Strip Splitting Algorithm and Hybrid

04 / Nov. 2011 Physics and Software meeting

Shinshu university k. kotera

Resent status of Strip Splitting Algorithm

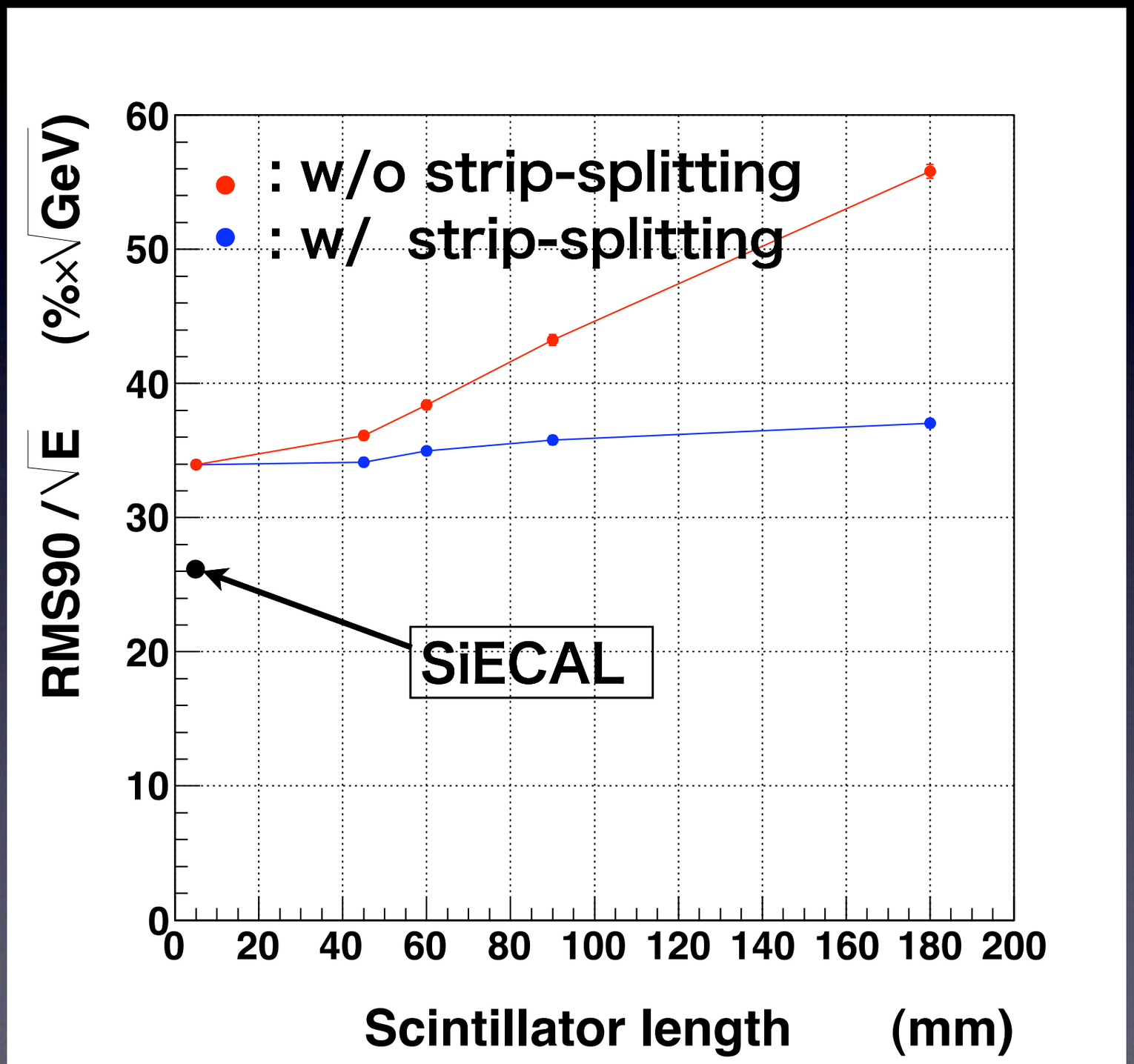
- I have showed StripScECAL(45x5mm) performance for 45 GeV Jet at ILD software meeting May 2011 in Paris:

  $\sigma E/E < 30\%$ (a milestone)

- Remaining problems:
  - End-cap▶JER degrades on End-caps and near there.
  - Higher energy Jet▶Not yet with current PFA conditions
  - more multi-jet
  - performance for physics analyses
  - .....
- To release SSA processor as Marlin framework◀I've had a svn account in MarlinReco, and just started preparing to check:

  https://svnsrv.desy.de/desy/marlinreco/MarlinReco/trunk/hybridEcalSplitter

Length dependence of JER 45 GeV after tuned by author of PandoraPFA



-with default parameters for PandraPFANew (calibrations have been done for ScECA)

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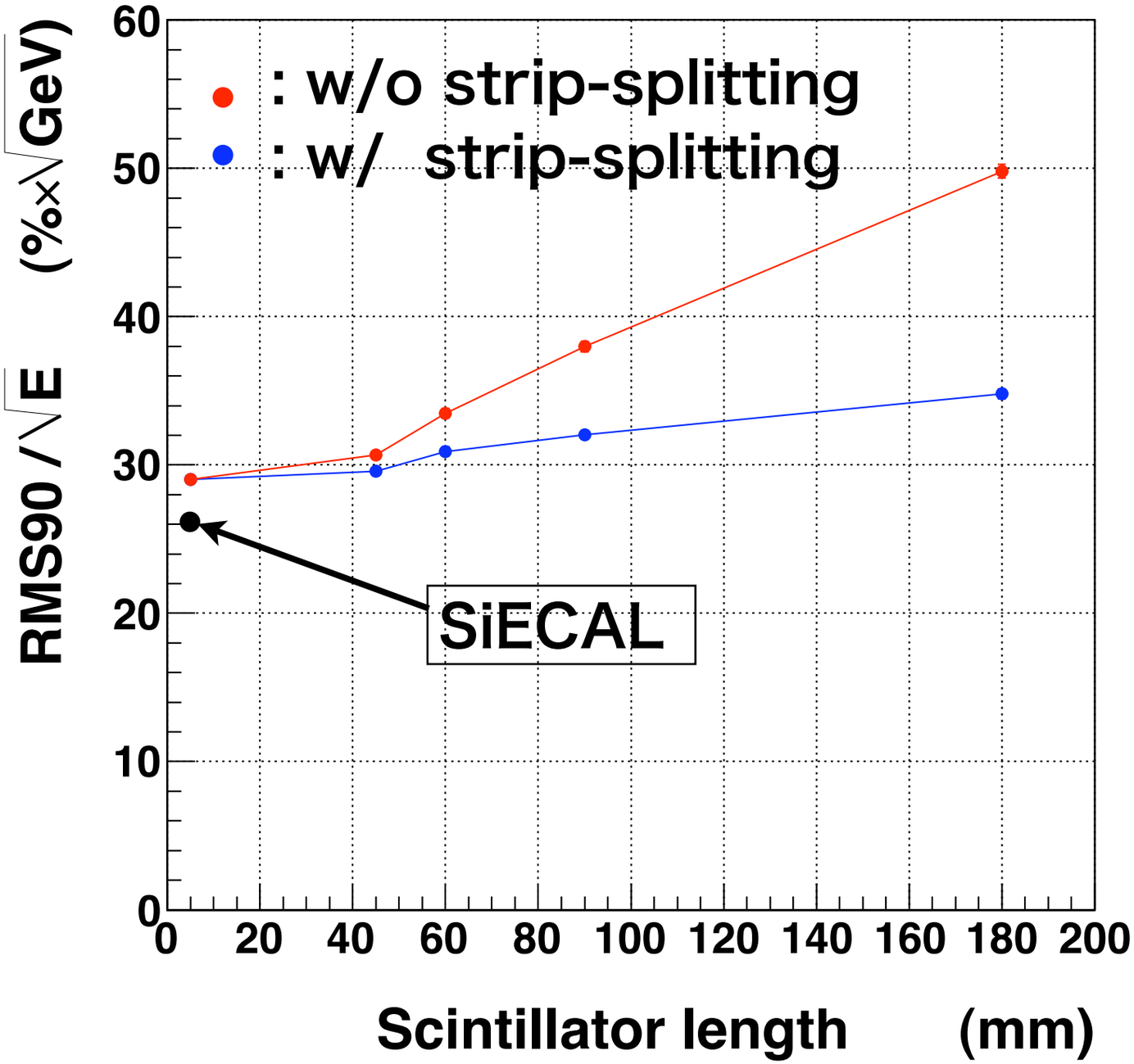

- PandoraPFA parameters for ScECAL45x5mm² were Tuned by Mark Thomson.
- Sc45x5mm²StripECAL achieves to have JER/√E less than 30%.

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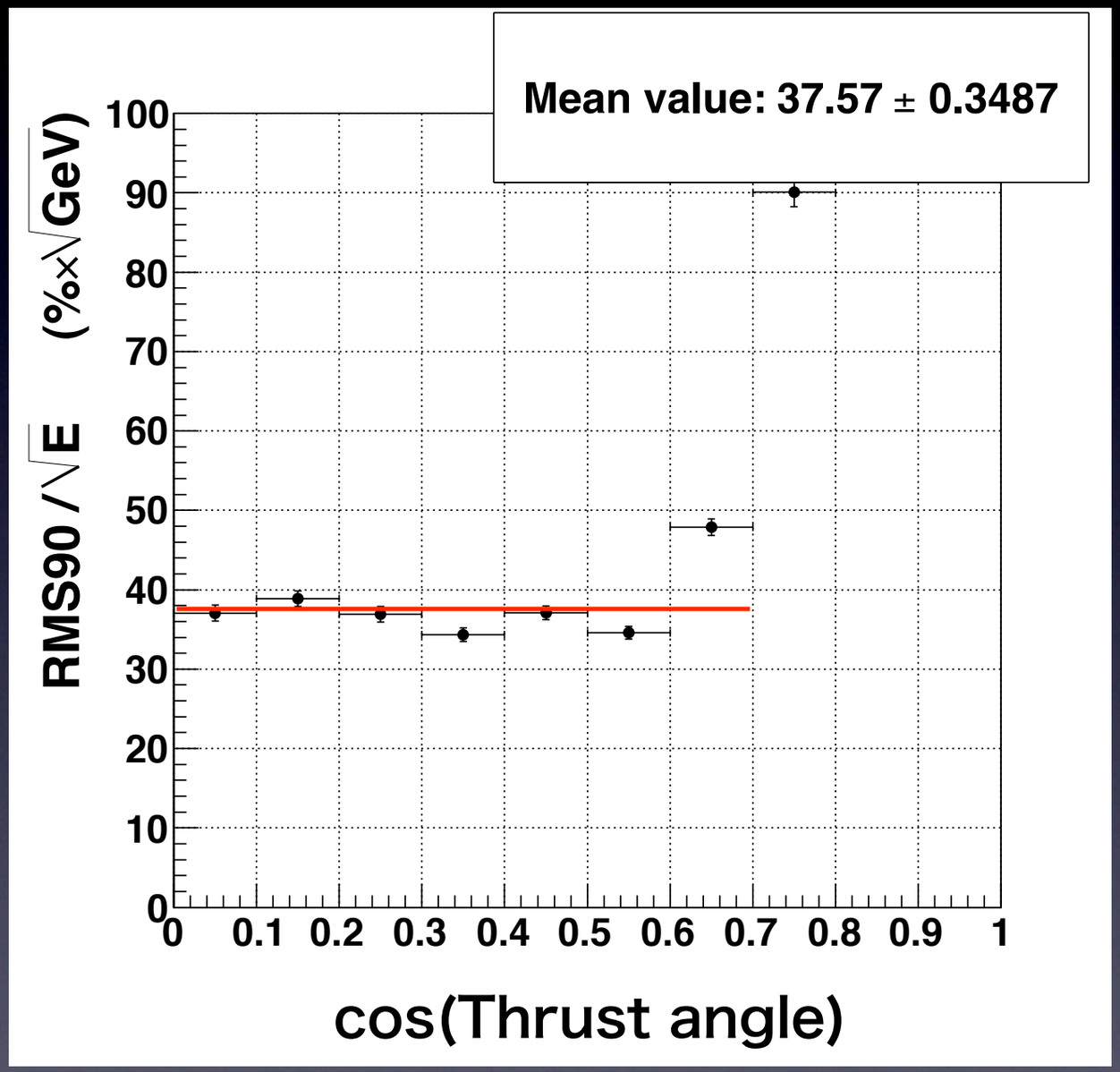
Thrust angle dependence of 100 GeV JER



Around end-caps JER degrades.
I will see what happens on boundary

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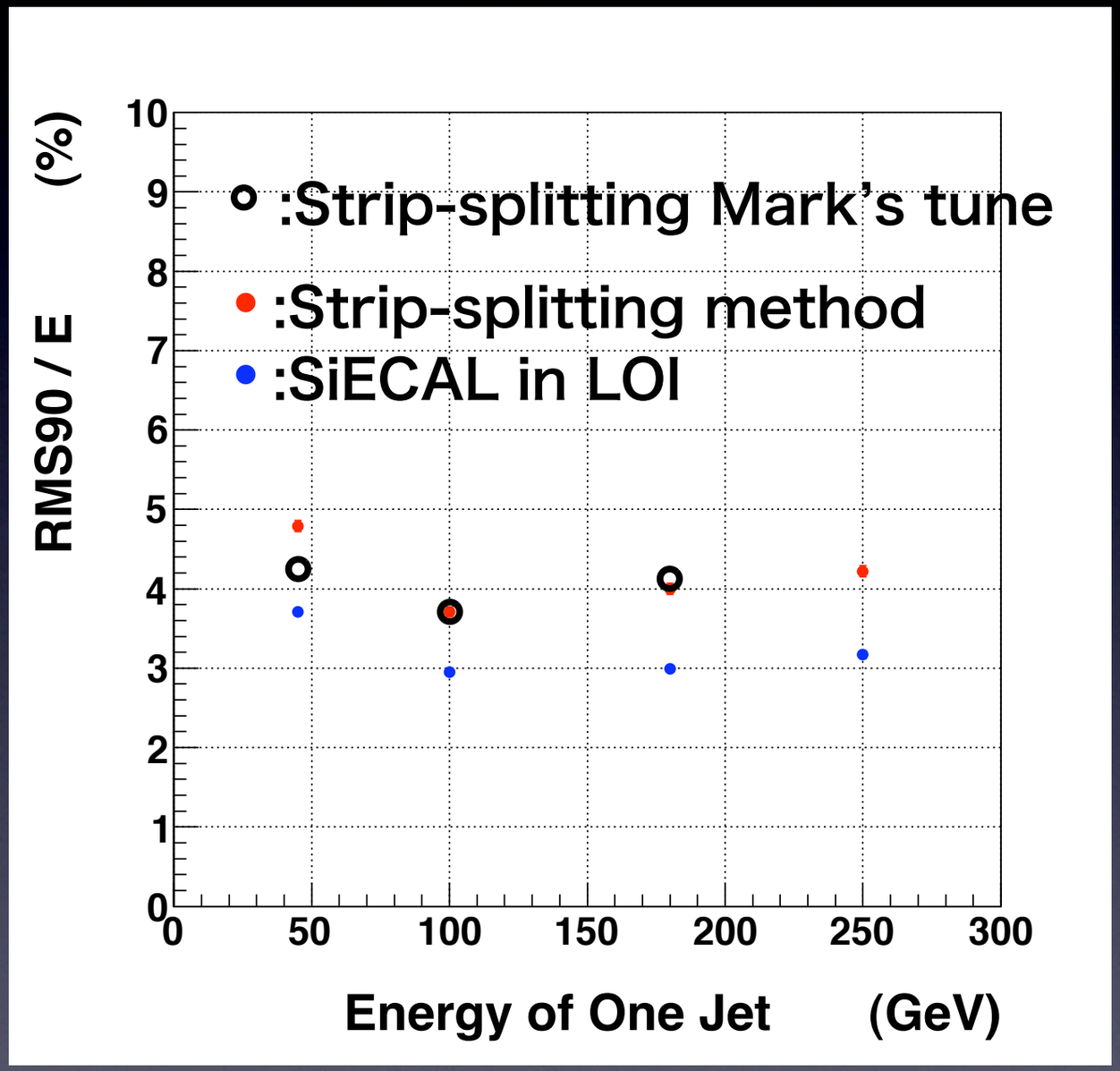
Mark's tuning 100 GeV, 180 GeV



Mark's tune works only for 45 GeV Jet events!
We need to see what happens event by event and I need to learn how PandoraPFA works.

