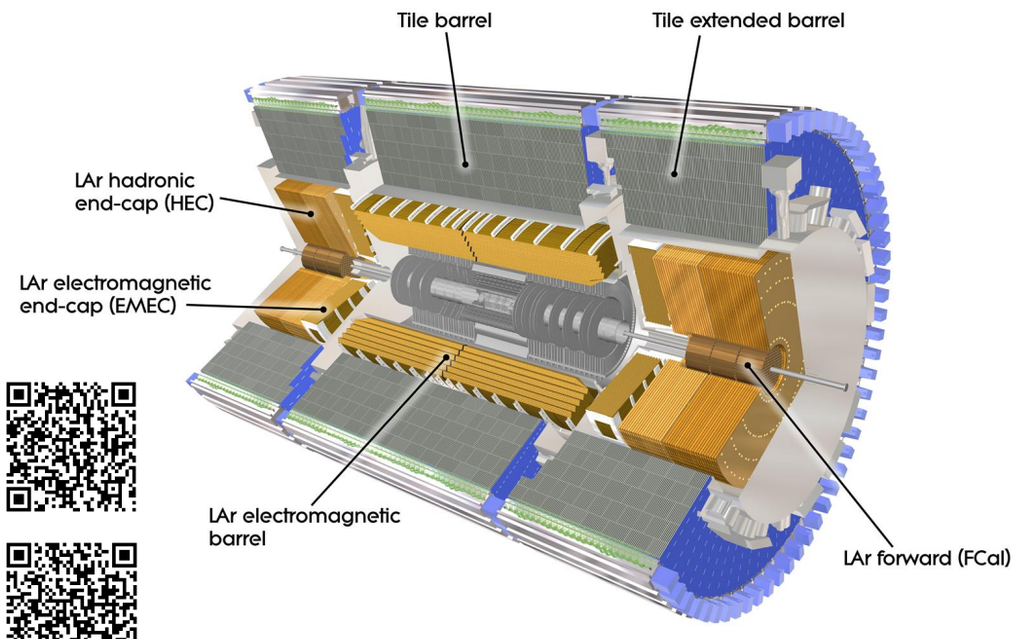
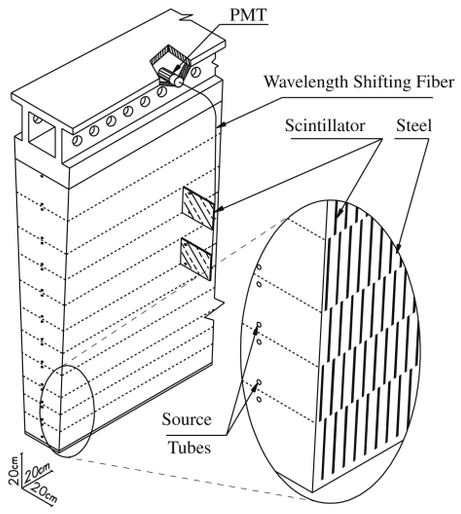
LHCP Poster Session – 14 May 2013

The ATLAS Tile Calorimeter Calibration and Performance

- ATLAS TileCal is a hadronic calorimeter
- A long barrel and extended barrel cover |eta| < 1.7
- Design: jet energy resolution σ/E = 50%/√E ⊕ 3%
- Design: uncertainty on jet energy ~1%



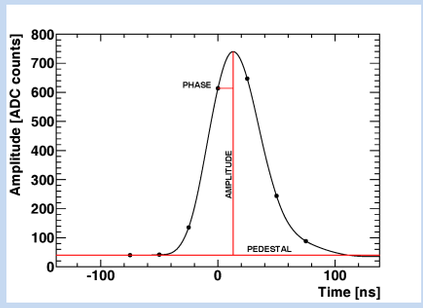


- Sampling calorimeter, groups of alternating layers of plastic scintillator / steel make up cells
- 9852 PMTs read out signals
- Signal shaped, digitized by sampling every 25 ns
- Amplitude of digitized pulse stored in ADC counts
- Calibrate to electromagnetic energy scale using:

