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CMS Pixel detector development for the HL-LHC

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The LHC is planning an upgrade program which will bring the luminosity up to about $7.5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ in 2027, with the goal of an integrated luminosity of 3000 fb^{-1} by the end of 2037. This High Luminosity scenario, HL-LHC, will present new challenges of higher data rates and increased radiation tolerance for the pixel detector ($2 \times 10^{16} \text{ neq/cm}^2$, or equivalently 1 Grad, is expected on the inner pixel layer for 3000 fb^{-1} integrated luminosity). To maintain or even improve the performance of the present system, new technologies have to be fully exploited for the so-called Phase-II upgrade. Among them is the future version of front-end chips in 65-nm CMOS by the CERN RD53 Collaboration which supports small pixel sizes of 50×50 or $25 \times 100 \mu\text{m}^2$ and lower thresholds ($\sim 1000 \text{ e}^-$). For the development of the appropriate planar pixel sensor, CMS has recently launched a submission of n-in-p sensors on 6 inch wafer with an active thickness of $150 \mu\text{m}$ at Hamamatsu. The submission consists of physical thinned, direct bonded and deep diffused wafers with p-stop or p-spray isolation. A variety of sensors with and without biasing scheme is designed to match the different read-out chips (RD53A, ROC4Sens, etc.) and first hybrid modules are assembled at Fraunhofer IZM. In this talk, we will present an overview of the Phase II pixel R&D program and report on preliminary results on the HPK submission.

Primary author: SCHWANDT, Joern (Hamburg University (DE))

Presenter: SCHWANDT, Joern (Hamburg University (DE))

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