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Radiation Resistant Innovative 3D Pixel Sensors for the CMS Upgrade at the High Luminosity LHC

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The High Luminosity upgrade of the CERN Large Hadron Collider (HL-LHC) calls for new high-radiation tolerant silicon pixel sensors, capable of withstanding, in the innermost tracker layer, fluences up to 2.3×10^{16} neq/cm² (1MeV equivalent neutrons). An extensive R&D program aiming at 3D pixel sensors, built with a top-side only process, has been put in place in CMS in collaboration with FBK (Trento, Italy) and CNM (Barcelona, Spain) foundries. A few sensors were interconnected with the RD53A readout chip, the first prototype, in 65nm technology, of the pixel readout chip which will be used in the HL-LHC inner trackers. In this presentation results obtained in laboratory measurements and beam tests experiments before and after irradiations will be reported. Irradiation of single chip interconnected modules were performed at CERN IRRAD facility or in KIT Irradiation Center, up to a maximum equivalent fluence of 1×10^{16} neq/cm². Preliminary analysis of collected data shows excellent performance and hit detection efficiencies close 99% measured after the above mentioned irradiation fluences. New ideas and designs for 3D sensors will also be illustrated.

Submission declaration

Redundant (overlaps with already published)

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