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back up

Strip-splitting Algorithm

1. Assume that n-th is an z-layer (fine segmentation in z direction), while n±1 layers are x-layers (fine segmentation in x direction).
2. Split each strip in n-th layer into virtual square cells.
3. Energy deposit in n-th layer
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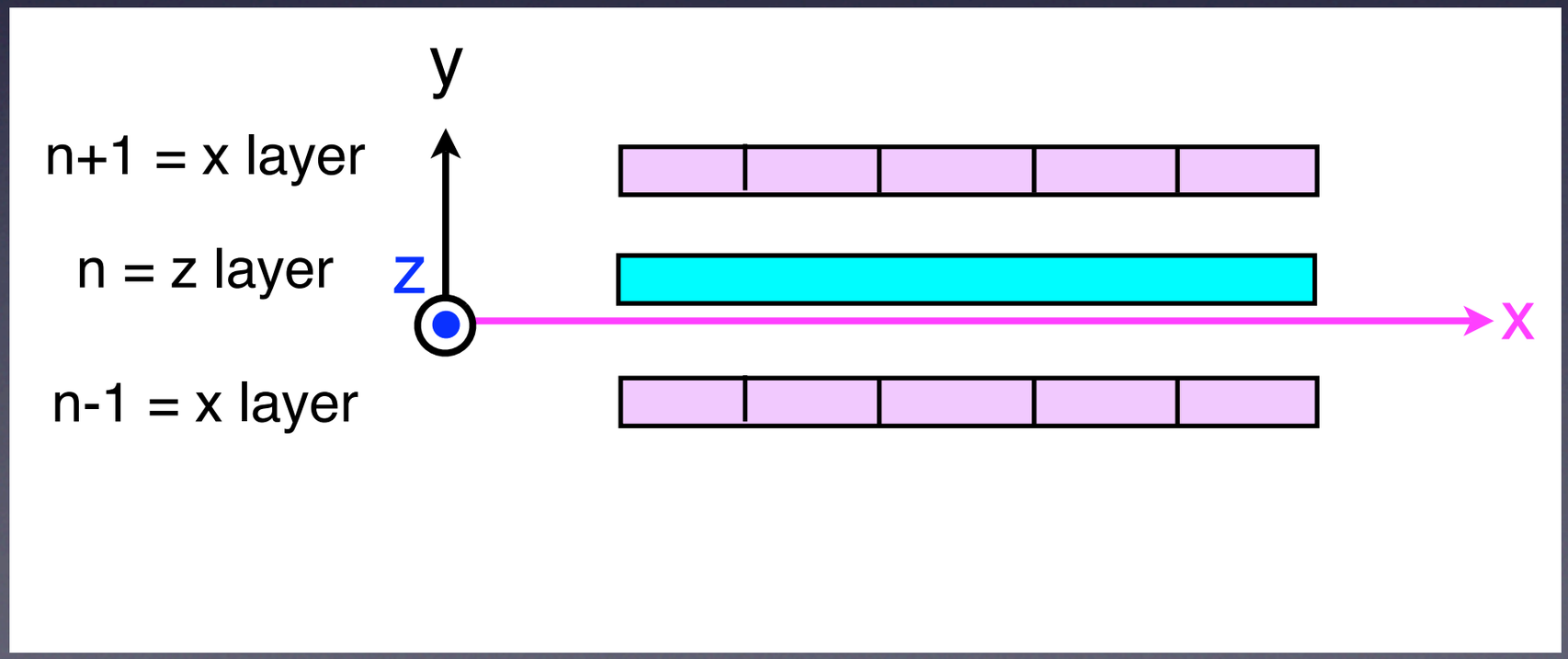
5. The position and energy of virtual square cells are fed into PandoraPFA.



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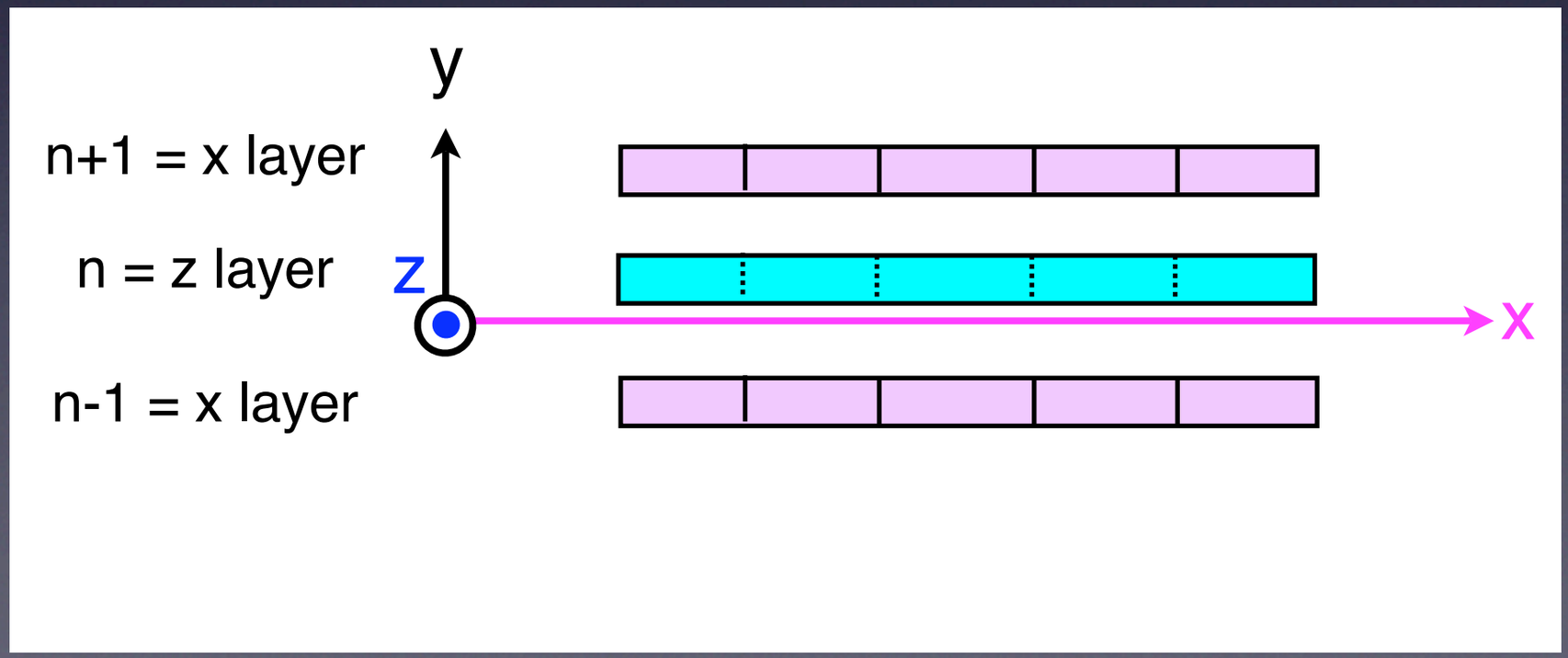

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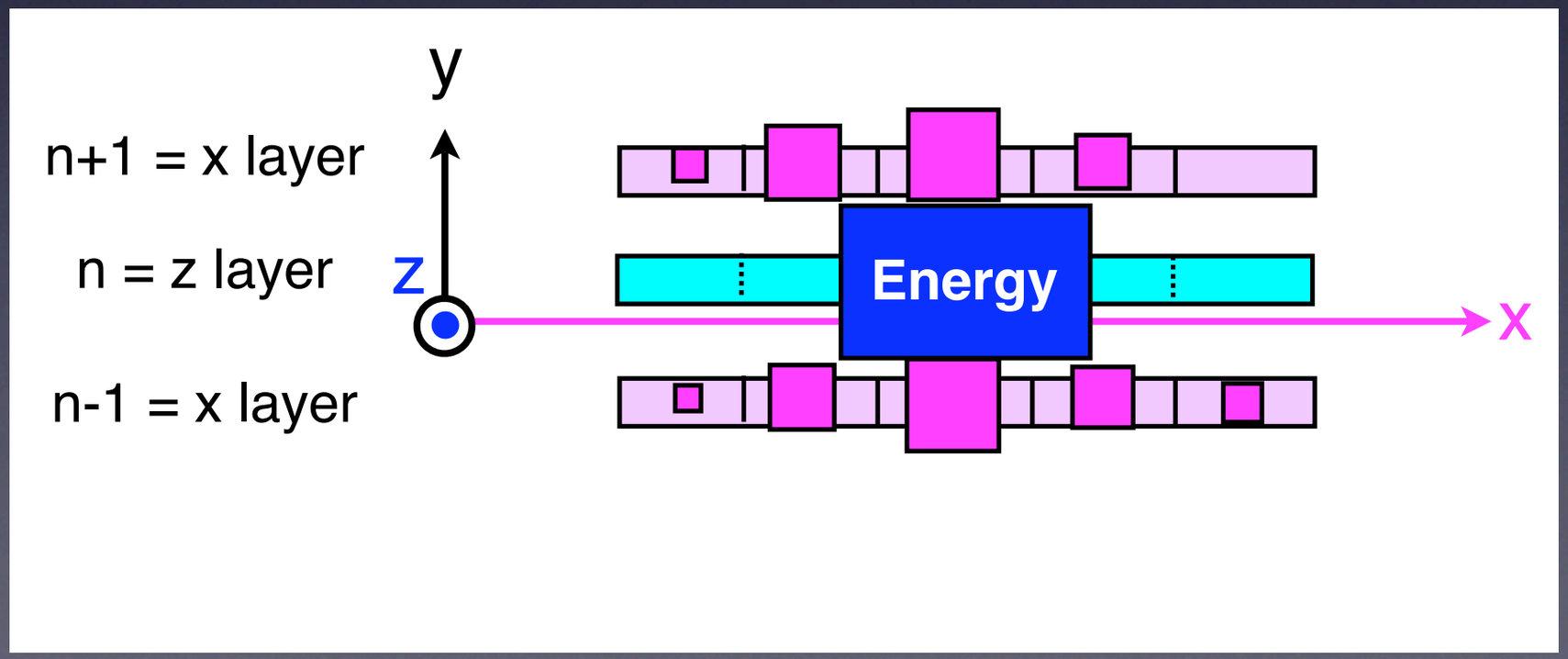

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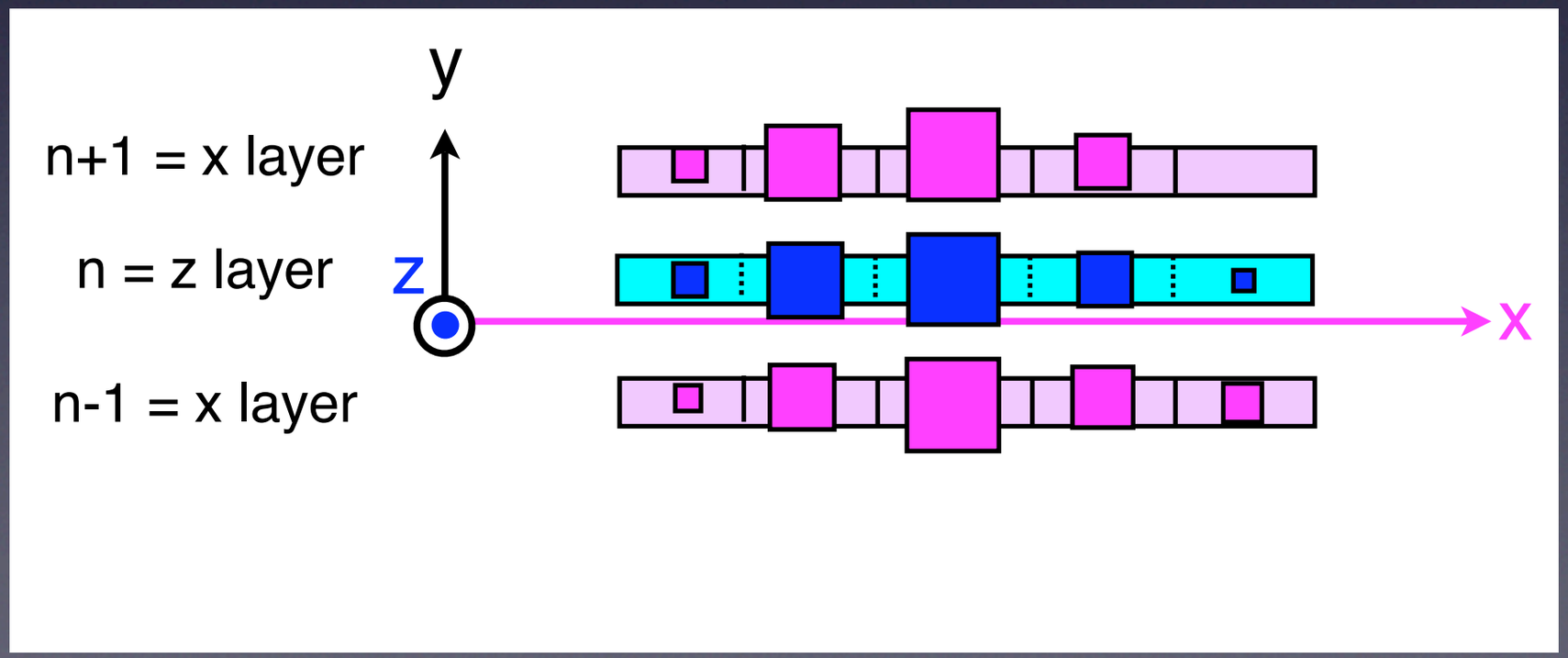

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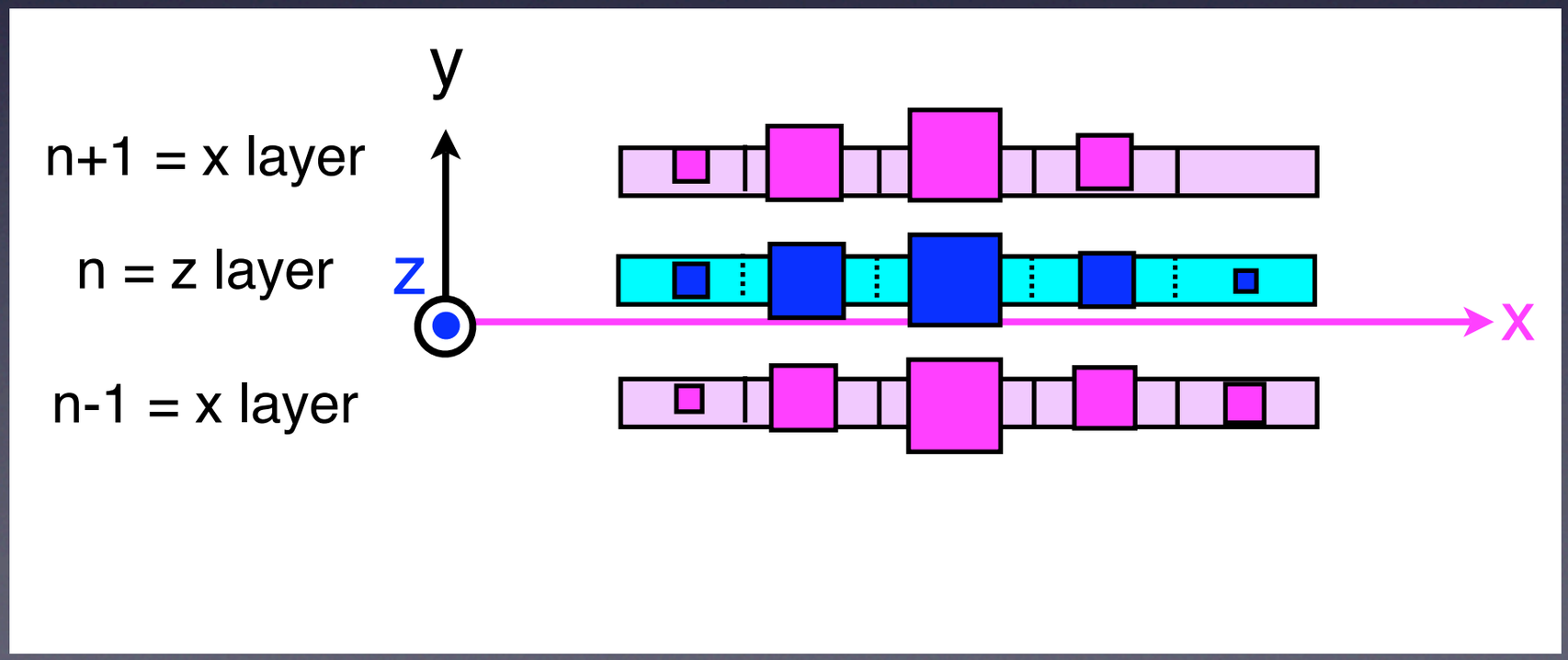
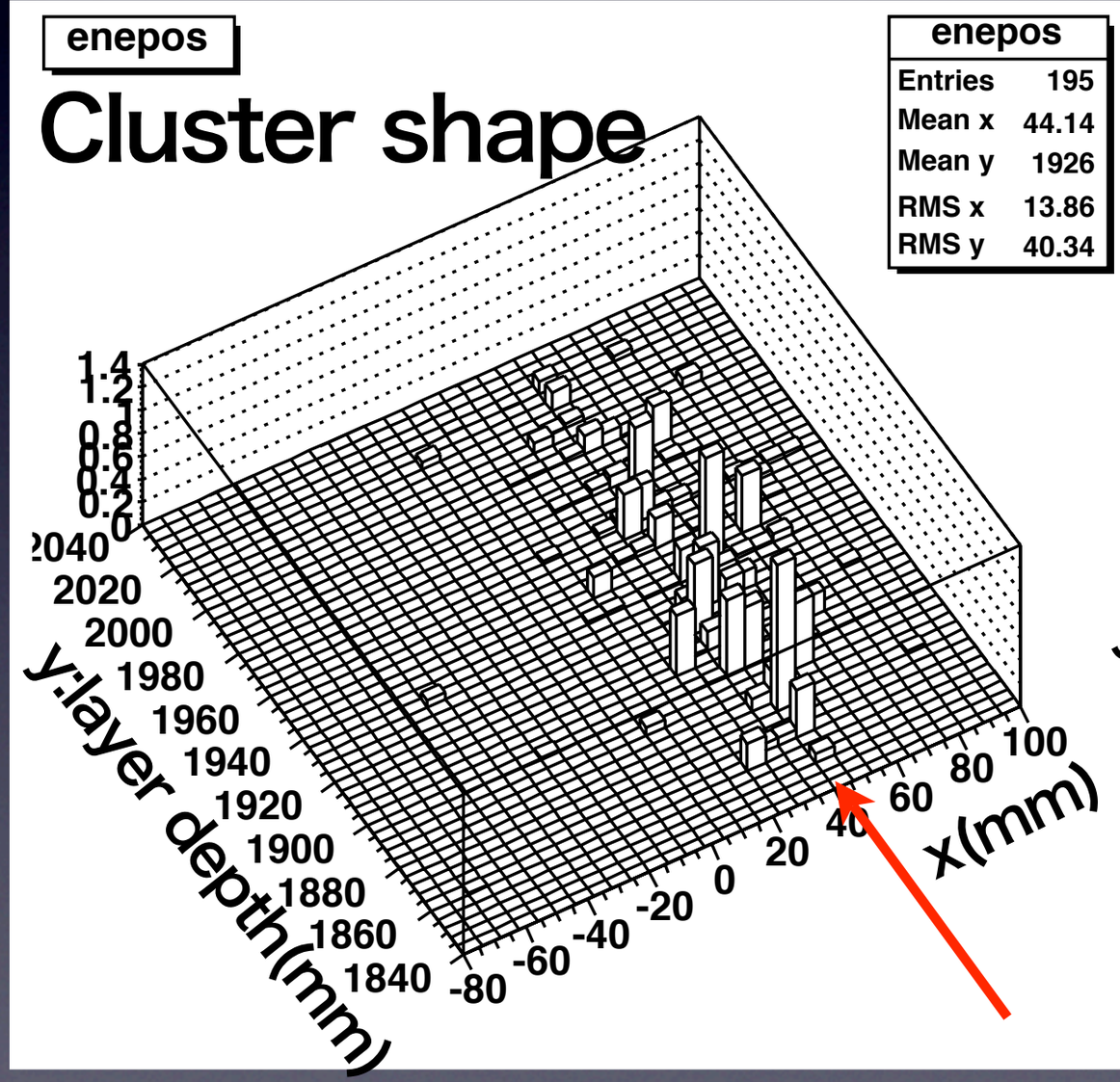


