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Implementation and Performance of the ATLAS Second Level Jet Trigger

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ATLAS is one of the four major LHC experiments, designed to cover a wide range of physics topics. In order to cope with a rate of 40MHz and 25 interactions per bunch crossing, the ATLAS trigger system is divided in three different levels. The first one (LVL1, hardware based) identifies signatures in 2 microseconds that are confirmed by
the the following trigger levels (software based). The Second Level Trigger (LVL2) only looks at a region of the space around the LVL1 signature (called Region of Interest or ROI), confirming/rejecting the event in about 10 ms, while the Event Filter (Third Level Trigger, EF) has potential full event access and larger processing times, of the order of 1 s.
The jet selection starts at the LVL1 with dedicated processors that search for high ET hadronic energy depositions. At the LVL2, the jet signatures are verified with the execution of a dedicated, fast jet reconstruction algorithm. Given the fact that the main jet's background are jets,the energy calibration at the LVL2 is one of the major dificulties of this trigger, allowing to distinguish low/high energy jets. The algorithm for the calibration has been chosen to be fast and robust, with a good performance.
The other major dificulty is the execution time of the algorithm,dominated by the data unpacking time due to the large sizes of the jet ROI. In order to reduce the execution time, three possible granularities have been proposed and are being evaluated: cell based (standard), energy sums calculated at each Fron-End Board (FEB) and the use of the LVL1 Trigger Towers. The FEB and Trigger Tower granularities are also being used/evaluated for the reconstruction of the missing ET triggers at the Event Filter, given the short times available to process the full event. In this presentation, the design and implementation of the jet trigger of ATLAS will be discussed in detail, emphasasing the major dificulties of each selection step. The performance of the jet algorithm, including timing, eficiencies and rates will also be shown, with detailed comparisons of the different unpacking modes.

Submitted on behalf of Collaboration (ex, BaBar, ATLAS)

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