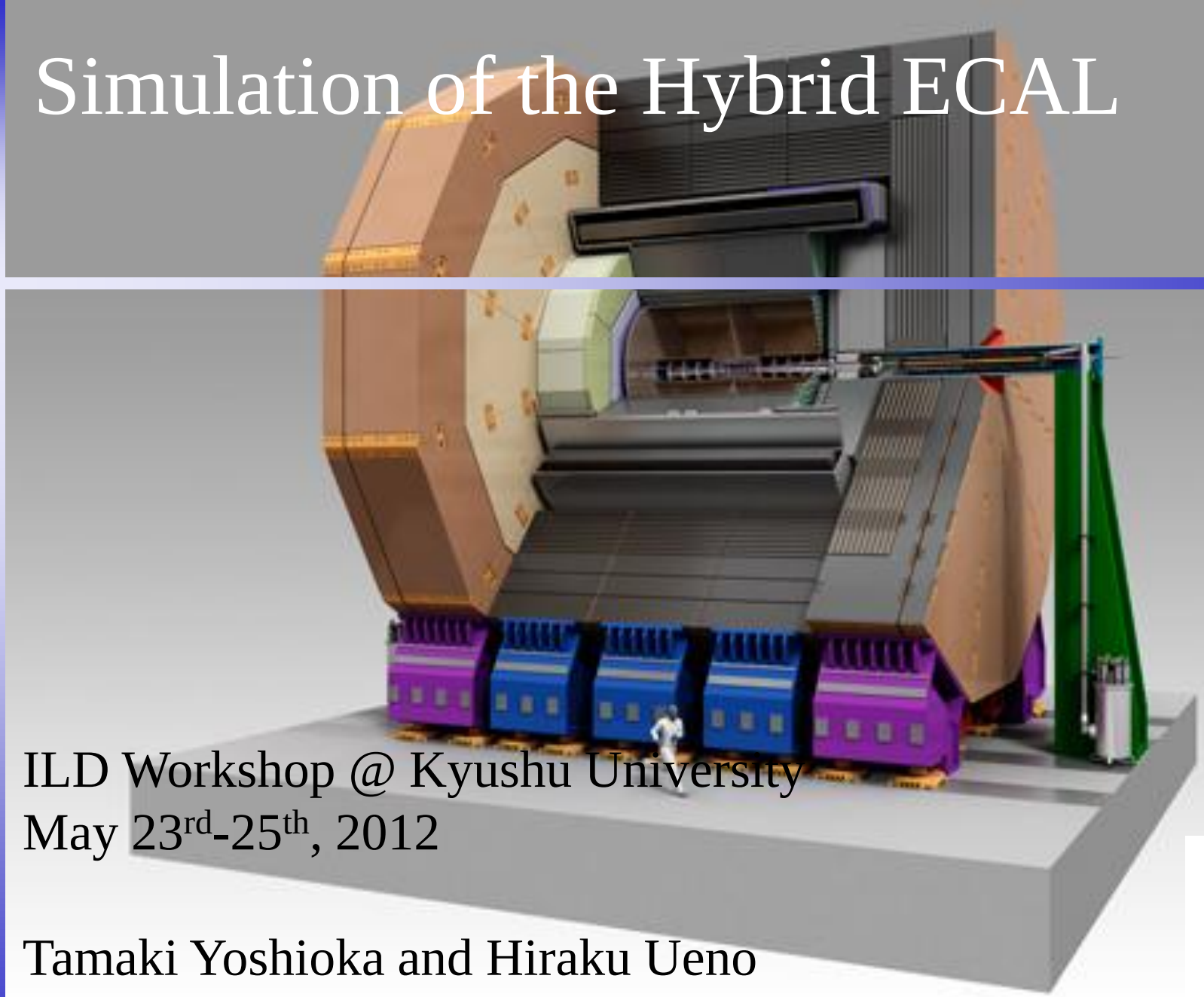
Simulation of the Hybrid ECAL



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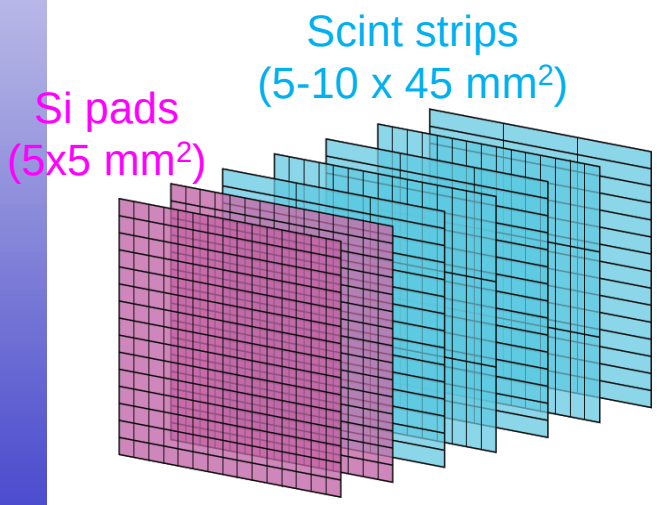
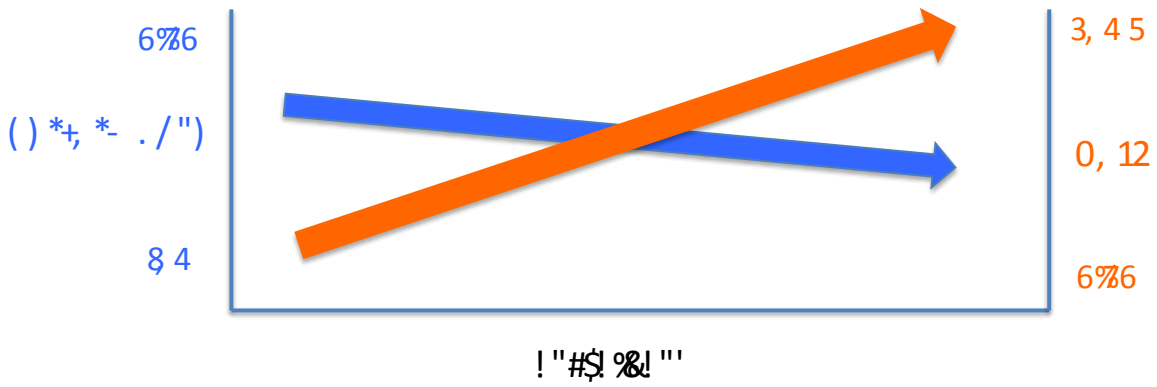
Motivation for the Hybrid ECAL

- A solution to make the ECAL with a reasonable cost while keeping the performance as much as possible would be mixture of the Silicon layers and Scintillator-strip layers.
  →Hybrid ECAL
- We have started the simulation study in order to evaluate the Hybrid ECAL performance.

