

ATLAS Hardware based track-finding: Present and Future

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The ATLAS Fast TracKer (FTK) is a hardware based track finder for the ATLAS trigger infrastructure currently under installation and commissioning. FTK sits between the two layers of the current ATLAS trigger system, the hardware-based Level 1 Trigger and the CPU-based High-Level Trigger (HLT). It will provide full-event tracking to the HLT with a design latency of 100 μ s at a 100 kHz event rate, reducing the need for computationally intensive tracking in the HLT, which is several orders of magnitude slower. Having tracking information available at the trigger level will significantly improve trigger efficiencies and thresholds for many physics objects, including b-jets and tau leptons. FTK uses a two-stage tracking procedure implemented with massive parallelization in FPGAs and associative memory ASICs for fast pattern matching. In the first stage, hits are compared in parallel to 1 billion precomputed patterns shared across 8192 associative memory chips, and tracks in the matched patterns are then fit at a design speed of 1 fit per nanosecond per FPGA across 512 fitter FPGAs. The second stage tracks are extrapolations of the first stage tracks into additional layers of the tracking detector. The proposed Hardware Track Trigger (HTT) for the ATLAS Phase-II upgrade at the High Luminosity LHC (HL-LHC) uses a conceptually similar two-stage pattern matching tracking procedure. However, the HTT is instead a co-processor to the CPU-based Event Filter (EF) trigger, providing regional tracking at the full 1 MHz EF input event rate as well as full-event tracking on request at 100 kHz. This talk reviews the current design and performance of FTK, as well as the conceptual design and performance of the HTT co-processor for the HL-LHC.

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