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Upgrade of the ATLAS Tile Calorimeter for the High Luminosity LHC

The Tile Calorimeter (TileCal) is the hadronic calorimeter covering the central region of the ATLAS experiment. TileCal is a sampling calorimeter with steel as absorber and scintillators as active medium. The scintillators are read-out by wavelength shifting fibers coupled to photomultiplier tubes (PMTs). The analogue signals from the PMTs are amplified, shaped, digitised by sampling the signal every 25 ns and stored on detector until a trigger decision is received. The High-Luminosity phase of LHC (HL-LHC) expected to begin in year 2026 requires new electronics to meet the requirements of a 1 MHz trigger, higher ambient radiation, and for better performance under high pileup. Both the on- and off-detector TileCal electronics will be replaced during the shutdown of 2024-2025. PMT signals from every TileCal cell will be digitised 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. Changes to the electronics will also contribute to the data integrity and reliability of the system.

Results are presented from a prototype of the new electronics (demonstrator) that was inserted in a TileCal module and tested in CERN's H8 beam line with electrons, muons, and hadrons. The demonstrator is undergoing extensive testing and will be inserted in the ATLAS detector during the current shutdown.

Primary author: ATLAS COLLABORATION

Presenter: ATLAS COLLABORATION

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