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Performance and development for the Inner Detector Trigger algorithms at ATLAS

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The performance of the ATLAS Inner Detector (ID) Trigger algorithms being developed for running on the ATLAS High Level Trigger (HLT) processor farm during Run 2 of the LHC are presented. During the 2013-14 LHC long shutdown modifications are being carried out to the LHC accelerator to increase both the beam energy and luminosity. These modifications will pose significant challenges for the ID Trigger algorithms, both in terms execution time and physics performance. To meet these challenges, the ATLAS HLT software is being restructured to run as a more flexible single stage HLT, instead of two separate stages (Level2 and Event Filter) as in Run 1. This will reduce the overall data volume that needs to be requested by the HLT system, since data will no longer need to be requested for each of the two separate processing stages.

Development of the ID Trigger algorithms for Run 2, currently expected to be ready for detector commissioning near the end of 2014, is progressing well and the current efforts towards optimising the operational performance of these algorithms is discussed. The new tracking strategy employed for Run 2 will use a Fast Track Finder (FTF) algorithm to seed subsequent precision tracking, and will result in an improved track parameter resolution and faster exe- cution times than achieved during Run 1. This will be achieved without compromising the algorithm robustness with respect to the expected increase in multiplicity of separate proton- proton interactions (pileup) per LHC bunch crossing.

The performance of the new algorithms has been evaluated using an extensive suite of profiling tools to identify those aspects where code optimisation would be most beneficial. The methods used to extract accurate timing information for each execution step are described, as well as the analysis of per-call level profiling data and the sampling of hardware counters to study the efficiency of CPU utilisation. In addition, a summary of the effective optimisation steps that have been applied to the new algorithms are discussed. The profiling infrastructure, constructed to provide prompt feedback from the optimisation, is described, including the meth- ods used to monitor the relative performance improvements as the code evolves. This is with a view to understanding how the profiling and optimisation testing methods might be extended to other ATLAS software development.

The increased use of parallelism for HLT algorithm processing has also been explored. Possible new opportunities arising from explicit code vectorisation and the potential inclusion of co-processors to

accelerate performance in key sections of the online tracking algorithms are also discussed.

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