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The Silicon Sensors for the High Granularity Calorimeter of CMS

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During the Long Shutdown 3 (LS3) of the Large Hadron Collider (LHC), around 2024-2026, significant parts of the CMS detector will be upgraded to allow an efficient data taking during the subsequent High Luminosity LHC phase (HL-LHC). The HL-LHC will have a factor 5 higher instantaneous luminosity - resulting in a factor 5 higher event "pileup", and a factor 10 increase in integrated luminosity by ˜2037 compared with the end of LHC operation. Especially the forward calorimeters will be exposed to unprecedented levels of radiation and pileup. The CMS collaboration will, during LS3, replace the existing endcap calorimeters with a new High Granularity Endcap Calorimeter (CE). It features unprecedented transverse and longitudinal segmentation for both electromagnetic (CE-E) and hadronic (CE-H) compartments. This will facilitate particle-flow calorimetry, where the fine structure of showers can be measured and used to enhance pileup rejection and particle identification, whilst still achieving very good energy resolution. The CE-E and a large fraction of CE-H will consist of a sandwich structure with silicon sensors as active detector material. The sensors will be of hexagonal shape, maximizing the available area of 8-inch wafers and covering 600mˆ2 in total. Each sensor consists of either 192 or 432 individual hexagonal diodes, each of 0.5 - 1.1 cmˆ2 in size, without any common biasing structure. Biasing and readout of each diode is performed on the module level through a printed circuit board (PCB), which is glued onto the sensor and equipped with readout ASICs, connected by wire-bonding through holes in the PCB to the sensor. In this talk, we present the current status of the HGCAL project, with special focus on the silicon sensors. It will show the R&D path being followed for the sensors, the design of the modules and larger structures (cassettes, disks) to build up the whole detector. Optimization studies of the sensors, measurement results of the first prototypes, irradiation studies and beam tests will be shown.

Submission declaration

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