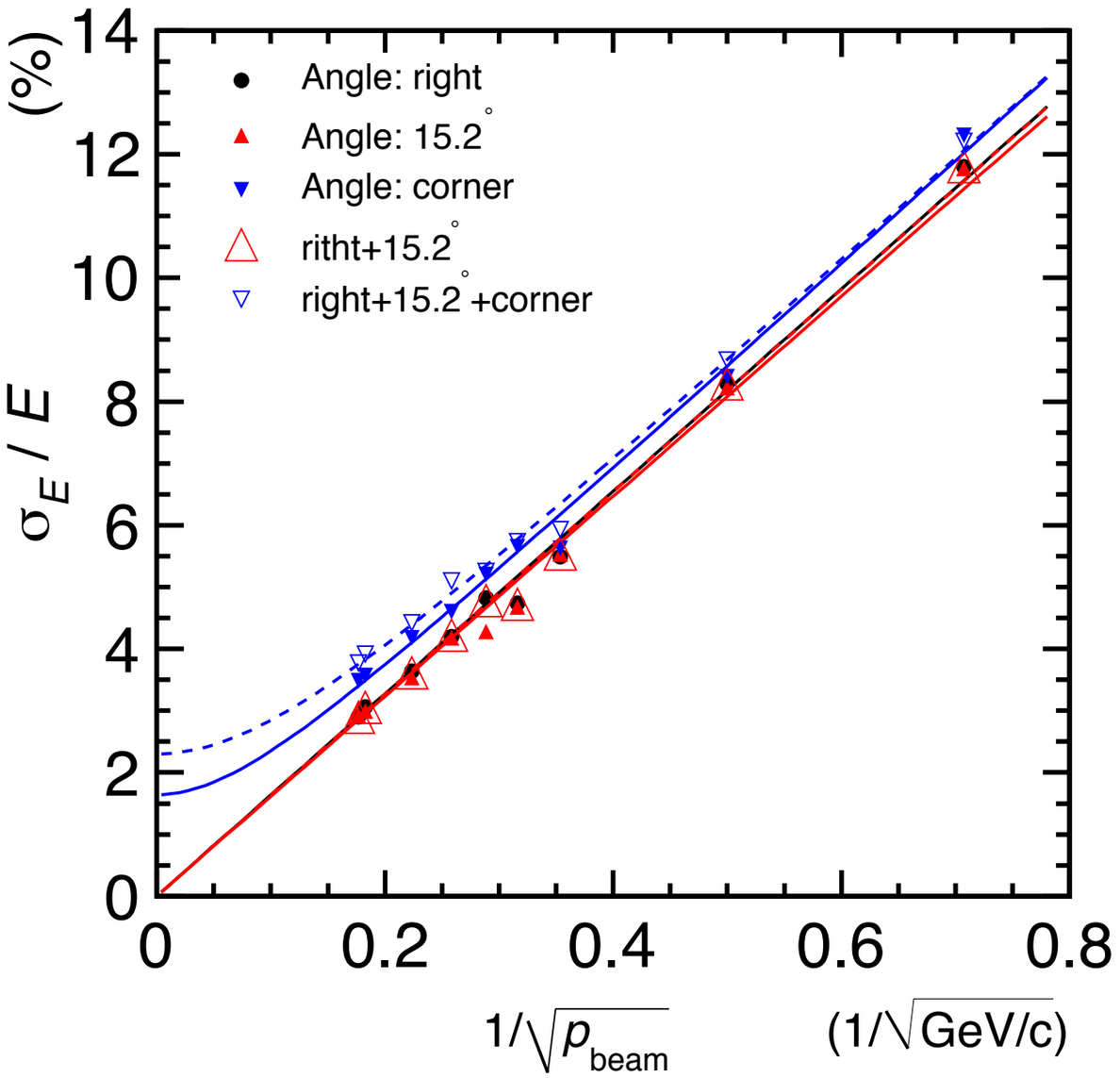
~5% small on the corner

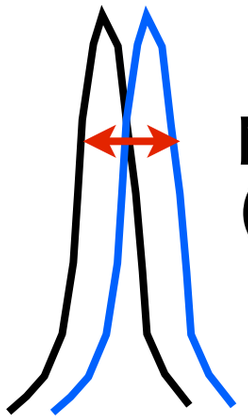
On right angle, mean is a little larger than 15.2°
but not so serious.