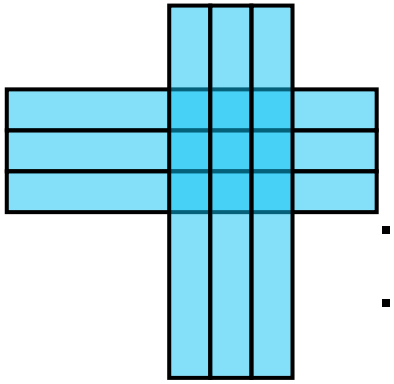




Hybrid ECAL Configuration

Sc layer

45mmx5mm strips

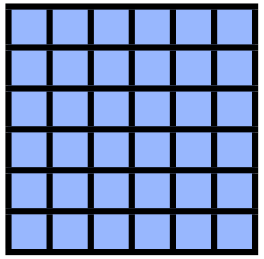


orthogonal

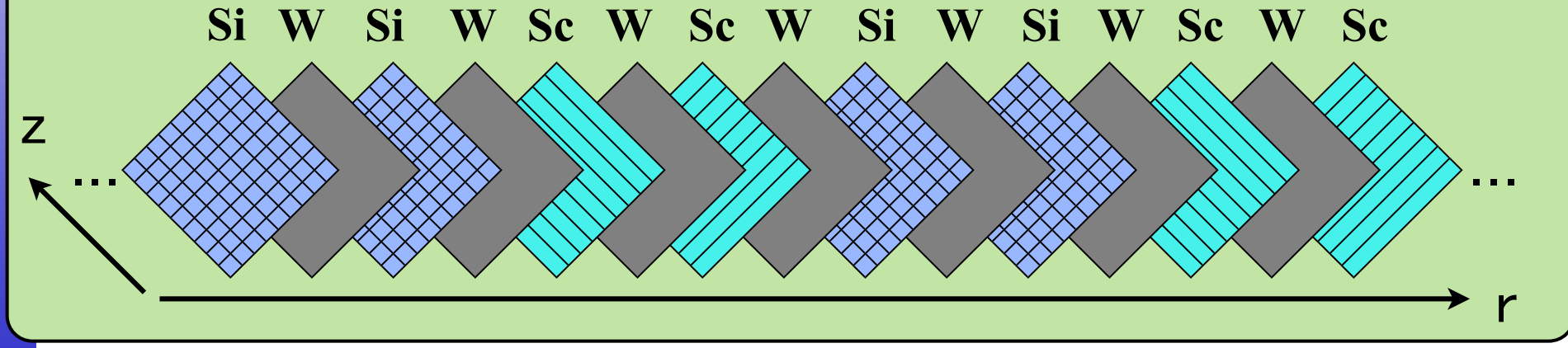
- 5mmx5mm spacial resolution
- possibility of ghost

Si layer

5mmx5mm cells



The configration of Hybrid ECAL



ECAL Parameters

- We have studied the Hybrid ECAL with the following parameters. We have also studied the ScECAL and SiECAL for comparison.

- Notice that the absorber thickness and number of layers are same for all ECAL and different from those of default values.

	Active Layer Thickness	Absorber Thickness	Number of Layers
Hybrid ECAL	Scintillator : 2.0mm Silicon : 0.5mm	2.1mm for inner 20 layers 3.5mm for outer 7 layers	27
ScECAL	Scintillator : 2.0mm		
SiECAL	Silicon : 0.5mm		

Calibration

- Calibration constants should be determined in order to convert the energy deposit in the active layers to the actual energy. We have employed the standard calibration method in Marlin.

  - ✓ 10 GeV photon for ECAL
  - ✓ 10 GeV KL for HCAL
  - ✓ 10 GeV Muon for MIP calibration

- Calibration method for the Hybrid ECAL is not trivial; Calibration constants for Silicon layers and Scintillator layers should be determined separately.

Calibration Method for Hybrid ECAL

- There are four calibration constants for the Hybrid ECAL. We assumed the relation between the calibration constants by taking into account their radiation length.
  →Then these constants can be represented by a single parameter.

$$E_{true} = a \times E_{Sc}^{inner} + b \times E_{Si}^{inner} + c \times E_{Sc}^{outer} + d \times E_{Si}^{outer}$$

$$a : b = \frac{L_{Sc}}{X_0^{sc}} : \frac{L_{Si}}{X_0^{si}} = \frac{1}{21.2} : \frac{1}{18.73}$$

