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ATLAS Level-1 Level-2 Trigger Integration Commissioning

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The ATLAS detector will be exposed to proton proton collision at the center of mass energy of 14 TeV with the bunch crossing rate of 40 MHz. In order to reduce this rate down to the level at which only interesting events will be fully reconstructed, a three-level trigger system has been designed. The level 1 (LVL1) trigger reduces the rate down to 75 kHz via the custom-built electronics. The Region of Interest Builder (RoIB) delivers the Region of Interest (RoI) records to the level 2 (LVL2) trigger which runs the selection algorithms with the commodity processors and brings the rate further down to ˜3 kHz. Finally the Event Filter (EF) reduces the rate down to ˜200 Hz for permanent storage. The LVL1, LVL2 systems will be overviewed. The commissioning in situ using almost full detectors, the full trigger system and the DAQ system will be discussed. Results on system functionality and performance based on the cosmic data will be presented. Some studies on system scalability and reliability will be shown with preselected simulated events running through the trigger and dataflow system.

Summary

The ATLAS LVL1 system identifies the basic signatures of interesting physics with high efficiency algorithms executed via custom electronics, but based on detector data of coarse granularity. It consists of three components, the Calorimeter Trigger, the Muon Trigger and the Central Trigger. The Central Trigger includes the Central Trigger Processor (CTP) and the Muon-to-CTP-Interface (MUCTPI). The Calorimeter Trigger system forms electron/photon, tau/hadron, and jet multiplicities as well as global event energy information. The MUCTPI obtains muon candidate information from the barrel and endcap muon trigger chambers, then produces muon multiplicities for six configurable transverse momentum (pT) thresholds. Based on these local trigger objects the CTP makes the trigger decision (L1A) with a configurable trigger menu. The L1A signal is distributed to all subdetectors to initiate readout of the triggered event.

The ATLAS RoIB is a customized VME system. For each L1A it assembles RoI information identified at LVL1 into a full record and passes it to the Level 2 Supervisors (L2SV). L2SVs distribute the records to the LVL2 processing farm which runs the high level trigger (HLT) algorithms. A small fraction of the full event data is requested in fine granularity at this level and a decision to accept or reject is made. Events accepted by LVL2 are fully assembled and formatted in the Event Builder (EB) nodes. Subsequently the complex selection algorithms are executed on full events on the EF farms.

The LVL1 system is fully installed and the LVL2, DAQ systems are being deployed towards the final scale. Integrated commissioning is being performed by taking cosmics with partial muon detector and calorimeter. Cosmic data have been recorded in situ and analyzed. The results show all subsystems function as expected and the full hardware and software chain installed at the experiment site works in a coherent and consistent way.

Specific tests of the trigger and DAQ system are also being performed without detector, focusing on system scalability, reliability, behavior under stress and fault tolerance. The system is being tuned to the optimal state for the data taking, with the preselected simulated proton proton events running through the trigger and dataflow chains, including RoIB, LVL2, EB, EF and sometimes partial LVL1. The subsystem performance has been scrutinized. Some critical system quantities, such as the trigger rate and the event processing time, have been studied using different trigger algorithms as well as different dataflow configurations.

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