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The MDT Trigger Processor development for the ATLAS Level-0 Muon Trigger at HL-LHC

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The novel MDT Trigger Processor (MDTTP) is a fundamental component of the ATLAS Level-0 Muon trigger upgrade, designed to meet High-Luminosity LHC requirements. The MDTTP will use MDT hits to improve the momentum resolution of muon candidates provided by RPC and TGC detectors and to reduce the fake rate.
A hardware demonstrator has been developed based on the Apollo ATCA platform.
The demonstrator includes two large FPGAs, high-speed FireFly optical transceivers, and other peripheral hardware. We present here demonstrator test results, plans for the prototype design, firmware implementation, including the core algorithm and control and monitoring.

Summary (500 words)

The first-level muon trigger (L0Muon) of the ATLAS experiment will be upgraded to operate in the substantially increased luminosity environment of the HL-LHC. The selectivity of the current system is limited by the moderate spatial resolution of RPC and TGC trigger chambers. The Monitored Drift Tube (MDT) chambers currently used for offline precision tracking will be included in the trigger to improve the transverse momentum resolution and the reduce the fake muon trigger rate.

The processing of MDT hits will be performed by the MDT trigger processor (MDTTP) ATCA blades, which will define regions of interest based on the candidates provided by the Sector Logic boards, formed using RPC or TGC data, and identify the MDT hits that are compatible in space and time. Those hits are then used to form track segments and combine them for the determination of the transverse momentum. The MDTTP will also be used to reject low quality sector logic candidates for which no MDT track segments could be found. Simulation studies confirm that the MDTTP will reduce the L0Muon output trigger rate up to 70%, while keeping a high efficiency plateau of 95%, for a single muon trigger with a threshold of 20 GeV.

The MDTTP blade will be implemented using the generic open-source platform Apollo. An Apollo ATCA blade is comprised of two PCB modules. The generic "Service Module", common to all Apollo applications, provides the required ATCA Intelligent Platform Management Controller (IPMC), power entry and conditioning, a powerful system-on-module (SoM) computer, and flexible clock and communications infrastructure. The application-specific "Command Module"provides the processing FPGAs and the FireFly Transceivers for communication with the other systems inside ATLAS.

In addition to the trigger processing tasks, the MDTTP will be also responsible for the configuration and monitoring of the MDT front-end boards, and to transmit MDT hit information to the FELIX system on receipt of a L0 acceptance signal.

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