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Demonstrator system for the high-luminosity upgrade of the ATLAS hadronic Tile Calorimeter

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The high-luminosity upgrade to the LHC (HL-LHC) leads to considerable challenges for the ATLAS detector, including greater radiation exposure to the on-detector electronics and increased pileup from low momentum collisions affecting trigger selection performance. The ATLAS Tile Calorimeter (TileCal) is a hadronic sampling calorimeter made of steel tiles as absorber and scintillating plastic tiles as active medium. The light produced by the tiles is read out by photomultiplier tubes (PMTs). The PMT signals are shaped, conditioned, and then digitized every 25 ns before being sent off-detector. A complete replacement of the on- and off-detector electronics for TileCal will take place in preparation for the HL-LHC program in 2026. The new system is designed to digitize and transmit all sampled calorimeter data to the off-detector systems, where the data are stored in latency pipelines. Quasi-projective digital trigger tower sums are formed and forwarded to the level-1 trigger. The TileCal upgrade program has included extensive R&D and test beam campaigns. The new design includes state-of-the-art electronics with extensive use of redundancy and radiation-tolerant electronic components to avoid single points of failure. Multi-Gbps optic links drive the high volume of data transmission, and Field Programmable Gate Arrays (FPGAs) provide digital functionality both on- and off detector.

A hybrid demonstrator prototype module, instrumented with new module electronics and interfaces for backward compatibility with the present system, was assembled and inserted in ATLAS in June 2019 to gain experience in actual detector conditions. We present the current status and test results from the Phase-II upgrade demonstrator module running in ATLAS.

In-person participation

Yes

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