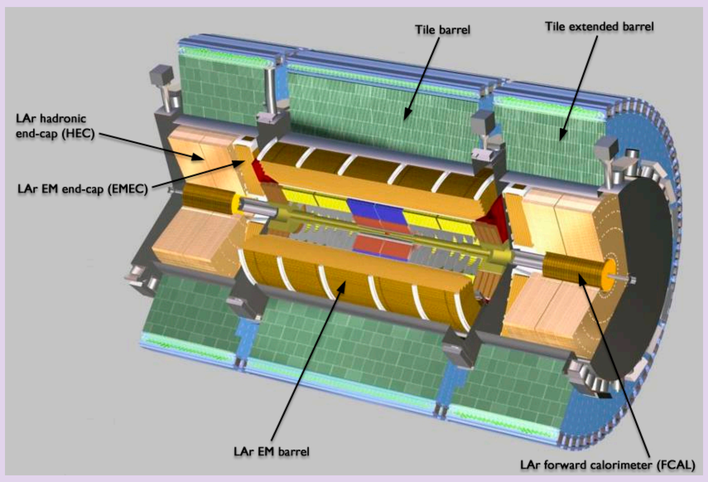
12th Pisa Meeting on Advanced Detectors

Calibration and Monitoring systems of the ATLAS Tile Hadron Calorimeter

The Tile Hadron Calorimeter



The ATLAS Tile Calorimeter is a sampling detector relying on plastic scintillators and iron absorbers. **Scintillators** are grouped into cells.

Signals of scintillator plates (tiles) are transmitted by fibers. The signals are read-out by **photo-multipliers** (PMTs).

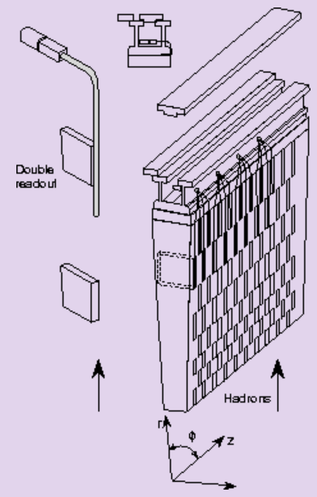
Partitions and Modules : 4 partitions segmented in 64 modules in ϕ

Granularity : $\Delta\eta \times \Delta\phi = 0.1 \times 0.1$

Coverage : $-1.7 < \eta < 1.7$

Number of read-out channels : ~ 10 000

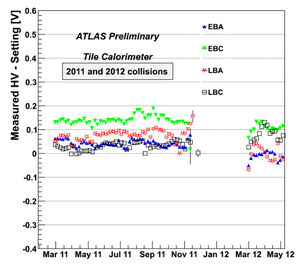
Weight : 2300 tons

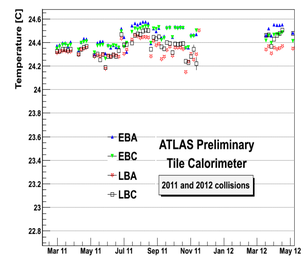


Monitoring of the HV and Temperature

Stability monitoring of the PMT high voltage with respect to its set value, averaging over all PMTs for two running periods of 9 months in 2011 and 3 months in 2012 separated by the maintenance period, shows **a typical variation of 0.4V**.

The stability of temperature, as measured in one PMT in each drawer, averaging over all drawers and presented for the same periods as for the HV monitoring analysis shows a **typical variation of 0.2 C**. This small variation allows for no correction in the PMT gain since the gain changes with -0.2%/C.