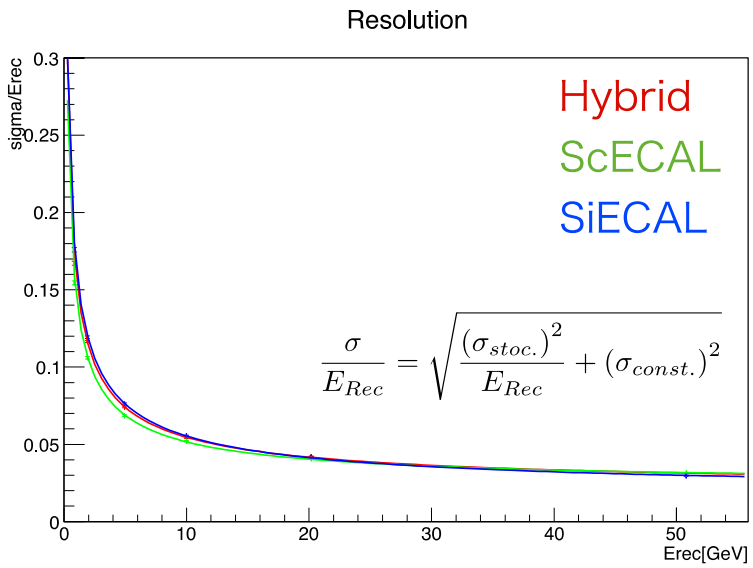
L:active layer thickness
X_0:radiation length

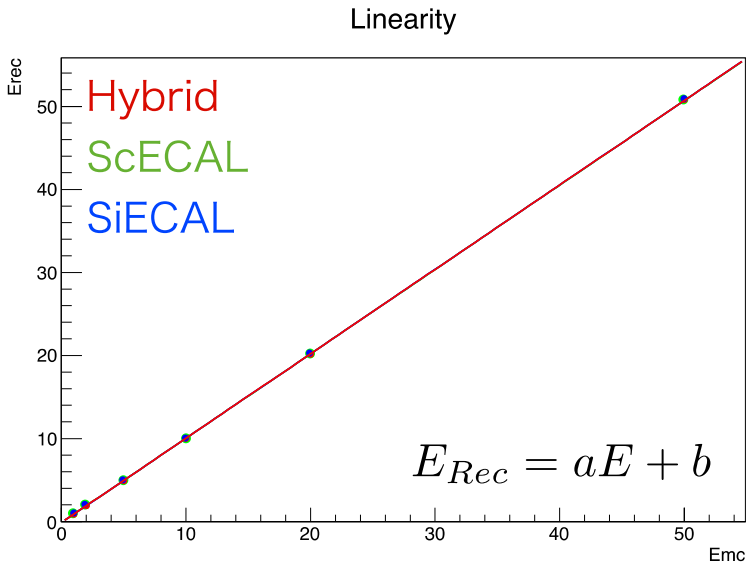
$$a : c = b : d = L_W^{inner} : L_W^{outer} = 2.1 : 3.5$$

$$\therefore \quad a : b : c : d = 1 : 1.13 : 1.67 : 1.89$$

ECAL Performances

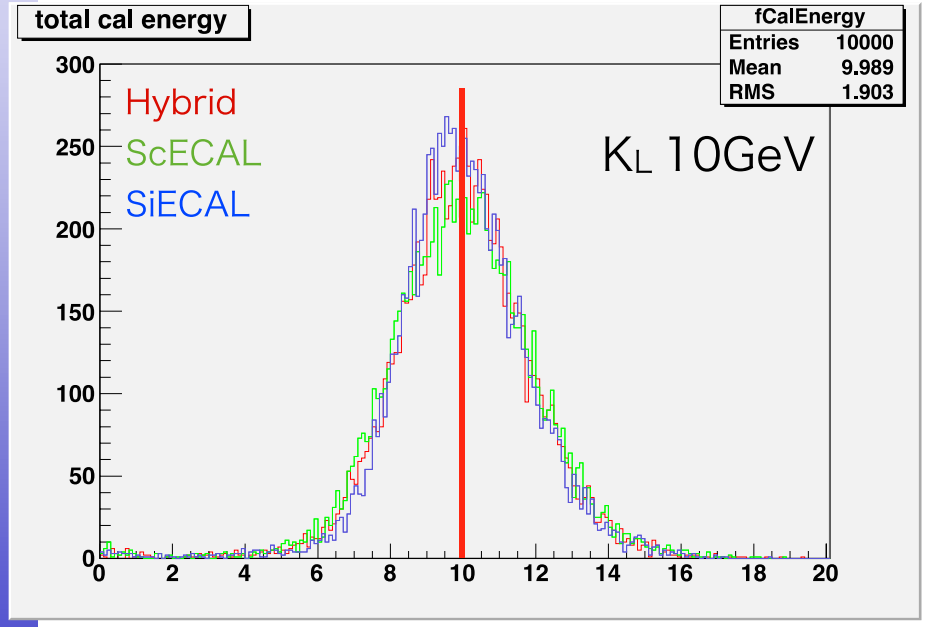
- In order to check the calibration method, we have evaluated the energy resolution and linearity of the ECALs by using 1~50GeV photons.
- The performances of all ECALs are almost same.
  →The calibration method works well.

