九州大学

Analysis of CERN'14 TB data

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Outline

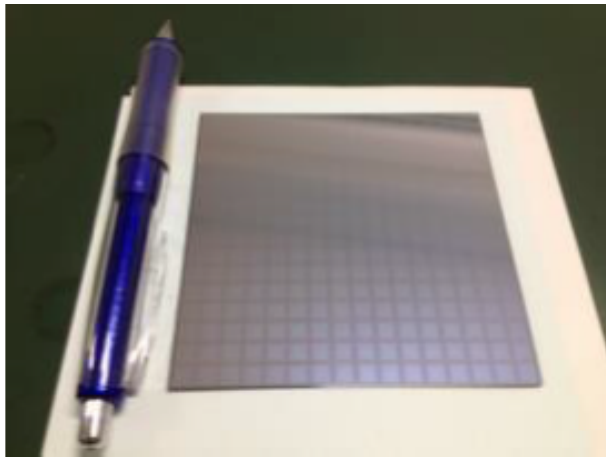
- Introduction
- Setup
- Gain calibration
- Test beam result
- Summary

ILD ECAL

Requirement

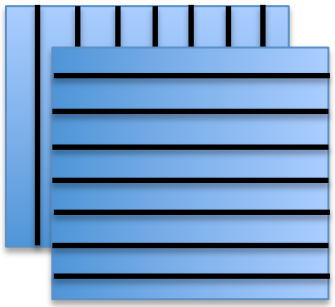
- **Fine granulated detector for PFA**

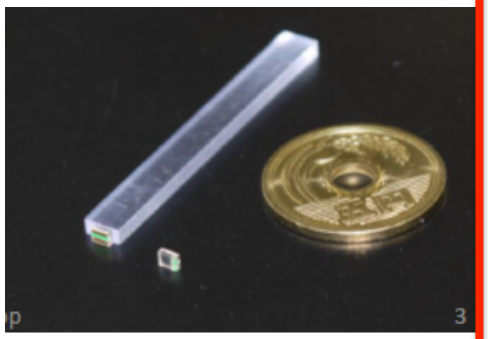
Pixelized silicon detector



- High resolution(**5mmx5mm**)
- Good advantage for PFA
- High cost

Scintillator + MPPC detector





- Low cost
- Cross arrangement of strip (**45mmx5mm**)

Hybrid ECAL (ECAL using Si & Sc)
We can reduce cost, while achieve 3-4% of jet energy resolution.

Motivation

We would like to use both detectors using same software for hybrid CAL.

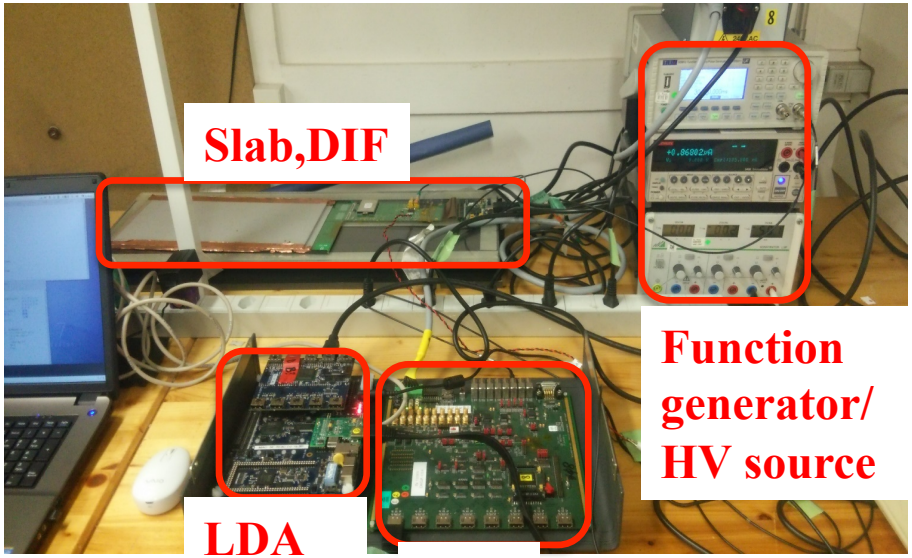
Now…

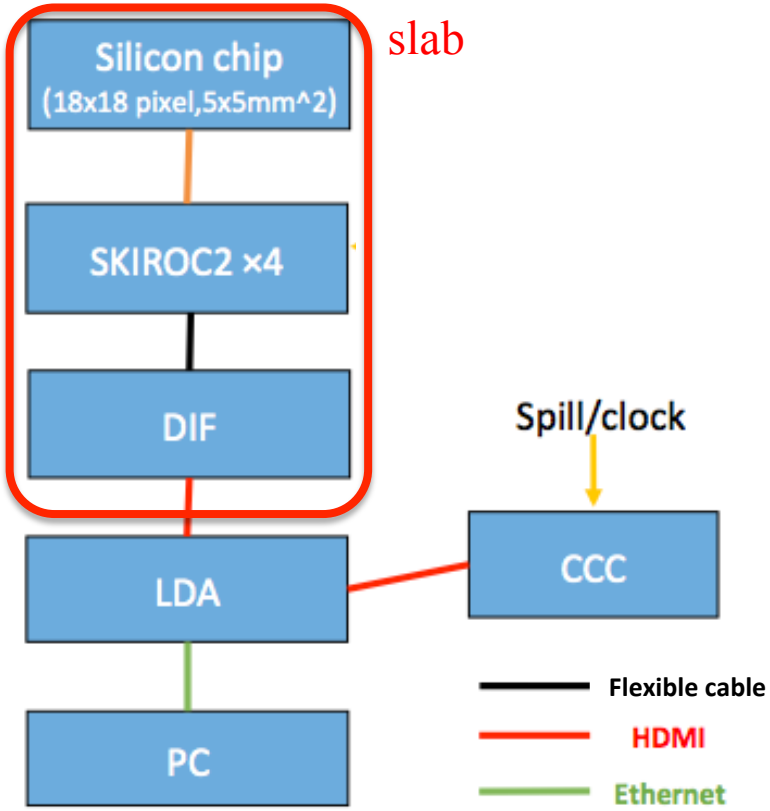
Silicon detector
- ASIC : SKIROC2
- Software : Calicoes

Scintillator + MPPC detector
- ASIC : SPIROC2
- Software : LAB VIEW

- Combined DAQ test using Si detector and Sc detector at CERN
  - Calibration for Si detector (Setup and RI source Test)
  - Analysis combined DAQ result of TB