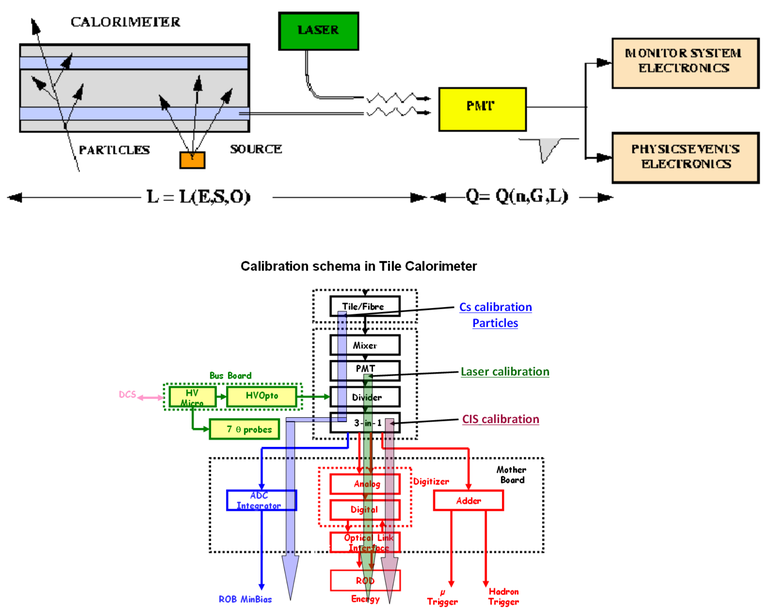


Calibration scheme

The Tile calorimeter calibration relies on several dedicated systems:

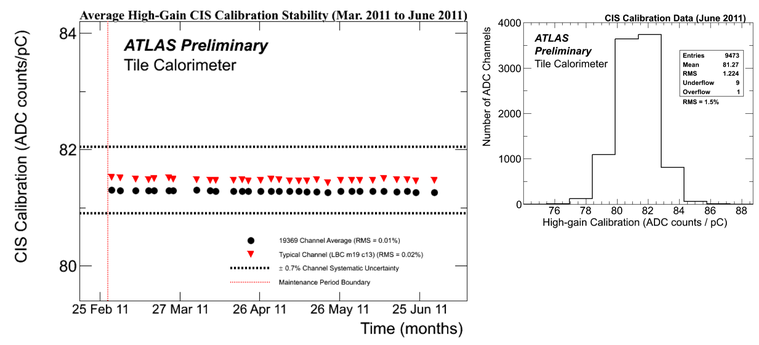
- spaced by weeks or months, calibrations of Tile optic components with movable **Cs radioactive gamma source** ;
- frequent calibrations of phototube gains and linearities with custom **LASER calibration system** ;
- daily to weekly calibrations of digital gains and linearities with **charge injection system (CIS)** integrated on the drawer FE ;
- monitoring of beam conditions and Tile optics with the so-called **integrator system (min.bias)**.

The calibration tools follow different and partially overlapping paths allowing for easier identification of potential failure and for crosschecks.



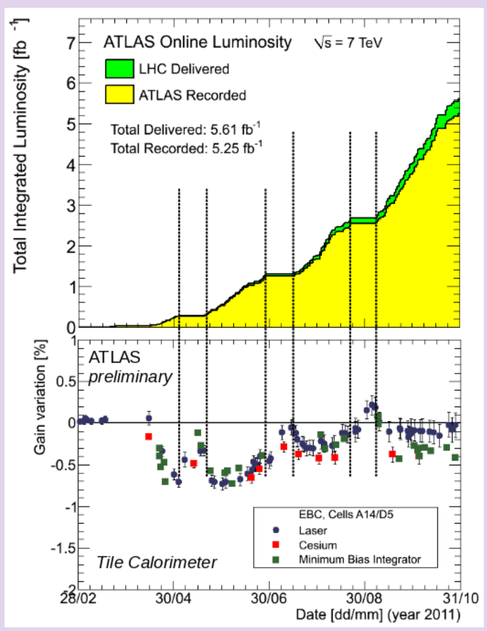
The Charge Injection System

The CIS provides calibration constants that translate ADC counts to pC.



