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Testbeam studies of irradiated sensors for the ITk strip detector

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To cope with the increased occupancy and radiation dose expected at the High-Luminosity LHC, the ATLAS experiment will replace its current Inner Detector with the Inner Tracker (ITk), containing all-silicon pixel and strip sub-detectors. The strip detectors will be built from modules each consisting of one or two n⁺-in-p sensors, one or two PCB hybrids containing the front-end electronics, and one powerboard. The sensors in the barrel region of the cylindrical ITk will use simple rectangular pixels, while those in the circular endcaps will use a radial pixel layout.

To validate the expected performance of the ITk strip detector, a series of testbeam campaigns has been performed over several years at the DESY-II electron accelerator. Beam particles are tracked by EUDET telescopes, consisting of six high-resolution pixel detectors, plus an additional fast detector to improve timing resolution. Tracks are reconstructed with a spatial resolution of several microns, and compared to hits in the module under test. To evaluate the end-of-life performance of the ITk, modules from different regions of the detector have been built using sensors and/or front-end electronics irradiated to the maximum dose expected in the HL-LHC, plus a 50% safety factor, and measured in the testbeam to assess charge collection, signal efficiency, and noise occupancy. The results of this analysis give confidence in the detector meeting specifications across its operational lifetime.

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testbeam

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HL-LHC

Keyword-3

strip sensors

Author: JESSIMAN, Callan (Carleton University (CA))

Presenter: JESSIMAN, Callan (Carleton University (CA))

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