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Silicon sensor technologies for ATLAS IBL upgrade

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New pixel sensors are currently under development for ATLAS Upgrades. The first upgrade stage will consist in the construction of a new pixel layer that will be installed in the detector during the 2013 LHC shutdown. The new layer (Insertable-B-Layer, IBL) will be inserted between the inner most layer of the current pixel detector and the beam pipe at a radius of 3.2cm. The expected high radiation levels require the use of radiation hard technology for both the front-end chip and the sensor.

Two different pixel sensor technologies are envisaged for the IBL. The sensor choice will occur in July 2011. One option is developed by the ATLAS Planar Pixel Sensor (PPS) Collaboration and is based on classical n-in-n planar silicon sensors which have been used for the ATLAS Pixel detector. For the IBL, two changes were required: The thickness was reduced from 250 μm to 200 μm to improve the radiation hardness. In addition, so-called “slim edges” were designed to reduce the inactive edge of the sensors from 1100 μm to only 250 μm which is important as shingling of modules will not be possible for IBL.

The other option is developed by the ATLAS 3D Collaboration. 3D silicon technology is an innovative combination of VSLI and MEMS (Micro-Electro-Mechanical-Systems) where electrodes are fabricated inside the silicon bulk instead of being implanted on the wafer surface. Two layouts have been developed: one with electrodes penetrating entirely the wafer thickness and with active edges (full-3D) and one with no active edges with electrodes do not necessarily penetrating the entire thickness (partial-3D). For IBL only the later design is considered.

An overview of the 3D and PPS sensor technologies with particular emphasis on irradiation and beam tests for the IBL qualification will be presented.

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