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Tracking and Vertexing with the ATLAS Inner Detector in the LHC Run2 and Beyond

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Run-2 of the LHC has provided new challenges to track and vertex reconstruction with higher centre-of-mass energies and luminosity leading to increasingly high-multiplicity environments, boosted, and highly-collimated physics objects. To achieve this goal, ATLAS is equipped with the Inner Detector 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. In addition, the Insertable B-layer (IBL) is a fourth pixel layer, which was inserted at the centre of ATLAS during the first long shutdown of the LHC. An overview of the use of each of these subdetectors in track and vertex reconstruction, as well as the algorithmic approaches taken to the specific tasks of pattern recognition and track fitting, is given. The performance of the Inner Detector tracking and vertexing will be summarised. These include a factor of three reduction in the reconstruction time, optimisation for the expected conditions, novel techniques to enhance the performance in dense jet cores, time-dependent alignment of sub-detectors and special reconstruction of charged particle produced at large distance from interaction points. Moreover, data-driven methods to evaluate vertex resolution, fake rates, track reconstruction inefficiencies in dense environments, and track parameter resolution and biases will be shown. Luminosity increases in 2017 and beyond will also provide challenges for the detector systems and offline reconstruction, and strategies for mitigating the effects of increasing occupancy will be discussed. Finally, the upgraded 'ITk' tracking detector for operation at the High-Luminosity LHC will be presented. The tracking performance of the all-silicon tracker, which includes an increased tracking acceptance up to |Î·|<4.0, under expected HL-LHC conditions with up to 200 interactions per bunch crossing will be shown. Ongoing optimisation of the track reconstruction and future approaches that may improve the physics and/or technical performance of the ATLAS track reconstruction for HL-LHC are considered.

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Summary

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