Analysis of 2012/13 SiW ECAL beam test data

Jérémy ROUËNÉ
ECAL Meeting

Laboratoire de l'Accélérateur Linéaire, Orsay

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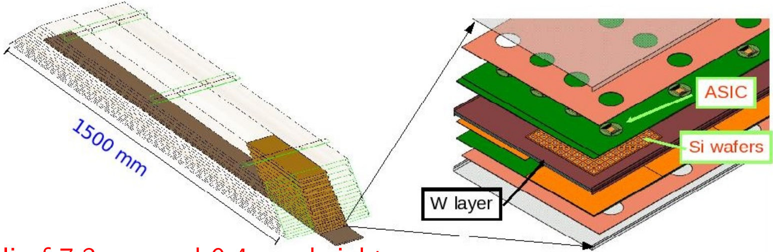
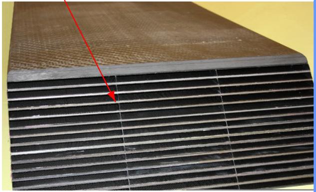
Outline

The Technological Prototype: Proof of Engineering Feasibility

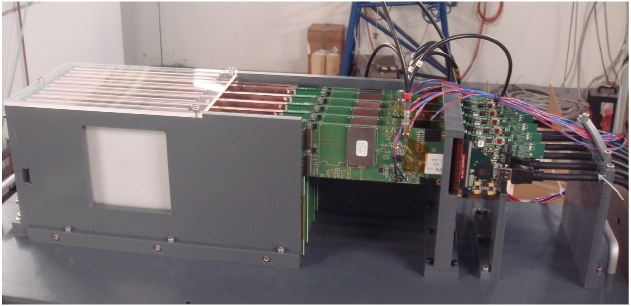


Alveoli of 7.3 mm and 9.4 mm height



- Realistic dimension: 3/5 of a barrel module.
- Integrated front-end electronics.
- Large mechanical structure.
- Test of power-pulsed electronics: 5 Hz and 1% duty cycle.
- Study of various approaches to cooling.

First Beam Test Prototype



DESY, 2012 - 2013: $e^{-}(1-5\,\mathrm{GeV})$:

- Up to 10 layers with possibility to put W plates(2.1 mm) between the layers.
- 4 ASICs per layers (1/4 of the final design): 256 channels per layers.
- All channels working with internal trigger (auto-trigger), with and without power-pulsing.
- For all the problems/filtering/solutions see T.Frisson's talk.

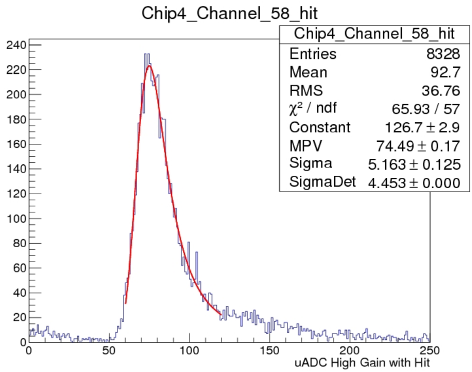
The MIP Calibration

Goals of the MIP Calibration

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

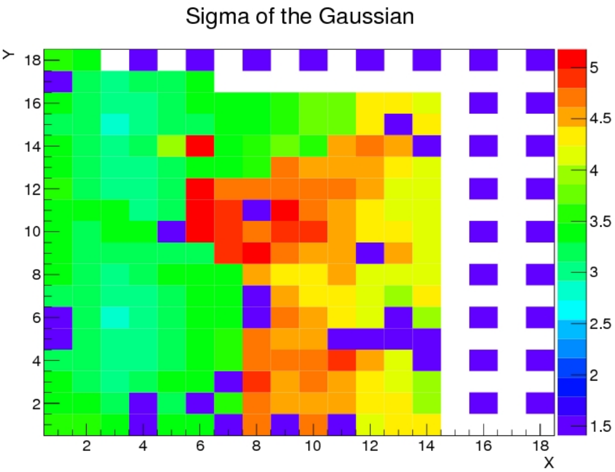
1. For that we want to find the relation:
   electronic signal (ADC units)$\Longleftrightarrow$ energy units (MIP units).
2. First the pedestal is subtracted from the results to have the actual signal value.
3. We can take all the events because at the test beam energy electrons act like MIP particles.

