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Overview and Performance of the ATLAS IBL Detector

For Run 2 of the LHC a fourth, innermost Pixel Detector layer on a smaller radius beam pipe has been installed in the ATLAS Detector to add redundancy against radiation damage of the current Pixel Detector and to ensure a high quality tracking and b-tagging performance of the Inner Detector over the coming years until the High Luminosity Upgrade. State of the art components have been produced and assembled onto support structures known as staves over the last two years. In total, 20 staves have been built and qualified in a designated Quality Assurance setup at CERN of which 14 have been integrated onto the beam pipe. Results from the testing are presented and represent the performance of the detector before integration into ATLAS.

Summary

During the Phase 0 upgrade of the ATLAS Detector an additional layer of the Pixel Detector, the Insertable B-Layer (IBL), is being installed. The IBL is composed of 14 carbon fibre staves with integrated titanium pipes for CO_2 cooling. Each stave hosts 32 FE-I4 chips, adding more than 12M read out channels in total. Two different sensor types are chosen: a planar design based on the current ATLAS Pixel sensor and 3D sensor designs which find their first application in high energy physics experiments. After full assembly and transportation to CERN the staves undergo Quality Assurance (QA) testing which will be described in this document.
The QA procedure covers important measurements to qualify a stave for integration around the beam pipe. This includes cold operation to simulate run time conditions as well as various calibration and data taking modes. The outcome of the stave QA procedure is used as a basis to select staves for integration and it provides a deeper understanding of the assembled detector.
In total, 20 staves have been produced as IBL candidates, for which the 14 highest ranked staves are to be installed in the IBL. Hence results from the QA represent a projection of the performance of the IBL after installation into the ATLAS Detector.

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