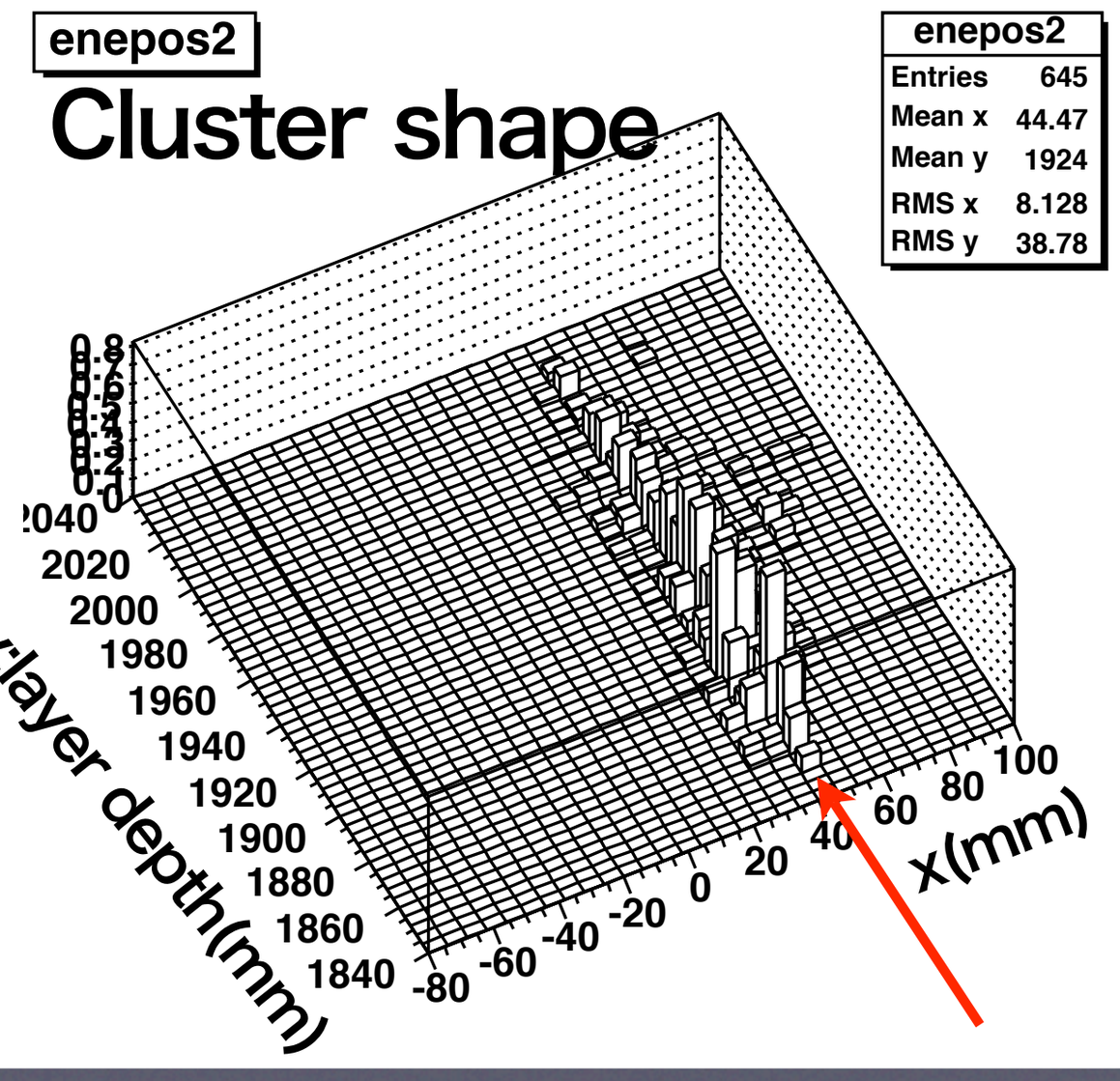
10GeV photon typical event

Energy summed up to z direction (y-x plane)

Before Strip-Splitting



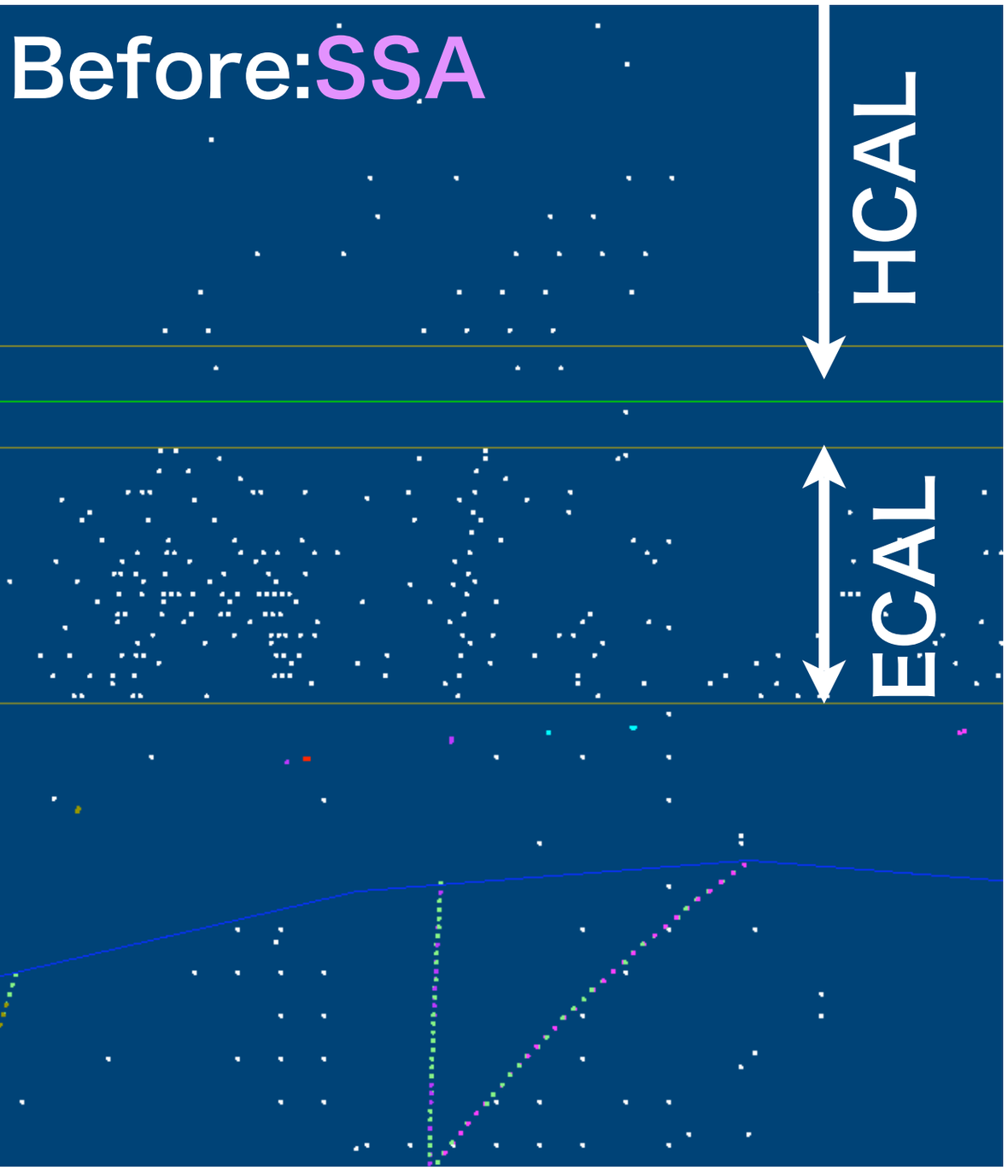
After Strip-Splitting

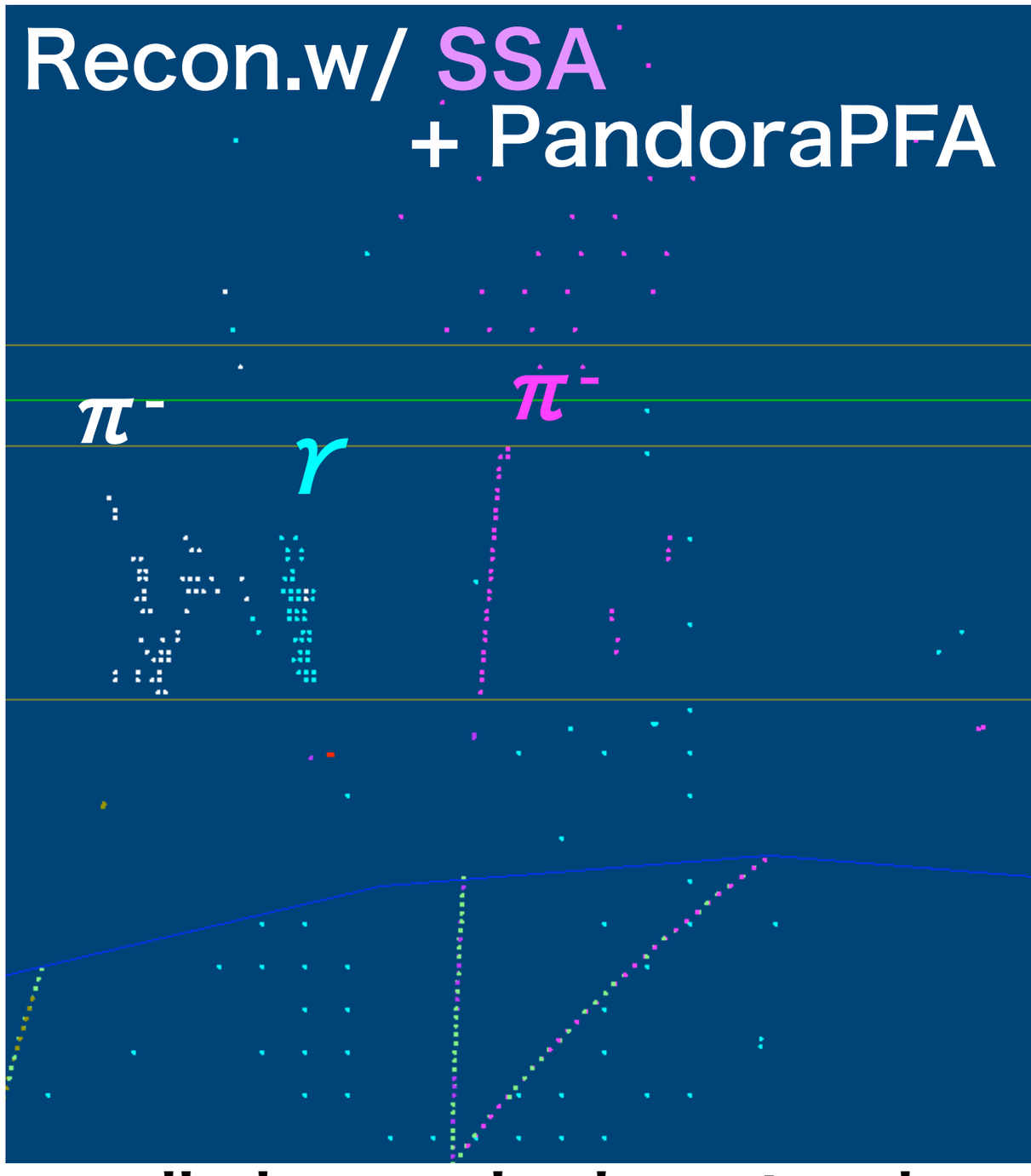


Nice cluster can be seen after Strip-splitting.

