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First results on the final readout chip for the High-Luminosity LHC upgrade of the CMS Inner Tracker

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The CMS Readout Chip (CROC) is a 65 nm CMOS hybrid pixel readout chip for the High Luminosity LHC upgrade of the CMS Inner Tracker. The new detector will be instrumented with approximately 1.3×10^4 of these readout chips, covering an area of about 5.2 m^2.

The chip has been developed by the CERN/RD53 Collaboration in order to withstand very high radiation doses (500 Mrad) and hit rates (up to 3 GHz/cm^2 at pileup 200 on the innermost tracking layer) during operation. Moreover, it must handle an increased sensor granularity (pixel cell size of 2500 μm^2) with respect to current detectors and operate at low detection thresholds (1000 e$^-$).

Twenty wafers of the prototype chip (CROCv1) have been produced in 2021, amounting to 2760 chips. The prototype chip has been thoroughly studied and its suitability for operation at HL-LHC has been assessed. The chip has been studied in single-chip assemblies, in prototype detector modules with bump-bonded sensors, and at wafer level. The performance of fresh and irradiated CROCv1 ASICs has also been studied in several beam tests, bump-bonded to sensors with different technologies (planar, 3D). The characterisation and verification campaign has, overall, demonstrated the radiation resistance of the chip and its performance, but a few improvements have been identified. These improvements have been implemented in the final version of the chip (CROCv2) that has been submitted in October 2023. Sixteen wafers from the engineering run have been received in January 2024.

In this talk, the first results from the testing of the CROCv2 engineering run, amounting to more than 2000 chips, will be outlined.

Collaboration

CMS

Role of Submitter

I am the presenter

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