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Recent Progress of the ATLAS Upgrade Planar Pixel Sensor R&D Project

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To extend the physics reach of the LHC, upgrades to the accelerator are planned which will increase the peak luminosity by a factor 5 to 10. This will lead to increased occupancy and radiation damage of the inner trackers.

To cope with the elevated occupancy, the ATLAS experiment plans to introduce an all-silicon inner tracker with the HL-LHC upgrade. With silicon, the occupancy can be adjusted by using the appropriate unit size (pixel, strip or short strip sensors). For radiation damage reasons, only electron-collecting sensors designs are considered (n-in-p and n-in-n).

To investigate the suitability of pixel sensors using the proven planar technology for the upgraded tracker, the ATLAS Planar Pixel Sensor R&D Project was established comprising 17 institutes and more than 80 scientists. Main areas of research are the performance of planar pixel sensors at highest fluences, the exploration of possibilities for cost reduction to enable the instrumentation of large areas, the achievement of slim or active edges to provide low geometric inefficiencies without the need for shingling of modules and the investigation of the operation of highly irradiated modules at low thresholds to increase their efficiency.

The presentation will give an overview of the recent accomplishments of the R&D project. Among these are testbeam results obtained with n-in-n pixel sensors irradiated up to 2 10**16 neq/cm**2, investigations of the edge efficiency of dedicated slim-edge sensors and comparisons of these experimental findings with TCAD device simulations taking into account the radiation damage.

Updates will be given on the status of several efforts towards fully active edges with planar technology and on n-in-p and n-in-n productions with substrate thicknesses down to 150 um.

Finally, first laboratory and testbeam measurements of sensors using the new ATLAS readout chip FE-I4 will be shown including the exploration of the low-threshold behaviour of highly irradiated assemblies.

Preferred medium (Oral/poster)

Oral

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