Strip Splitting Algorithm

100 GeV Jet x 2: easy case

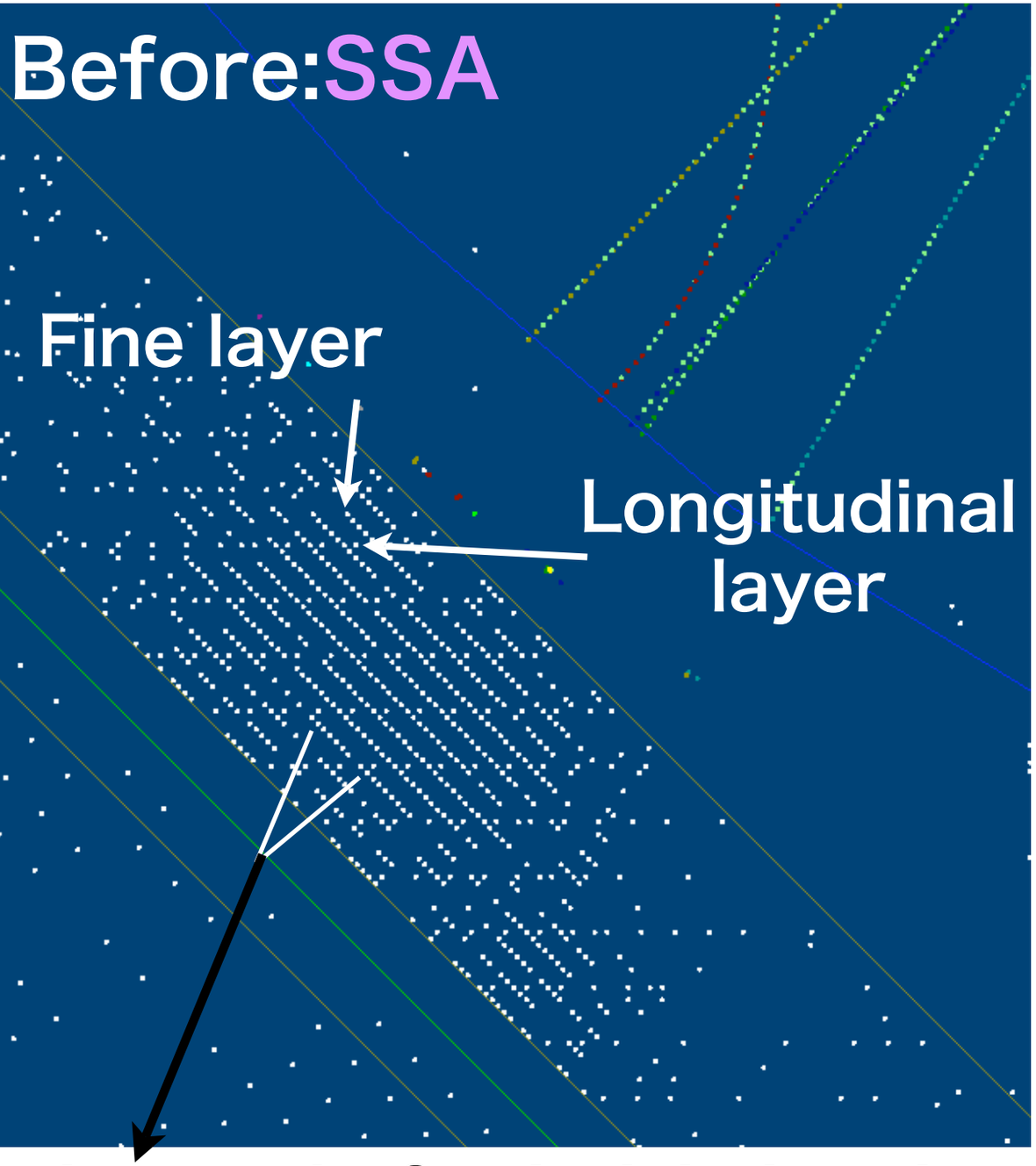


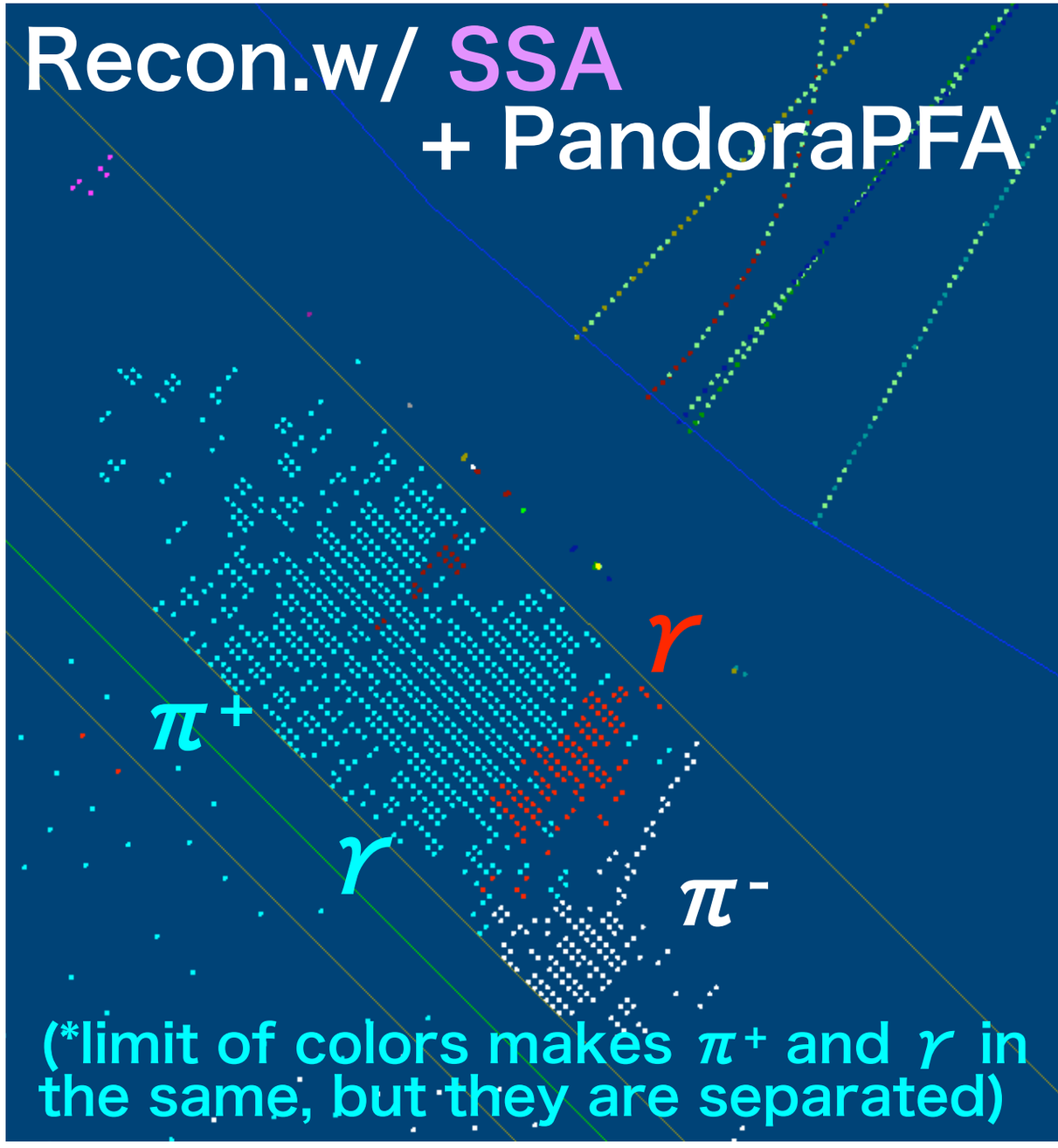


A small shower looks a track

Strip Splitting Algorithm

100 GeV Jet x 2: more difficult case





Interval of scinti. in longitudinal layers is 45 mm,
while fine segmented layers: 5 mm (width of scinti.)

Strip Splitting Algorithm

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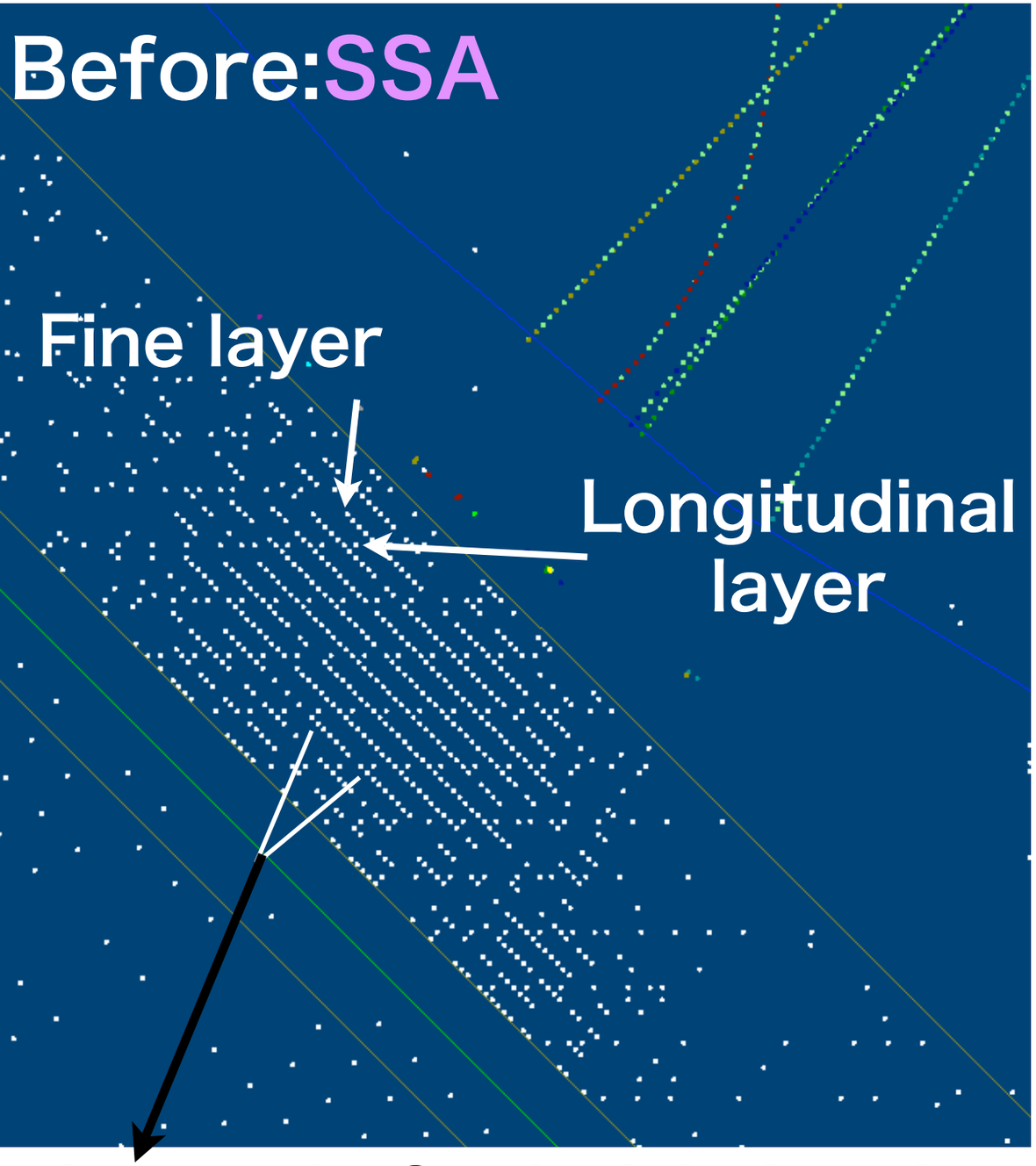

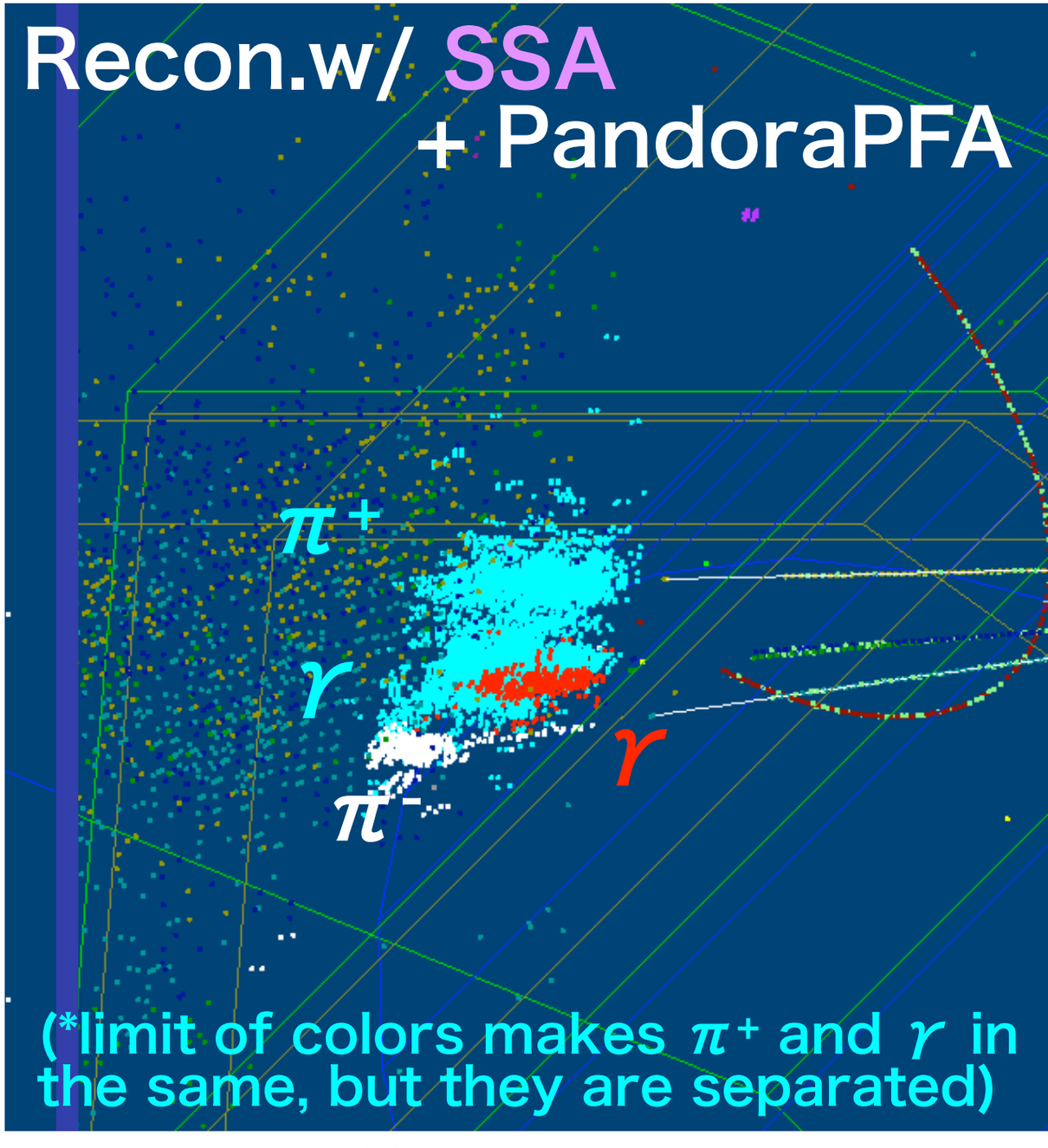

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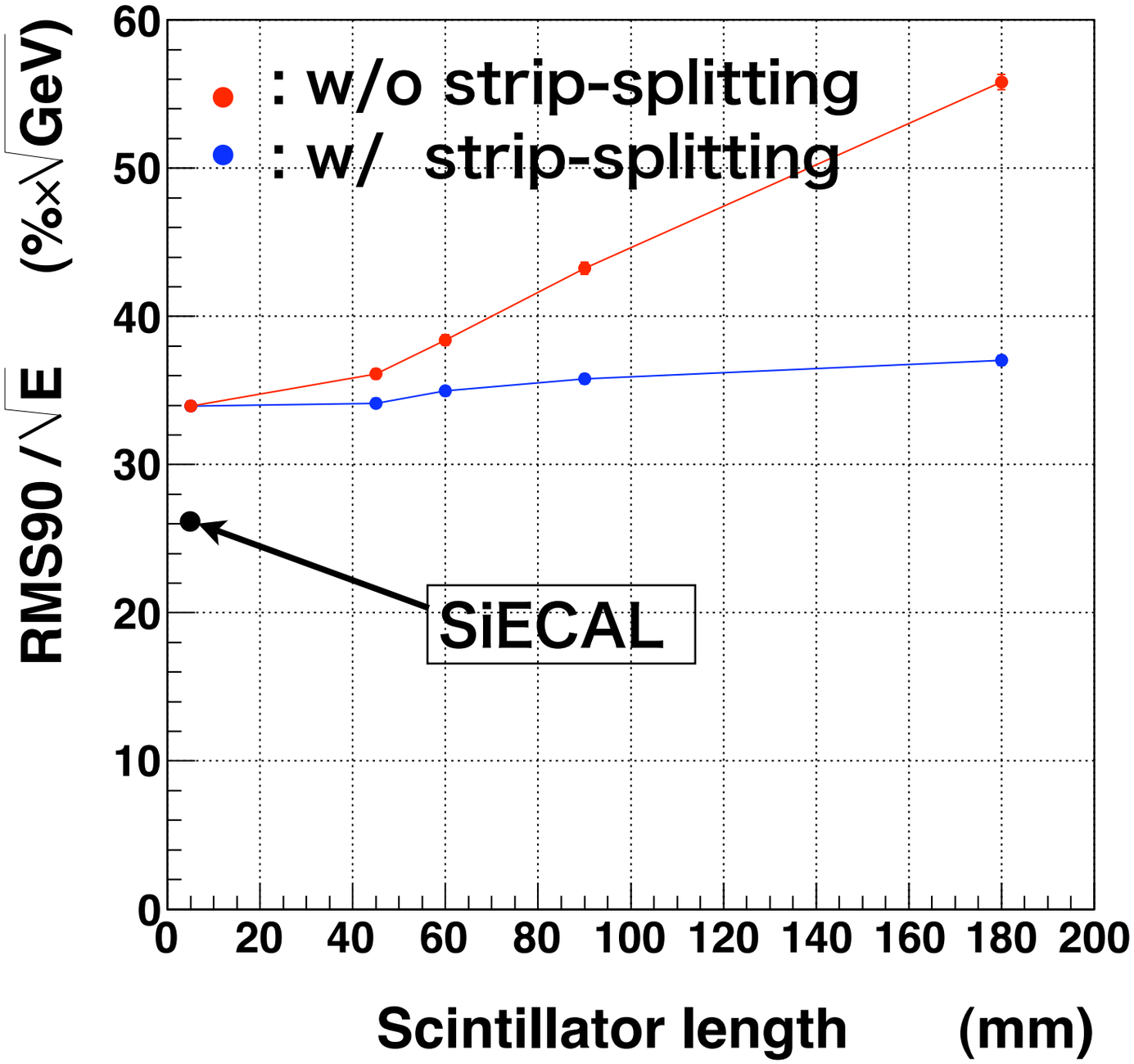
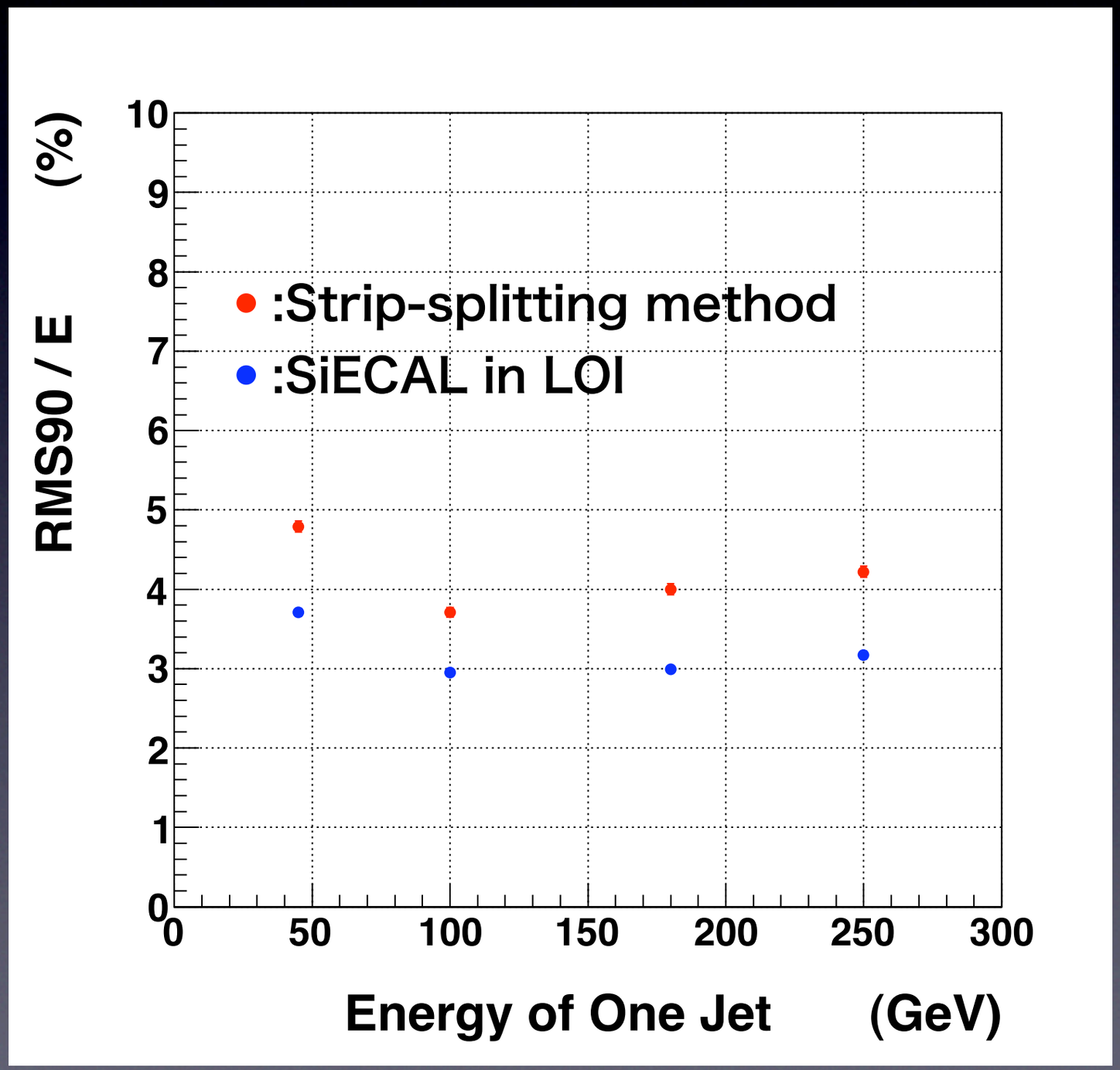
Length dependence of JER 45 GeV with realistic generator