Si detector DAQ





Slab ：technological prototype

SKIROC2：64ch ASIC、preamp、self trigger、12bit PHADC

Detector Interface(DIF):readout from ASIC and send to PC

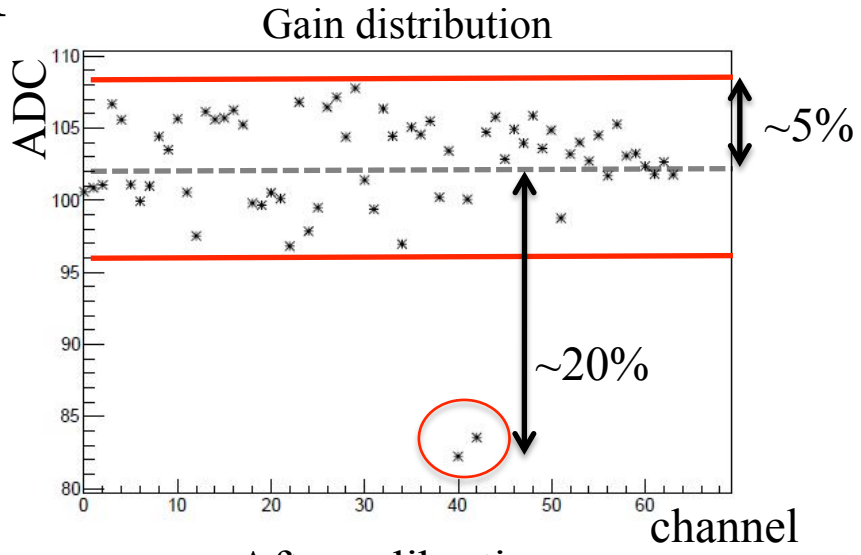
Link Data Aggregator (LDA)：Communicate with multiple DIFs, CCC and PC(via ethernet)

Clock and Control Card (CCC)：Send clock/spill to LDA

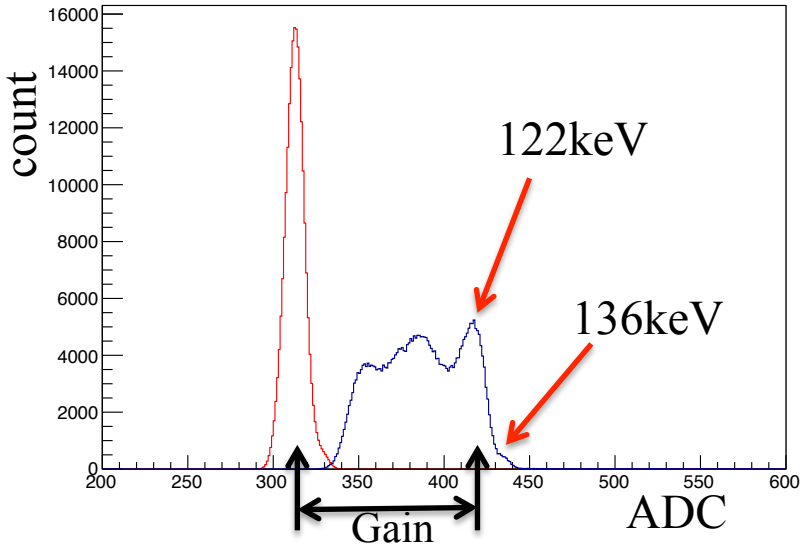
Gain calibration

We measured ASIC's gain per channel using RI source.

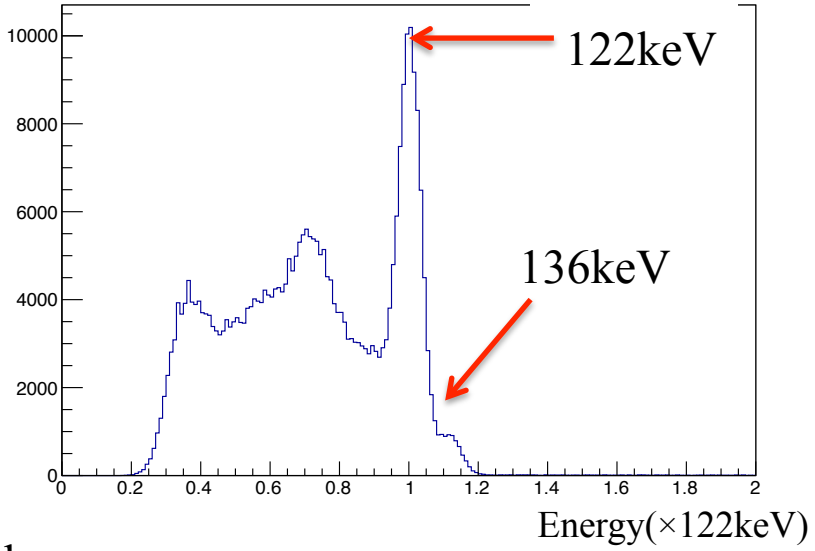
RI source
^{57}Co->122 keV(86%),136 keV(11%),γ ray



