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# First test beam results of HPK planar pixel sensors with the CROC readout chip for the CMS Phase 2 Upgrade

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The current tracking system of the CMS experiment will be fully replaced for the High-Luminosity running phase of the LHC with a planned integrated luminosity of more than 3000 $fb^{-1}$ delivered to the experiments. The innermost layers of the CMS Inner Tracker (IT) will be subject to particle fluences up to about $2 \times 10^{16}$ $cm^{-2}$ (1 MeV neutron equivalent).

In an extensive R&D program with several vendors, various pixel sensor options have been evaluated, including different pixel pitches and sensor cell designs, and only recently the final decision has been made. All layers (except the innermost layer of the barrel section of the IT) will be equipped with planar $n^{+}$-p sensors with an active thickness of 150 $\mu$m and pixel pitches of $25 \times 100$ $\mu m^2$. In the previous phase of the sensor qualification campaign, sensors were coupled to demonstrator chips (RD53A) and the modules were irradiated to fluences up to $\Phi_{eq} = 2 \times 10^{16}$ $cm^{-2}$ and extensively tested in both CERN and DESY test beam facilities. During the last year, single chip assemblies and the first full modules with the final, full-size prototype readout chip (CROC) became available.

This talk will present an overview of the first very preliminary test beam results obtained at DESY for CROC assemblies. Studies of the hit efficiency, spatial resolution and noise for both non-irradiated samples and assemblies irradiated up to $\Phi_{eq} = 1 \times 10^{16}$ $cm^{-2}$ will be presented. The preliminary results obtained are compatible with previous results obtained with RD53A assemblies. The results described in this contribution are important input for the designers of the final CROC_v2 readout chip and will allow CMS to start the pre-production phase for pixel sensors for the IT soon.

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