- Realistic simulation (generator:Gabriel)
  - intrinsic strip shape
    - not needed to merge square cells in generator(no doubt to accidentally cheat square information)
  - MPPC dead volume
  - reflector dead volume
  - PCB boad
  - copper radiator ...
- StripSplittiong method works well
- difference of JER between SiECAL and ScECAL remains

Jet energy resolution vs. jet energy



Difference of JER between ScECAL and SiEAL exists

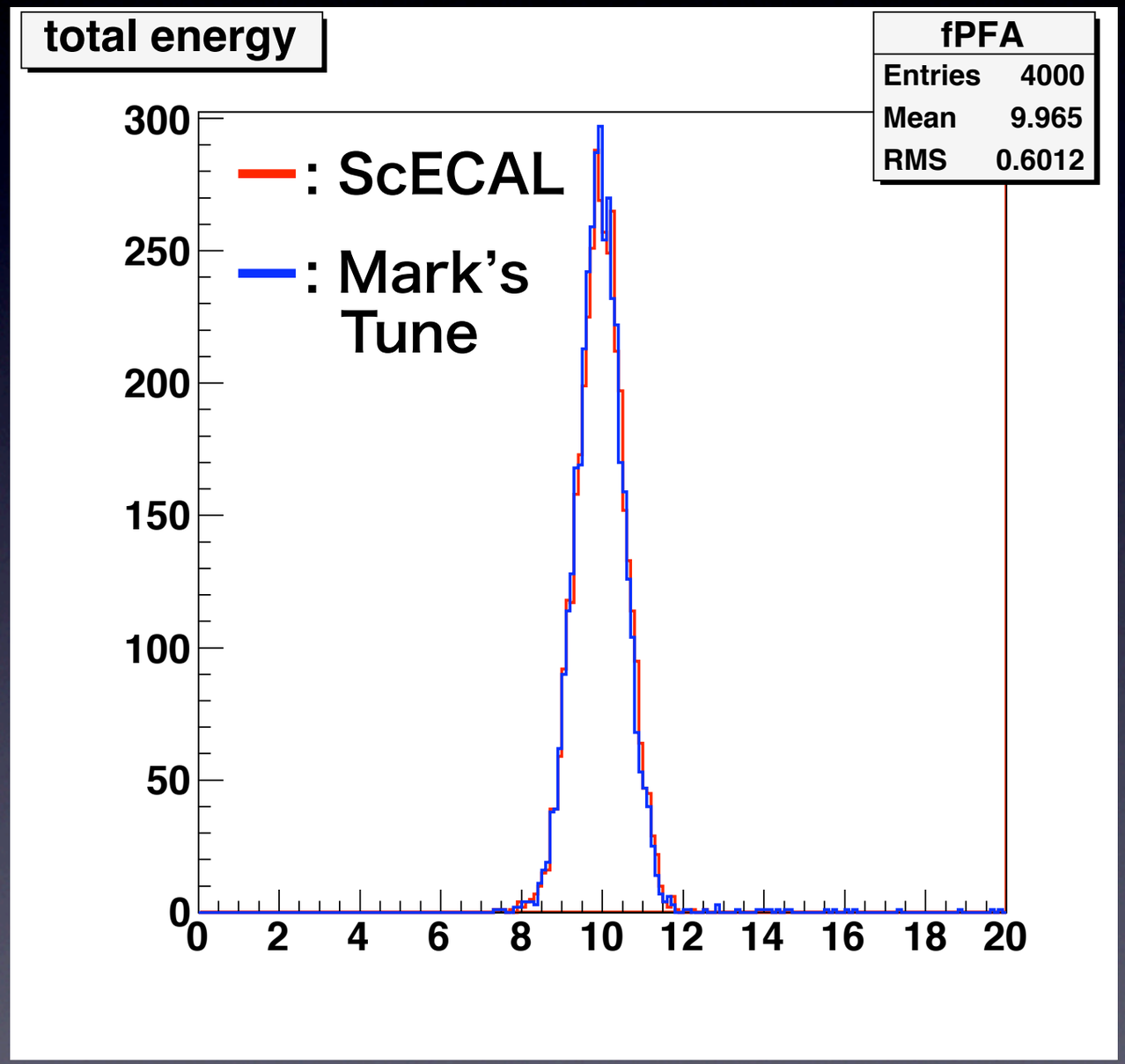
The behavior of ScECAL is similar to that of SiECAL in LOI

There is a difference of layer structure between ScECAL and SiECAL: SiECAL has fine layers in 1st - 20th layers

Similar layer structure for ScECAL was tested ▶ no effect

need fine tuning for PFA

Energy resolution of 10 GeV photon



- One photon energy resolution is similar between default analysis and M.Thomson's. This is a starting point
- RMS90
  0.488±0.06 (Default)
  0.479±0.06 (Mark's)
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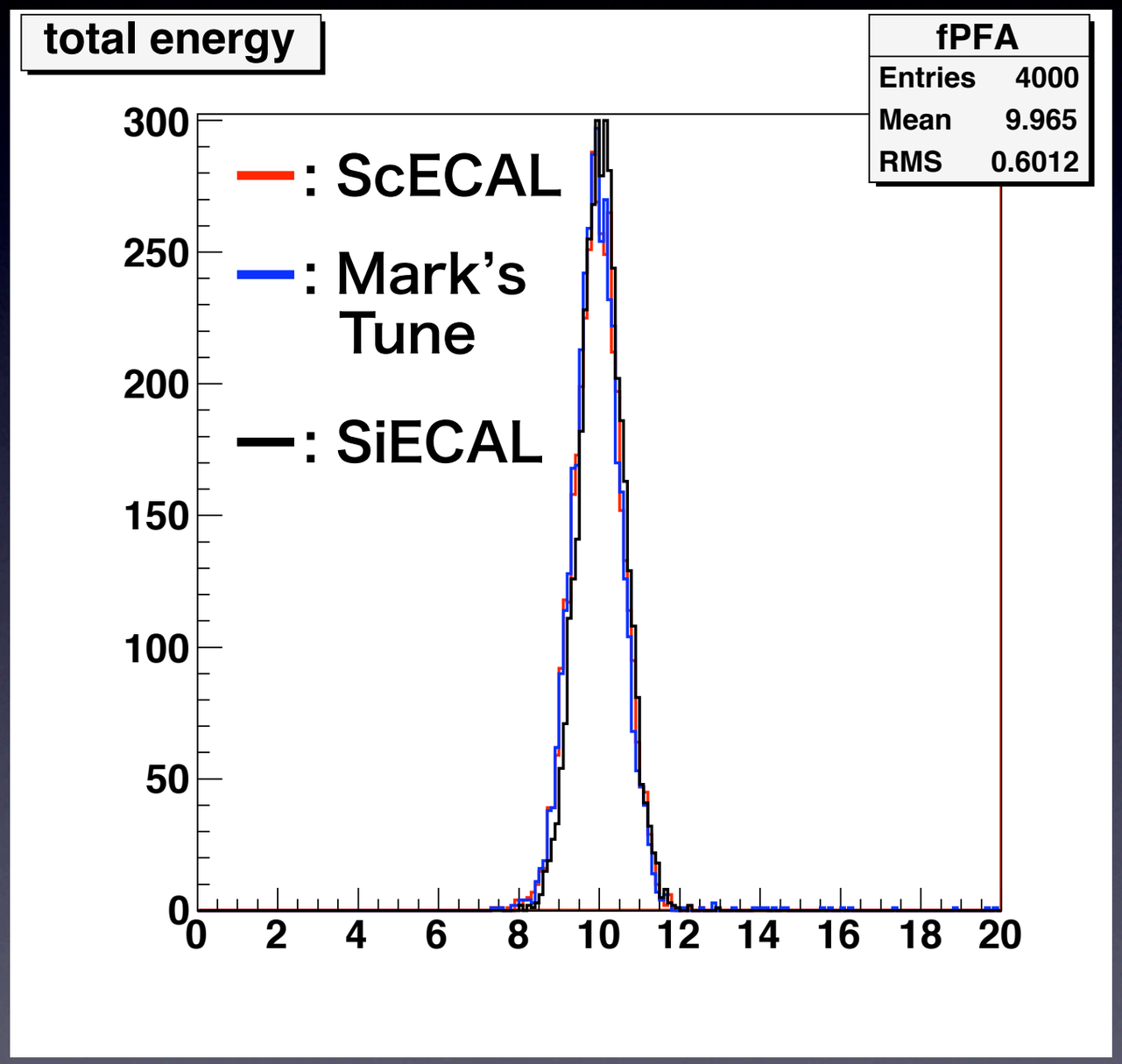

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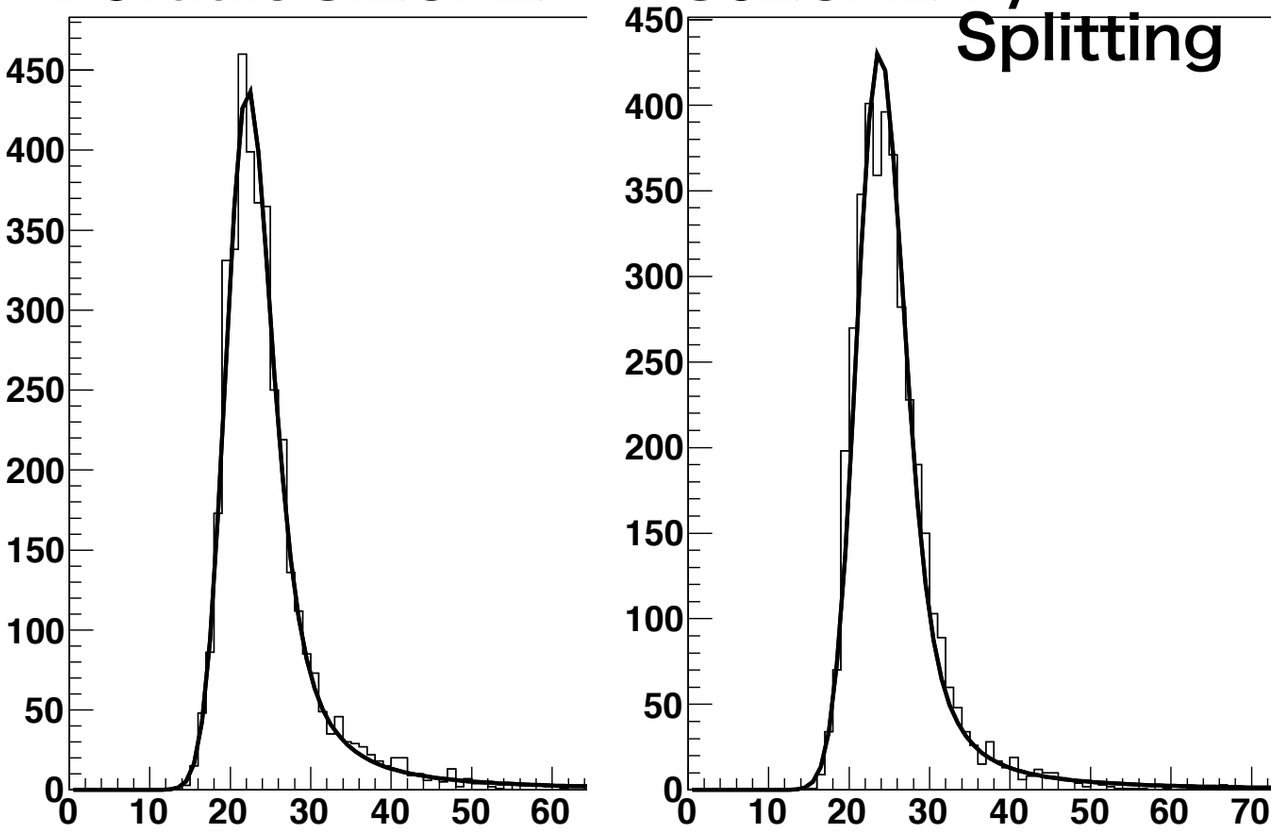
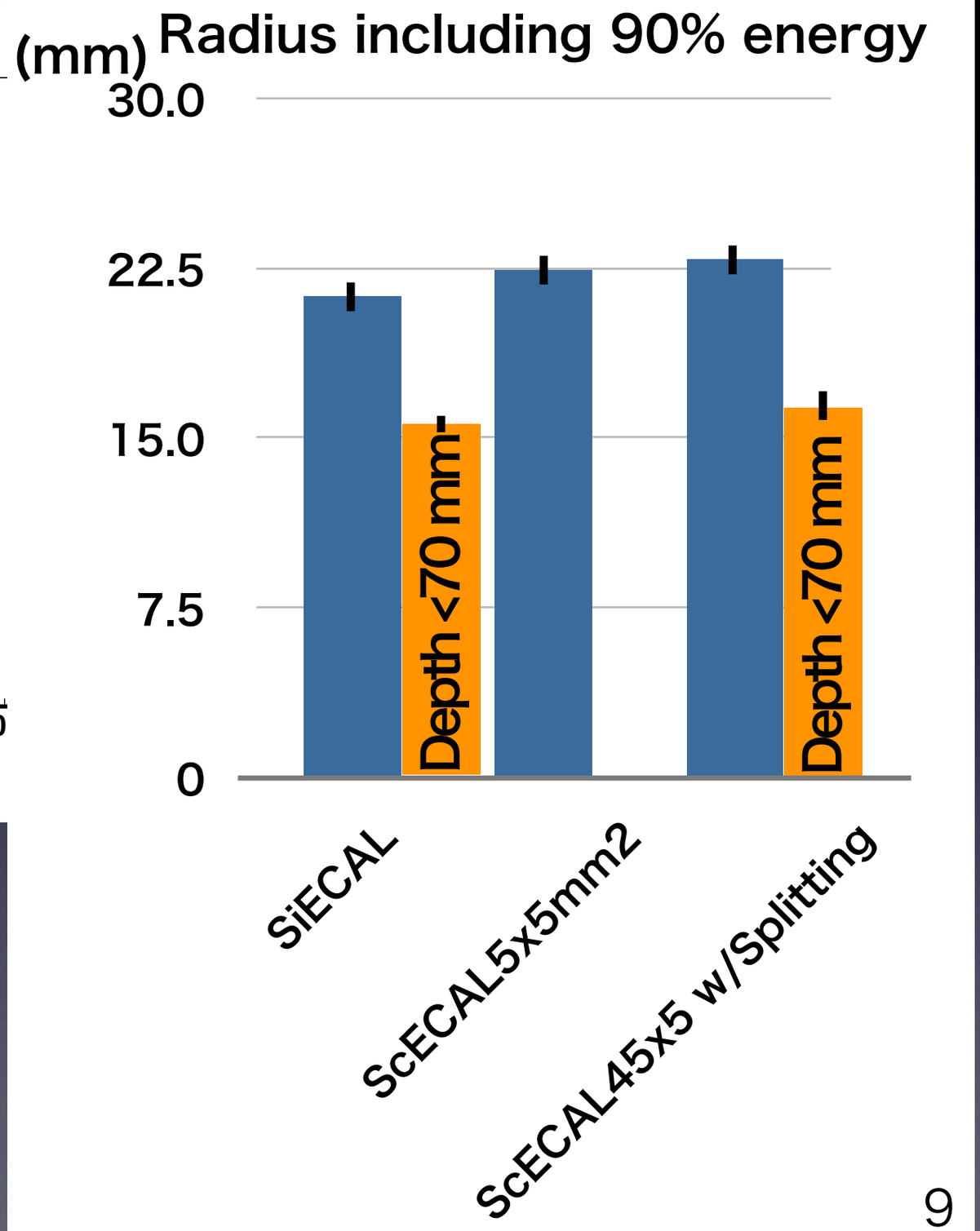
- SiECAL also has almost similar energy resolution
- RMS90
  0.471±0.05 (SiECAL)