Before calibration Red : pedestal 、Blue : signal



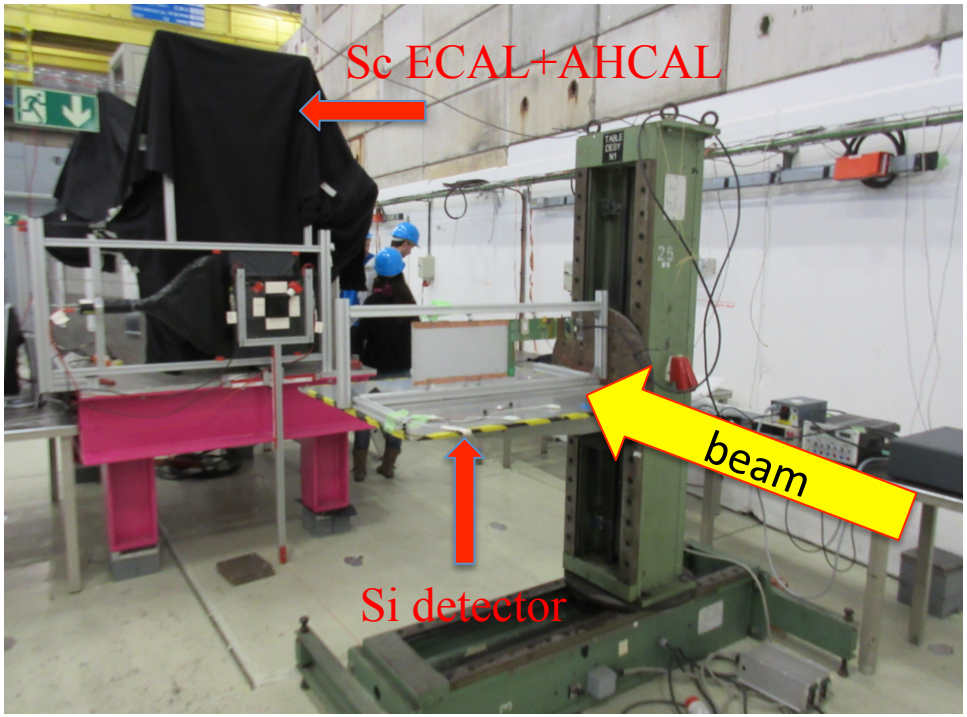
After calibration



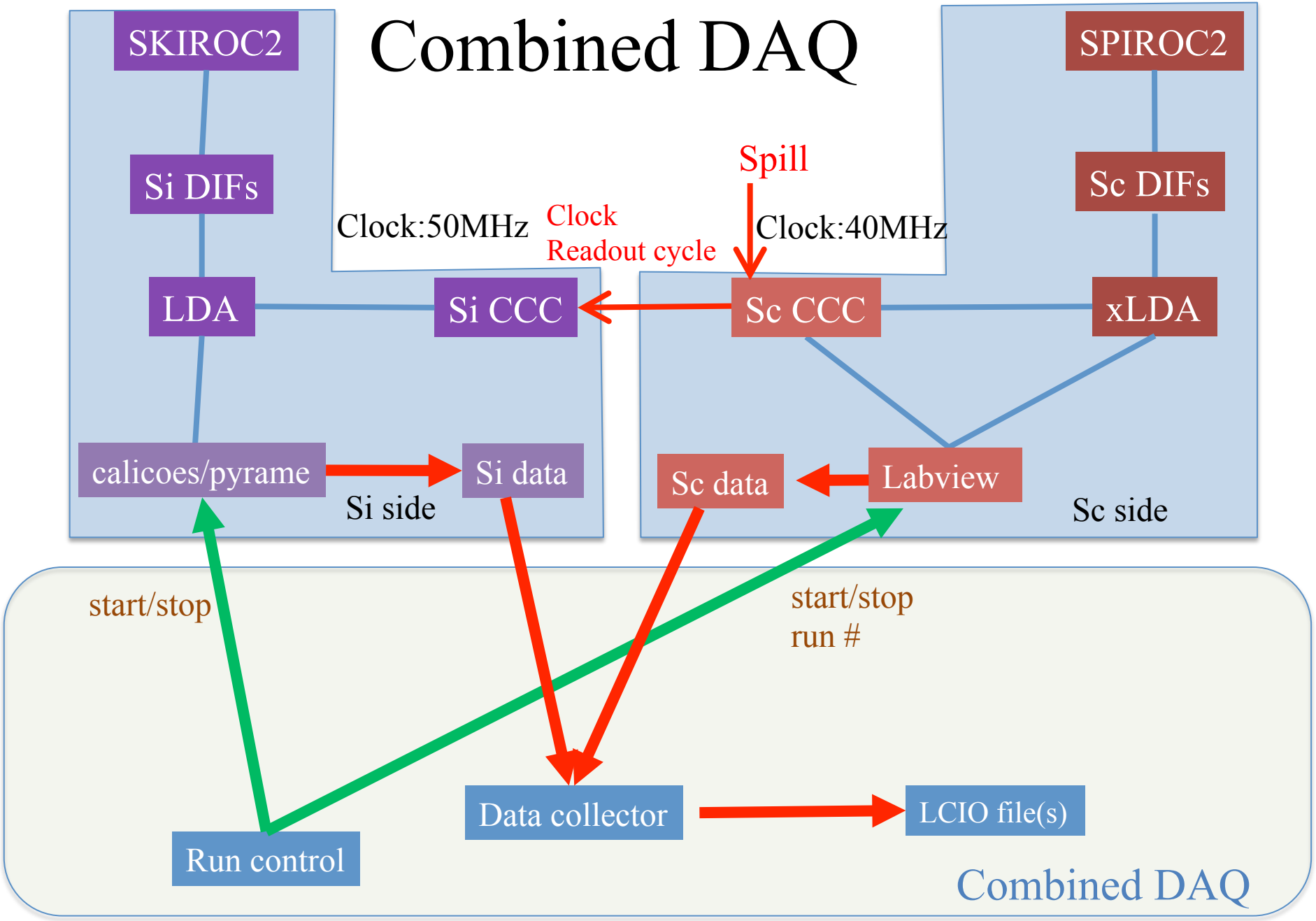
Gain distribution is around 5% in most of channels
We observed 2 low gain channels caused by electronics.

Test beam setup at CERN

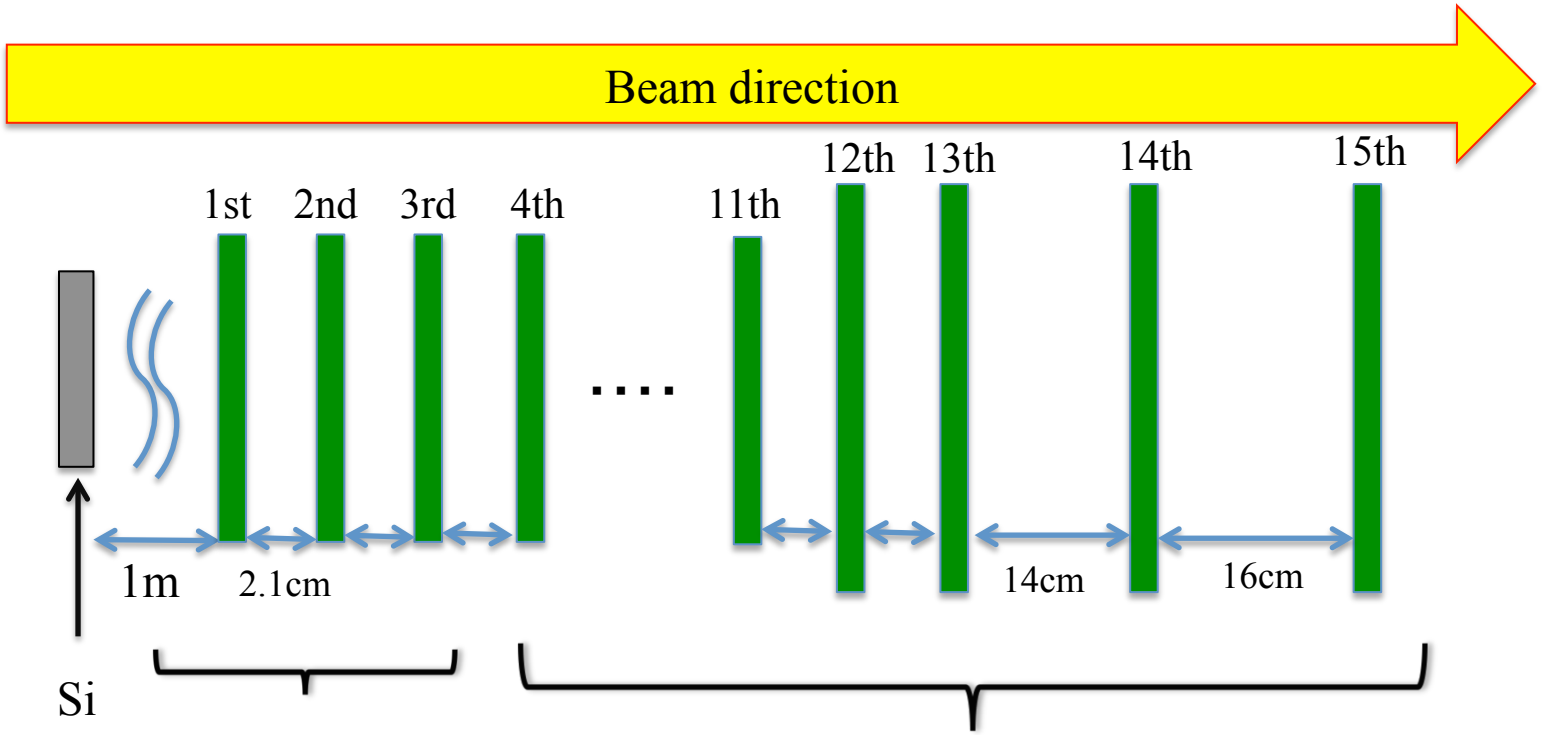
- We set up at T9 line in PS(11/26-12/8)
- We tested DAQ with Sc ECAL+AHCAL group.
- One Si slab was set in front of ScECAL and AHCAL
- We tested combined DAQ based on EUDAQ and combined run (Si and Sc)



