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A Fast Hardware Tracker for the ATLAS Trigger System

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In hadron collider experiments, triggering the detector to store interesting events for offline analysis is a challenge due to the high rates and multiplicities of particles produced. The LHC will soon operate at a center-of-mass energy of 14 TeV and at high instantaneous luminosities of the order of 10ˆ34 to 10ˆ35 / cmˆ2 / second. A multi-level trigger strategy is used in ATLAS, with the first level (L1) implemented in hardware and the second and third levels (L2 and EF) implemented in a large computer farm. Maintaining high trigger efficiency for the physics we are most interested in while at the same time suppressing high rate physics from inclusive QCD processes is a difficult but important problem. It is essential that the trigger system be flexible and robust, with sufficient redundancy and operating margin. Providing high quality track reconstruction over the full ATLAS detector by the start of processing at L2 is an important element to achieve these needs. As the instantaneous luminosity increases, the computational load on the L2 system will significantly increase due to the need for more sophisticated algorithms to suppress backgrounds.

The Fast Tracker (FTK) is a proposed upgrade to the ATLAS trigger system. It is designed to enable early rejection of background events and thus leave more L2 execution time by moving track reconstruction into a hardware system that takes massively parallel processing to the extreme. The FTK system completes global track reconstruction with near offline resolution shortly after the start of L2 processing by rapidly finding and fitting tracks in the inner detector for events passing L1 using pattern recognition from a large, pre-computed bank of possible hit patterns.

We describe the FTK system design and expected performance in the areas of b-tagging, tau-tagging, and lepton isolation which play and important role in the ATLAS physics program.

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