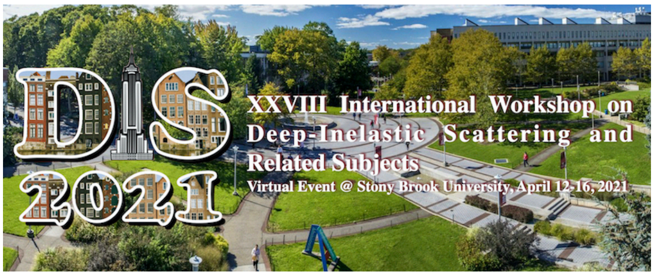
XXVIII International Workshop on Deep-Inelastic Scattering and Related Subjects



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The ATLAS Tile Calorimeter performance and its upgrade towards the High-Luminosity LHC

The Tile Calorimeter (TileCal) is a sampling hadronic calorimeter covering the central region of the ATLAS experiment. TileCal uses 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 TileCal front-end electronics reads out the signals produced by about 10000 channels measuring energies ranging from about 30 MeV to about 2 TeV. Each stage of the signal production from scintillation light to the signal reconstruction is monitored and calibrated to better than 1% using radioactive source, laser and charge injection systems. The performance of the calorimeter has been measured and monitored using calibration data, cosmic ray muons and the large sample of proton-proton collisions acquired in 2009-2018 during LHC Run-1 and Run-2. The High-Luminosity phase of LHC, delivering five times the LHC nominal instantaneous luminosity, is expected to begin in 2027. TileCal will require new electronics to meet the requirements of a 1 MHz trigger, higher ambient radiation, and to ensure better performance under high pile-up conditions. Both the on- and off-detector TileCal electronics will be replaced during the shutdown of 2025-2026. 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. Changes to the electronics will also contribute to the data integrity and reliability of the system. New electronics prototypes were tested in laboratories as well as in beam tests. Results of the calorimeter calibration and performance during LHC Run-2 are summarized, the main features and beam test results obtained with the new front-end electronics are also presented.

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