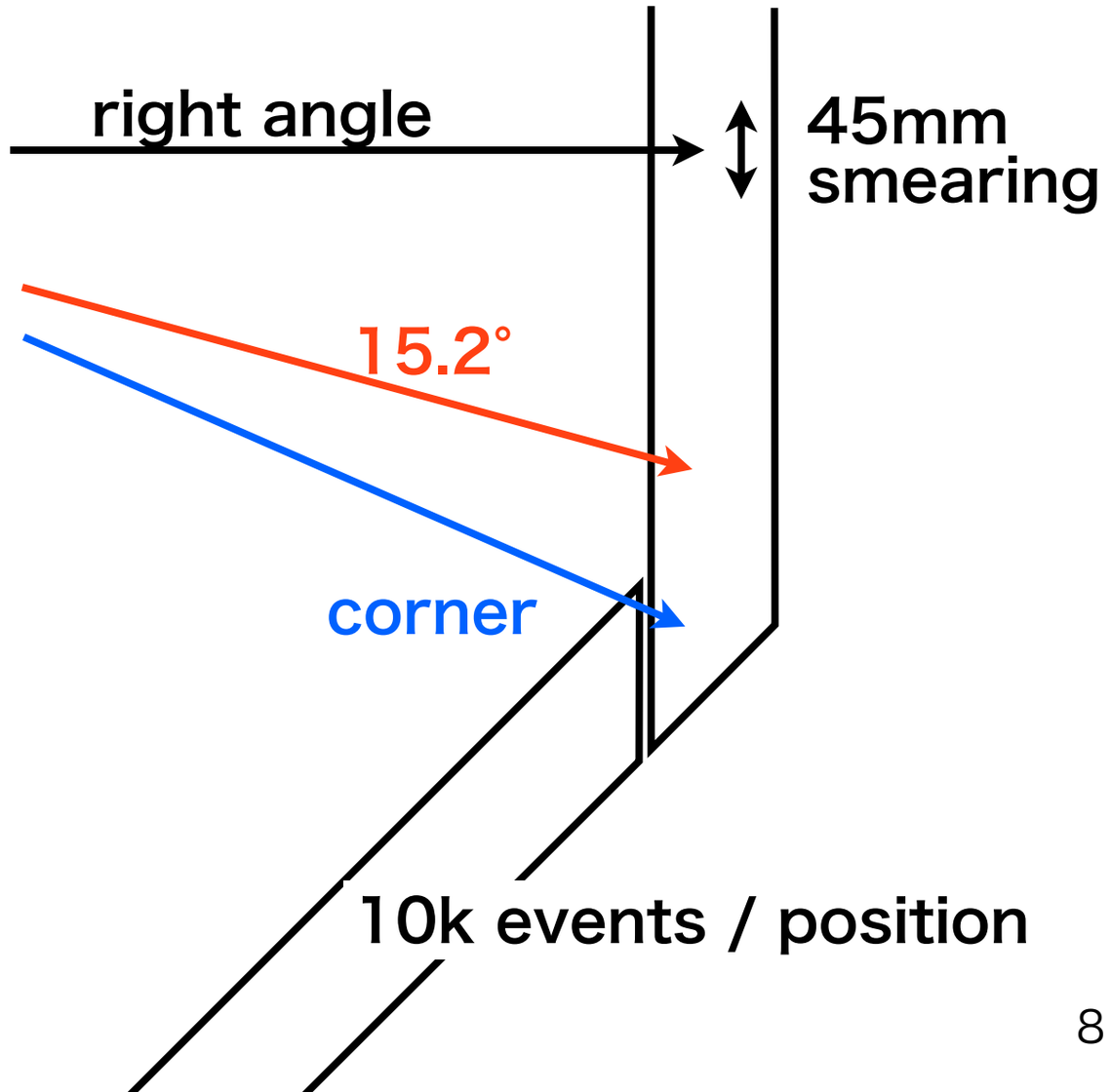
Single particle energy resolution of Pandora PFO degrades on stave boundary

