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Upgrade of the ATLAS Level-1 Trigger with event topology information

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The Large Hadron Collider (LHC) in 2015 will collide proton beams with increased luminosity from 10^{34} up to $3 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$. ATLAS is an LHC experiment designed to measure decay properties of highly energetic particles produced in these proton-collisions. The high luminosity places stringent physical and operational requirements on the ATLAS Trigger in order to reduce the 40 MHz collision rate to an event storage rate of 1 kHz, thereby retaining events with valuable physics content. The hardware-based first ATLAS trigger level (Level-1) has an output rate of 100 kHz and decision latency of less than $2.5 \mu\text{s}$. It is composed of the Calorimeter Trigger (L1Calo), the Muon Trigger (L1Muon) and the Central Trigger Processor. In 2014, there will be a new trigger system has been added: the Topological Processor System (L1Topo system).

The L1Topo system consists of a single AdvancedTCA shelf equipped with three L1Topo processor blades. It processes detailed information from L1Calo and L1Muon in individual state-of-the-art FPGA processors to derive decisions based on the topology of each collision event. Such topologies are the angles between jets and/or leptons or global event variables based on lists of pre-selected/-sorted objects. The system is designed to receive and process up to 6 Tb/s of real time data. The talk is about the relevant upgrades of the Level-1 trigger with focus on the topological processor design and commissioning.

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