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Alignment of the ATLAS Inner Detector Upgraded for the LHC Run II

ATLAS is a multipurpose experiment at the LHC proton-proton collider. Its physics goals require high resolution, unbiased measurement of all charged particle kinematic parameters. These critically depend on the layout and performance of the tracking system, notably quality of its offline alignment. ATLAS is equipped with a tracking system built using different technologies, silicon planar sensors (pixel and micro-strip) and gaseous drift- tubes, all embedded in a 2T solenoidal magnetic field. For the LHC Run II, the system has been upgraded with the installation of a new pixel layer, the Insertable B-layer (IBL). Offline track alignment of the ATLAS tracking system has to deal with about 700,000 degrees of freedom (DoF) defining its geometrical parameters. The task requires using very large data sets and represents a considerable numerical challenge in terms of both CPU time and precision. The adopted strategy uses a hierarchical approach to alignment, combining local and global least squares techniques. An outline of the track based alignment approach and its implementation within the ATLAS software will be presented. Special attention will be paid to integration to the alignment framework of the IBL, which plays the key role in precise reconstruction of the collider luminous region, interaction vertices and identification of long-lived heavy flavor states. Techniques allowing to pinpoint and eliminate tracking systematics due to alignment as well as strategies to deal with time-dependent variations will be briefly covered. The first results from Cosmic Ray commissioning runs and status from proton-proton collision in LHC Run II will be discussed.

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