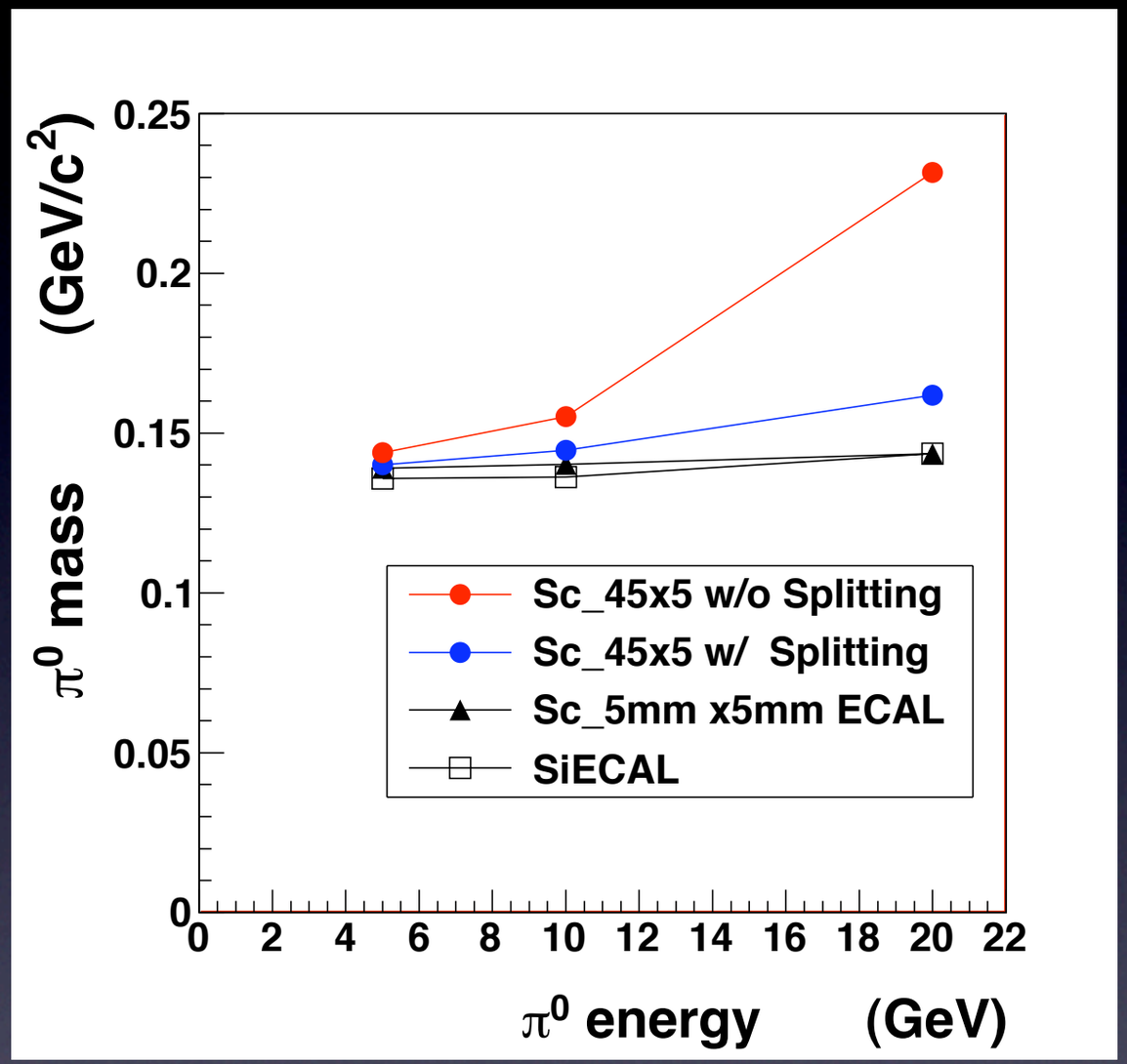
Radius of 10 GeV photon in ECAL

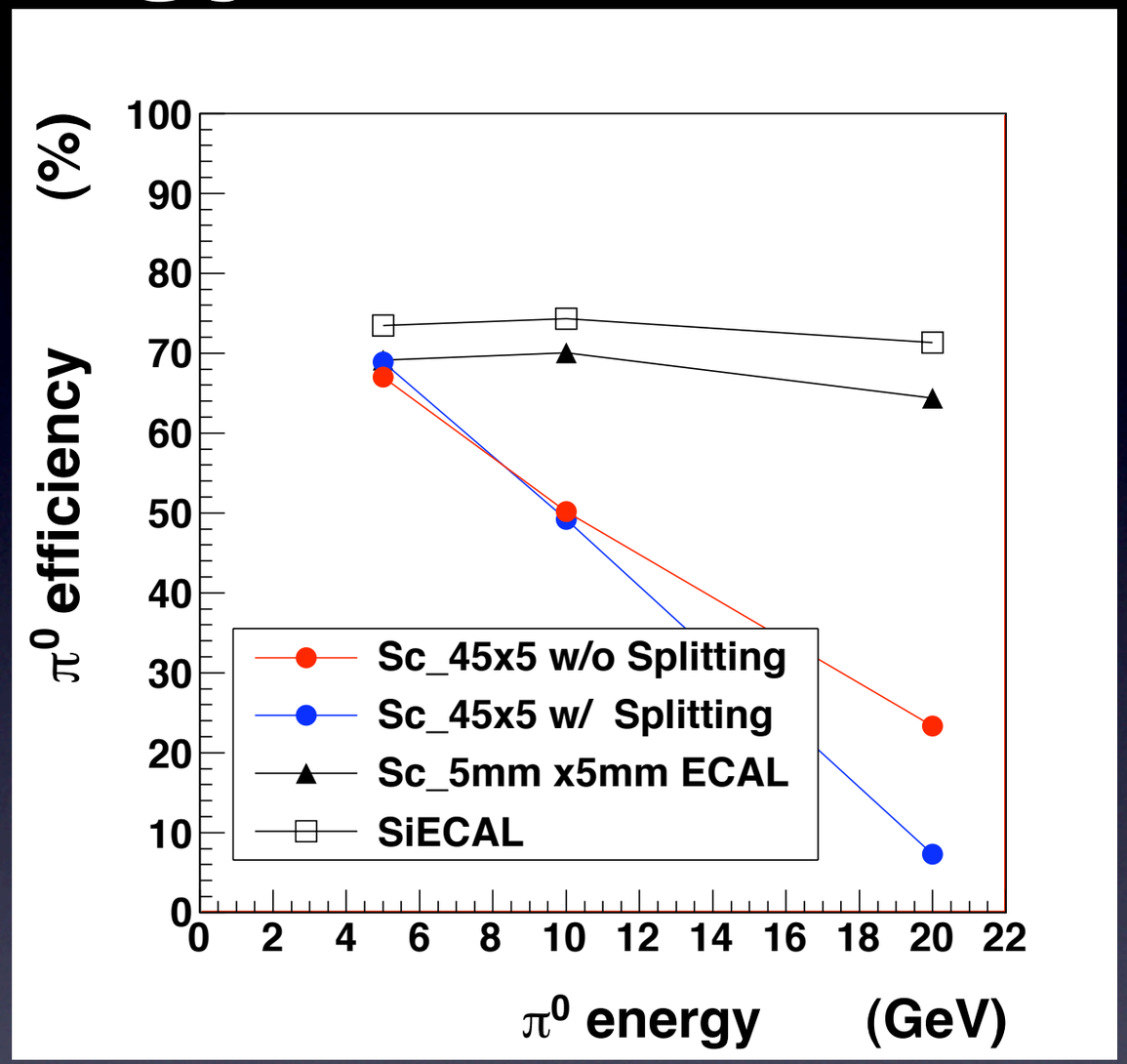




-MPV of Landau-gaussian fit to cluster radius including 90% energy is not so different between SiECAL and ScECAL

π^0 mass and π^0 recon.efficiency vs. π^0 energy





- Reconstructed π^0 mass using strip-Splitting method looks reasonable.
- Efficiency degrades with higher energy.
- Sc5x5squareECAL has reasonable efficiency ▶ This does not explain the difference of JER between SiECAL and ScECAL
- Need tune photon separation for strip-Splitting method.

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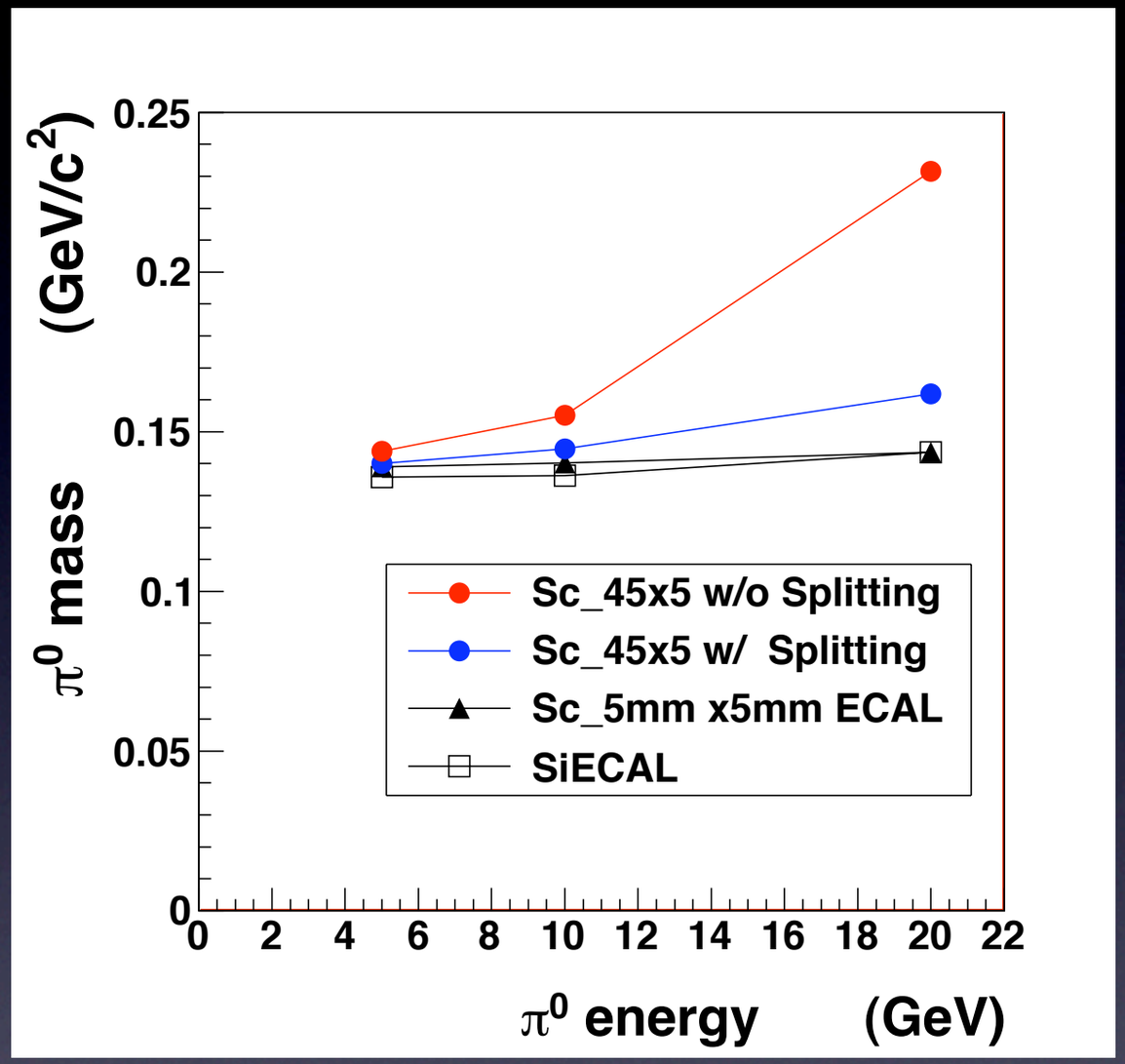

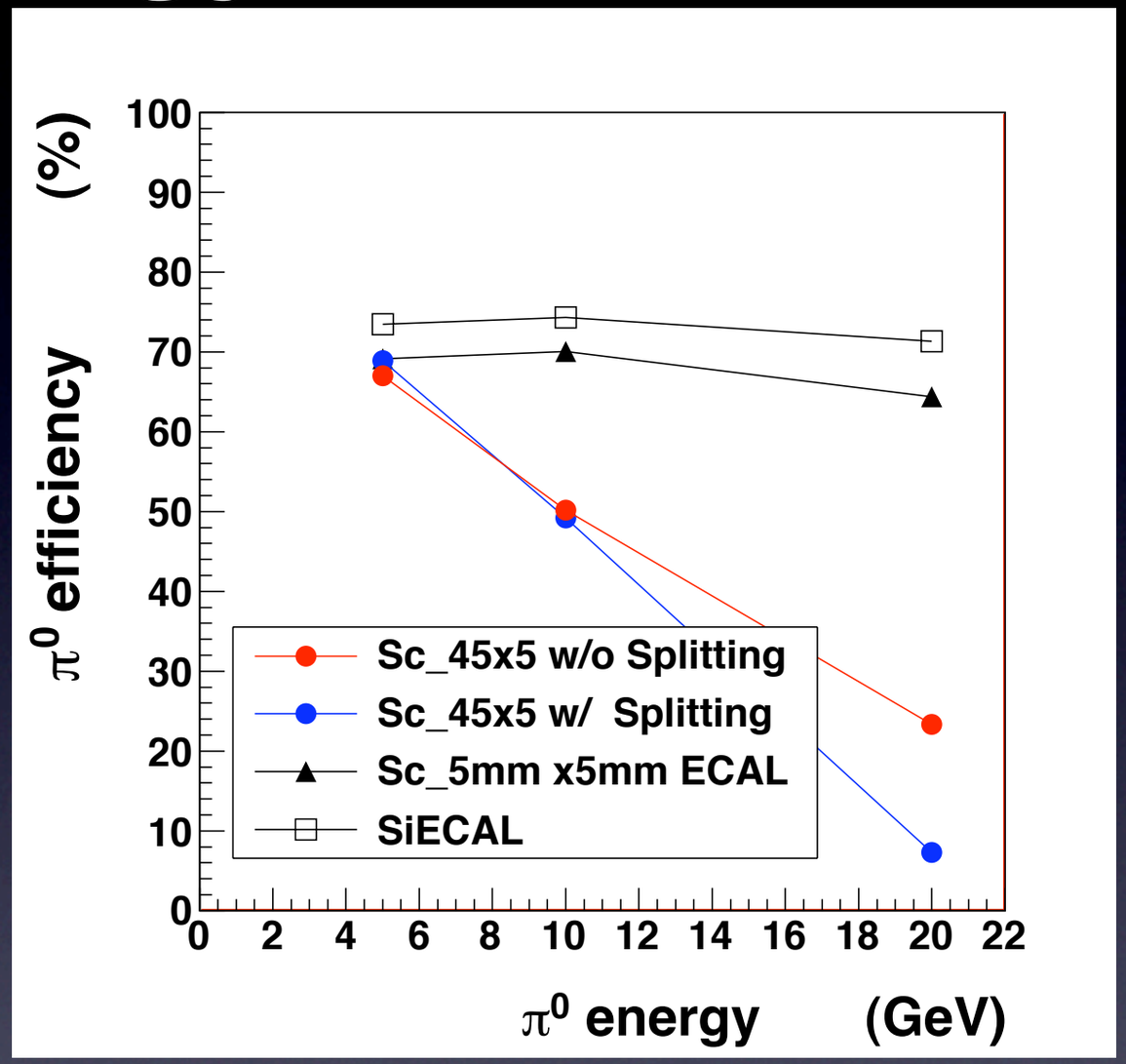

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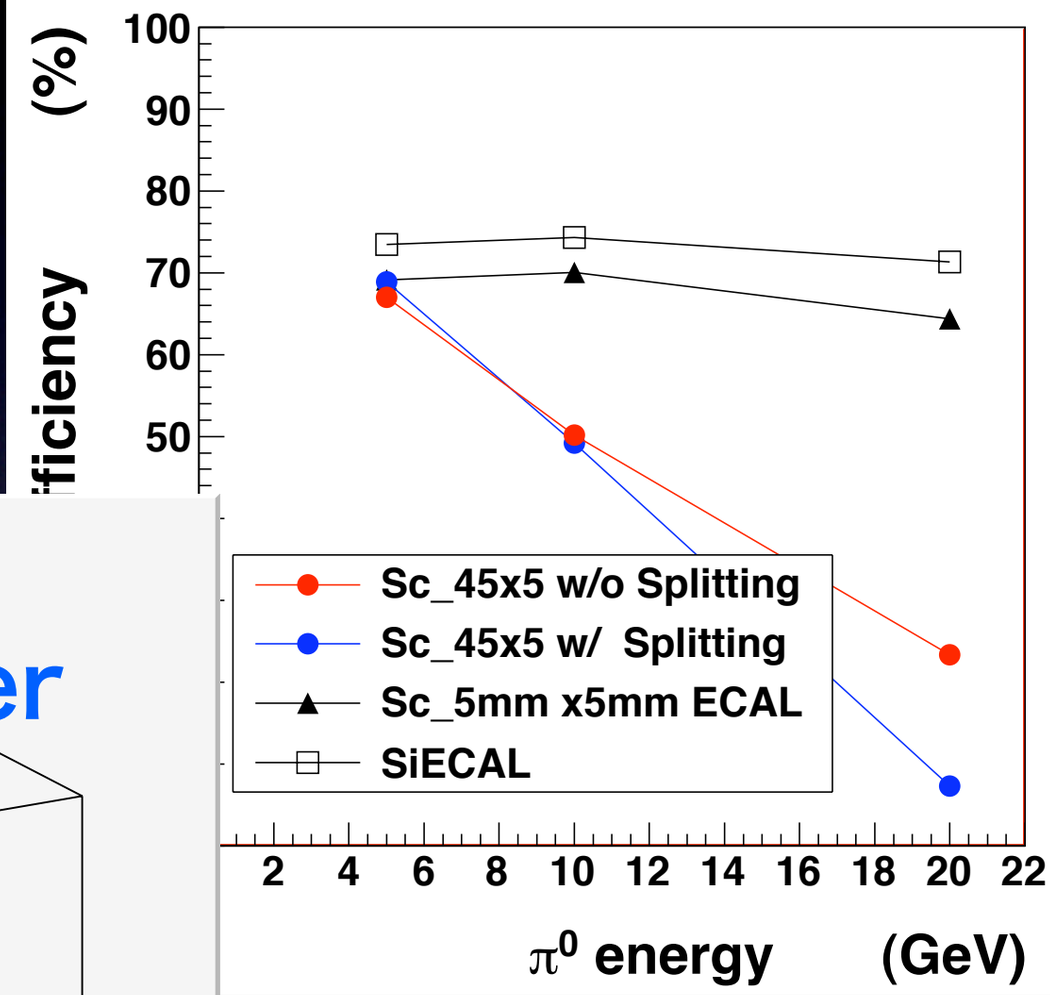
Case:
Merged in one cluster



