Performance of the ATLAS Tile Calorimeter

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on behalf of the ATLAS Collaboration

The ATLAS Tile Calorimeter

- Hadronic sampling calorimeter using steel as absorber, scintillating tiles as an active medium and wave length shifting fibers
- Divided into long barrel (LB) and two extended barrels (EB) with overall dimensions of ~12 m length and 4.25 m (2.28 m) outer (inner) radius
- Granularity:
  - 64 wedge-shaped modules $\Delta\eta = 0.1$
  - 3 radial layers: A($\Delta\eta=0.1$), BC($\Delta\eta=0.1$), D($\Delta\eta=0.2$) and special layer E (single scintillators in the gap between LB and EB)
- Each normal cell is readout by two photomultiplier tubes (PMT) to achieve uniform response; 5k cells, 10k PMTs
- Dynamic range of PMT: 10 MeV to 750 GeV
- Performance goals:
  - Energy resolution for jets
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  - Linear within 2% (4 TeV jets)
  - Precision of the measurement is better than 0.5% for each channel
- The maximum drift is observed in the E layer BC
- The response is integrated over all $\eta$ bins which are the cells with the highest energy deposit
- The difference between Laser and Minimum Bias (or Cesium) response gives the effect of the scintillators irradiation (~ -2% max in 2012)

Energy reconstruction and calibration procedure

- The signal from the PMTs is shaped and amplified using two gains (1:64) with 10-bits ADCs each 25 ns
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- The charge injection system (CIS)
- The laser system
- The cesium system

Amplitude and time are reconstructed using optimal filtering algorithm

$$E(\text{GeV}) = A(\text{ADC}) \times C_{\text{ADC}} \times C_{\text{data}} \times C_{\text{gain}}$$

$$C_{\text{ces}}$$ was measured at the test beam

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Performance

- The values of $dE/dx$ obtained from collision events with muons produced in $W \rightarrow \mu$ decays as a function of $\Delta\eta - \delta\eta$ difference between muon impact point and cell center
- U-shape obtained with RUN1 data was used to improve MC simulation for RUN2
- Uniformity of the cell response to cosmic muons, expressed in terms of normalized truncated mean of $dE/dx$, as a function of $\eta$ for radial layer BC
- The response is integrated over all cells in each $\eta$ bin
- The results for data and MC are normalized to their averages
- Energy over momentum ($E/p$) as a function of $\eta$ for isolated tracks, where $E$ is measured by the Tile Calorimeter and $p$ by the Inner Detector
- 2012 data and MC agree within 5% except point at $\eta = -1.5$ where disagreement is 9%