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The INFN-FBK Pixel R&D Program for HL-LHC

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We report on the INFN ATLAS-CMS joint research activity in collaboration with FBK, which is aiming at the development of new pixel detectors for the LHC Phase-2 upgrades. The High Luminosity LHC will need the complete replacement of the ATLAS and CMS inner trackers with new ones fulfilling the requirements of higher radiation fluence (2x10E16 neq/cm2, or equivalently 1 Grad, expected on the inner pixel layer for 3000 fb-1 integrated luminosity), higher event pile-up (from 140 to 200 events/bunch-crossing). To reach the same or even better performance of the present system, new technologies have to be fully exploited for the redesigned Pixel detectors. Among them, the future version of front-end chips in 65-nm CMOS by the CERN RD53 Collaboration will allow for smaller pixel sizes (50x50 or 25x100 µm2) and lower thresholds (~1000 e-). The advances in the front-end design shall require sensors with smaller pixel cells and thinner active thickness to match the reduced pixel dimension and to improve track resolution and cluster separation in a higher pile-up environment. To this purpose, a new generation of 3D and planar pixel sensors with active edges are being developed in the R&D project to be fabricated at the pilot line of FBK, which was recently updated to process 6-inch wafers. The R&D program includes the design of sensors that can be readout with the present ATLAS and CMS readout chips with standard pixel pitch and also finer pitch pixels with a matching mask purposely designed on the active device. The talk will cover the main aspects of the research program, starting from the sensor design and fabrication technology, with an outlook on the future steps using both Silicon On Insulator (SOI) and Direct Wafer Bonded (DWB) wafers. A first batch of planar sensors has been already produced on DWB of two active depths (100 and 130 µm) and a few sensors have also been sent to irradiation facilities: first results from device characterization will be shown.

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