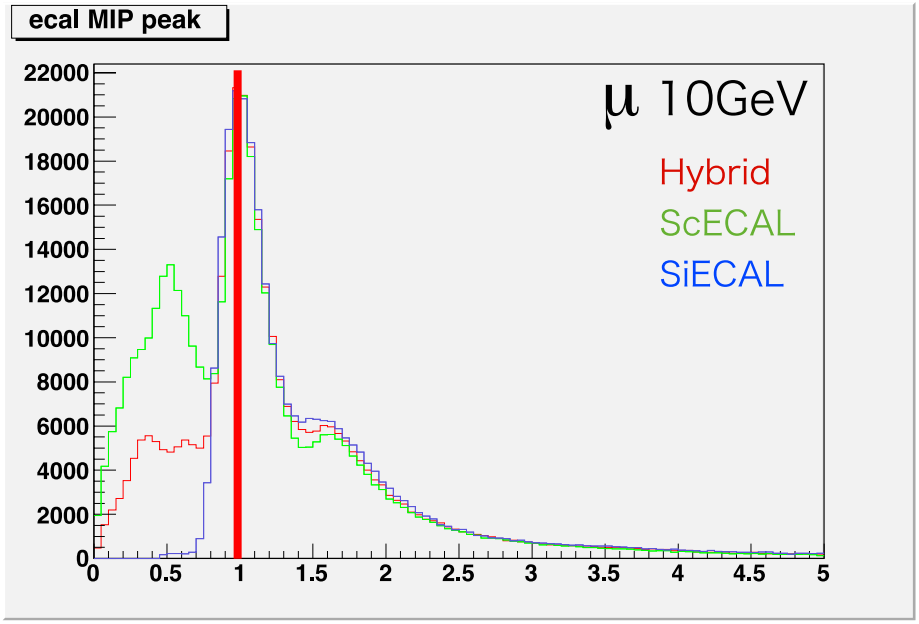




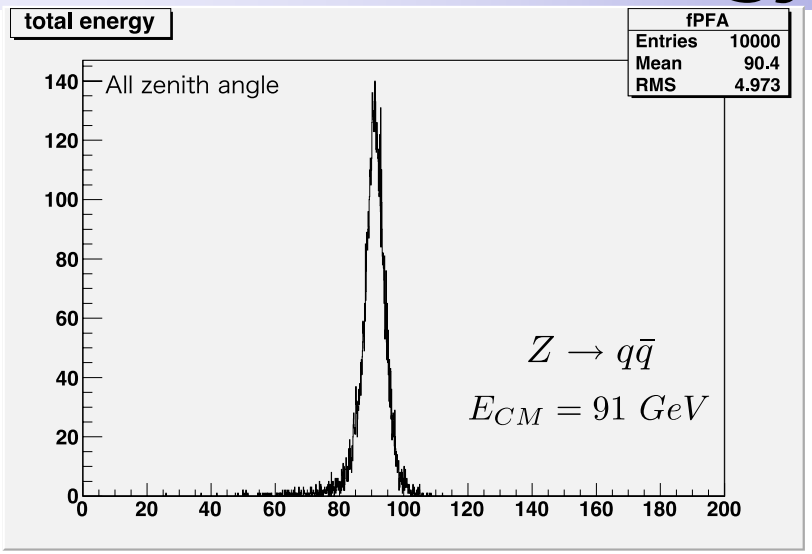
Other Calibrations

- HCAL calibration and MIP calibration are performed by following the standard calibration method in Marlin.



