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Silicon sensors for the HGCAL upgrade: challenges, sensor design & electrical characterization

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The CMS detector will undergo significant improvements to face the 10-fold increase in integrated luminosity of LHC, the so-called High-Luminosity LHC, scheduled to start in 2026. This will include a completely new calorimeter in the CMS endcap regions, which should be able to withstand fluences of up to 10ˆ16 n_{eq}/cmˆ2. The new High Granularity Calorimeter (HGCAL) will have unprecedented transverse and longitudinal readout and trigger segmentation that will facilitate the particle-flow approach to reconstruct electromagnetic and hadronic particle showers and their energies. In regions of low radiation, HGCAL will be equipped with small plastic scintillator tiles as active material coupled to on-tile silicon photomultipliers. In the higher radiation zone silicon has been chosen due to its intrinsic radiation hardness. The silicon sensors will be of hexagonal shape, with three nominal thicknesses of 120 um, 200 um and 300 um, optimized for regions of different radiation levels. They will be segmented into several hundred cells with hexagonal shape of 0.5 to 1.1 cmˆ2 in size, each of which is read out individually. A comprehensive campaign is in progress to converge on optimal sensor design choices and parameters, such as bulk doping, layouts and production methods. In this talk, results from full electrical sensor characterization are presented for different sensors, together with first results from an irradiation campaign of large-area silicon sensors.

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