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Testbeam studies of irradiated modules for the ATLAS ITk Strip upgrade

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In order to cope with the occupancy and radiation doses expected at the High-Luminosity LHC, the ATLAS experiment will replace its Inner Detector with an all-silicon Inner Tracker (ITk), containing pixel and strip subsystems. The strip subsystem will be built from modules, consisting of one n+-in-p silicon sensor, one or two PCB hybrids containing the front-end electronics, and one powerboard with high voltage, low voltage, and monitoring electronics. The sensors in the central region of the detector will use a simple rectangular geometry, while those in the forward region will use a radial geometry with built-in stereo angle. 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 testbeam facility. Tracking was provided by EUDET telescopes, consisting of six Mimosas26 pixel planes. An additional pixel or strip plane was used to improve the timing resolution of the telescope. Tracks are reconstructed using the General Broken Lines algorithm, resulting in a spatial resolution of several microns. In the year 2021 the focus of test beam campaigns has been on assessing the module performance post-irradiation, using the final production versions of the sensors and front-end electronics. Three modules were built from irradiated components, including the first “split” R5 module containing two sensors to be tested at testbeam. Measurements were performed of the charge collection, signal efficiency, and noise occupancy of the modules, as well as of the tracking performance in various sensor regions. The results give confidence in the operability of the detector across its lifetime.

In-person participation

Yes

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