LHCC Poster Session - CERN, 2 March 2016

ATLAS Jet Trigger Efficiency in 2015 Data

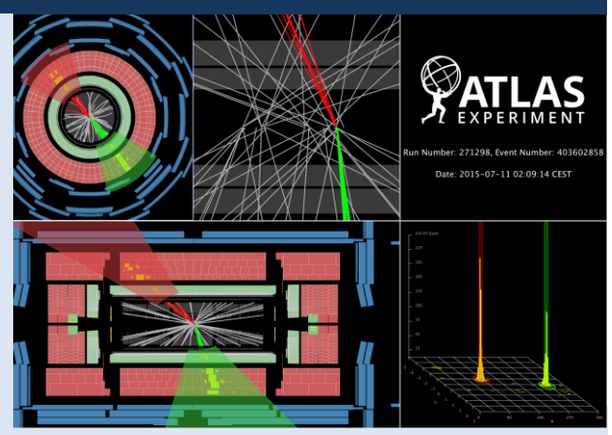
The ATLAS experiment at the LHC uses a two-level trigger system to preferentially select events with a predefined topology of interest for future analysis. In this poster, the hadronic jet trigger efficiency for proton-proton collision data at a centre-of-mass energy of 13 TeV is presented. The single-jet and multi-jet efficiency is presented as a function of the jet transverse momentum. In addition, the efficiency of specialist triggers that use scalar-summed jet transverse momenta are also presented.

The ATLAS trigger system

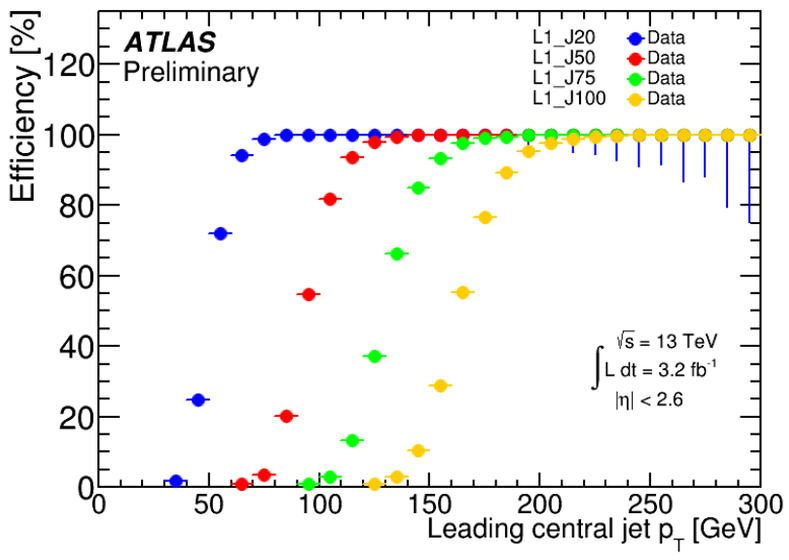
- ATLAS uses a two-level trigger system to select interesting events from an event rate of up to 40 MHz
- Level 1 (L1) trigger: hardware trigger that creates Regions of Interest (RoIs) and reduces the rate to 100 kHz
- High Level Trigger (HLT): software trigger seeded by L1 RoIs. Uses fast algorithms to reconstruct the full event and reduces the rate to 1 kHz

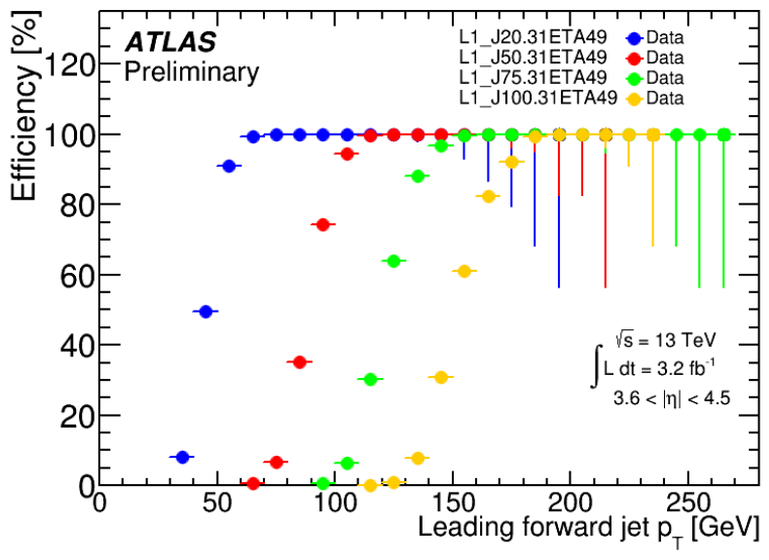
Jet trigger system

- The jet triggers primarily select events with high transverse momentum (p_T) jets
- L1 trigger jets are formed from RoIs, of size 0.8 x 0.8 in η x φ, at the electromagnetic energy scale
- HLT jets are formed from calorimeter clusters at the electromagnetic energy scale using the anti-k_T algorithm with distance parameter R = 0.4. The HLT jets are then calibrated to the hadronic scale by first applying a jet-by-jet area subtraction procedure followed by a jet energy scale weighting that is dependent on the HLT jet p_T and η



