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Performance of highly irradiated FBK 3D and planar pixel detectors

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The High Luminosity upgrade of the CERN Large Hadron Collider (HL-LHC) requires new radiation tolerant silicon pixel sensors. In the case of the CMS experiment, the first layer of pixel detectors will be installed at about 3 cm distance from the beam pipe: fluence up to $2E16$ neq/cm² (1 MeV equivalent neutrons) are expected. The 3D concept for silicon pixel sensors presents several advantages with respect to traditional, planar, sensors. Thanks to their peculiar structure, 3D sensors are resistant to radiation damage, making them suitable for use in the inner layer of the future CMS tracker. In this presentation results obtained in beam test experiments with highly irradiated 3D and planar pixel sensors interconnected with the RD53A readout chip are reported. RD53A is the first prototype in 65nm technology issued from RD53 collaboration for the future readout chip to be used in the upgraded pixel detectors. The sensors were made in FBK foundry in Trento, Italy, and their development was done in collaboration with INFN (Istituto Nazionale di Fisica Nucleare, Italy). Both 3D and planar sensors feature a pixel area of 2500 μm^2 and an active thickness of 150 μm . The interconnected modules, irradiated to fluences up to $2.4E16$ neq/cm², were tested in various test beam facilities: analysis of collected data shows excellent performances measured after unprecedented irradiation fluences. All results are obtained in the framework of the CMS R&D activities.

Collaboration

The CMS Collaboration

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