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High-Level Trigger Performance for Calorimeter based algorithms during LHC Run 1 data taking period

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The ATLAS detector operated during the three years of the run 1 of the Large Hadron Collider collecting information on a large number of proton-proton events. One the most important results obtained so far is the discovery of one Higgs boson. More precise measurements of this particle must be performed as well as there are other very important physics topics still to be explored. One of the key components of the ATLAS detector is its trigger system. It is composed of three levels : one (called Level 1 - L1) built on custom hardware and the two others based on software algorithms - called Level 2 (L2) and Event Filter (EF) – altogether referred to as the ATLAS High Level Trigger. The ATLAS trigger is responsible for reducing almost 20 million of collisions per second produced by the accelerator to less than 1000. The L2 operates only in the regions tagged by the first hardware level as containing possible interesting physics while the EF operates in the full detector, normally using offline-like algorithms to reach a final decision about recording the event.
Amongst the ATLAS subdetectors, there is a complex set of calorimeter specialized to detect and measure the energy of electrons, photons, taus, jets and even measure global event missing transverse energy.
The present work describes the performance of the ATLAS High-Level Calorimeter Trigger. Algorithms for detecting electrons and taus were able to reconstruct clusters of calorimeter cells, measure their energy and shower shape variables for particle classification with quite high efficiency. Since the beginning of the operation only minor modification on cut values were necessary given the wide range of instantaneous luminosity explored (over 5 order of magnitude). Another class of algorithms studies jets and can detect and estimate the energy of these using different cone sizes and jet finding techniques. Finally, an algorithm only for the Event Filter was design to measure with high precision the total transverse energy using only cells that are above their own noise level.
As the luminosity increased, it was fundamental to create an option for reducing the rate of events from the L1 into for EF missing E_{T} chains. So, the ATLAS L2 trigger operating paradigm of only using regions around the L1 based had to be broken for the special case of the missing E_{T}. The paper describes the parallel chain built in the ATLAS data acquisition system to accomplish this task. Also, it seemed increasingly important to work on a similar topic for the L2 jets. The usage of full detector information so that jets could be found in full scans of the detector - not limited by the L2 regions - is quite relevant for the efficiency of multiple jet algorithms. The option taken will also be described in the paper. Finally, we will describe the future plans of operation for the LHC run 2 data

taking period.

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