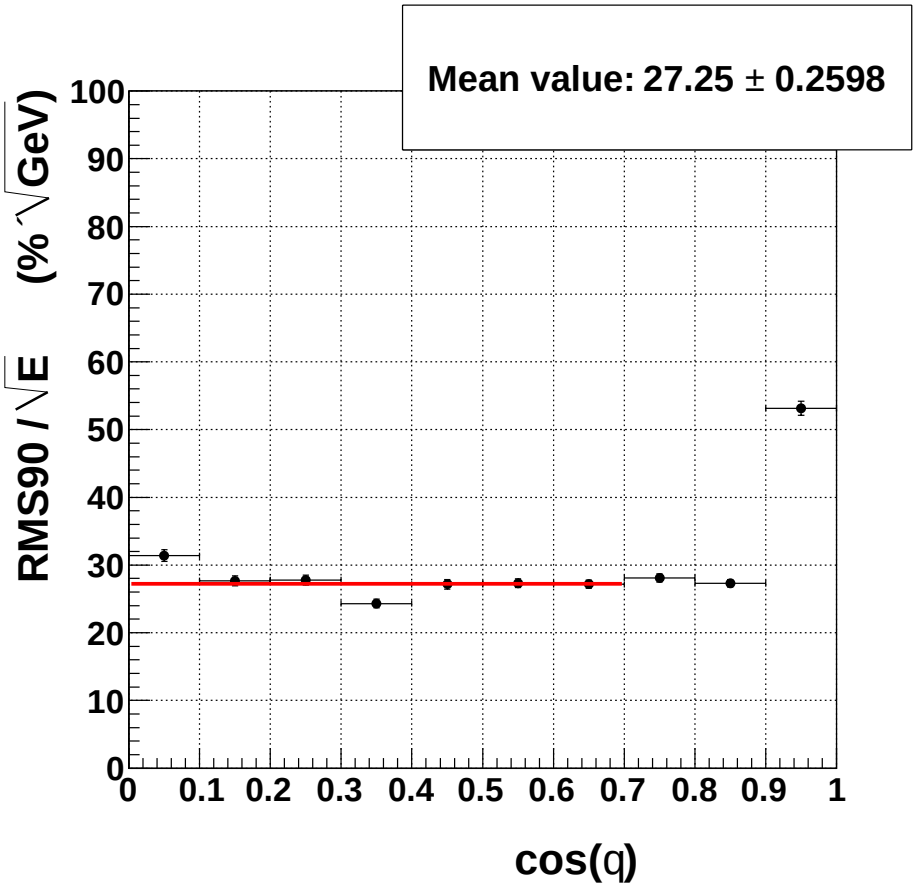


Jet Energy Resolutions



Hybrid ECAL+Strip Splitting Algorithm(SSA)

	RMS90(cosθ<0.7)
SiECAL	27.20±0.26%
Hybrid ECAL	27.41±0.26%
ScECAL	27.64±0.26%



- Notice that the performances of SiECAL and ScECALwith current configuration are almost same for Z-pole events.

Summary and Future Plans

- We have established a calibration method for the Hybrid ECAL.
  → Will look for another better method.

- We have evaluated the jet energy resolution for Z-pole events.
  →Hybrid ECAL works well.

- Performance of ScECAL would be degraded by “ghost” hits due to the strip structure as jet energy increases.
  →Will study higher jet energies. We expect the “ghost” hits can be removed with the support of the silicon layers in the case of the alternate structure.

- We will repeat same procedure with various Hybrid ECAL configurations.