Contribution ID : **653** Type : **Oral talk**

Development and characterization of novel silicon sensors for neutron detection

Thursday, 8 October 2020 12:45 (15)

The planned final upgrade of the LHC accelerator at CERN, namely the high luminosity phase of the LHC (HL-LHC), foreseen beyond 2026, will mean unprecedented radiation levels, Due to the radiation damage limitations of the silicon sensors presently used, new radiation-hard tracking detectors will be required by the physics experiments. 3D silicon pixel detectors are among the radiation-hard solutions designed for the extreme radiation levels expected for the vertexing layers at the HL-LHC. The 3D technology features electrodes penetrating inside the silicon bulk. While keeping a high carrier collection efficiency in heavily irradiated detectors, this configuration minimizes the detector dead border region. Neutron detectors fabricated with 3D technologies and coupled to different neutron converter materials have recently been the object of an increasing interest for possible replacement of 3He detectors. In the framework of the INFN DEEP_3D (Detectors for neutron imaging with Embedded Electronics Produced in 3D technology) project, a new monolithic detector for neutrons coupled with boron, lithium or their combination, is presented. The talk will cover aspects relevant to the electronics design, layout and validation of the key technological steps of these innovative 3D pixel sensors.

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Session Classification : Facilities and Advanced Detector Technologies

Track Classification : Facilities and advanced detector technologies