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Operational Experience and Performance with the ATLAS Pixel detector at the Large Hadron Collider at CERN

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The tracking performance of the ATLAS detector relies critically on its 4-layer Pixel Detector. Its original part consisting in 3 layers of planar pixel sensor is continuously operating since the start of LHC collisions in 2009, while its innermost layer, the Insertable B Layer (IBL) at about 3 cm from the beam line, was installed in 2014 before the start of LHC Run2 and consists of both planar and 3D pixel sensors.

As the closest detector component to the interaction point, this detector is subjected to a significant amount of radiation over its lifetime. At present, at the end of 2024 Run3 LHC collisions, ATLAS Pixel Detector on innermost layers, is operating after integrating fluence of $O(10^{15})$ 1 MeV n_{eq} cm^{-2} .

The ATLAS collaboration is continually evaluating the impact of radiation on the Pixel Detector. In this talk the key status and performance metrics of the ATLAS Pixel Detector are summarised at various levels of fluence and bias voltage values, putting focus on performance and operating conditions with special emphasis to radiation damage and mitigation techniques adopted, with prediction of their evolution until the end of LHC Run3 in 2026.

These results provide useful indications for the optimisation of the operating conditions for the new generation of pixel trackers under construction for HI-LHC upgrades.

Primary experiment

ATLAS

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