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The ID tracking trigger for run-3 of the ATLAS experiment

The performance of the Inner Detector tracking trigger of the ATLAS experiment at the Large Hadron Collider (LHC) is presented, evaluated using using early Run 3 data. Included are results from the evolved standard trigger track reconstruction, and from new unconventional tracking strategies used for the first time in the Run 3 trigger. The application of Inner Detector tracking in the Run 3 trigger is significantly expanded, in particular full-detector tracking is utilised for hadronic signatures such as jets and missing transverse energy triggers, for the first time.

To meet computing resource limitations, new features have been developed. These include machine-learning additions for the track seeding, together with many additional improvements with respect to the trigger tracking used in LHC Run 2.

As the world's highest energy particle accelerator, the LHC provides a unique opportunity for directly searching for new physics Beyond the Standard Model (BSM). Massive long-lived particles (LLPs), which are absent in the Standard Model are present in many well-motivated theories of Beyond the Standard Model physics. These new massive LLPs can decay into other particles far from the LHC interaction region, resulting in novel experimental signatures and so require new complex techniques for their identification: Prior to Run 3, the ATLAS trigger did not include dedicated tracking triggers for the explicit identification of massive LLPs decaying in the inner tracking detectors. To enhance the sensitivity of such searches, a series of new triggers were developed ready for the Run 3 data taking in 2022. These included various novel unconventional tracking signatures, such as those for displaced tracks, displaced jets, or short tracks which disappear within the inner detector tracking volume. With these developments, The high performance of the inner detector trigger remains essential for the ATLAS physics programme in Run 3, both for precision measurements of the Standard Model and now also searches for new physics beyond the standard model.

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