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Overview of the ATLAS Insertable B-Layer (IBL) Project

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The upgrades for the ATLAS Pixel Detector will be staged in preparation for high luminosity LHC. The first upgrade for the Pixel Detector will be the construction of a new pixel layer which is currently under construction and will be installed during the first shutdown of the LHC machine, in 2013-14. The new detector, called the Insertable B-layer (IBL), will be installed between the existing Pixel Detector and a new, smaller radius beam-pipe at a radius of 3.3 cm. The IBL required the development of several new technologies to cope with increased radiation and pixel occupancy and also to improve the physics performance through reduction of the pixel size and a more stringent material budget. Two different silicon sensor technologies, planar n-in-n and 3D, will be used, connected with the new generation 130nm IBM CMOS FE-I4 readout chip via solder bump-bonds. 32 FEs with sensors are glued to a light weight carbon-carbon structure which incorporates a titanium cooling tube for a CO2 cooling system. In total the IBL barrel layer will consist of 14 support structures and will cover 0.2m2 active area with 12 million pixels.
A production quality control test bench was setup in the ATLAS inner detector assembly clean room to verify and rate the performance of the detector elements before integration around the beam pipe. Bias voltage sensor measurements as well as new 130nm IBM CMOS front end chip functionality measurements are complemented with 241Am and 90Sr sources as well as cosmic muon measurements to rate the bump bond quality and charge measurement calibration. During the integration process these measurements are repeated to spot integration issues and optimize the final operation performance. A realistic CO2 cooling plant will allow to perform quick warm and cold tests to verify the electrical functioning integrity of the sensors and readout front-ends.

An overview of the IBL project, of the module design, the qualification for these sensor technologies, the integration quality control setups and recent results in the construction of this full scale new concept detector will be presented and discussed.

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