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A Fast Hardware Tracker for the ATLAS Trigger System

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As the LHC luminosity is ramped up to 3×10^{34} cm^{-2} s^{-1} and beyond, the high rates, multiplicities, and energies of particles seen by the detectors will pose a unique challenge. The current three-level trigger is designed to allow a rate reduction from 40 MHz to about 400 Hz. The Fast Tracker (FTK) is an approved upgrade to the current ATLAS trigger system that will operate at full Level-1 output rates and provide high-quality tracks reconstructed in the entire inner detector by the start of processing in the Level-2 Trigger. This will allow to select signals with high purity selection and reject efficiently fakes from QCD background and therefore will free time in Level-2 farm for more refined selections. FTK solves the combinatorial challenge inherent to tracking by exploiting the massive parallelism of associative memories that can compare inner detector hits to millions of pre-calculated patterns simultaneously. The tracking problem within matched patterns is further simplified by using pre-computed linearized fitting constants and relying on fast DSPs in modern commercial FPGAs. Overall, FTK is able to compute the helix parameters for all tracks in an event and apply quality cuts in less than 100 μs. The system design is defined and the performance presented with respect to high transverse momentum (high-pT) Level-2 objects: b jets, tau jets, and isolated leptons.

Optional extended abstract

We test FTK simulated algorithms using the full ATLAS simulation with WH events up to 3×1034 cm−2 s−1 luminosity showing the capabilities of FTK. We present the architecture and the status of the hardware development, including the last AM chip design and the first small FTK prototype installation for the 2012 run.

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