MIP Calibration of the Physics Prototype of the Silicon Tungsten Electromagnetic Calorimeter for the International Linear Collider

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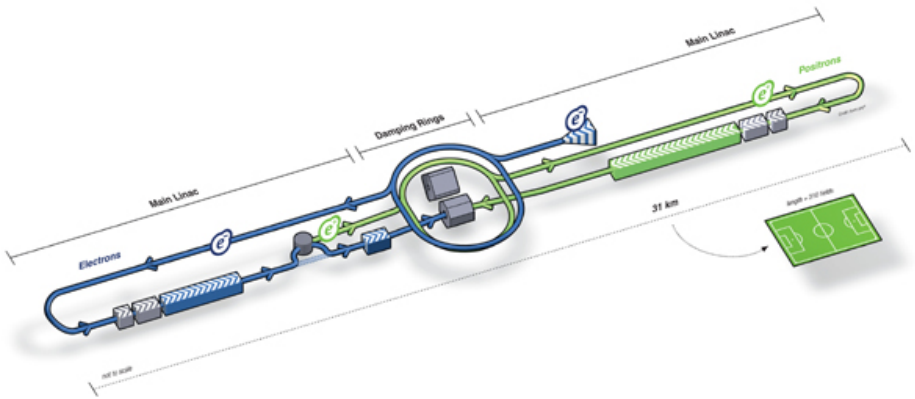
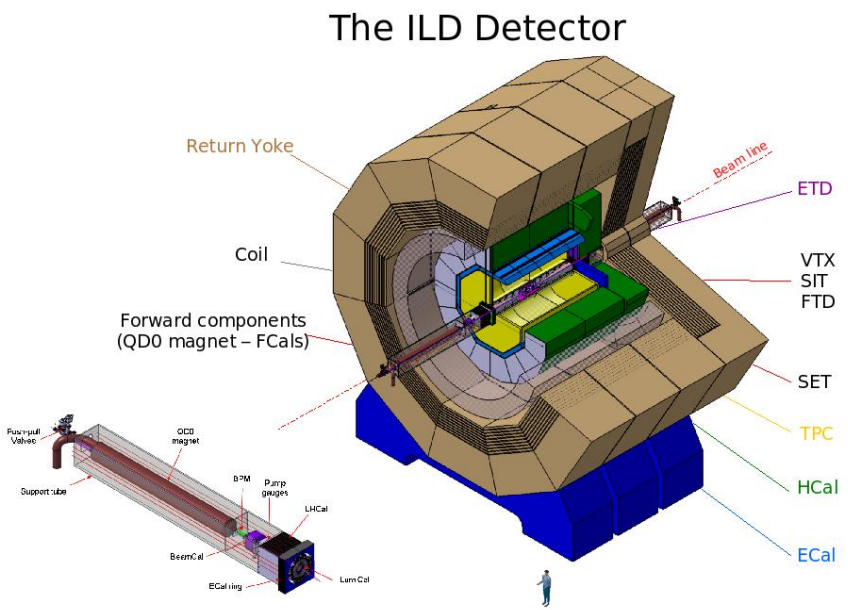
Outline

