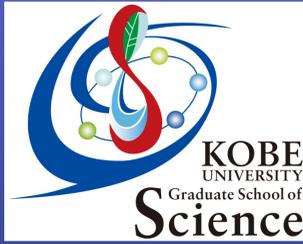


The Design and Performance of the ATLAS Jet Trigger



ATLAS
EXPERIMENT

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on behalf of the ATLAS Collaboration

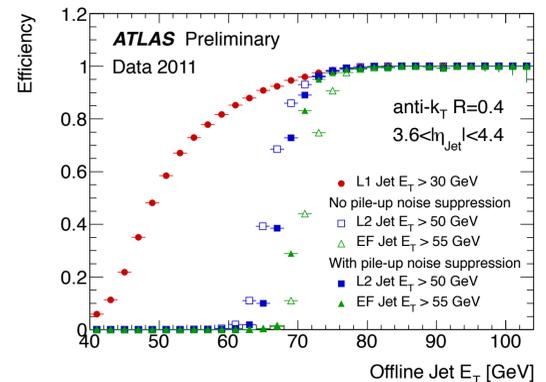
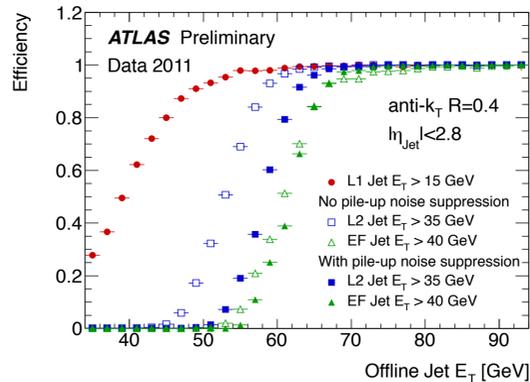


Introduction

Jet, a collimated spray of hadrons, is produced by a scattered quark or gluon with high transverse energy (E_T) and is an important signature in the collider physics. LHC provided proton-proton collisions at the centre-of-mass energies of 7 TeV with luminosity up to $3.65 \times 10^{33} \text{cm}^{-2}\text{s}^{-1}$ in 2011 and of 8 TeV with luminosity up to $6.76 \times 10^{33} \text{cm}^{-2}\text{s}^{-1}$, with the frequency of 20 MHz. The ATLAS trigger performs the first selection of interesting collision events at the LHC. ATLAS jet trigger is designed to tag jets with high flexibility, to adapt to the LHC beam conditions and to allow variety of physics analyses using the ATLAS data.

