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Expected tracking performance of the ATLAS Inner Tracker Upgrade for Phase-II

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With its increased number of proton-proton collisions per bunch crossing, track reconstruction at the High-Luminosity Large Hadron Collider (HL-LHC) is a complex endeavor. The Inner Tracker (ITk) is a silicon-only replacement of the current ATLAS Inner Detector as part of its Phase-II upgrade. It is specifically designed to handle the challenging conditions at the HL-LHC, resulting from greatly increased pile-up.

On the path towards the increased luminosity starting in LHC Run 4, the critical milestone of unifying the ITk and LHC Run 3 reconstruction software releases has been completed. This allows deployment of the software-level improvements added for LHC Run 3. At the same time, improvements to the simulated description of the detector construction, readout and reconstruction of ITk have been implemented.

With the state-of-the-art engineering description of ITk, the performance of the detector can be evaluated, leveraging the aforementioned improvements in simulation and reconstruction. This contribution will report on the updated performance of ITk tracking at high luminosities, which is increasingly representative of the actual expected reconstruction in LHC Run 4.

At the same time, the ATLAS upgrade effort consists as well of a comprehensive software upgrade programme, whose goal is not only to achieve the ultimate physics performance, but at the same time to modernise the software technology, to make best use of upcoming and future processing technologies and ensure maintainability throughout the operation of the experiment. In order to achieve these objectives, the ATLAS Collaboration has decided to extensively use ACTS for the Phase-II reconstruction software.

In this contribution, the current status of the ACTS integration for the ATLAS ITk track reconstruction is presented, with emphasis on the improvements of the track reconstruction software and the implementation of an ATLAS Phase-II EDM, interfaced with the ATLAS xAOD IO infrastructure.

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