MIP Calibration Algorithm



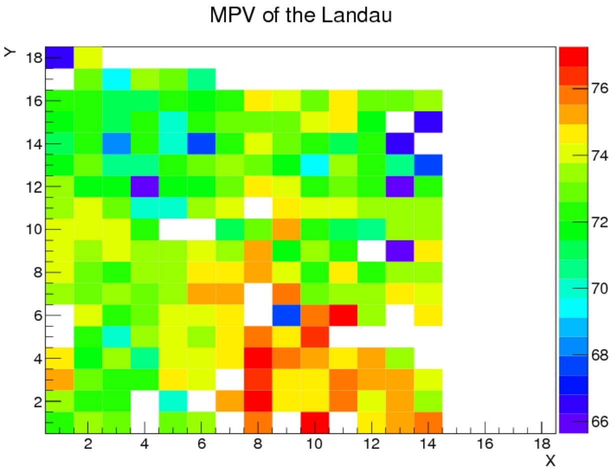
1. Each pad is fitted by a convolution of a Landau with a Gaussian.
2. The MPV of the Landau defines the calibration constant.
3. For each pad the pedestal value is subtracted. The sigma of the pedestal defines the signal noise.

The Sigma Detector map



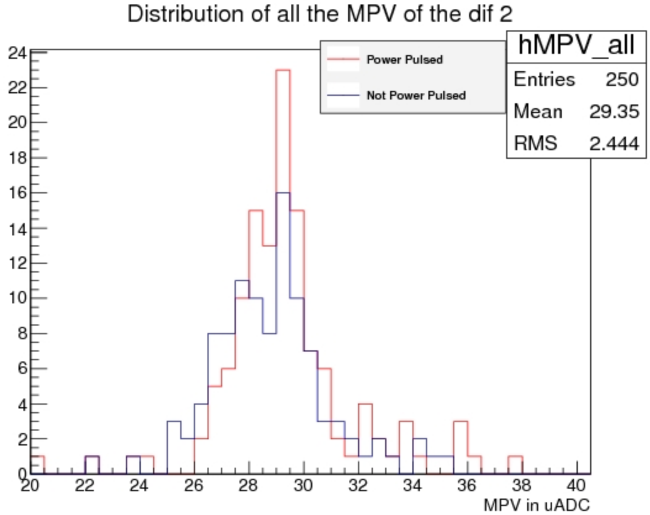
The mean Sigma of the detector for the dif0 is $3.8 \pm 1(25\%)\ uADC$.

The MPV map



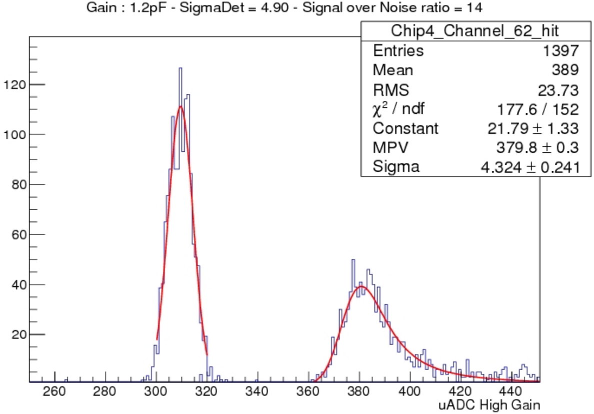
The mean MPV for the dif0 is $73 \pm 3(4\%)\ uADC$. From the simulation $1\ MIP = 0.095\ MeV$.

Comparison with and without Power Pulsing



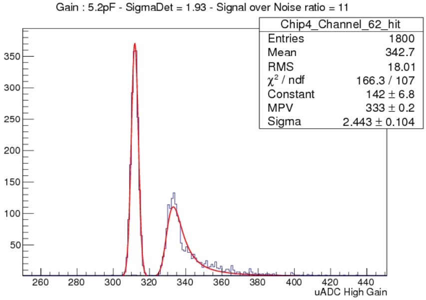
For Dif2 (one of the patched Dif) similar results with and without Power Pulsing.

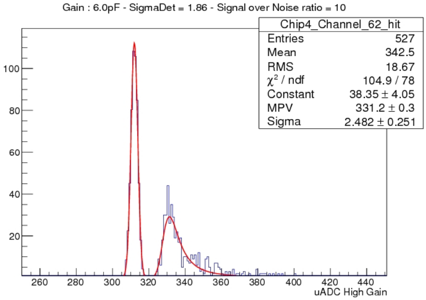
S/N for gain :1.2 pF



Reminder: the goal is S/N = 10. Here S/N = 14 but for a gain higher than the nominal one.