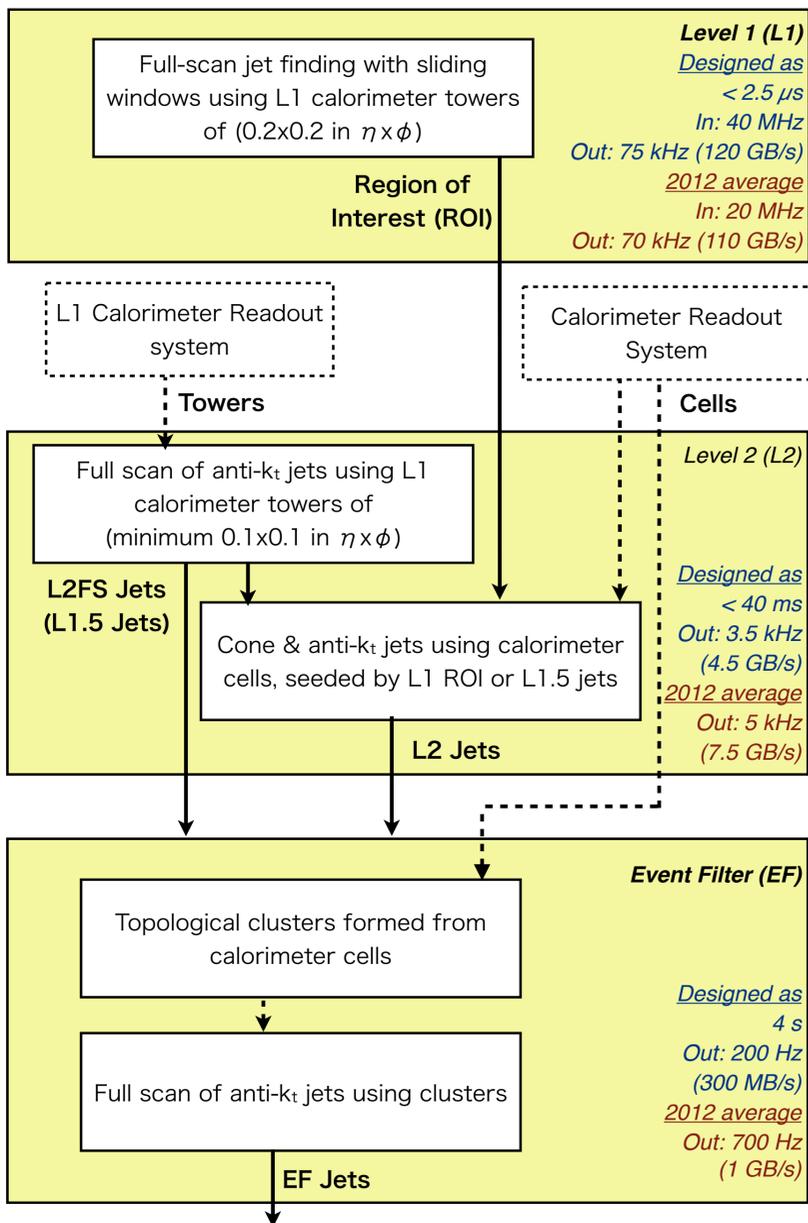
Pileup and Noise suppression

In order to suppress pileup and noise contributions, calorimeter cells with energy depositions above the threshold energies are considered at L2 and EF. This suppression gives improved jet energy resolution and hence sharpened efficiency turn-on.



Overview of ATLAS Jet Trigger

ATLAS trigger system consists of three levels, Level 1 (L1), Level 2 (L2) and Event Filter (EF), where L1 is hardware-based and L2 and EF are software-based. Jet trigger is allocated 25~30 % of the total bandwidth.

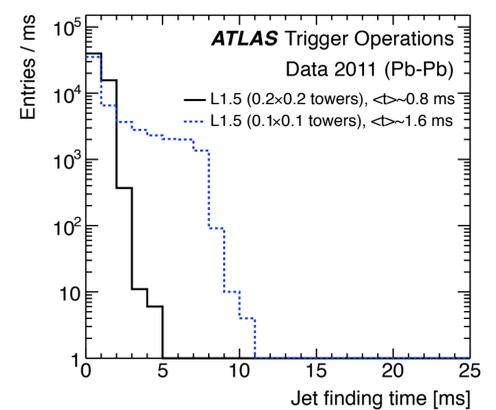
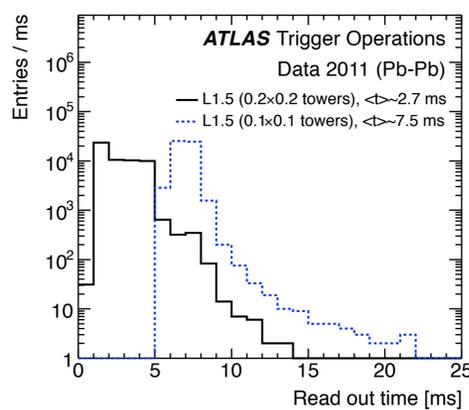
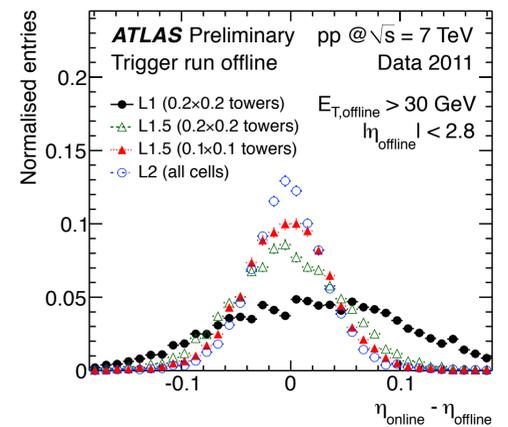


Performance of Level 2 Full Scan (L2FS)

L2FS is a new L2 algorithm and was in use in 2012. It reconstructs jets across the entire detector using L1 calorimeter towers (0.1×0.1 or 0.2×0.2 in $\eta \times \phi$) with the same jet algorithm as offline, e.g. anti- k_T algorithm. These L2FS jets (L1.5 jets) can be inputs to L2 jet finding, where jets are refined using calorimeter cells.

Improvement of jet angular resolution is seen by running the algorithm offline on the proton-proton collision data in 2011.

The time taken to read-out and to find jets for L2FS was measured during lead-lead collisions, where multiplicity in the ATLAS detector is extremely high. The plots show that the time needed is fast enough and within the design latency, ~40ms.



L2FS efficiency in 2012

Single jet trigger efficiency and multijet (≥ 6 jets) trigger efficiency are shown for L2FS jets in the 2012 operation.

While both electromagnetic (EM) jets with the threshold at 15 GeV and jets with hadronic calibration applied (EM+JES) with the threshold at 35 GeV give $>99\%$ efficiency at the offline jet p_T of 60 GeV, Trigger rate with EM+JES jets is smaller by 18% by EM jets.

As L2FS multijet trigger can use all the L1 calorimeter towers including the ones rejected at L1 jet finding, L2FS trigger achieves full efficiency. It couldn't be done with L1 ROI-based approach only. (In the plot, events are pre-selected by four-jet trigger.)