The International Linear Collider



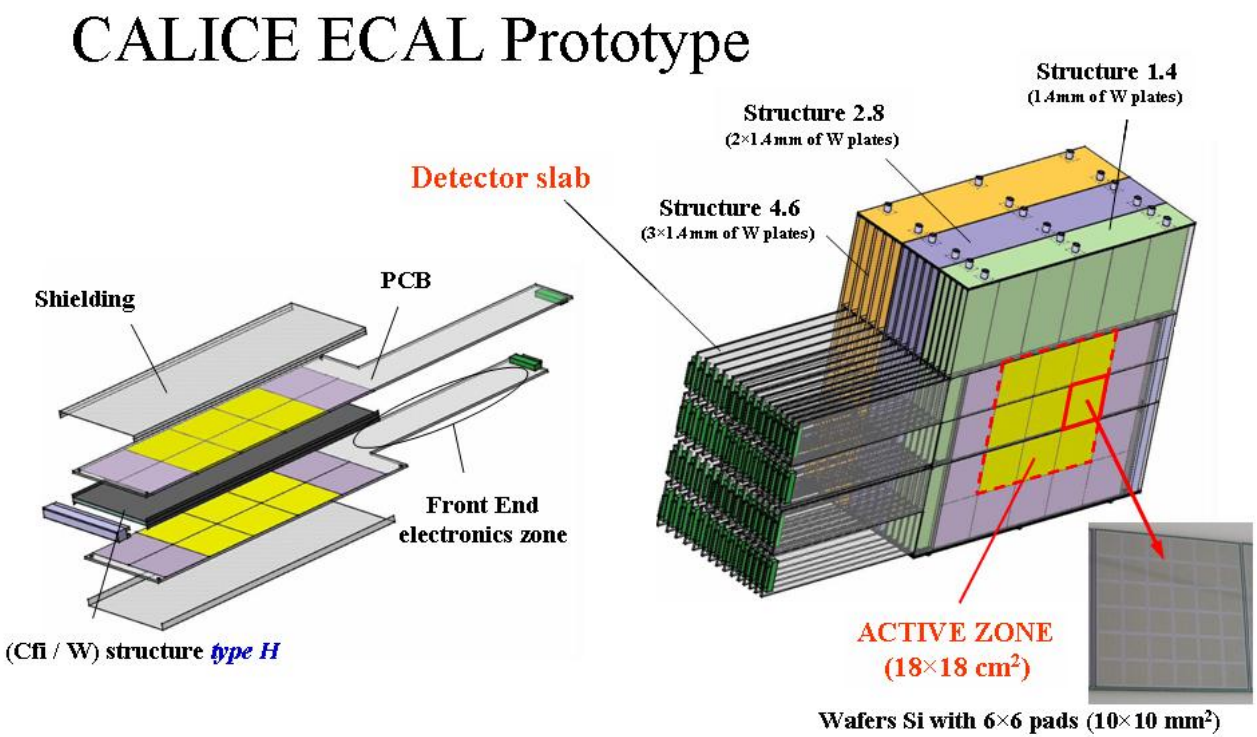
1. The ILC is an international project of e^+e^- collider.
2. The ILC will be optimized for 500 GeV center of mass energy.
3. Complement of the LHC: e^- are pointlike particles.

The International Large Detector



1. The ILD is one detector concept for the ILC.
2. The detectors are optimized for Particle Flow Algorithm.
3. Highly granular calorimeters are tested for the ILD.
4. The SiW ECAL is one of these calorimeters

The SiW-ECAL physics prototype



1. The prototype consists of 30 layers.
2. Pads size: $1 \times 1\, cm^2$.
3. There is a total of 9720 channels.

The ECAL physics prototype in test beam

The physics prototype is tested since 2005 in DESY, CERN or FNAL facilities. The prototype have been tested at FNAL in April 2011 in combination with a HCAL.

