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The INFN-FBK “Phase-2” R&D Program

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We report on the 3-year INFN ATLAS-CMS joint research activity in collaboration with FBK, started in 2014, aimed at the development of new pixel detectors for the LHC Phase-2 upgrades (aka HL-LHC). The latter will need the complete replacement of the ATLAS and CMS inner trackers with new ones fulfilling the requirements of a higher radiation fluence (2×10^{16} neq/cm², or equivalently 1 Grad, expected on the inner pixel layer for 2500 fb⁻¹ integrated luminosity in the Phase-2), higher event pile-up (140 events/bunch-crossing). To maintain the same performance of the present detector systems a new generation of technologies has 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 μm^2) 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 higher pile-up environment. Additional optimization of the new Pixel detector requires the reduction of the radiation-length of the layer to minimize secondary interactions and Multiple Coulomb Scattering effects.

To this purpose, a new generation of 3D sensors and of planar sensors with active edges are being developed in the project and will be fabricated at the pilot line of FBK, that was recently updated to 6-inch wafers. Another partnership is in place with Selex for further developing Indium bump-bonding technology, that is potentially more suited than solder-reflow for large chip sizes, thinner electronic and sensor substrates due to the lower temperature of the process (90 °C instead of 250 °C).

The talk will cover the main aspects of the research program, from the sensor design and simulation, to the fabrication technology, to the results of initial tests performed of the first prototypes.

Collaboration

On behalf of the ACTIVE (Atlas and Cms Towards InnovatiVe pixEls) Collaboration.

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