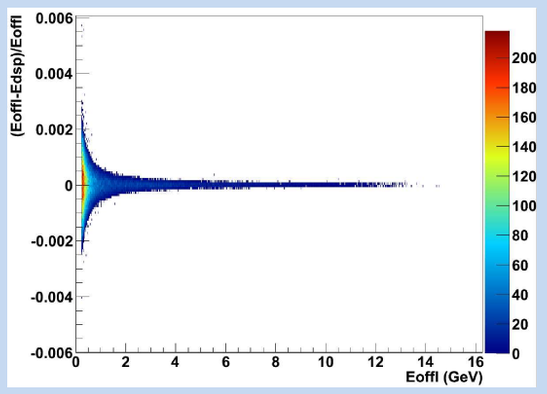
$$E\,[MeV] = C_{testbeam} * C_{laser} * C_{Cs} * C_{CIS} * Amp\,[ADC]$$

Signal Reconstruction

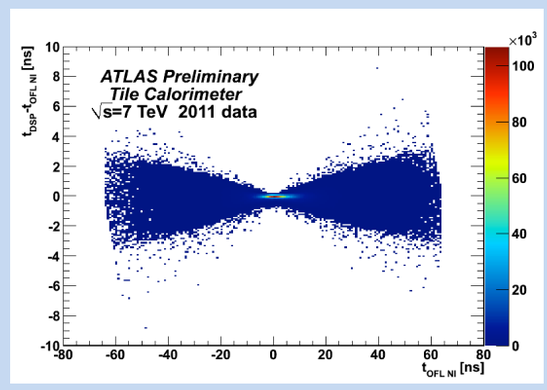
- Passive shaper used on PMT signal
- Results in FHWM ~50 ns pulse
- Sampled by 40 MHz ADC



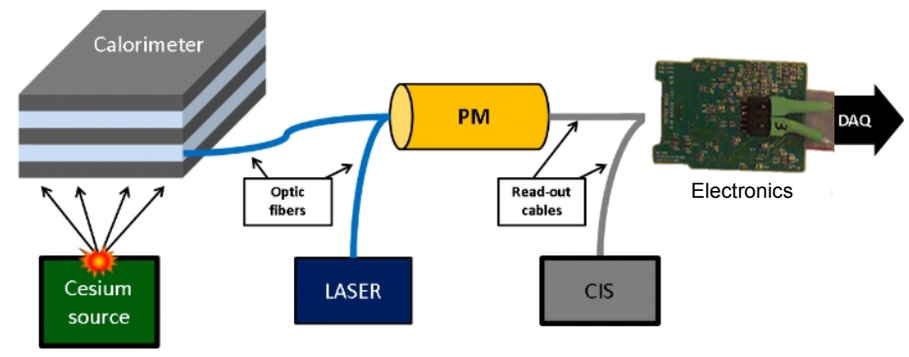
- Two gains to cover full signal range
- Amplitude and timing determined using optimal filter (OF) method
- Performed online using DSP
- Limits resolution due to use of fast look up table, calibration precision
- Compare with offline calculation using full precision (below)