Combined DAQ

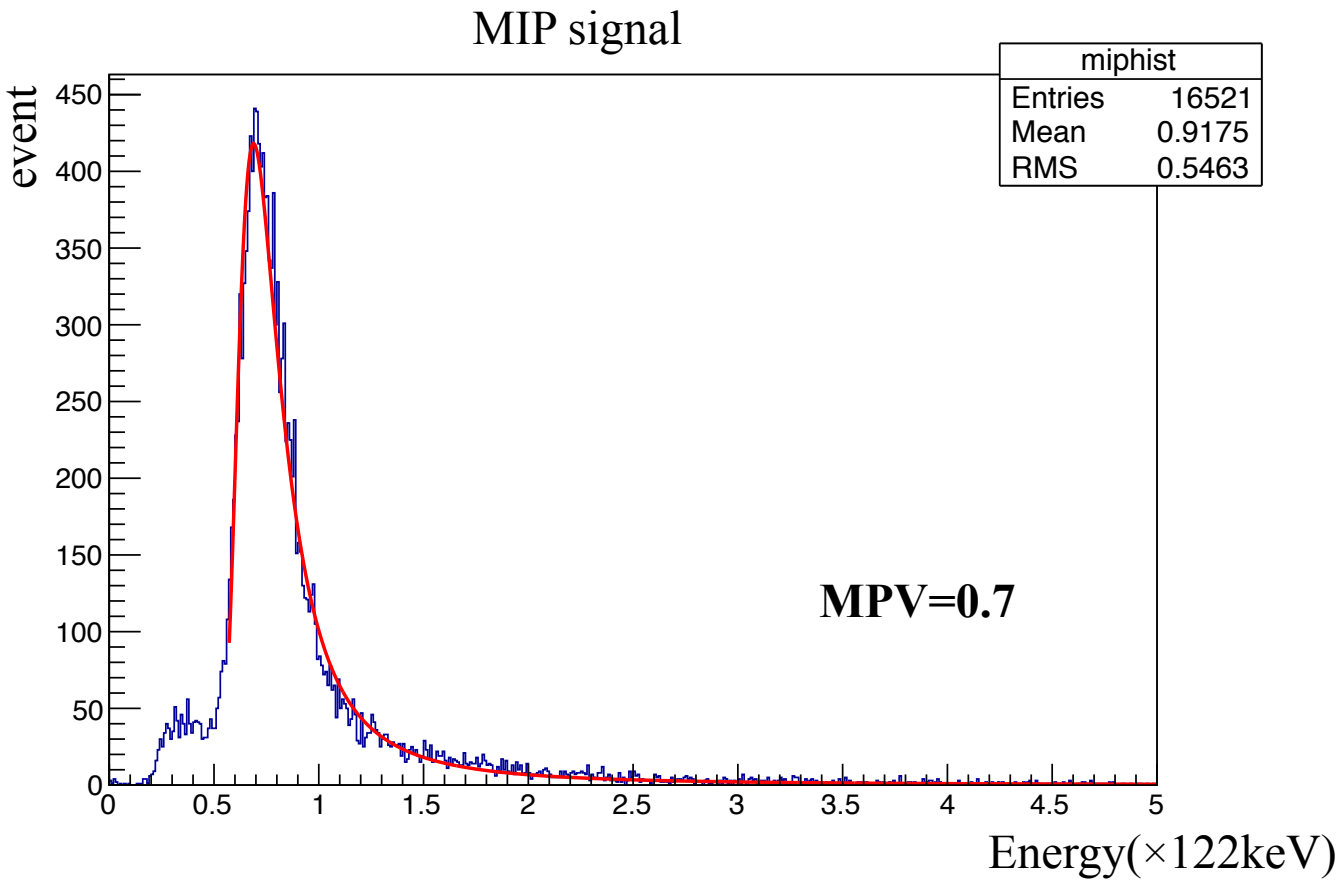


Layout



The distance between Si and Sc is 1m.
1st -3rd layers are strip Sc, and 4th-15th layers are tile Sc, and space between each layer is inserted absorber(Fe).
Si's pixel is 5mm x 5mm, and HBU's tile is 3cm x 3cm.

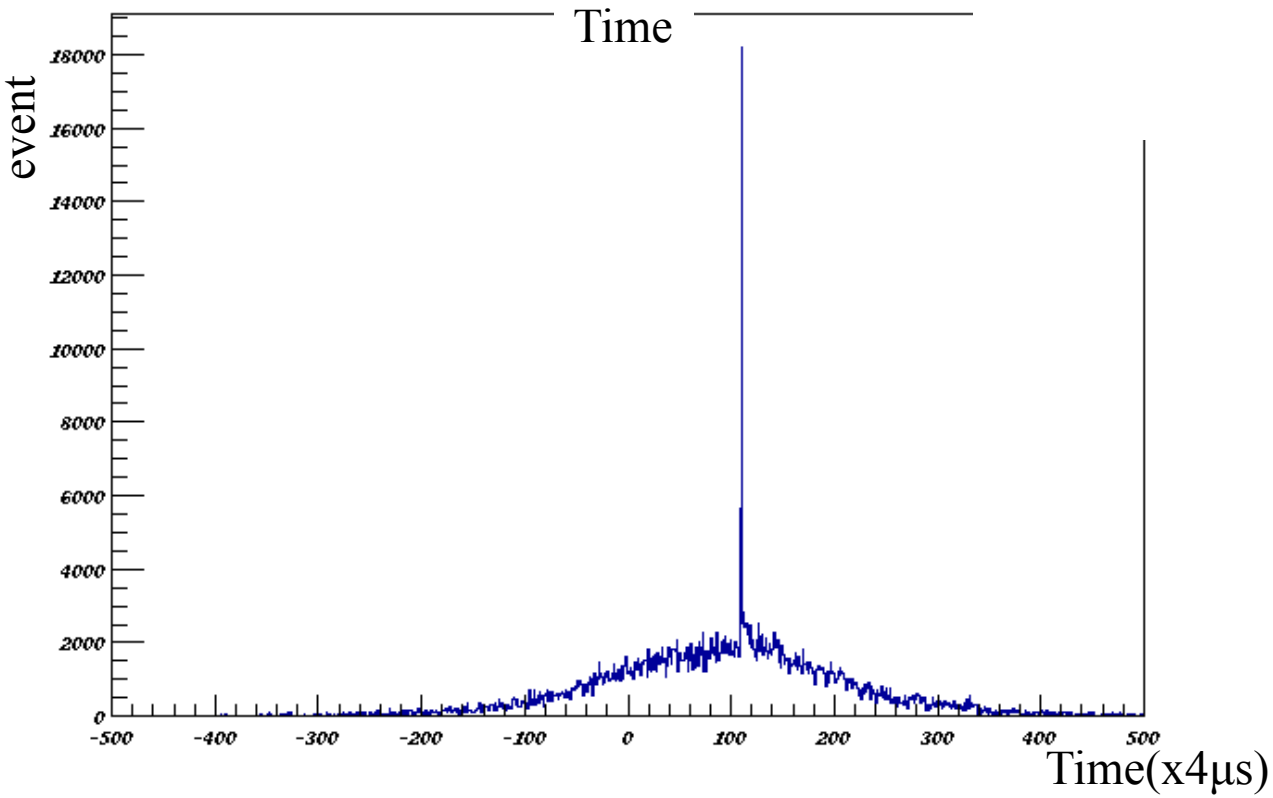
7 GeV muon MIP signal (Si)



This signal's pedestal has been already subtracted and signals have been calibrated gain per channel too .

