

CMS Inner Tracker Module Production and Qualification for the HL-LHC Upgrade

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The High-Luminosity Large Hadron Collider (HL-LHC) operation will push the CMS experiment to its limits, with an instantaneous peak luminosity of $7.5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ and an integrated luminosity of 300 fb^{-1} per year. This environment will expose the CMS Inner Tracker (IT) Pixel Detector at the center of CMS to unprecedented radiation, with a 1 MeV neutron equivalent fluence of $2.3 \times 10^{16} \text{ neq/cm}^2$ and a total ionizing dose of 1.2 Grad. To endure these conditions and handle hit rates of 3.2 GHz/cm^2 while managing a pileup of 140-200 collisions per bunch crossing, the new IT system will employ a highly granular design with thin silicon sensors, small pixels ($25 \times 100 \mu\text{m}^2$), and fast, radiation-hard electronics based on a 65 nm CMOS ASIC developed by the RD53 collaboration. Currently, pre-series modules for the IT system are being constructed, and rigorous testing is ongoing to validate both the module components and the quality control procedures. In the coming months, full-scale production of the IT modules will commence. The status of module production at the assembly sites, results from module testing and qualification, and the roadmap toward installation in 2028 will be presented.

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