Preparing the ATLAS Jet Trigger for High Luminosity

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1 Introduction

The jet trigger of the ATLAS detector [1] is crucial for selecting events containing jets of high transverse energy. The ATLAS trigger consists of three stages employing increasingly complex algorithms: Level 1, Level 2 and the Event Filter (EF).

This article describes the performance of the jet trigger during the first half of the 2011 ATLAS data taking period. In addition, changes in the Event Filter with respect to the 2010 LHC run are presented.

2 Jet Trigger

For jet finding at Level 1 the calorimeter is segmented in trigger towers with a size of $\Delta\eta \times \Delta\phi = 0.1 \times 0.1$. Jets are then reconstructed using an area of 4×4 trigger towers with the a sliding window algorithm. A Region of Interest is created if the jet transverse energy is above a chosen threshold.

At Level 2, jet finding is done with a simple $\Delta R = 0.4$ cone algorithm in a $\Delta\eta \times \Delta\phi = 1.0 \times 1.0$ window centered on Regions of Interest from Level 1.

In the EF a so-called *full-scan* approach is used. At this stage the full event is present in memory, and all calorimeter cells can be used for identifying hadronic jets. An anti-k_T [2] (R=0.4) algorithm is then used on all topological clusters - as opposed to being restricted to one Region of Interest. At all stages, jets are constructed using transverse energy corrected only for the energy response of the electromagnetic calorimeter.

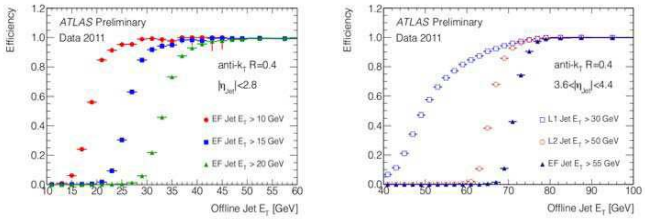
3 Changes and performance with early 2011 data

Switching the Event Filter from Region of Interest based read-out to the full-scan method leads to a faster execution in environments with many jets and does not produce (fake) duplicate jets. The new method also allows running Event Filter jet

algorithms after non-jet triggers on Level 1 and Level 2. This is useful for low energy threshold triggers for which the typically looser algorithms at Level 1 and Level 2 have too high rates.

Substituting the cone algorithm, previously used in the Event Filter, with the anti-k_T algorithm leads to better resolution with respect to offline jet reconstruction (which uses the anti-k_T algorithm). Reconstructing jets from topological clusters of calorimeter cells instead of simple trigger towers further improves the resolution. It also leads to increased stability in the presence of multiple interactions per bunch-crossing (pile-up).

Figure 1a shows the efficiency of Event Filter trigger selections with a low p_T threshold. Figure 1b shows the increasingly tight threshold, and sharper turn-on, of the forward jet trigger efficiency in the three trigger levels. The forward jet trigger selects jets with pseudo-rapidity (η) in the range $3.2 < |\eta| < 4.9$.



(a) Central, low threshold, EF-only chains.

(b) Forward jet chain at all three trigger stages.

Figure 1: Efficiency of different jet triggers with respect to the jet transverse momenta measured offline [3].

In summary, the ATLAS jet trigger selects events based on jets reconstructed in good agreement with offline algorithms.

References

[1] The ATLAS Collaboration *The ATLAS Experiment at the CERN Large Hadron Collider* JINST 3 (2008) S08003.

[2] M. Cacciari, G. Salam, G. Soyez *The anti-kt jet clustering algorithm* JHEP 0804 (2008) 063, arXiv:0802.1189.

[3] The ATLAS Collaboration *Public Jet Trigger Plots for Collision Data* https://twiki.cern.ch/twiki/bin/view/AtlasPublic/JetTriggerPublicResults retrieved on 14th November, 2011