ATLAS Tile Calorimeter Laser Calibration

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Introduction

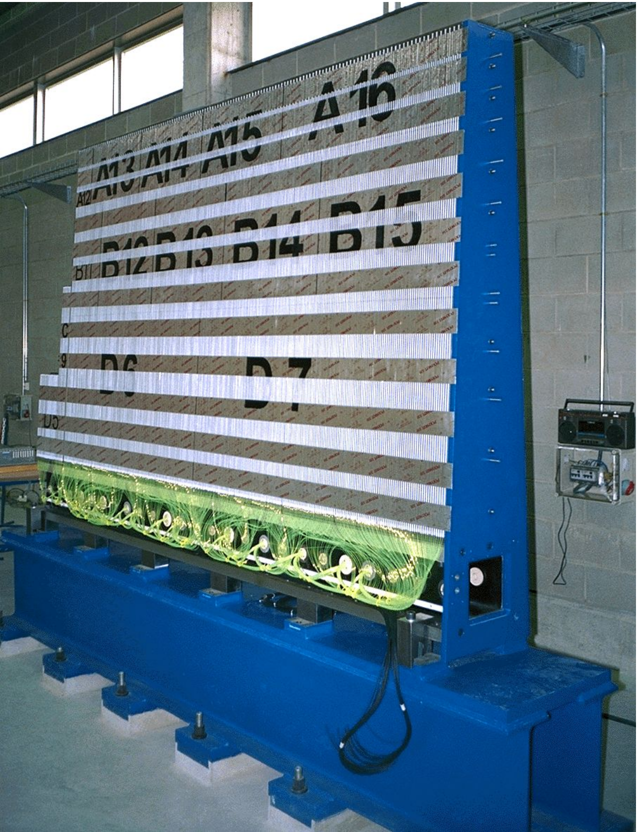
Working with the TileCal Laser Calibration System

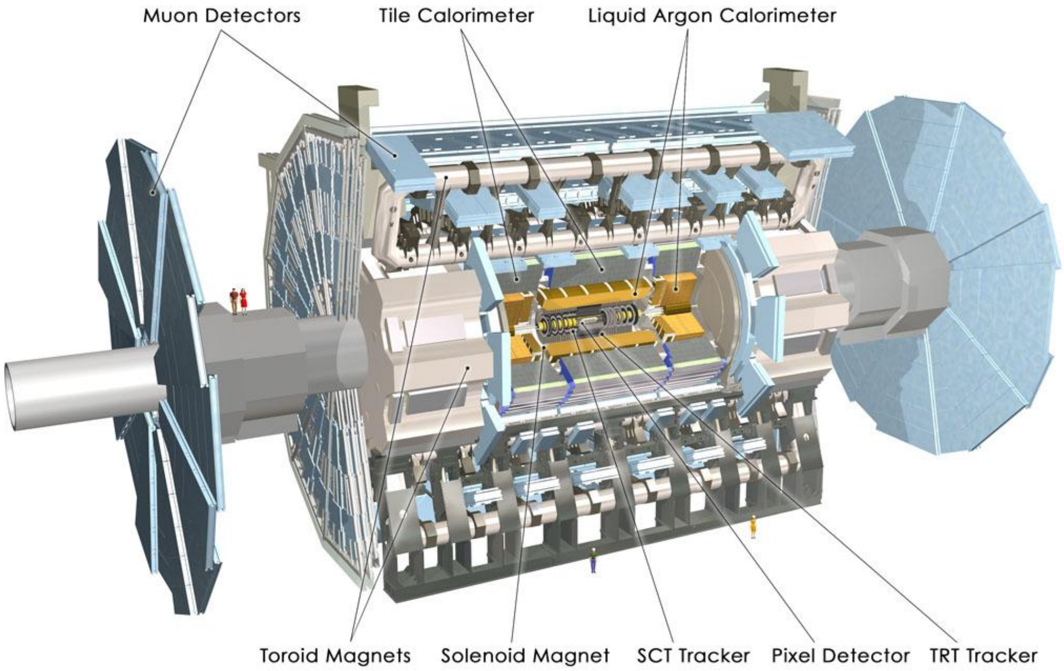
This system uses laser pulses sent in LHC empty bunches in addition to Laser calibration runs with no collisions

Purpose: to study the response stability of all 10000 Tile readout channels during a collision run