Energy resolutions of photon



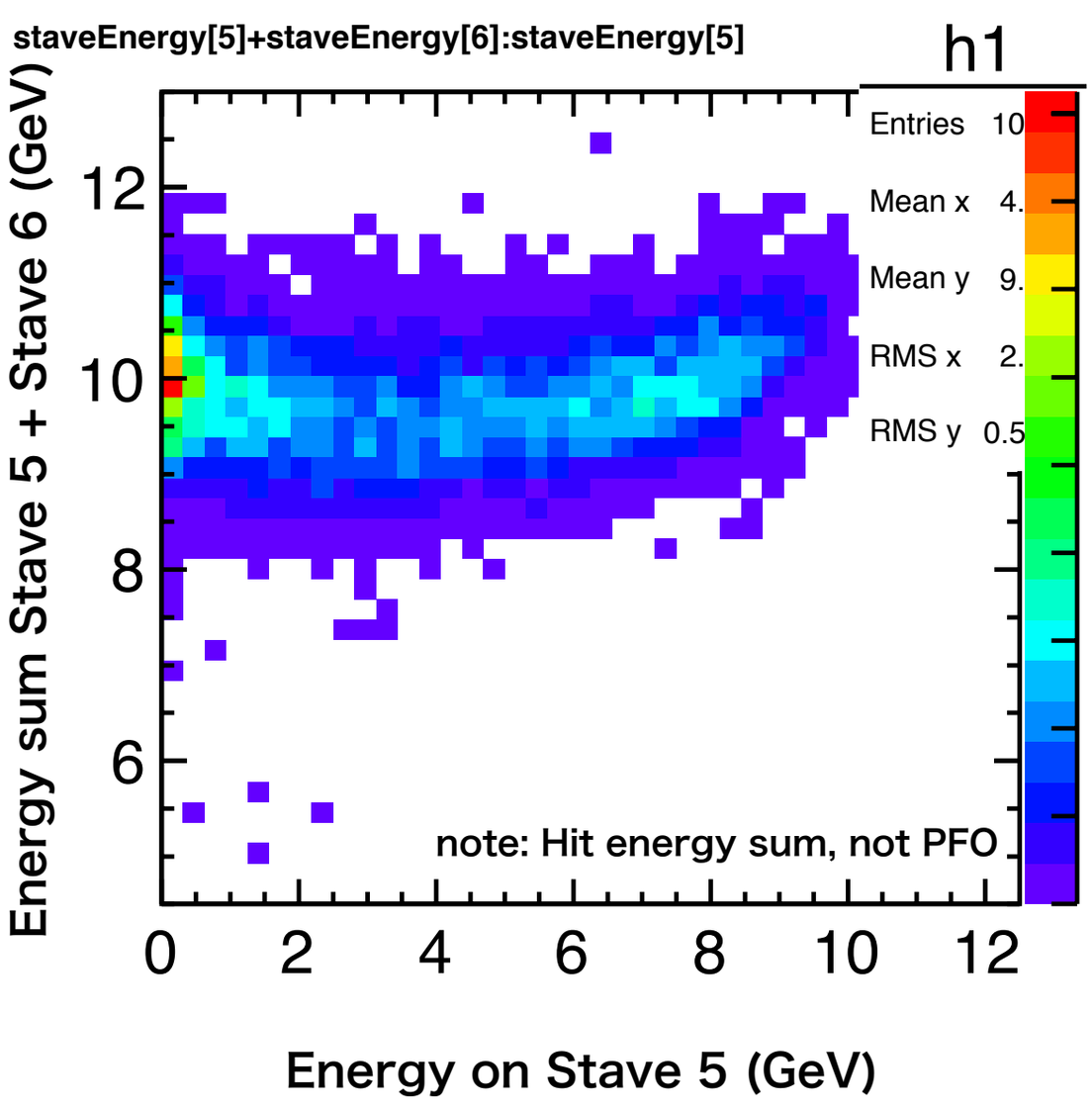


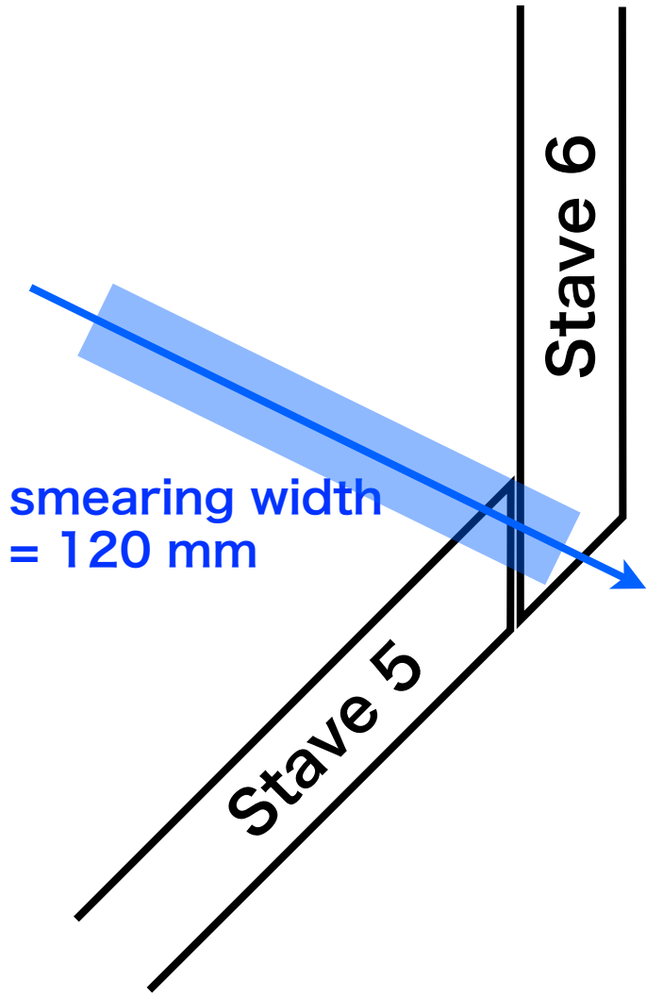
Multi-mean effect (MME)