We were able to observe MIP peak at around 0.7 x 122keV = 85keV.

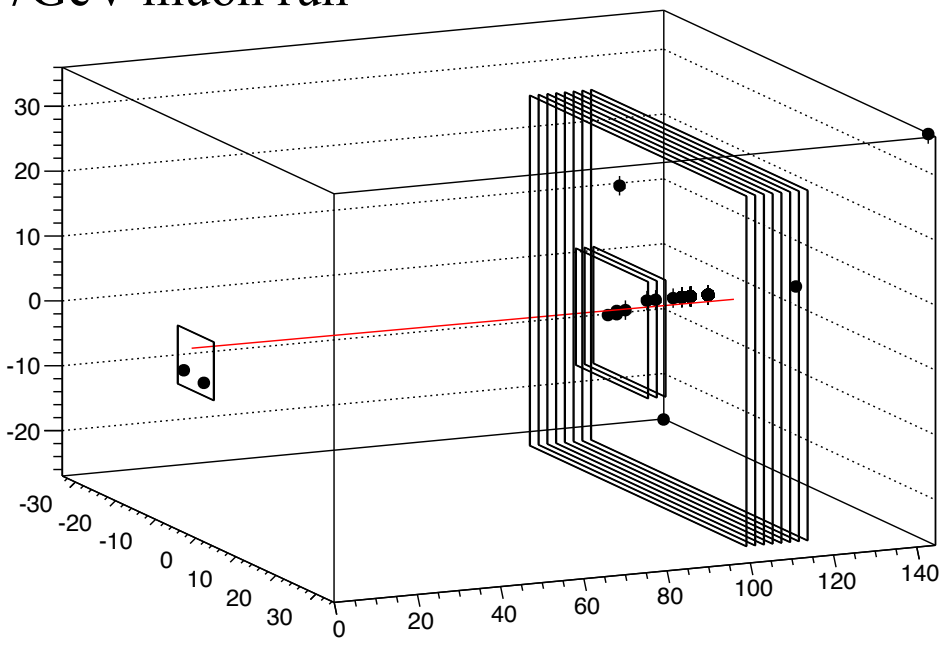
Si & Sc's distribution of time



Evidence of synchronization of Si and Sc layers
This figure shows difference of time between Si and Sc.
Si hits are selected and compared with every Sc hits at the same readout cycle
The peak shows the fixed time difference (of ~110 Sc BX = 440 usec)which is consistent with measured delay of electronics.

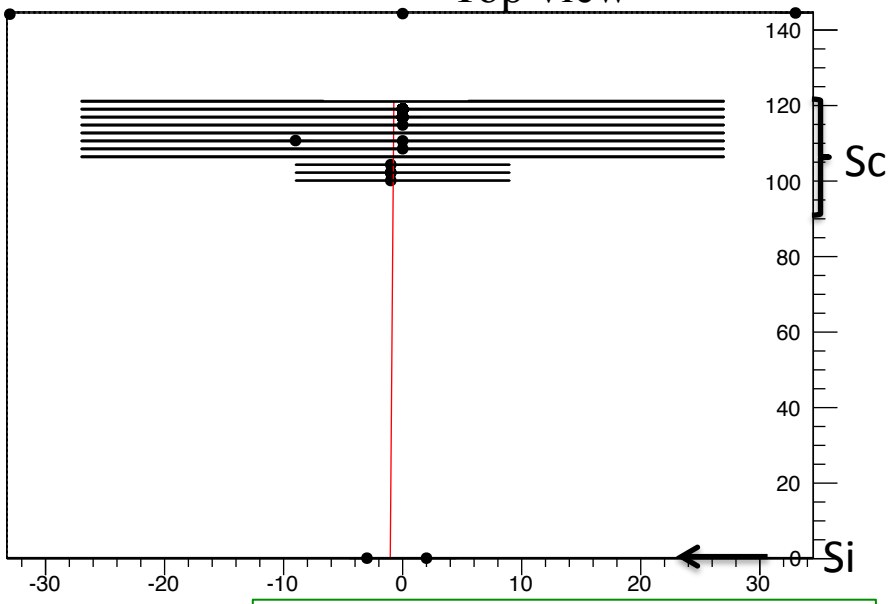
Muon track event

7GeV muon run



Side view

Top view



We fitted hit point in ebu and hbu.
Point's error bars are pixel size.
We observed track between Si and Sc.
Difference between line and Si' hit point was caused by layout.

Selection
Delay between Si and Sc (440μs)