Personal contribution: Build on the existing study of the PMT absolute response by studying the stability of the absolute PMT gain in collision runs

TileCal



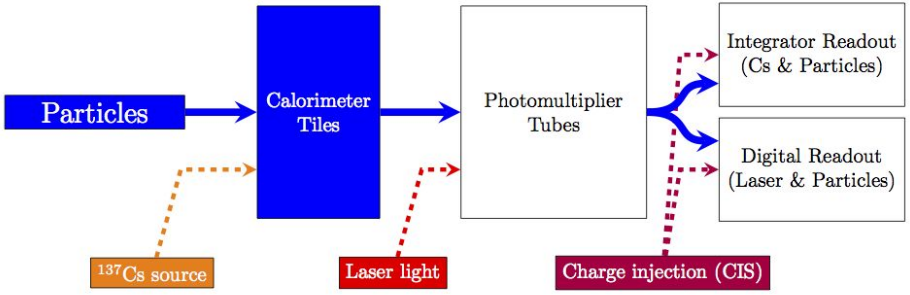


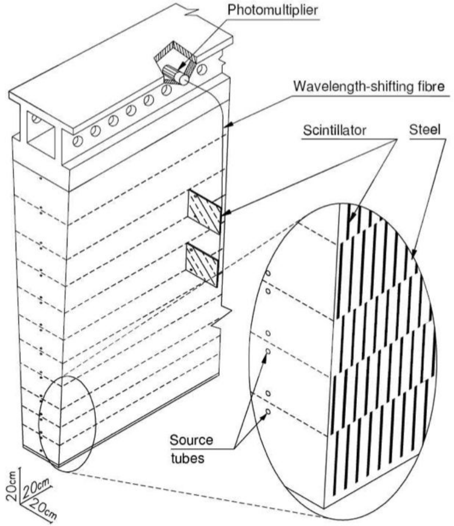
Central hadronic calorimeter of the ATLAS experiment

Sampling calorimeter of alternating iron plates (absorber) and plastic scintillation tiles (active medium)

Optical fibers deliver light from scintillator tiles to two PMTs per cell.

TileCal Calibration Systems





E(GeV) = A(GeV)*C(ADC→ pC)*C(pC→ GeV)*C(Cesium)*C(Laser)

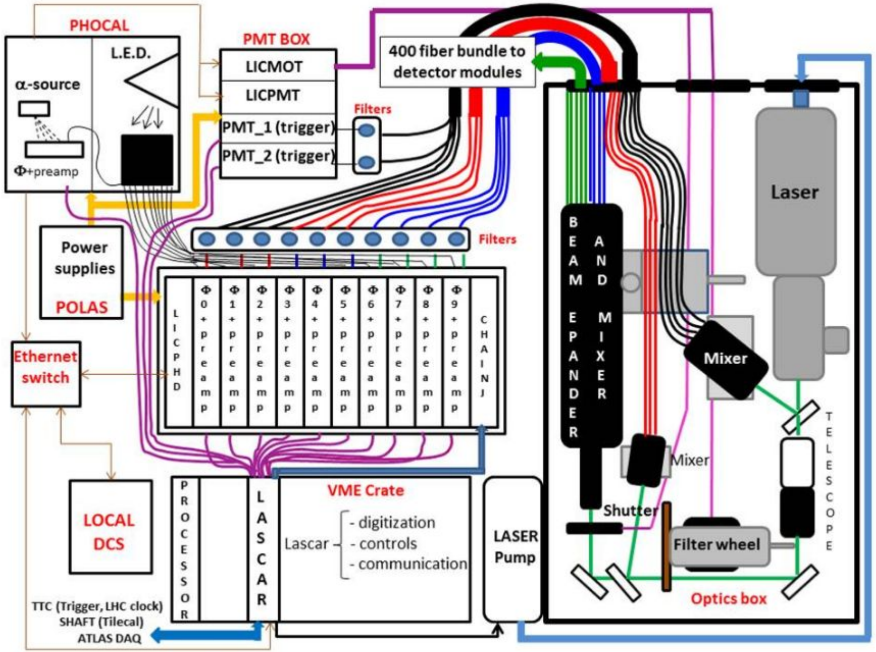
C: calibration constants

A: ADC counts converted to GeV

Laser system: controlled amount of light into photocathode of each PMT

Laser Calibration

The full LaserII system:



Laser is used to send laser pulses to all 10,000 PMTs via optical fibers

The response of each PMTs can be normalised to the response of a monitor diode just downstream of the laser

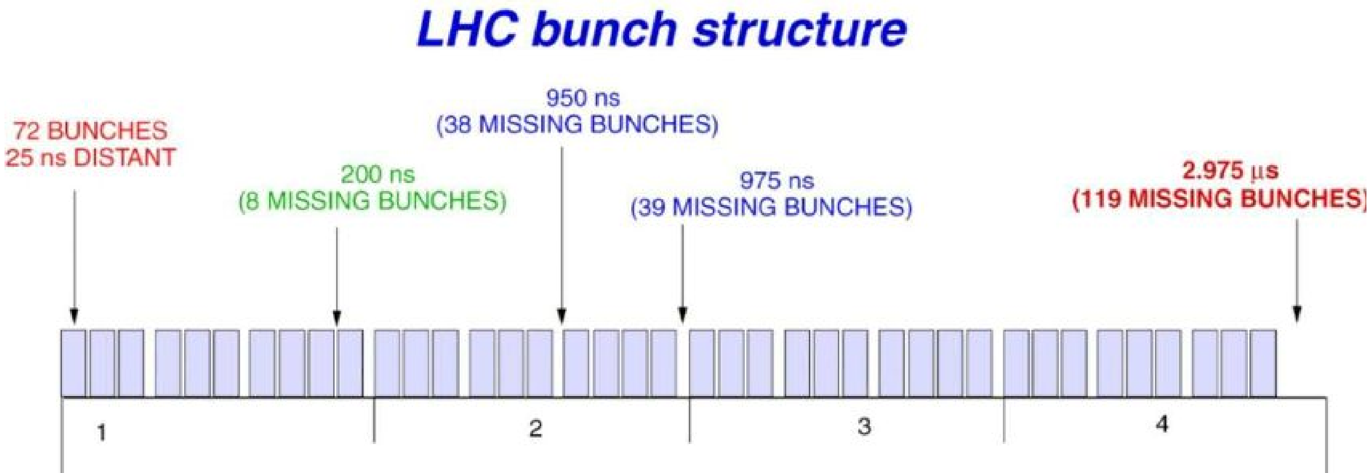
Laser Pulses in LHC Empty Bunches

In the LHC there are two beams circling in opposite directions

The protons of each beam are grouped into bunches separated by 25 ns

There are intervals of 25 ns with no protons i.e. “empty bunches”

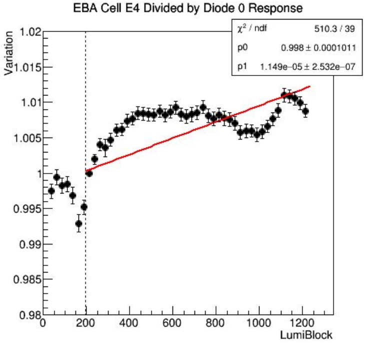
At the time in which empty bunches intersect at an interaction point laser pulses are sent to all TileCal channels