Energy sum depends on fraction of energy between two staves

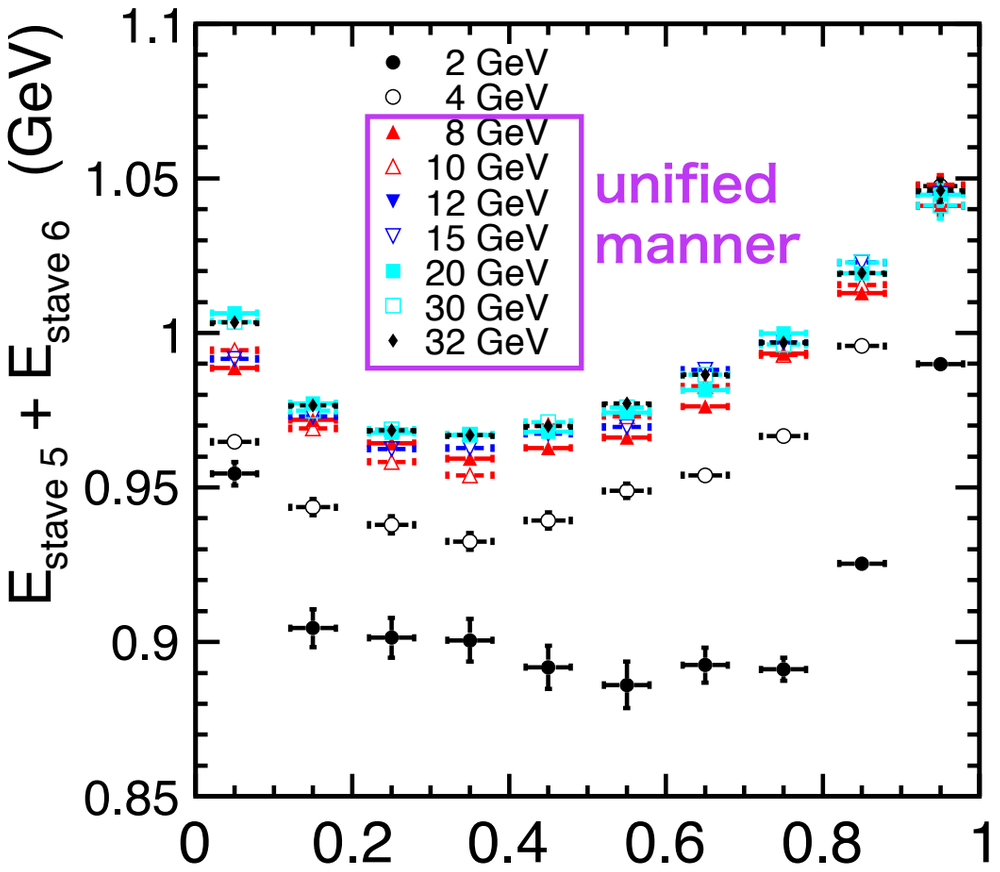
Simple energy sum of 10 GeV photon events
as a function of Energy on only stave 5