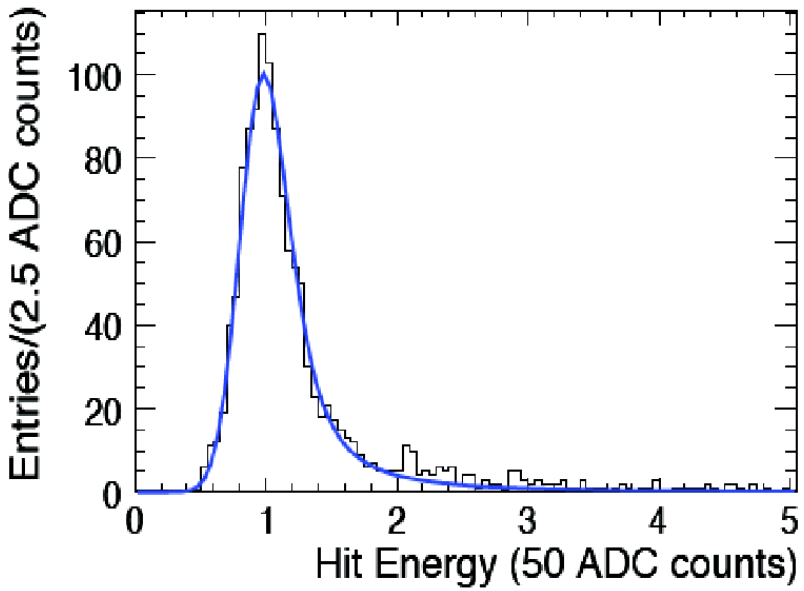
The Mip Calibration

Goals of the MIP Calibration

The calibration process goal is to equalize the reponse of all the pads.

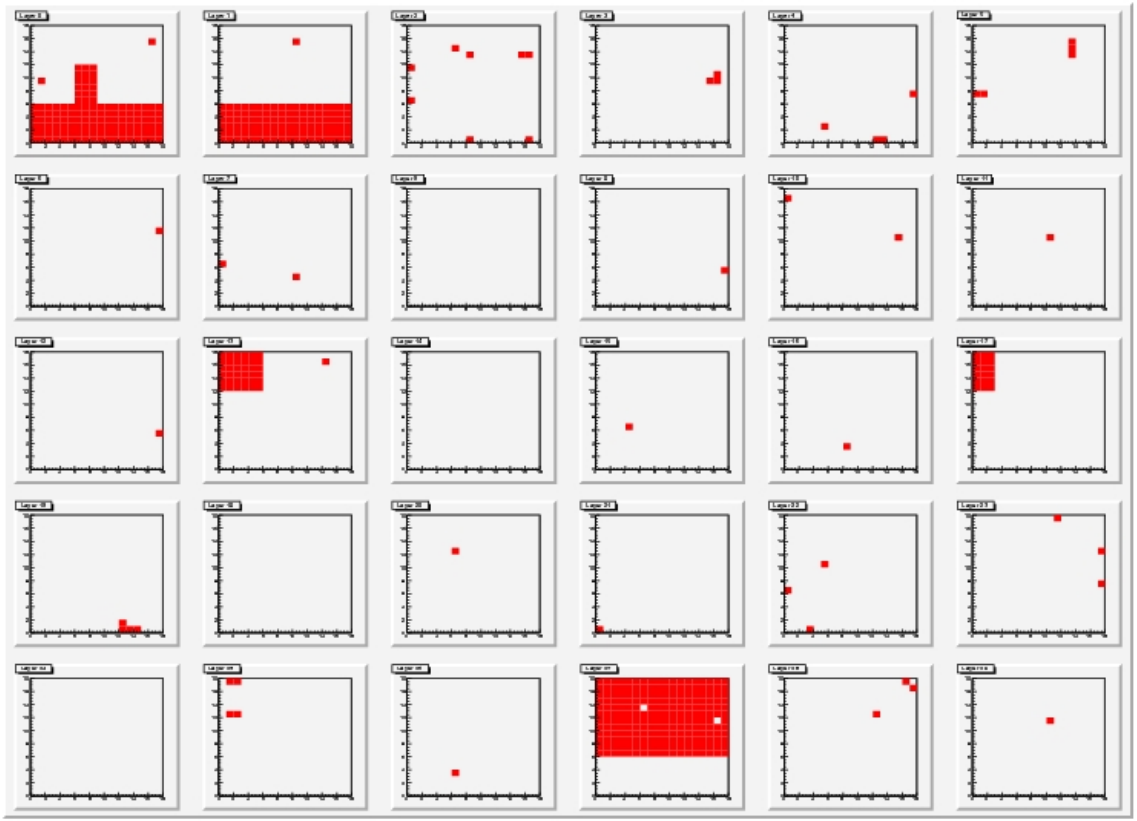
1. For that we want to find the relation:
   electronic signal (ADC units)$\Longleftrightarrow$ energy units (MIP units).
2. First the pedestal is substracted from the results to have the actual signal value.
3. Then events with muon are selected, because muons are MIP particles.
4. When we have a sample of muon events we can start the calibration algorithm.