- Si
  - Triggered
  - ADC > 350
- Sc
  - Triggered
  - ADC >350

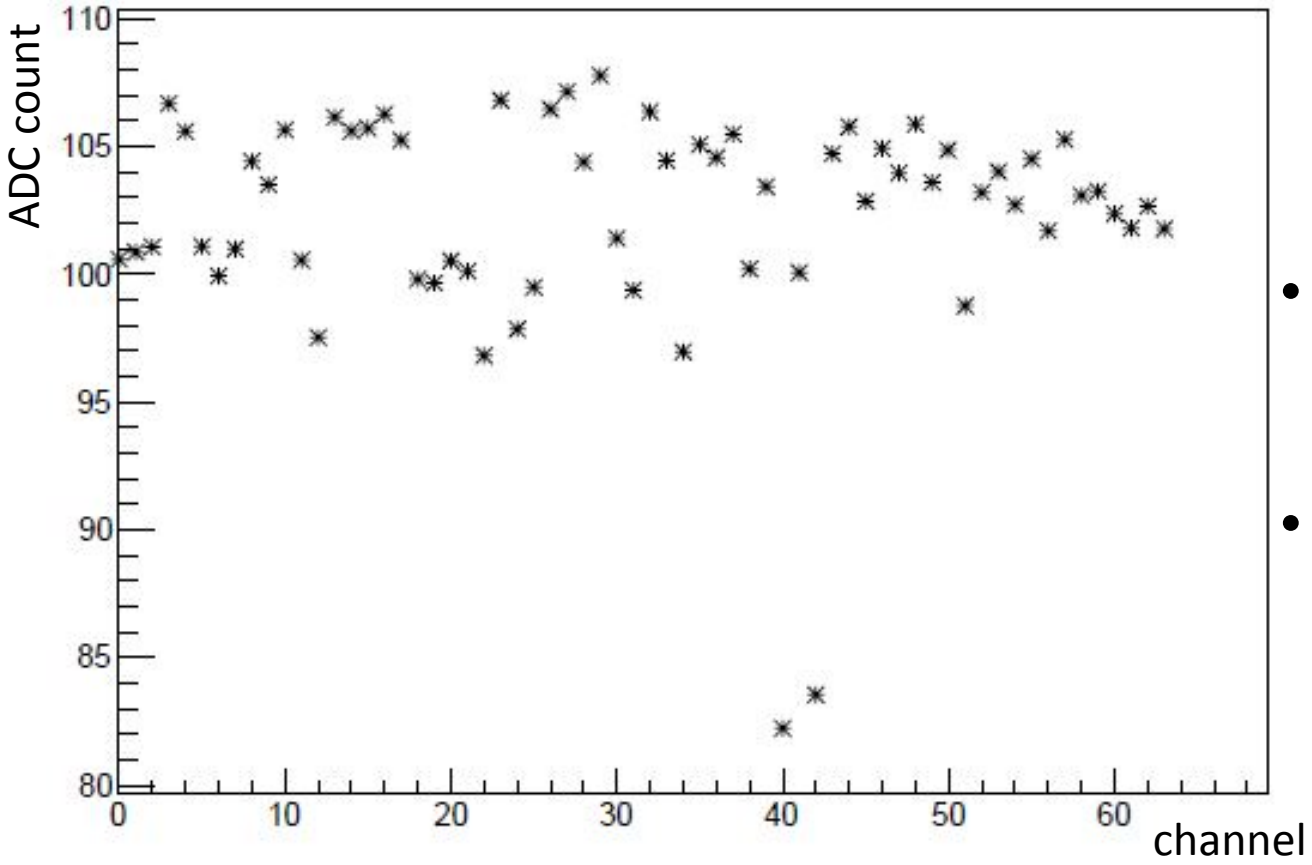
Summary and plan

- We made combined DAQ.
- We succeeded to test combined DAQ at PS.
- We could get synchronized data.
- We could observe a track of muon
- We will calculate Si's position resolution.

BACKUP

Gain calibration

gain

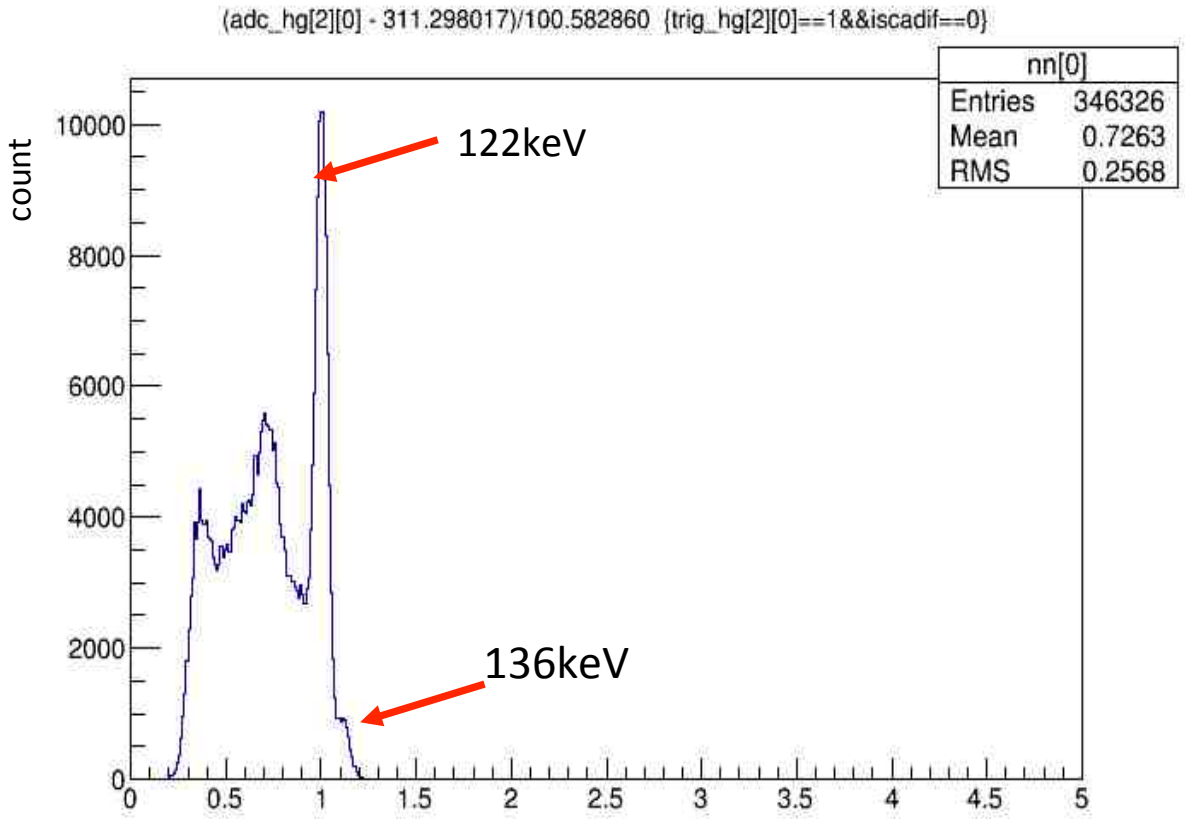


- Gain is defined by the difference between pedestal peak and signal peak
- Gain distribution is around 5% in most of channels
- Two channels with lower gain (by around 20%) found

Gain difference can be caused by electronics

Gain calibration

57Co spectrum after pedestal/gain calibration



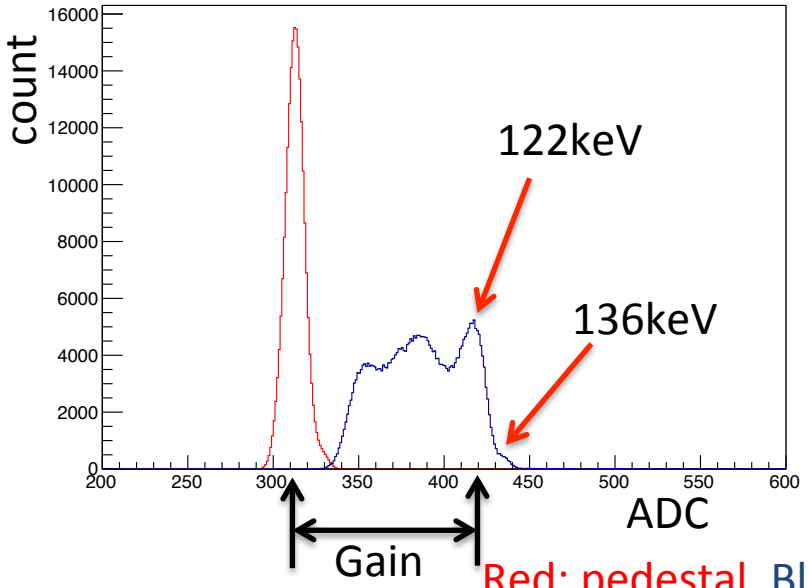
- Pedestal subtracted and gain calibrated per channel
- This figure is ADC distribution summed up 64 channels

Gain calibration

We measured gain used isotope.

