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Test beam measurements of the performances of the production modules of ATLAS Pixel Detector

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The ATLAS Pixel Detector is the innermost tracking system of the ATLAS experiment at the Large Hadron Collider.

The performances of the production modules of the ATLAS Pixel Detector have been studied using data collected with a 180 GeV/c pion beam at the CERN SPS accelerator.

Several of the modules have been irradiated after assembly and before the test beam using 24 GeV/c proton up to the full LHC fluence of 1015 1 MeV neq cm-2 and a total ionizing dose of 500 kGy.

In this contribution, a selection of the results from the analysis of test-beam data is presented. The post-irradiation depletion voltage and charge collection efficiency have been studied in detail. The spatial resolution, before and after irradiation, will be presented.

Particular emphasis will be given to the measurements of detection efficiency. The efficiency was studied as a function of the phase between the edge of the clock operating the detectors and the particle arrival time provided by the beam trigger detectors. This allowed the study of the optimal clock timing for the operation of the detectors at the LHC. The results for not irradiated and irradiated modules are discussed.

The timing uniformity between the different types of pixel cells and between the 16 front-end readout chips of a detector module is also presented. The interplay between the optimization of detection efficiency and spatial resolution was also studied.

Data were also taken with a high intensity beam in order to reach and exceed the pixel occupancy of the innermost ATLAS tracking layer during operation at the nominal LHC luminosity and test the limits of the data acquisition architecture. The detection efficiency as a function of the beam intensity is discussed for different configuration settings of the read-out electronics.

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