MIP Calibration Algorithm



1. Each pad is fitted by a convolution of a Landau distribution with a Gaussian.
2. The MPV of the Landau defines the calibration constant.
3. The sigma of the Gaussian defines the signal noise.

Dead pads Map

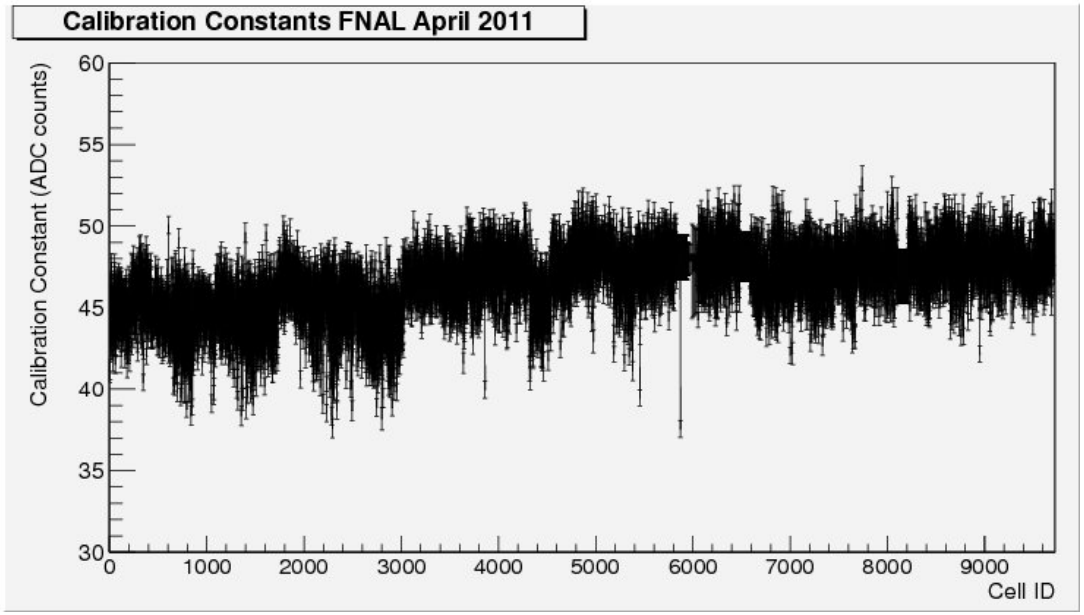


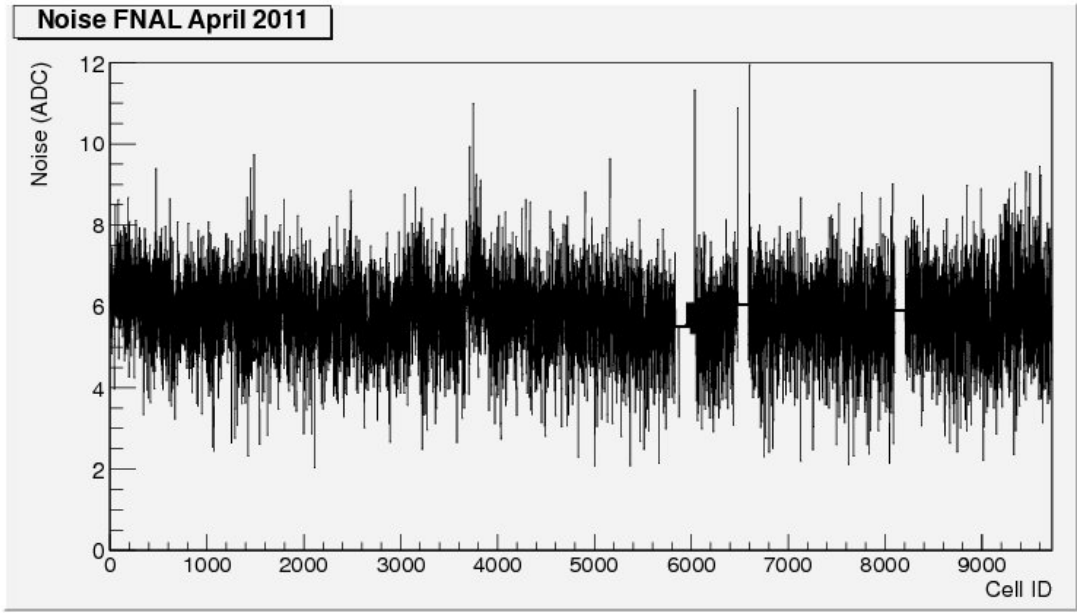
1. Map of the dead pads for each of the 30 layers.
2. Some pads are found to be dead because the fit failed.
3. Some other are really dead (they have no signal).

Replacement of dead pads values

The fit values of the dead pads are replaced by some average values (chip, wafer or layer).