L1 single-jet efficiencies

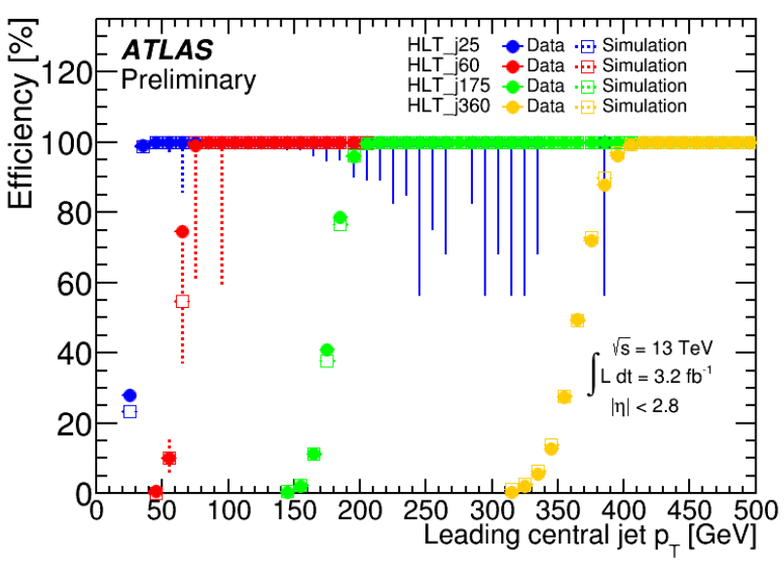


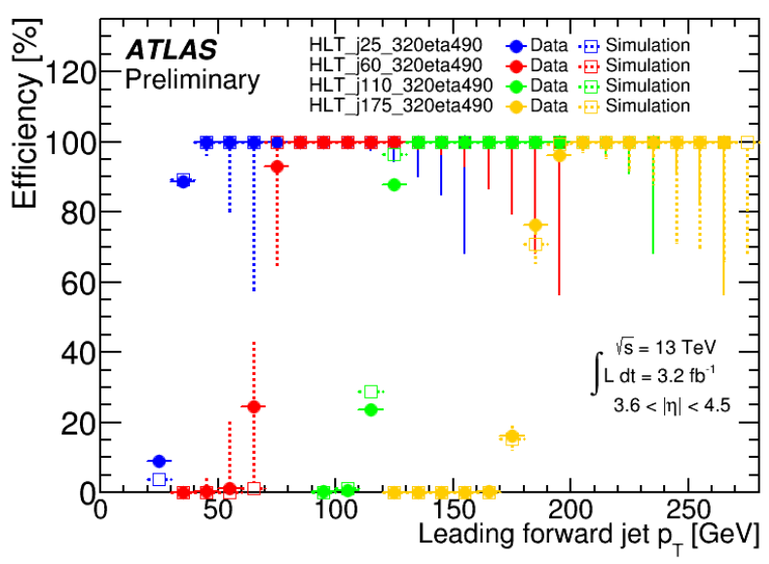


- Efficiencies are presented as a function of the transverse momentum for a selection of single-jet and multi-jet triggers
- Each efficiency is determined using events retained with a lower threshold trigger that is found to be fully efficient in the phase space of interest
- Per-event efficiency turn-on curves are compared between data and simulation (Pythia 8) for typical thresholds and the full 2015 dataset
- HLT_j360 was the lowest unprescaled trigger in 2015. The rest of the triggers were prescaled to typically 1 Hz

Comparison of (left) L1 central (|η| < 2.6) and (right) forward (3.6 < |η| < 4.5) per-event trigger efficiencies. The geometrical and algorithmic differences between L1 and offline procedures cause broad turn-ons.

