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Upgrade of the ATLAS Hadronic Tile Calorimeter for the High Luminosity LHC

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The Tile Calorimeter (TileCal) is the hadronic calorimeter covering the central region of the ATLAS experiment. It 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 TileCal response and its readout electronics are monitored to better than 1% using radioactive source, laser and charge injection systems. Both the on- and off-detector TileCal electronics will undergo major upgrades in preparation for the high luminosity phase of the LHC (HL-LHC) expected to begin in 2027, so that the system can cope with the HL-LHC increased radiation levels and out-of-time pileup and can meet the requirements of a 1 MHz trigger. PMT signals from every TileCal cell 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 R&D and test beam studies. A Demonstrator module with reverse compatibility with the existing system was inserted in ATLAS in August 2019 for testing in actual detector conditions. The main features of the TileCal upgrade program and results obtained from the Demonstrator tests will be discussed.

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