Calibration Constants of the ECAL





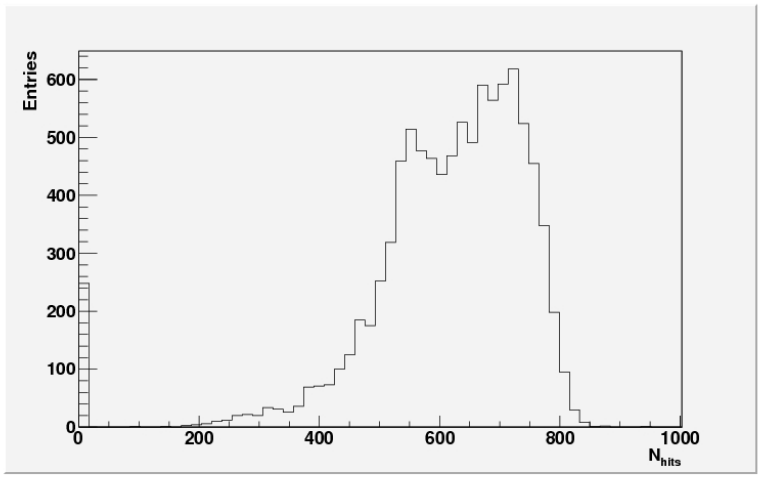
Average calibration constants

46.63 ADC counts with a RMS of 2.02 ADC counts

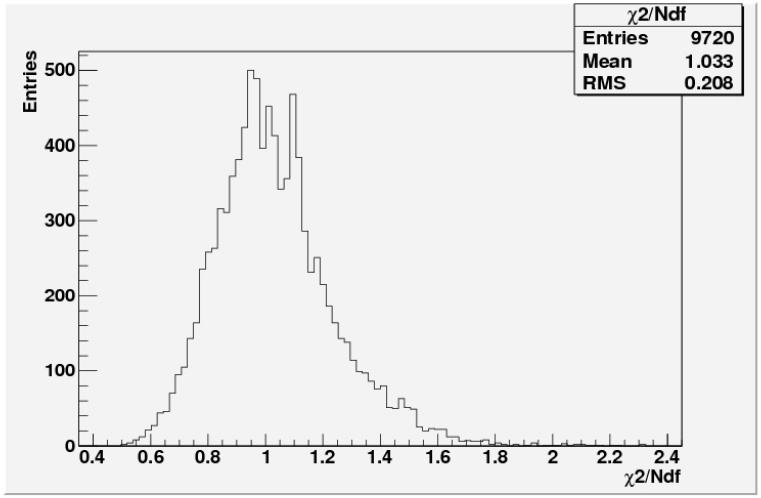
Average noise

5.79 ADC counts with a RMS of 0.95 ADC counts

Statistical issue

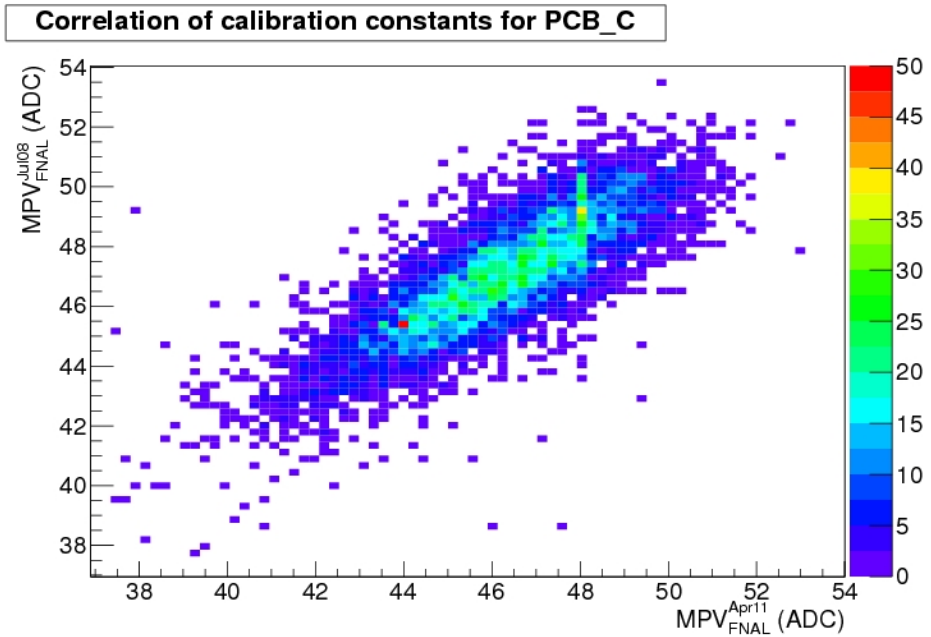


1. The number of hits of most of the pads is higher than 500.
2. The statistics is not yet enough to reach the required 1000 events/pad.
3. Notice the dead pad with no event.



1. The mean of the χ^2/Ndf shows that the fit works fine.

Correlation of the calibration with previous measurement



Correlation factor

Comparaison between 2008 and 2011 FNAL beam tests period. The correlation factor for central PCBs is 84.75%.

The calibration is very stable in time

This is very important to operate a detector which at the end will have 10^8 cells.

Conclusion

1. We have the calibration constants of the SiW-ECAL for each pads.
2. The average calibration constant is 46.63 ADC counts with a RMS of 2.02 ADC counts.
3. The average electronic noise is 5.79 ADC counts with a RMS of 0.95 ADC counts.
4. So the signal over noise ratio is 8.05.
5. The stability of the calibration constants have been checked.
6. The results show that the calibration procedure could be use for a complete SiW-ECAL.

Outlook

1. The work must be pursued with more statistics.
2. More work one the dead cells/PCB.
3. Use this calibration to analize the data of the ECAL.
    1. Deep analysis of hadronic showers.
    2. Interaction with the HCAL.

Good Fit Selection

A pad is said to be dead if it doesn't respect one of this criteria:

1. The MPV value is between 37.5 and 53.5 ADC counts.
2. The error on the MPV is less than 3 ADC counts.
3. The noise value is between 2 and 14 ADC counts.
4. The χ^2/Ndf is between 0.5 and 3.

SiW-ECAL + D-HCAL event display taken at FNAL

beam momentum 20 GeV/c.