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Acceleration of the ATLAS Calorimeter Calibration Algorithms Using GPUs

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The ATLAS experiment at the Large Hadron Collider (LHC) processes an extraordinary 60 terabytes of data every second in its endeavor to identify the most fundamental blocks that compose our universe. As the LHC approaches its High Luminosity Upgrade in 2030, the number of collisions per bunch crossing will increase from ~ 54 to 200. This will significantly increase the data volume and computational demand of the trigger algorithms, which the current infrastructure cannot handle.

This work aims to use GPUs to accelerate the calorimeter calibration algorithms that are used in the trigger, in order to address these new demands. The four calibration algorithms—Classification, Hadronic Calibration, Out-Of-Cluster Correction, Dead Material Correction—are being implemented in GPU in an optimized way, and benefiting from the massively parallel architecture to achieve significant computational performance improvements. Preliminary results show a 11x speedup for jet events and 22x speedup for $t\bar{t}$ events, with 87 % of calibrations showing differences of less than 10 % compared to previous CPU results.

These results highlight the potential of GPUs to enable significantly faster algorithms in the trigger system, ensuring that the computational challenges of the High Luminosity phase of the LHC can be effectively addressed.

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