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Test Beam Results of Planar Pixel Sensor for the CMS Phase 2 Inner Tracker Upgrade

Results of the test beam measurements that characterize the performance of CMS Readout Chip (CROC) sensors to be used in the High Luminosity era of the Large Hadron Collider (HL-LHC) are presented. The HL-LHC peak instantaneous luminosity of 7.5×10^{34} cm$^{-2}s^{-1}$ corresponds to an average of around 200 inelastic proton-proton collisions per beam-crossing every 25 ns. In order to efficiently reconstruct and track particles in these extreme and challenging conditions, the present CMS tracking detector will be completely replaced. The new tracking detector consists of an Inner Tracker closest to the beamline and an Outer Tracker surrounding it. These are populated with modules constructed of readout chips and silicon sensors. The test beam measurements of these modules are vital to understand the performance of the related technologies. Using a primary 120 GeV proton beam from the Main Injector at Fermilab, data was collected at the Fermilab Test Beam Facility (FTBF) using the silicon tracker telescope that provides a precision position measurement of the track impact point with less than 5 micron uncertainty. The proton beam was incident on a 1x2 planar CROC module with sensor developed by Hamamatsu. The sensor has 100x25 μm^2 standard pixels and also a smaller number of 225x25 μm^2 longer pixels at the boundary between the two ROCs. We present characterisation of these modules that includes pixel efficiency, resolution, cluster size and charge distributions.

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