Contribution ID: **50** Type: **talk**

Characterization of planar and 3D pixel sensors for the inner tracker of the CMS experiment (in-person)

Wednesday, 15 September 2021 09:00 (15 minutes)

The Compact Muon Solenoid (CMS) experiment is expected to collect an integrated luminosity of 3000 or even 4000fbˆ-1 in the ultimate scenario during the High Luminosity phase of the Large Hadron Collider (HL-LHC). This scenario comes with a high number of collisions per bunch crossing, and in turn, a high level of radiation for the inner layer of the CMS tracker. The simulations estimate a 1-MeV neutron equivalent fluence, phi_eq, of 2.3\times 10ˆ16 cmˆ-2 at a distance of 2.8 cm from the collision point (for the integrated luminosity of 3000 fbˆ-1). The inner tracker of the CMS detector is required to withstand this range of fluence and maintain its track-finding functionality.

Planner and 3D pixel sensors with an active thickness of 150 um and pixel sizes of 25 \times 100 umˆ2 or 50 \times 50 umˆ2 have been produced by Hamamatsu Photonics (HPK), Fondazione Bruno Kessler (FBK), and Microelectronic National Center(CNM). The sensors were bumped bonded to the RD53A readout chip prototype. The sensor-chip modules were irradiated with 23 MeV and 24 GeV protons to the fluence of up to 2.4 \times 10ˆ16 cmˆ-2 the Karlsruhe Institute of Technology (KIT) and PS-IRRAD proton facility.

The modules were tested in the DESY II beam test facility. The hit efficiency and spatial resolution as a function of the incidence angle of pixel sensors were determined from these measurements. It has been shown that for the highest fluence, the planar modules still reach 99\% hit efficiency, required for the Phase-2 IT, at bias voltages below 800V. For 3D sensors, no significant change in efficiency was observed after irradiation. This talk presents the results for planar and 3D sensors before and after irradiation.

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Session Classification: Advances in Pixel Detectors and Integration Technologies I

Track Classification: Advances in Pixel Detectors and Integration Technologies