S/N for lower gain

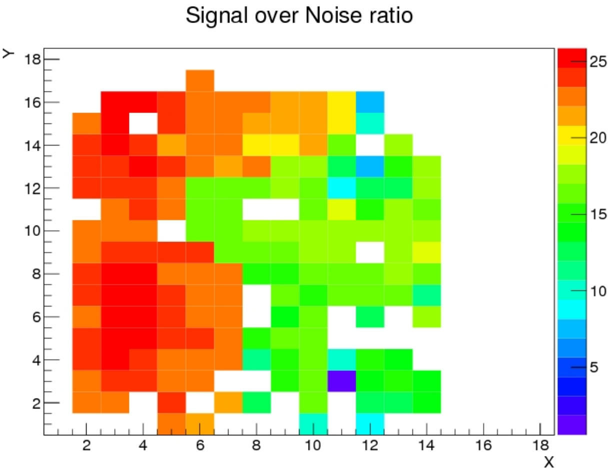




For nominal gain ($6\,pF$) S/N = 10

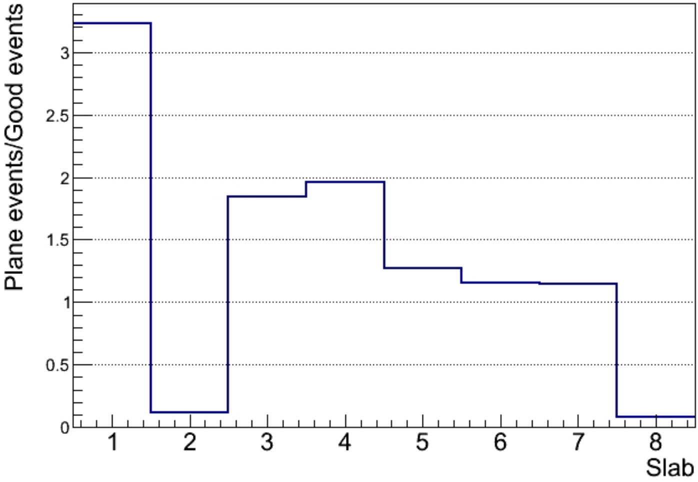
The Signal over Noise ratio is still higher than 10 for the gain use to have the nominal dynamic range.

Map of S/N for gain :1.2 pF



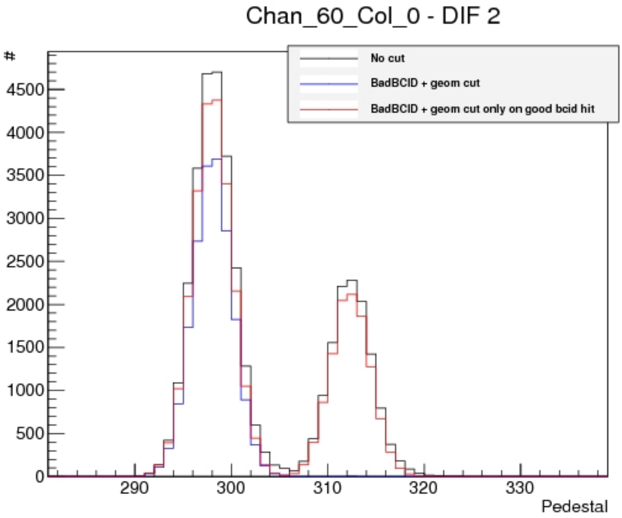
Almost always above 10 with the same structure than the sigma detector map.

Plan event in test beam



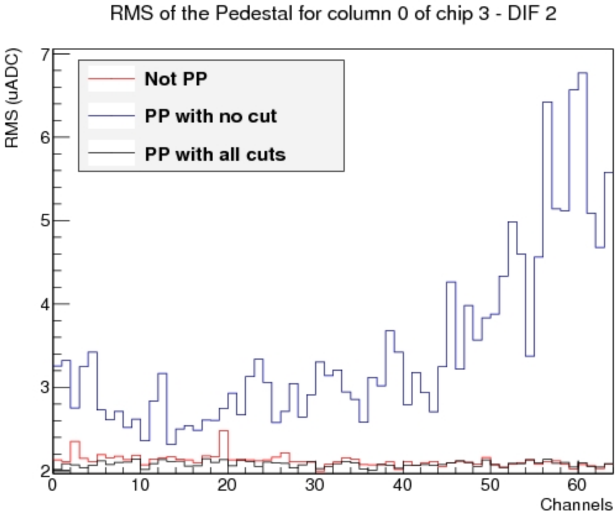
Patched slabs with pin-clipping and higher capacitance give better results in test beam.

Double Pedestal Pic



Second pic always comes with bad BCID in previous events. Effect still to be understood. May be BandGap ?

Double Pedestal Pic



This effect give a bad RMS for the pedestal. It can be solve offline but made the trigger calibration difficult.

Conclusion

1. We have test the calibration method of the SiW-ECAL technological prototype.
2. The results for the signal over noise ratio are very good ($S/N \geq 10$).
3. The first results with power pulsing are promising.
4. The trigger calibration should be improve with the channel by channel DAC adjustment.