The ATLAS Tile Calorimeter performance at LHC

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The ATLAS Tile Calorimeter

ATLAS is a general purpose experiment installed at the Large Hadron Collider (LHC) at CERN. It is delivering stable proton beams since 2009 and currently provides collisions at a center of mass energy of 8 TeV. The Tile Calorimeter (TileCal) is the central section of the ATLAS hadronic calorimeter. It detects hadrons, jets and taus, while also contributing to the jet energy and Missing E\text{\scriptsize{T}} reconstruction, as well as assisting the spectrometers in the identification and reconstruction of muons.

Calibration

TileCal uses a complex calibration scheme which allows for individual components to be tested and calibrated. Different types of calibration allow the following:
- Calibration of the initial part of the signal readout path (including the optics elements and the PMTs) with movable radioactive Ca\text{\textgreek{y}}-sources.
- Monitoring of the gains of the photomultipliers by illuminating all of them with a laser system.
- Calibration of the front-end electronic gains with a charge injection system.
- Current integration over several thousand bunch crossings during collision data-taking to monitor luminosity and to assist response uniformity studies.

Cosmic Muons & Splash Events

Cosmic muons pass through the detector leaving some of their energy in the calorimeter. The estimator for the muon response is the truncated mean of d\text{\scriptsize{E}}/dx, defined as the mean after 1% of the events in the high-energy tail of the distribution were removed. The truncated mean is less sensitive to the muon’s radiative losses in the cells.

TileCal cell energy uniformity

Cosmic muons are produced when a single beam is run into a calorimeter approximately 150m upstream of the detector. This produces a splash of particles that hit the detector at very low angles with respect to the beam axis, allowing for checking the synchronization of the TileCal cells. The obtained distribution shows that the cells are synchronized within 1 ns.

TileCal cell timing

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TileCal standalone energy resolution for pions from beam tests presented in the left plot. The data (full circles) are in good agreement with MC simulations (open squares).

Collision Performance

A dedicated TileCal read-out providing the anode output for each photomultiplier is used to measure the Minimum Bias current, which is proportional to the interaction rate. The 2010 data have been used to prove they follow the luminosity evolution within 0.5%.

Online energy reconstruction performance

Due to the limited bandwidth of the TileCal readout, during high luminosity runs the digitized samples from the ADCs cannot be transferred. Instead, just the energy and timing information obtained from the Digital Signal Processor (DSP) is available. However, during lower luminosity runs, when both of these can be obtained, the ratio of the two provides valuable insight to the quality of the reconstruction performed by the DSP. It is shown here for well synchronized pulses to be less than 0.4%.

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