Time stability of the average readout calibration constants from March 2011 to June 2011 for 19369 ADC channels in high-gain. **The typical channel-to-channel variation is 1.5%**

Monitoring the luminosity effects



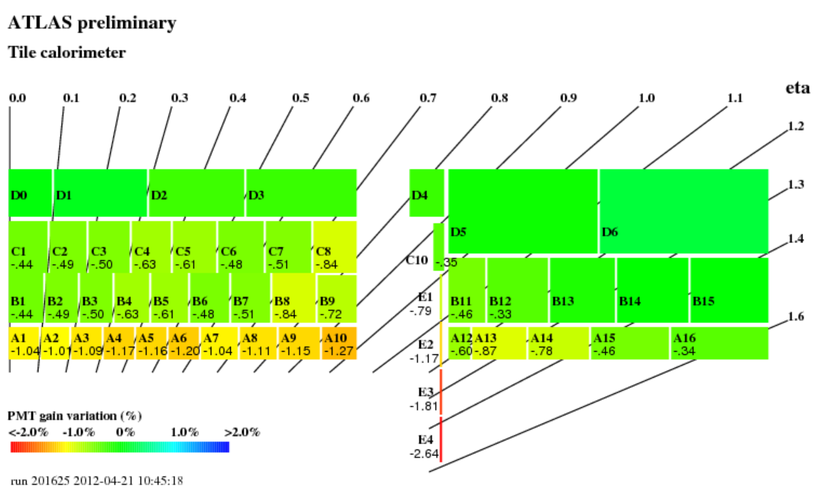
Measurements of the drift in response of the A14 cell normalised to the drift in the D5 cell using laser, cesium and minimum bias integrator show a similar behaviour that is attributed mostly to a variation of A14 photomultiplier gain.

The downdrift periods coincide with the periods of data taken with high instantaneous luminosity, while the updrifts coincide with the technical stops (no collisions). The maximum variation is below 1% over all 2011 data taking period with an integrated luminosity of ~5.6 fb^{-1}.

The cesium calibration system is used to to equalize the response of all the cells and restore the electromagnetic scale.

Monitoring of the Tile Calorimeter with the Laser system

The gain in each PMT is measured using a laser calibration system that sends a controlled amount of light in the photocathode of each PMT in the absence of collisions.

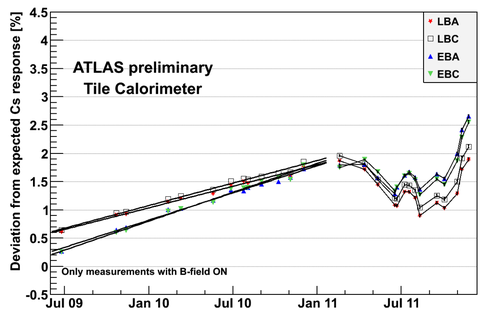


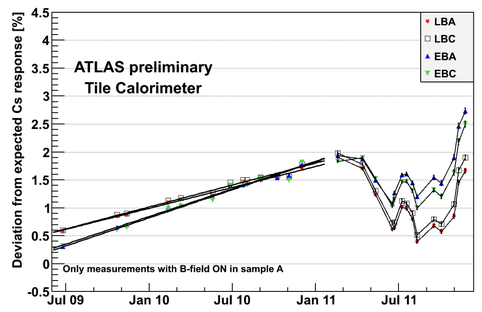
The mean gain variation of the 10000 channels is computed cell by cell as a function of eta and radius, between the 19 March 2012 and the 21 April 2012.

The precision of the Laser system allows to see a down-drift of <2%. It mostly affects cells at inner radius, that are the cells with higher current.

Monitoring of the Tile Calorimeter with the Cesium source

The Cesium System is based on the response of the calorimeter to the ^{137}Cs gamma source





Deviation of measured Cesium signals (in %) from expected values, assuming the response follows the Cesium decay curve (-2.3% per year). Average up-drift of about 0.8% per year was observed in 2009-2010. Up-drift effect disappeared in 2011 and **sizable down-drift is seen now when beam is on** while the response recovers slowly when beam is off (during technical stops).

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