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The ATLAS Level1 Level2 Trigger Integration

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The ATLAS detector is designed to study the 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 the events will be fully reconstructed, the multi-level trigger system is being deployed. 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 (L2LV) 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 cosmic ray data taking in situ using partial detectors, the full trigger system and the DAQ system will be discussed. Results on system functionality, consistency in the full hardware and software chain based on the cosmic data will be presented. The trigger system performance will be shown with some critical quantities obtained by running preselected simulated events through the trigger and dataflow chains.

Summary

The ATLAS LVL1 system identifies the basic signatures of interesting physics with high efficiency algorithms executed via custom electronics. 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 MUCTPI obtains muon candidate information from the barrel and endcap muon trigger chambers, then produces muon multiplicities for six configurable transverse momentum (pT) thresholds. The Calorimeter Trigger system forms electron/photon, tau/hadron, and jet multiplicities as well as global event energy information. 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 LVL1 latency is required to be less than 2.5 us.

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

Integration tests of the LVL1 system, the LVL2 system and the DAQ system have been successfully performed by taking cosmic data 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.

Integration and commissioning of the trigger and DAQ system at the experiment site are also being performed without the detector. Different tests have been done with preselected simulated proton proton events through the trigger and dataflow chains. The chain includes RoIB, LVL2, EB, EF and sometimes partial LVL1. The functionality and the stability have been scrutinized. Some critical quantities for the final system, such as the trigger rate and the event processing time, have been studied using different trigger algorithms as well as different dataflow configurations.

Primary author: ZHANG, Jinlong (Argonne National Laboratory (ANL))

Presenter: ZHANG, Jinlong (Argonne National Laboratory (ANL))

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