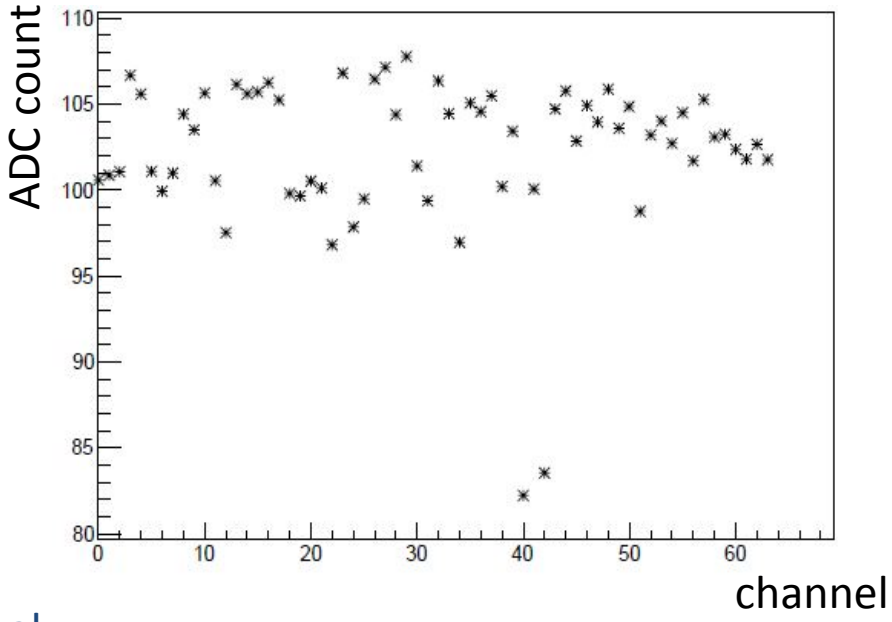
^{57}Co->122 keV(86%),136 keV(11%),γ ray

Before calibration



Red: pedestal ,Blue: signal

Gain distribution



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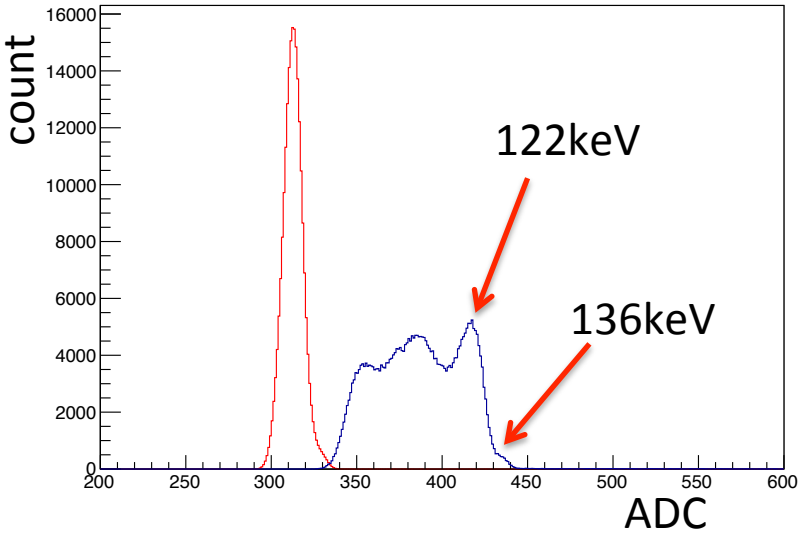
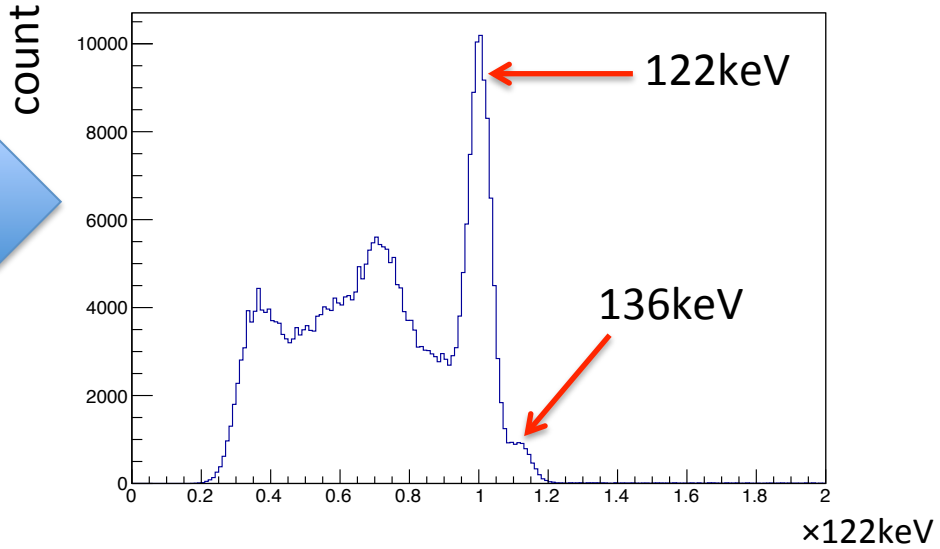
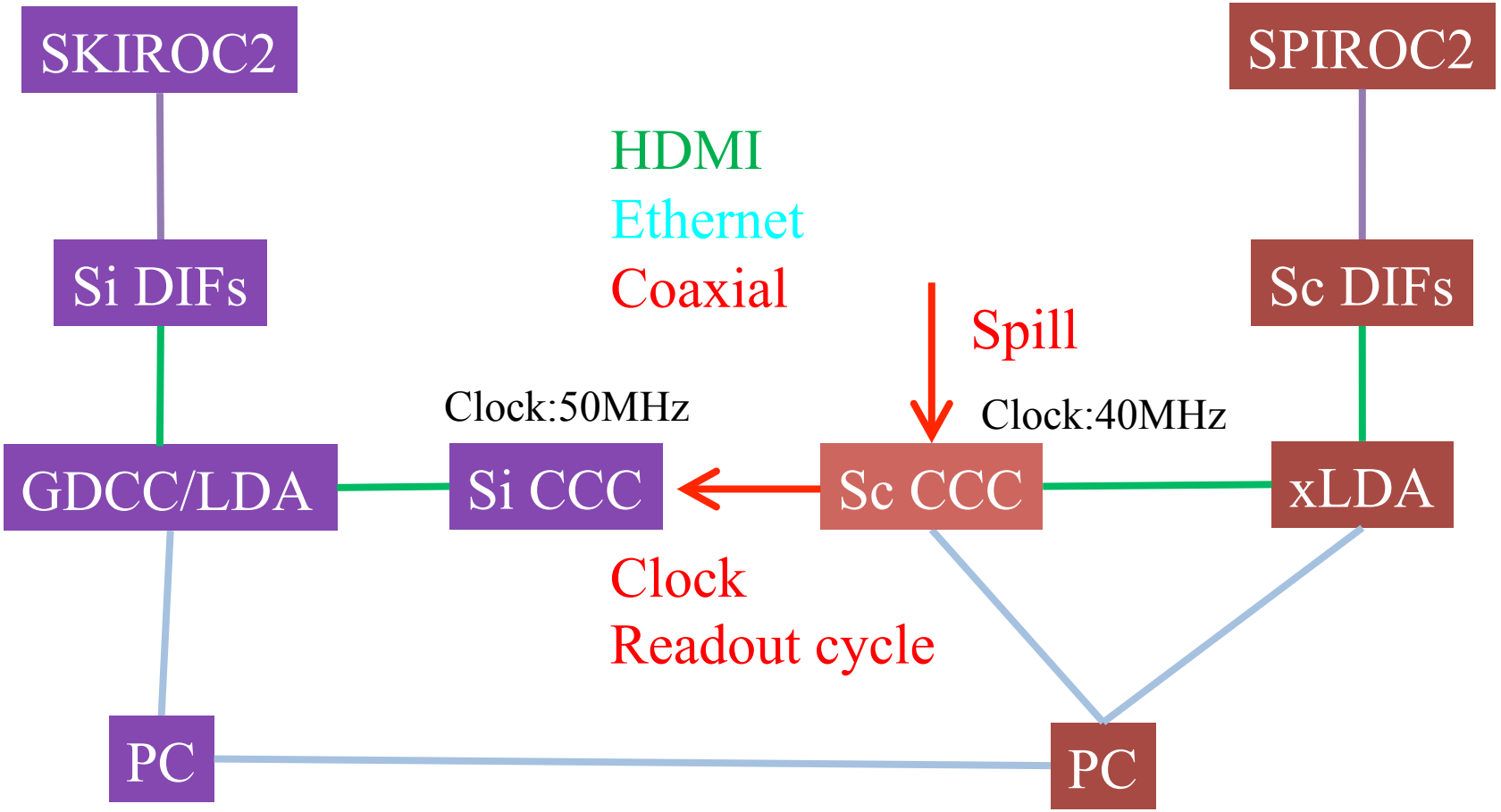


