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First Measurements with the ATLAS Level-1 Calorimeter Trigger Preprocessor System

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The level-1 calorimeter trigger is a hardware-based system with the goal of identifying high-pt objects within an overall latency of 2.5us. It is composed of a preprocessor system which digitises 7200 analogue input channels, determines the bunch-crossing of the interaction and provides a fine timing and energy calibration; and two subsequent digital
processors.

The Preprocessor plays a central role during integration of the system as it provides digitisation and readout of calorimeter signals and serves as a digital signal source for the
subsequent processors.

Results of data taken with cosmic muons are shown, and the experience gathered during the system integration is described.

Summary

The high luminosity and bunch-crossing rate of the LHC pose a particular challenge to the trigger.

The ATLAS level-1 calorimeter trigger has to process 7200 trigger towers within an overall latency of 2.5us. reducing the event rate from 40 MHz to below 100 kHz. It is realised completely in hardware, including ASICs and FPGAs, in a VME-based system.

The Preprocesor of the ATLAS Level-1 calorimeter trigger is a compact system which digitises the detector signals, determines the bunch-crossing number of the interaction and provides a fine timing and energy calibration. The result is sent to two digital
processors, the Cluster Processor and the Jet-Energy Processor. The Cluster Processor identifies electrons/photons and taus. The Jet-Energy Processor identifies jets and computes missing and total transverse energy. Both digital processors provide their information
to the Central Trigger Processor which generates the level-1 decision.

The Preprocessor is a highly modular system consisting of eight crates hosting a total of 124
Preprocessor modules. Each of these modules processes 64 channels in parallel, with the main signal processing performed in the custom-built Preprocessor ASICs located in 16 four-channel Multichip Modules.

The location of the Preprocessor within the trigger system, combined with the fact that it
provides its own DAQ readout path leads it to play a central role when it comes to integrating the trigger with the detectors. It is the only place where digital readout of all trigger towers in parallel is possible. Tasks that are addressed include channel-mapping connectivity tests, timing measurements and signal quality tests.

This talk gives an introduction to the tasks of the level-1 calorimeter trigger with focus on the Preprocessor system. Data taken with cosmic muons are shown in addition to results from the system integration.

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