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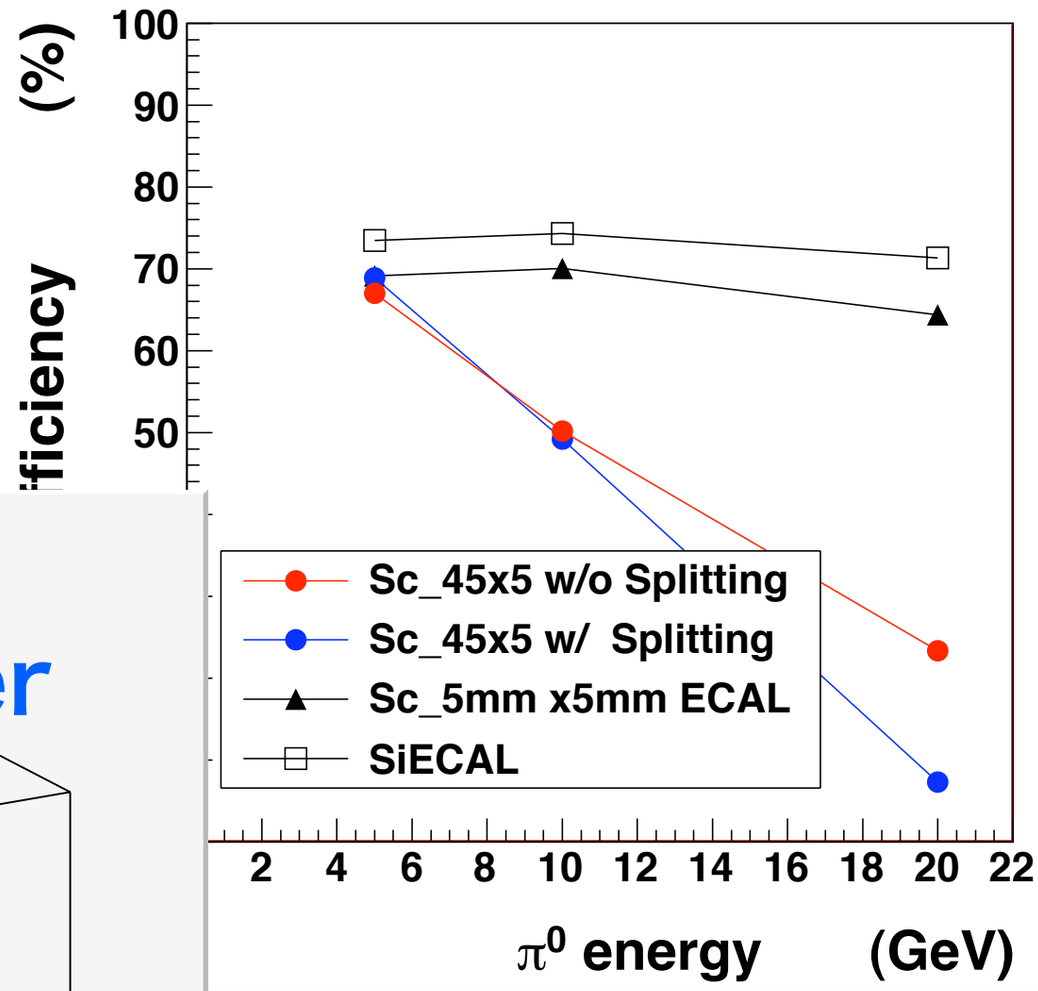

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Summary

- Strip-Splitting method was devised last year.
- With Strip-Splitting method ScECAL with 45x5 mm scintillator strip achieved less than 30% of JER/√E for 45 GeV jet.
- Still not arrived at SiECAL resolution.
- Basic energy resolutions for one photon events is almost similar for ScECAL and SiECAL.
- Some rooms are there for improvement of cluster separation.
- Difference of performance between SiECAL and ScECAL should be removed with fine tuning of PandoraPFA. Event by event study
- Implement StripSplitting method in Calice-soft

Hybrid ECAL

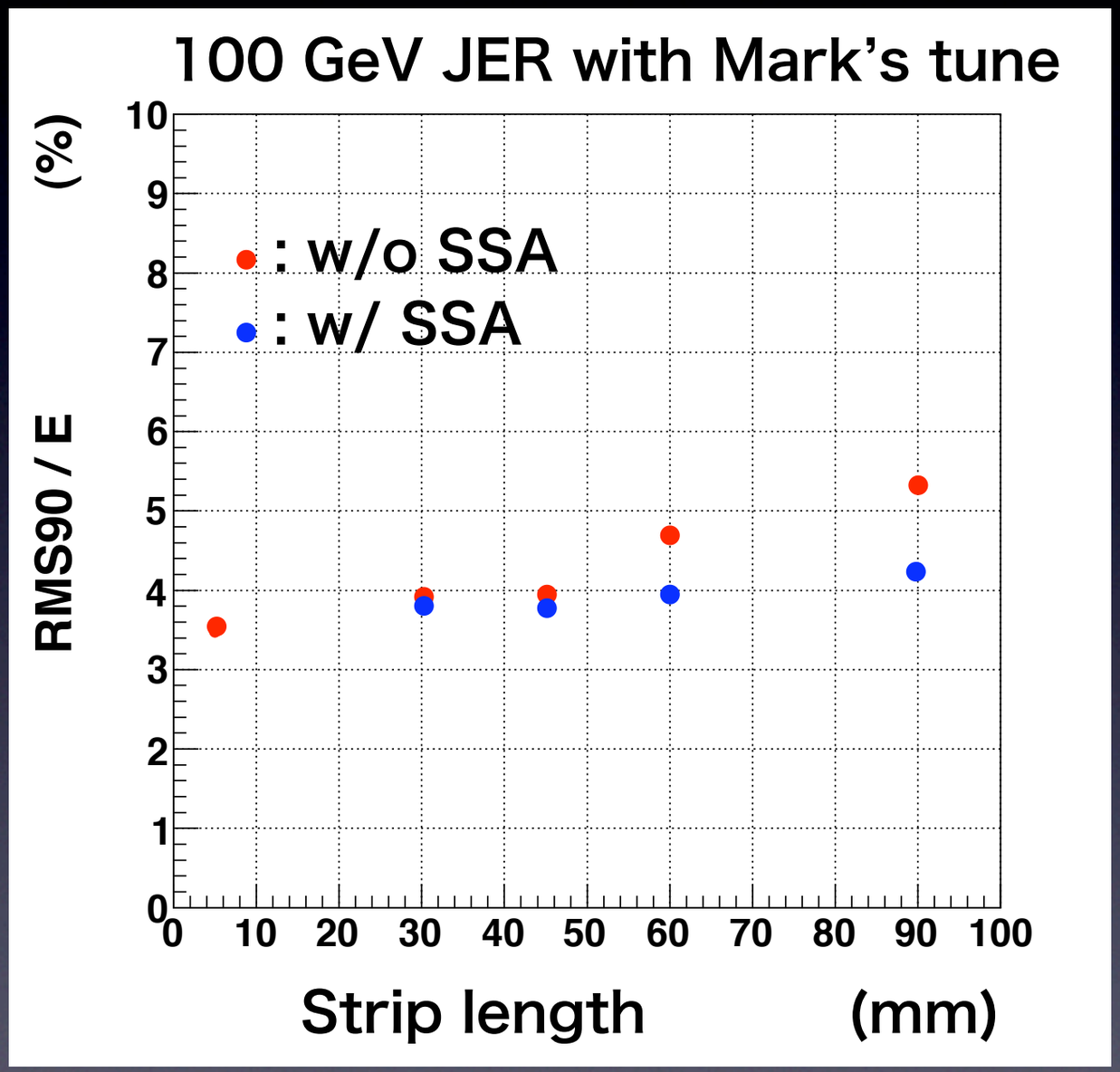
- Daniel Jeans implemented this algorithm for Sc-Si hybrid ECAL and brushed up it, called hybridRecoProcessor,
- Current Mokka, one can select scintillator layer or silicone layer only by alveolus,

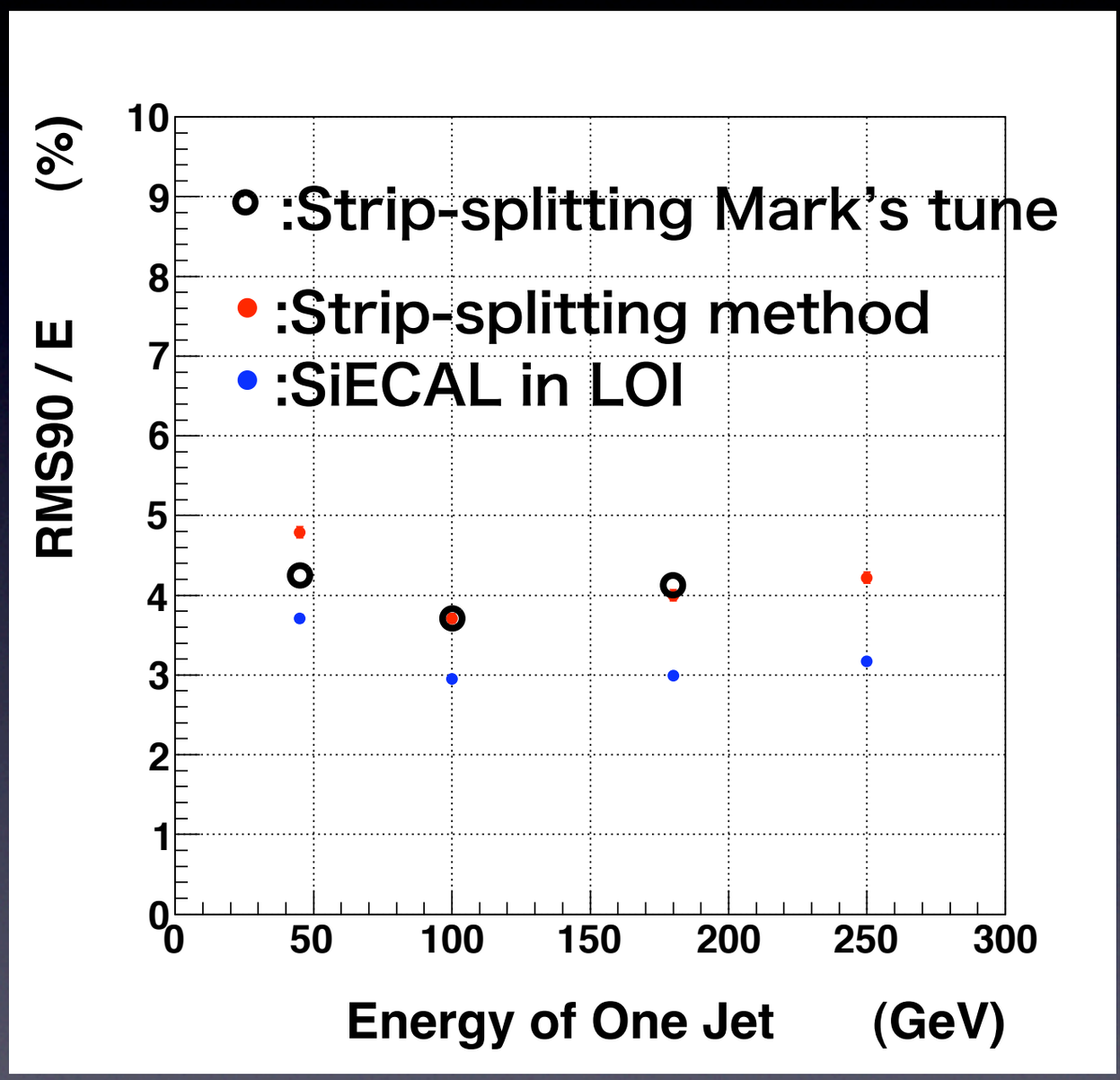
sisi	scsc	sisi	scsc	sisi	scsc	sisi	scsc	sisi	scsc	sisi	scsc	sisi	scsc	s

sisi	sisi	sisi	sisi	sisi	sisi	sisi	sisi	sisi	sisi	scsc	scsc	scsc	scsc	scsc	s

- I have already registered to make SVN repository for HybridRecoProcessor at DESY, ... but not yet released,

