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Performance and upgrade of the ATLAS Hadronic Tile Calorimeter

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The Tile Calorimeter (TileCal) is a sampling hadronic calorimeter covering the central region of the ATLAS experiment, with steel as absorber and plastic scintillators as active medium. The scintillators are read-out by the wavelength shifting fibres coupled to the photomultiplier tubes (PMTs). The analogue signals from the PMTs are amplified, shaped, digitized by sampling the signal every 25 ns and stored on detector until a trigger decision is received.

The upcoming High-Luminosity phase of the LHC (HL-LHC), starting in 2030, will increase the nominal instantaneous luminosity by a factor of 5 to 7.5, alongside an upgraded ATLAS Trigger and Data Acquisition architecture. This upgrade necessitates a complete redesign of the readout electronics and power systems of TileCal. Both the on- and off-detector TileCal electronics will be replaced during the shutdown of 2026-2030. PMT signals from every TileCal channel will be digitized and sent directly to the back-end electronics, where the signals are reconstructed, stored, and sent to the first level of trigger at a rate of 40 MHz. This will provide better precision of the calorimeter signals used by the trigger system and will allow the development of more complex trigger algorithms.

The TileCal upgrade program has included extensive research and development, including test beam studies and the construction of a Demonstrator module. The Tile Demonstrator module with reverse compatibility with the existing system was inserted in ATLAS in July 2019 for testing in actual detector conditions.

A summary of first LHC Run 3 performance results including the calibration, stability, absolute energy scale, uniformity and time resolution will be presented. This talk will also include the ongoing HL-LHC developments for on- and off-detector systems, together with expected performance characteristics and results of test-beam campaigns with the electronics prototypes.

Secondary track

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