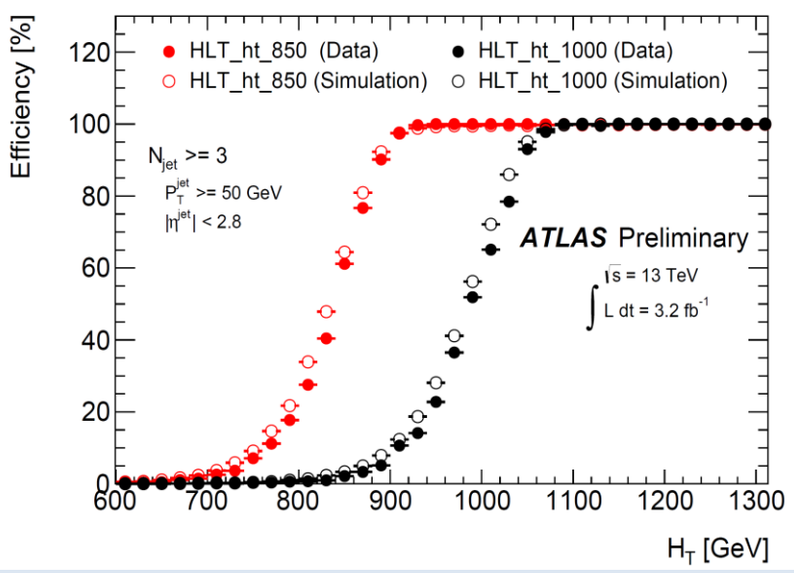
HLT single-jet efficiencies





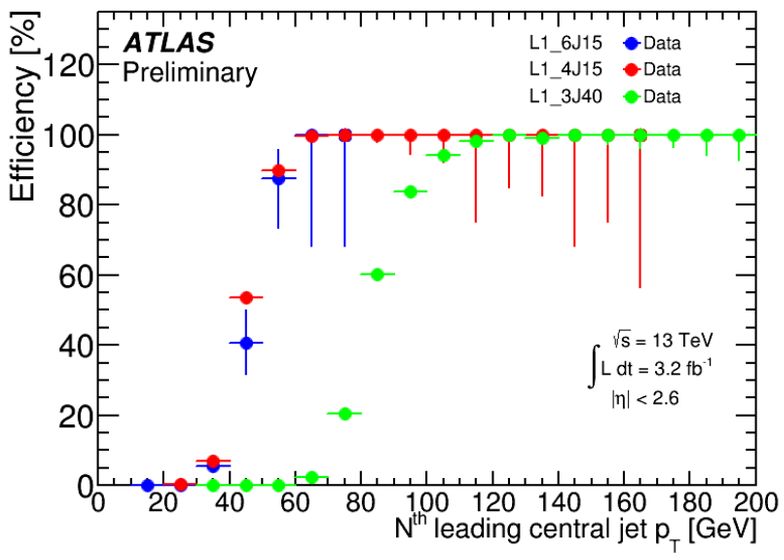
Comparison of (left) HLT central (|η| < 2.8) and (right) forward (3.6 < |η| < 4.5) per-event trigger efficiency turn-on curves. Steeper turn-on than L1 is observed and good agreement between data and simulation.

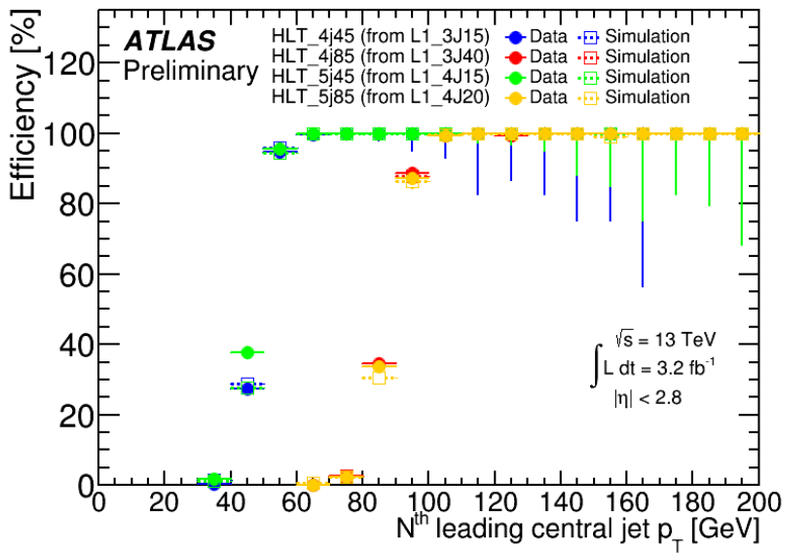
HT efficiencies



Comparison of per-event HT (scalar sum of jet p_T for all central jets with p_T > 50 GeV) trigger efficiency turn-on curves for events with at least three central jets with p_T > 50 GeV. Broad turn-on but good agreement between data and simulation.

Multi-jet efficiencies





Comparison of per-event isolated (left) L1 and (right) HLT multi-jet trigger efficiency turn-on curves. Isolation is enforced by requiring each of the N leading jets to be isolated by ΔR > 0.6 from all other reconstructed offline jets with p_T > 20 GeV. The efficiencies of HLT_4j45 and HLT_5j45 are very similar, the efficiency is relatively unaffected by the number of jets.

Summary

- Good agreement between data and simulation for single-jet triggers, both central and forward
- Multi-jet triggers with different number of jets but same threshold have very similar efficiencies
- The HT triggers have a broad turn-on but there is a good agreement between the data and the simulation
- The lowest unprescaled single-jet trigger, HLT_j360, is fully efficient above 410 GeV

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