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Recent Results of the ATLAS Upgrade Planar Pixel Sensors R&D Project*

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To extend the physics reach of the LHC experiments, several upgrades to the accelerator complex are planned. This upgrade, the HL-LHC, eventually leads to an increase of the peak luminosity by a factor of five to ten compared to the LHC design value.

To cope with the higher occupancy and radiation damage also the LHC experiments will be upgraded. The ATLAS Planar Pixel Sensor (PPS) R&D Project is an international collaboration of 17 institutions and more than 80 scientists, exploring the feasibility of employing planar pixel sensors for the upgraded tracker at HL-LHC.

Depending on the radius different pixel concepts are investigated using laboratory and beam test measurements. At small radii the extreme radiation environment and strong space constraints are addressed with very thin pixel sensors (active thickness in the range of 75-150 μm), and the development of slim as well as active edges. At larger radii the main challenge is the needed cost reduction to allow for instrumenting the large area of order 10 m². To reach this goal the pixel productions will be transferred to 6 inch production lines. Additionally, more cost-efficient and industrialized interconnection techniques as well as the n-in-p technology, which as a single-sided process requires less production steps, are investigated.

An overview of the recent accomplishments obtained within the PPS R&D project will be given. The performance in terms of charge collection and tracking efficiency, obtained with radioactive sources in the laboratory and at beam tests, will be presented for devices built from sensors of different vendors connected to either the present ATLAS read-out chip FE-I3 or the new IBL read-out chip FE-I4. The devices, with a thickness varying between 75 μm and 300
μm, have been irradiated to several fluences up to 20x10**15 neq/cm². Finally, the different approaches followed inside the collaboration to achieve slim or active edges for planar pixel sensors will be presented.

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