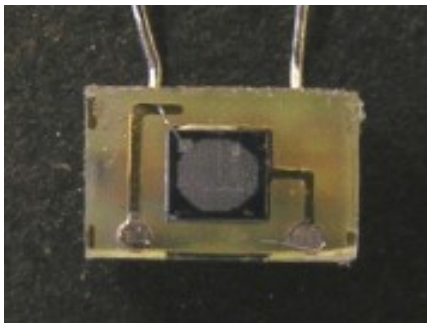
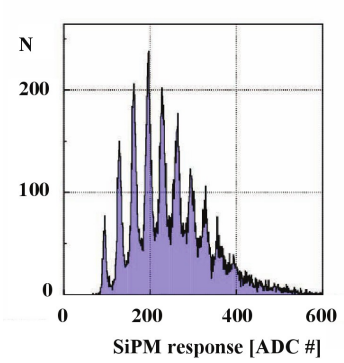
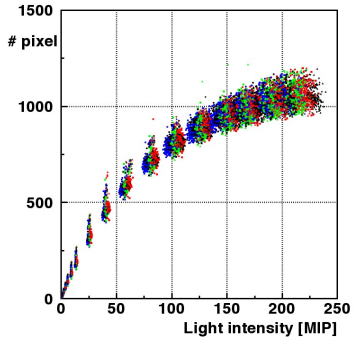
Measurement of Silicon Photomultiplier response curve

The aim of this thesis is to quantify the impact of different combinations of Silicon Photo-Multipliers (SiPM) and plastic scintillators on the SiPM response at different light intensities, with particular interest on the range of non-linear (saturated) response.
The basic detecting element (a *cell*) of the Analog Hadron Calorimeter (AHCAL)[1] of the International Large Detector (ILD) of the International Linear Collider (ILC) is in fact composed by a tile made of plastic scintillator (3 cm x 3cm x 3 mm), coupled with a SiPM (1mm x 1mm area) via a wavelength-shifting (WLS) cylindrical fiber (1mm diameter), to match the peak emission wavelength of the plastic scintillator and the peak sensitivity of the photo-detector.
The main task of this thesis is commissioning a setup to provide the SiPM response measurements, in order to provide reliable correction parameters to compensate for SiPM saturation effects in measuring the energy deposited by a shower in the calorimeter.[2]







Discuss:

- the general architecture of the ILD AHCAL;
- using the parameters expressed in Ref. 1, estimate the the dynamic range in energy deposited by a shower (e.g. the maximum visible energy from an EM shower started by a 30 GeV electron);
- the linearity range of the SiPM compared to the previously calculated physical dynamic range (assume that a MIP deposits 805 keV of visible energy per cell and the SiPM signal is of 15 photo-electrons/MIP);
- the expected energy resolution from a perfectly linear detector;
- the impact on energy resolution due to non-linearity in the response.

1 *Construction and Commissioning of the CALICE Analog Hadron Calorimeter Prototype*, C. Aldoff et al., arXiv:1003.2662v1

2 *Electromagnetic response of an highly granular hadronic calorimeter*, C. Aldoff et. al., arXiv:1012.4343v4