After calibration



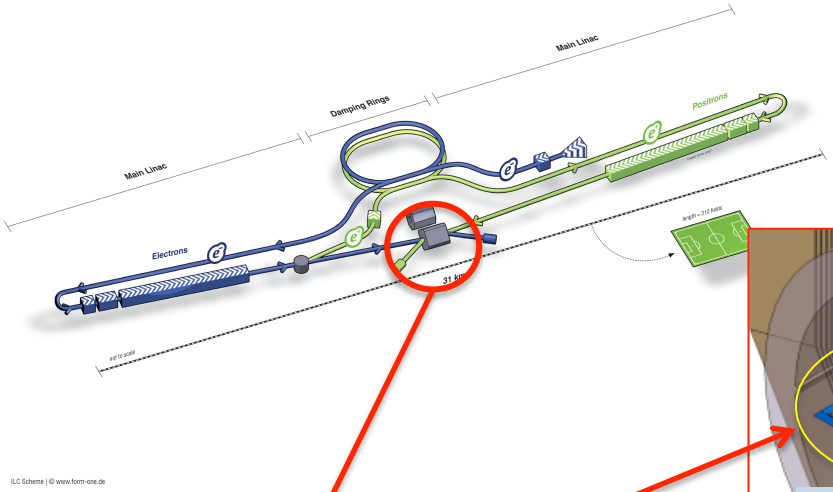
We clearly observed 122keV peak signal.
We corrected gain to correspond 122keV to 1.

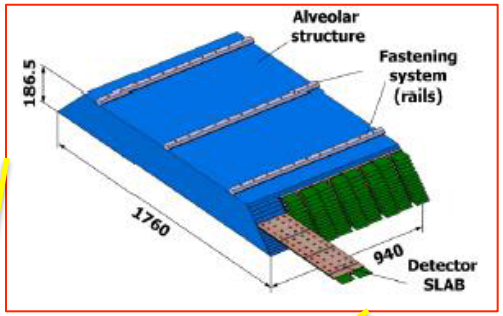
Si and Sc DAQ

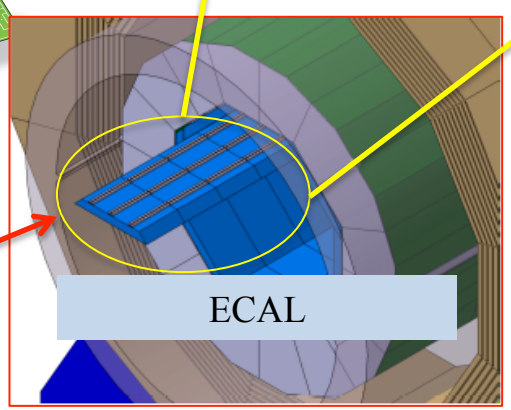


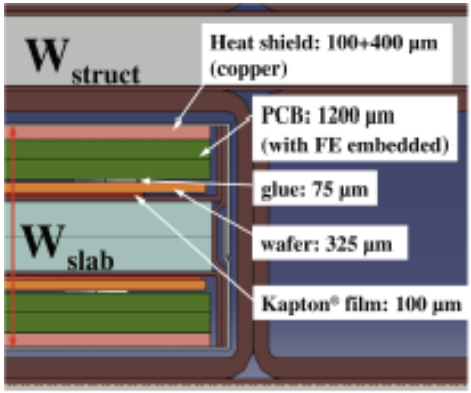
Si's CCC receives beam spill via Sc's CCC. We tried to get synchronized data by Sc's CCC supplying clock and same readout cycle to Si's CCC.

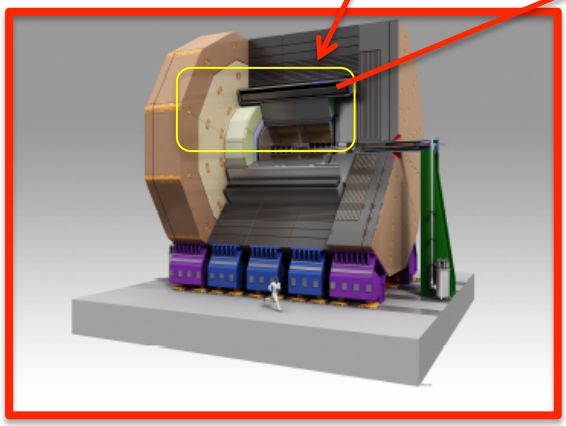
International Linear Collider











- Yoke/muon
- Coil
- HCAL
- ECAL
- TPC
- SIT
- Vertex detector

International Large Detector (ILD)

ECAL: Sampling calorimeter (Si/Sc and W)

- High Jet energy resolution is required in ILC event
  →Particle Flow Algorithm(PFA)

Requirement of ECAL
- High position resolution for PFA