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Study of 3D pixel sensors after non-uniform proton irradiation

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The Phase-II upgrade of the inner tracker of the CMS experiment is considering to use 3D pixel sensors for the innermost layers, given their intrinsic properties, well suited to resist the extreme radiation fluences expected at the High Luminosity Large Hadron Collider (HL-LHC). In this talk we present data collected from beam tests of 3D sensors bump-bonded to the RD53A prototype readout ASIC, irradiated with protons at CERN IRRAD facility, to a target equivalent fluence of about $1 \times 10^{16} n_{eq}/cm^2$ (1 MeV equivalent neutrons). We will present the methodology used to precisely estimate the actual fluence reached at the sensor, showing that different fluences are present in the same module because of the irradiation beam spot size. We use the different estimated fluence regions to study in the same module the sensor response with respect to the irradiated fluence, obtaining a potential indication of charge multiplication when increasing the fluence.

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