- Good E/t reconstruction seen for majority of cells used in physics

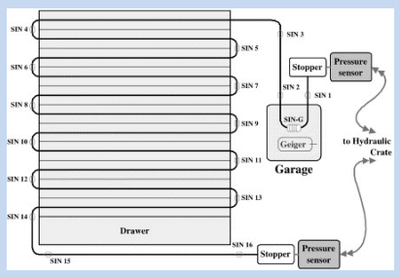


Calibration System Overview

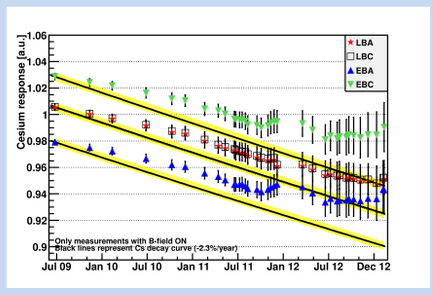


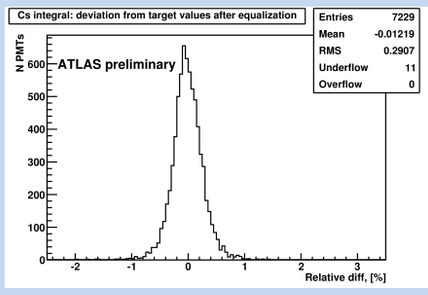
Cesium System

- ^{137}Cs source emits photons with E = 0.662 MeV
- Total integrated current is read out as source passes each cell
- Check of entire readout path
- Provides relative calibration
- Uses test beam as initial reference for pC → GeV

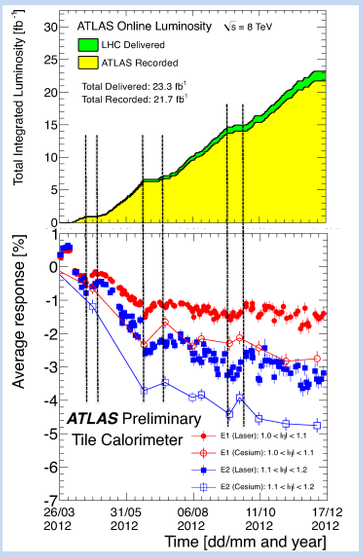


- Transfer test beam calibration using same source
- Cross check of calibration performed in situ with muons
- Evolution of system vs. expected ^{137}Cs decay (below)
- Clear difference due to PMT drift → apply correction

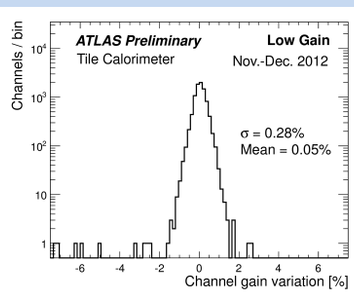


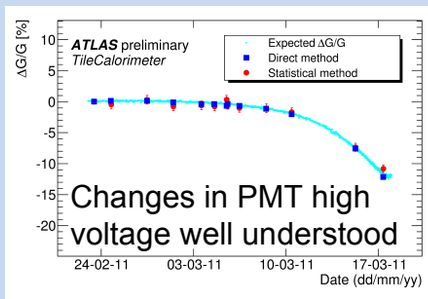


Laser System

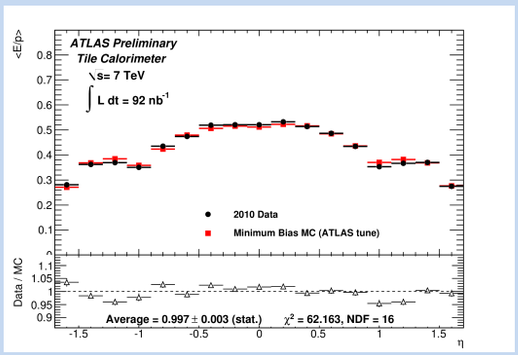


- Sends a laser pulse with known amplitude to PMT
- Provides relative energy response between ^{137}Cs runs
- Drift over time consistent between ^{137}Cs and Laser
- E cells show largest drift, other cells much more stable
- Reference value taken immediately following ^{137}Cs run
- Drift vs. reference used as additional calibration
- Also used during physics runs to monitor timing of cells