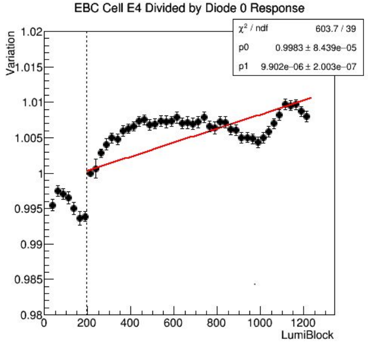


Run 327764

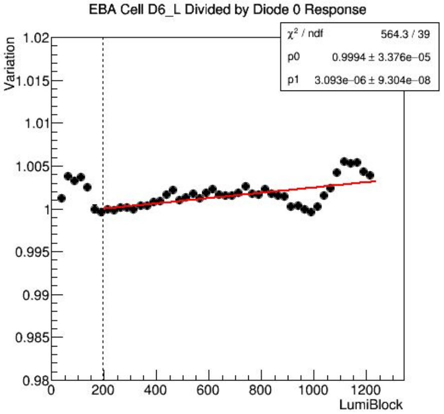
Peak Lumi: $1.4e+4e30cm^{-2}s^{-1}$

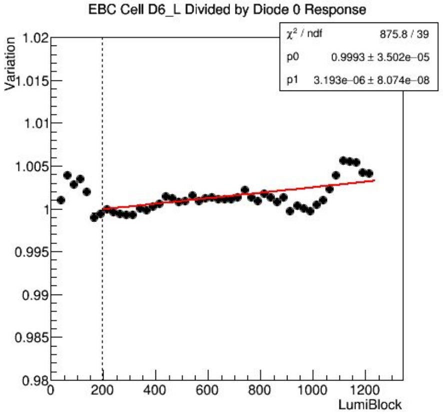
Very Irradiated

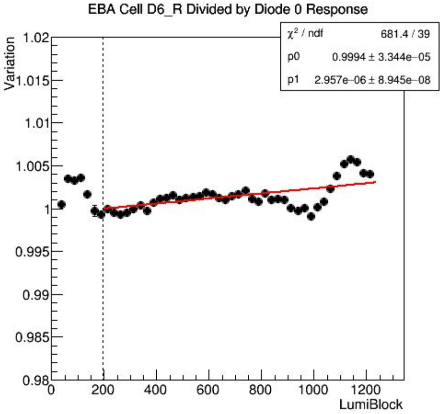


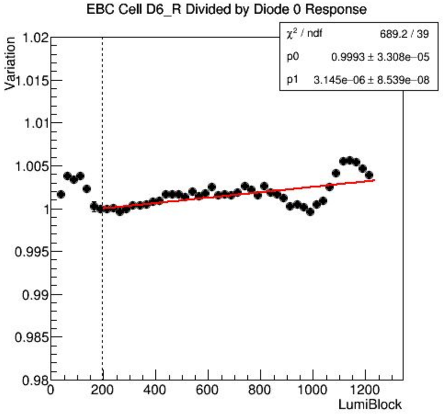


Less Irradiated









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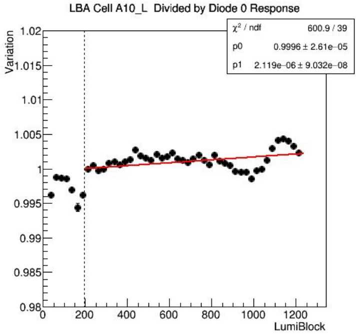

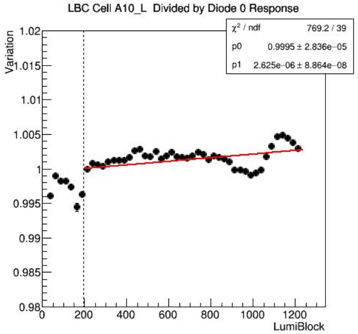

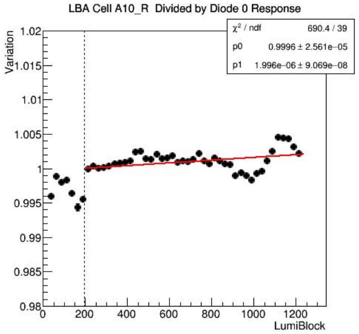

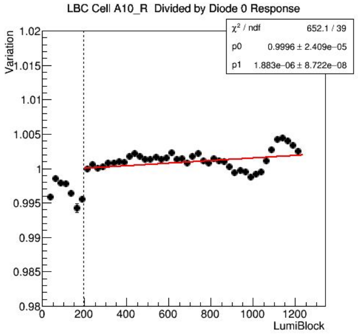

Plan for the Summer

Run the analysis over the 2017 data

Study the absolute PMT gain

Investigate the response of the PMTs to laser pulses sent in empty bunches in runs with different characteristics

Study the correlation between the luminosity and the PMT response evolution and jump amplitude just before stable beam is declared

Study the correlation between the squeezing of the beams and a jump in PMT response

Backup

Skills to Gain this Summer:

Knowledge of operation of a hadronic calorimeter

Knowledge of calibration systems for sub-detectors

Knowledge in C++ programming for developing analysis algorithms

Knowledge of using the ROOT software package

Physics Runs

Exclude all bad PMTs

Total response of each event divided by response of diode 0 (for each individual pmt)

Average over all events in 25 LumiBlock period (for each individual pmt)

Normalize to first bin of stable beam

Take Mean over all modules for a given cell over a given 25 LumiBlock period

Plot response versus LumiBlock → evolution of the response

Normal Calibration Runs

Divide into 10 bins of equal number of events ~ 10 second bins

Special Calibration Runs

Bins of ~ 5 LumiBlock by assuming ~ 180 events per LumiBlock