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Radiation hardness of the ATLAS Tile Calorimeter optical components

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The Tile Calorimeter (TileCal) is a sampling hadronic calorimeter and an essential part of the ATLAS experiment at the LHC. The active material is made of plastic scintillating tiles, and the light produced in the scintillators is transmitted to the photomultiplier tubes by wavelength shifting fibres. During the High Luminosity LHC (HL-LHC) program, the luminosity can reach a value seven times higher than the one that TileCal was designed for. Two critical points that affect the detector performance are the increased exposure to radiation that will degrade the TileCal optics and natural ageing. Since the optical components of the TileCal cannot be replaced, the radiation hardness must be evaluated. The Laser and Cesium calibration systems are used to evaluate the robustness of the TileCal optical components. Taking advantage of these systems it is possible to isolate the response of the tiles and fibres and evaluate the evolution of the yield light with the dose. The results obtained during the Run 2 were extrapolated to the end of the HL-LHC phase, indicating that around 50% of the TileCal cells will lose up to 35% of the light yield response. These cells correspond to the least exposed to radiation, for the most exposed cells the loss of the light yield is more pronounced. Nevertheless, the extrapolation uncertainty is large, more data needs to be explored to reach better precision and finer conclusions. This study constitutes an essential step for predicting the calorimeter performance in future runs.

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