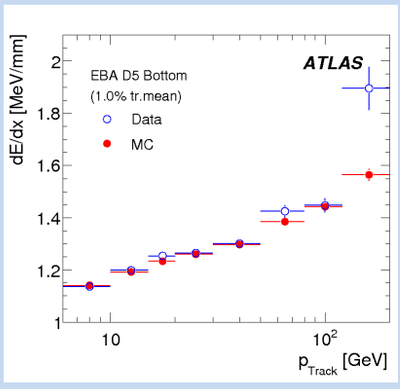


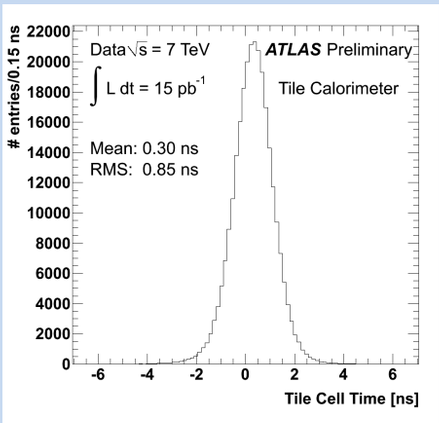
TileCal Performance



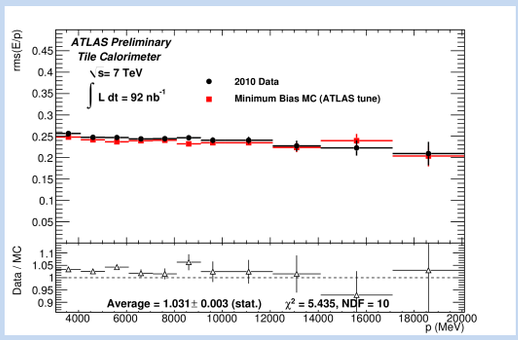
E/p ratio using single hadron response → response well modeled in MC.

dE/dx for muons in the D5 layer used to verify calibration of cells. Good agreement between data and MC.



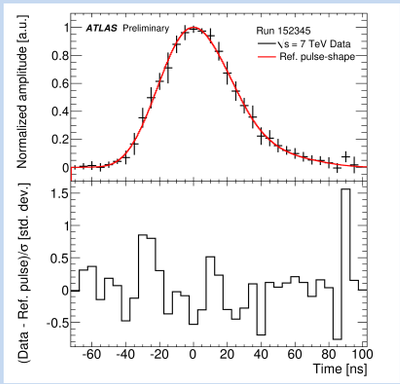


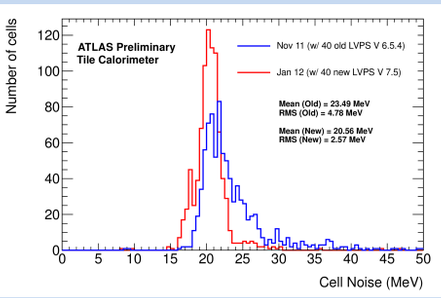
Good E reconstruction due to cell time < 2 ns.



Resolution of E/p ratio agrees within 5% between data and MC.

In situ pulse shapes well described by reference pulse used for reconstruction.

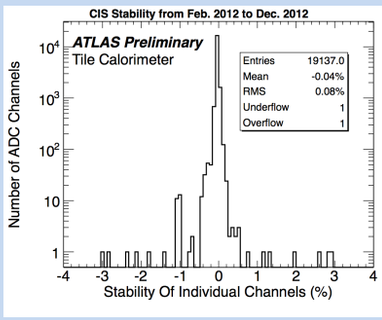


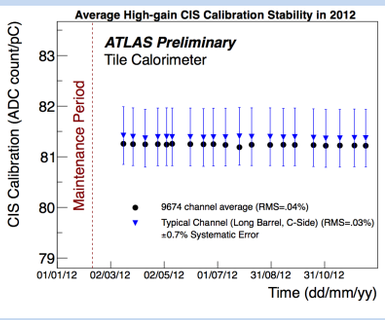


New power supplies provide more Gaussian noise.

Charge Injection System (CIS)

- Inject pulse with known charge into readout
- Determine ADC → pC factor using scan of injected charges
- Stability of channels over the year is better than 1%
- Change in calibration factor happens in-frequently (once per year) for most channels





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