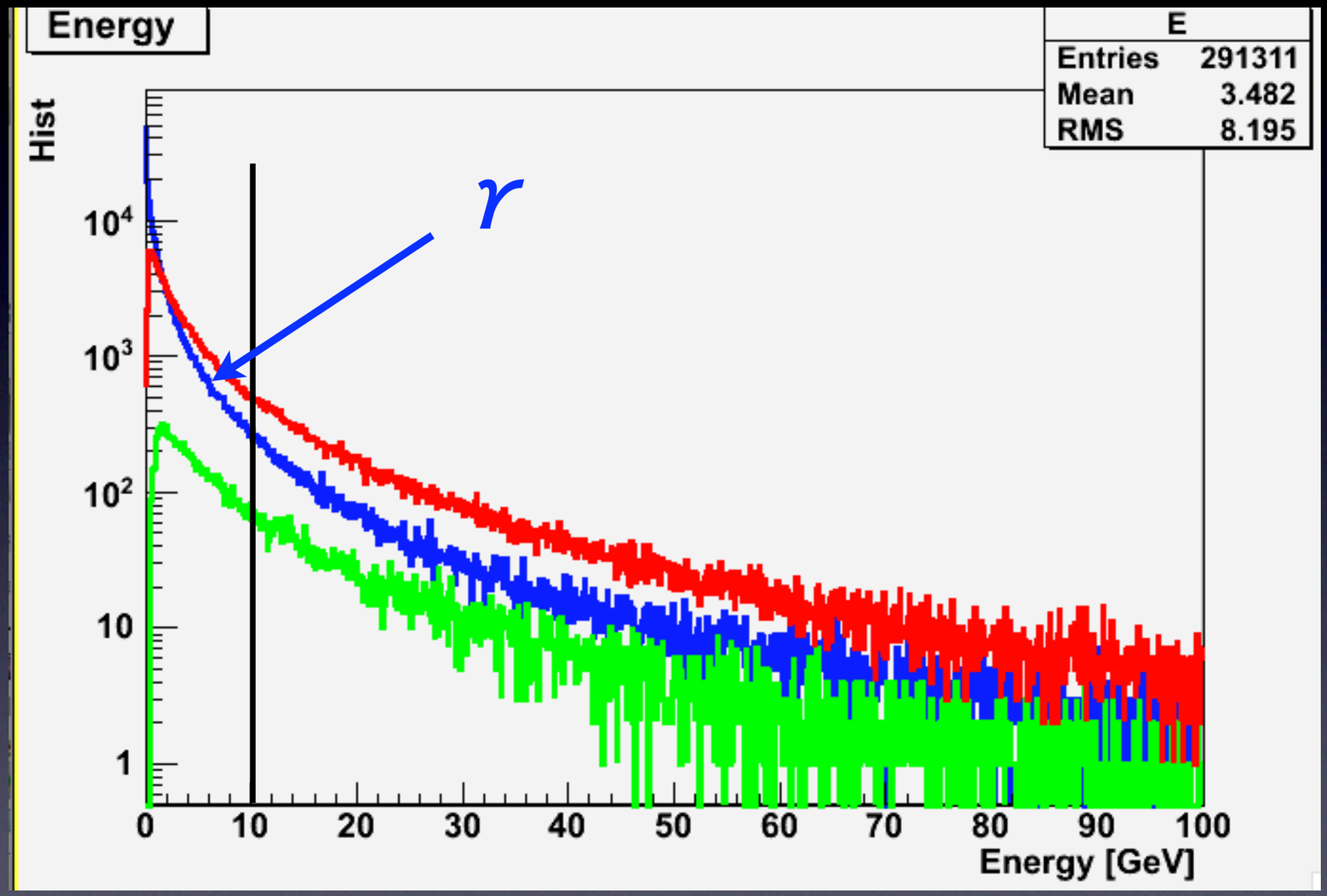
Mark's tuning
100 GeV, 180 GeV





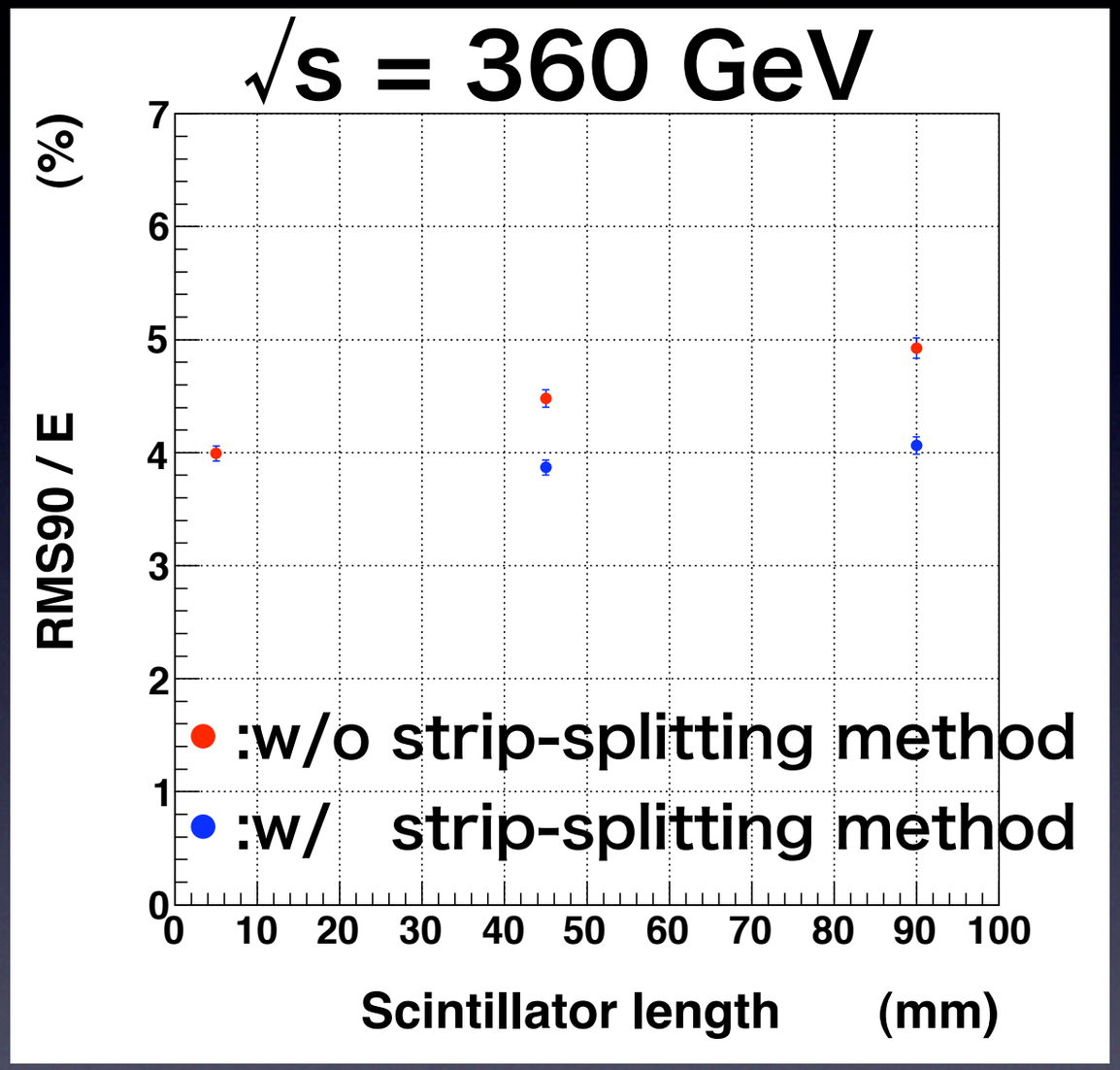
Mark's tune works only for 45 GeV Jet events,

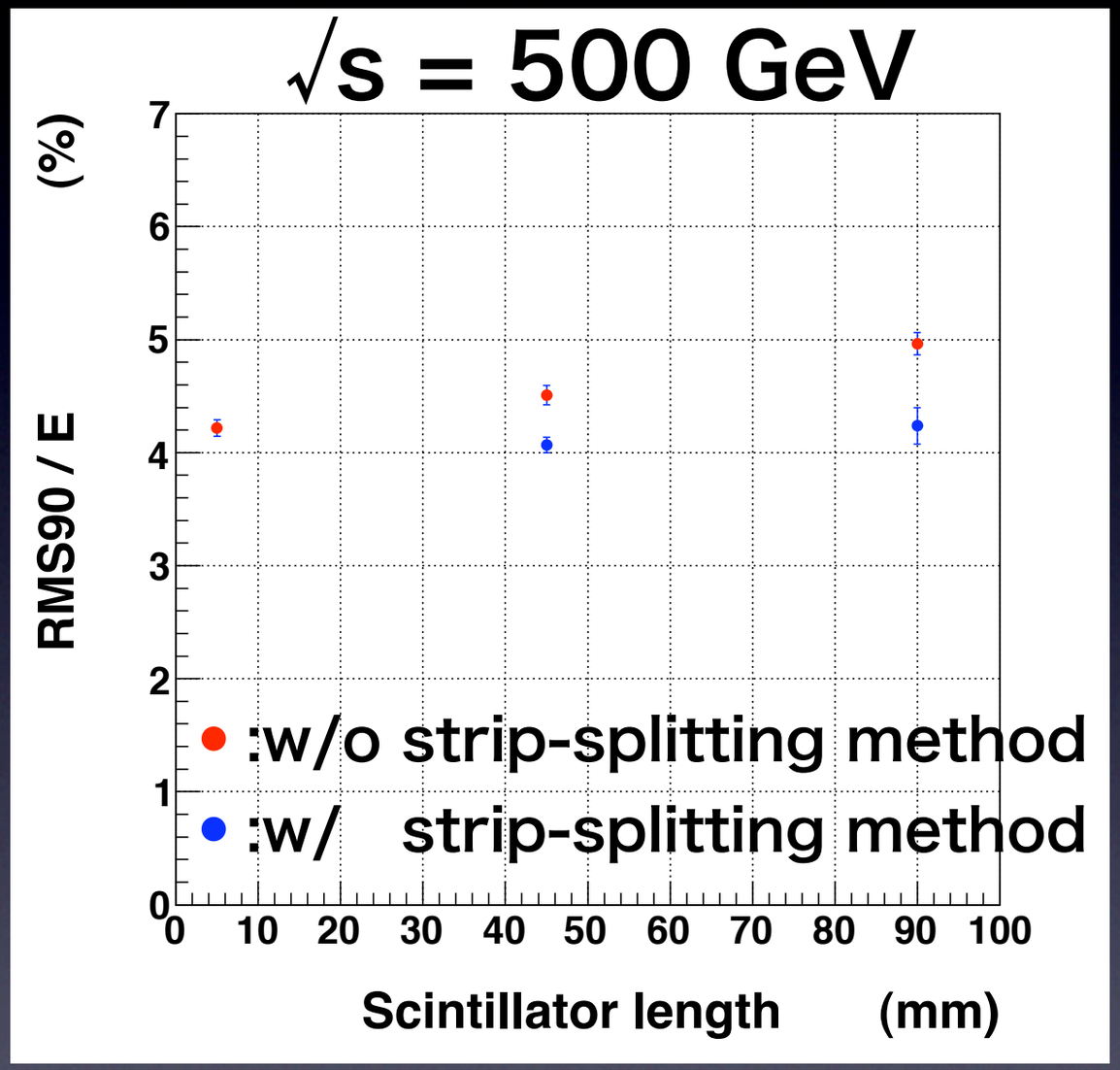
Energy of particles in 1.5 TeV Jet



- Energy of photons is dominated by less than 10 GeV

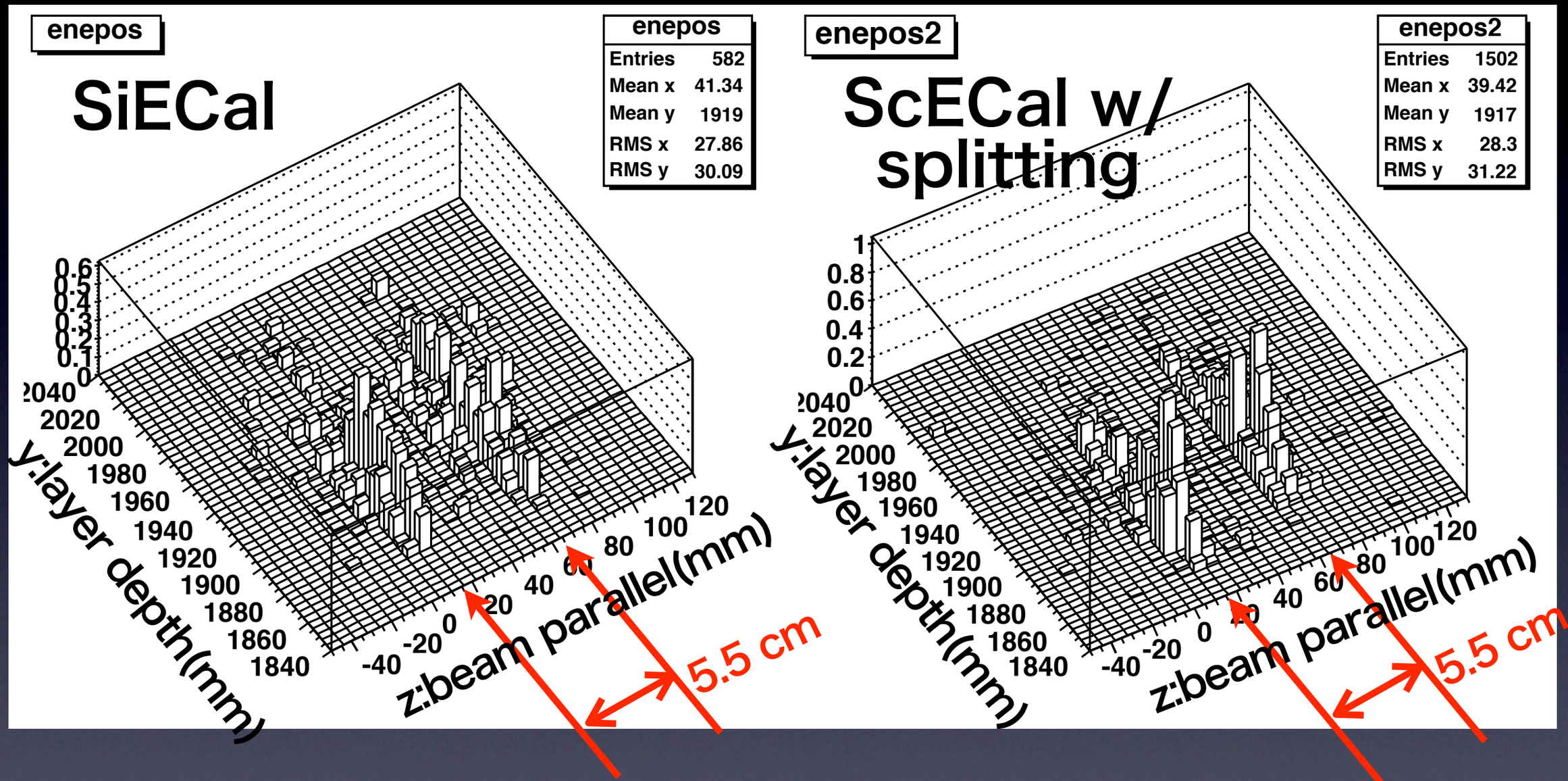
Jet energy resolution vs. scintillator strip length at higher energy



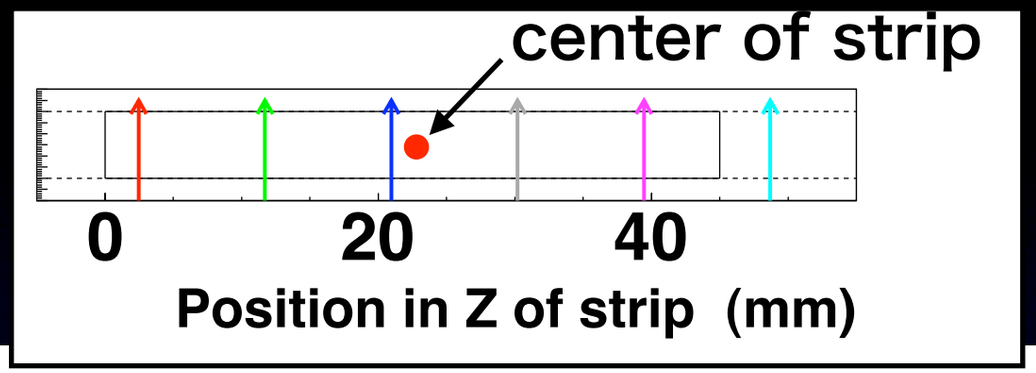


Even at √s = 500 GeV, 45 mm x 5 mm ScECAL shows similar performance to that of 5 mm x 5 mm square tile ScECAL.

Two photon clusters in SiEcal and ScStirpEcal with Splitting method

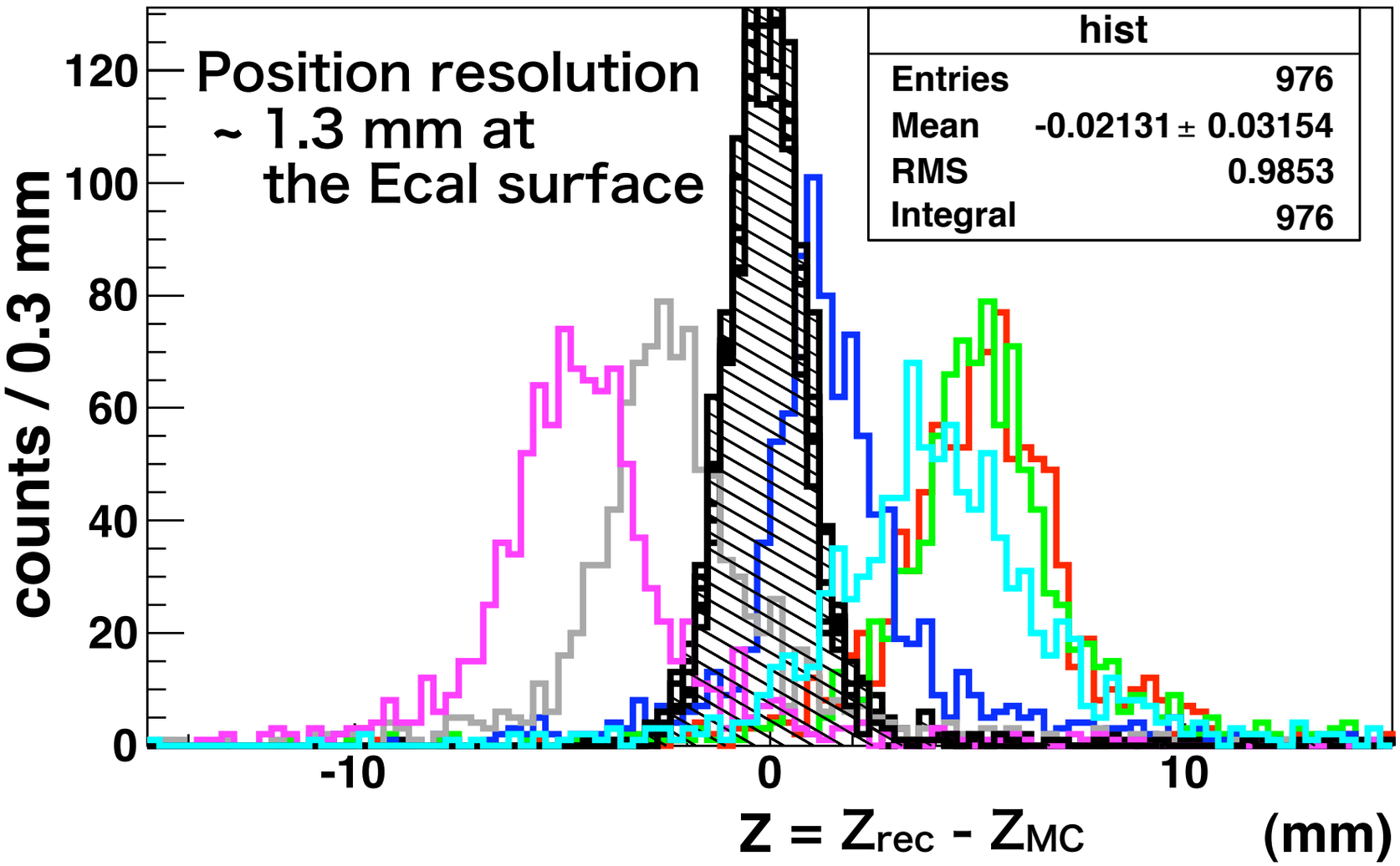


Position resolution: in z for 10 GeV photons



Position difference between reconstructed position and MC true ($z = z_{rec} - z_{MC}$) at the ILD ECAL surface for 10 GeV photons with incident polar angles approximately 90°.

For 45 mm x 5 mm strips:



colored: z distributions of energy-weighted mean position without the strip-splitting method

Black: z distribution of reconstructed PFO with strip-splitting method

Systematic shift is removed by the strip-splitting method.