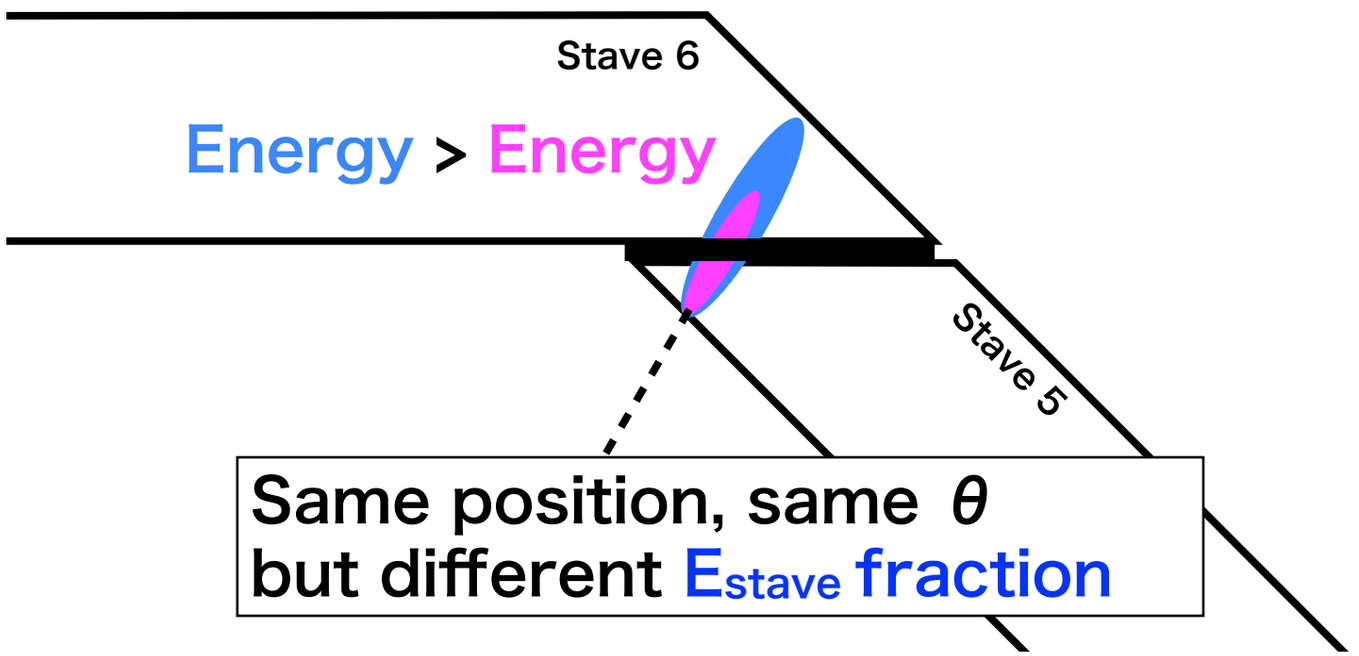


Phenomenon dose not depend on the energy of particles if we take E_{stave} fraction

Projection of previous plot changing energy of particles



θ does not work like this.
E_{stave} fraction as a function of θ from IP depends on the E_{photon},
▶ correction by E_{stave} fraction should be better than by θ or position.



E_{photon} > 8 GeV, the phenomenon does not depend on photon energy.
minimum energy sum ~ 96%.
E_{photon} < 4 GeV, the effect is larger than the case E_{photon}>8 GeV,
▶ correction does not make over correction at least.

Summary

The number of pixels of SiPM

- 10 k SiPM is enough for √s = 500 GeV ILC.

Stave boundary

- Around 4% energy loss at E fraction = 0.35.
  This can be one of the reasons of degradation of single particle energy resolution.
- The energy fraction between staves can be a good observable for the correction.

Next

- make a correction using “Energy fraction between staves” in
  PandoraPFA or ?
  Digitizer ?

Backup