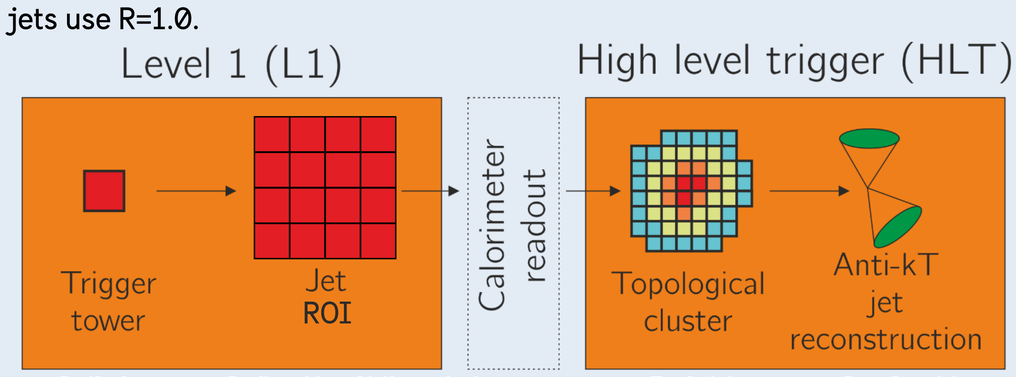
LHCP Poster Session - Bologna, 4-9 June 2018

TRIGGERING STRATEGY OF HADRONIC SIGNATURES IN ATLAS EXPERIMENT

Hadronic signatures, one of the cornerstone pieces of the ATLAS physics program, are facing challenging luminosity conditions during Run 2 of the LHC. Such signatures, ranging from standard quark or gluon jets to those originating from the decay of massive particles, are recorded using a specialised set of triggers in the ATLAS detector. Also, missing transverse energy (MET) from non-interacting particles provides a unique probe in the search for new physics. This poster highlights the performance and recent developments of the jet and MET triggering strategies as employed by the ATLAS experiment in 2017 and 2018.

Jet reconstruction in ATLAS

- Jets are built from calorimeter information to capture collimated showers of particles produced in high-energy collisions.
- Jets are defined by the reconstruction algorithm (anti-kT) and their radius (R) in the eta-phi plane. In the ATLAS trigger, small-R jets use R=0.4 and large-R jets use R=1.0.



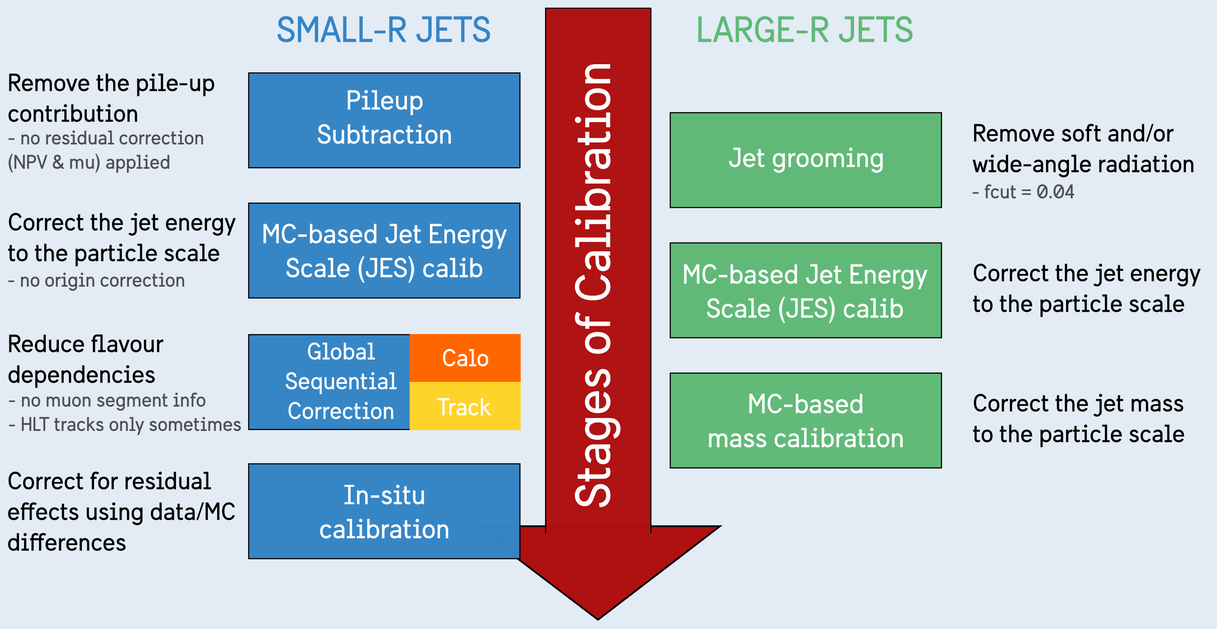
▲ Built from calo (0.2x0.2 in size)

▲ Defined by sliding window algo, creating Region of Interest (ROI)

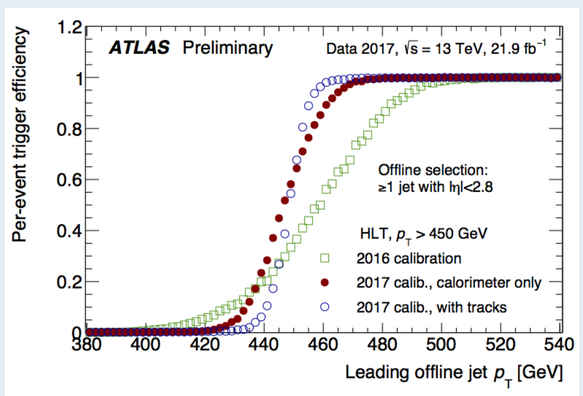
▲ Exploiting signal/noise ratio

▲ Jet algorithm

Jet trigger calibration



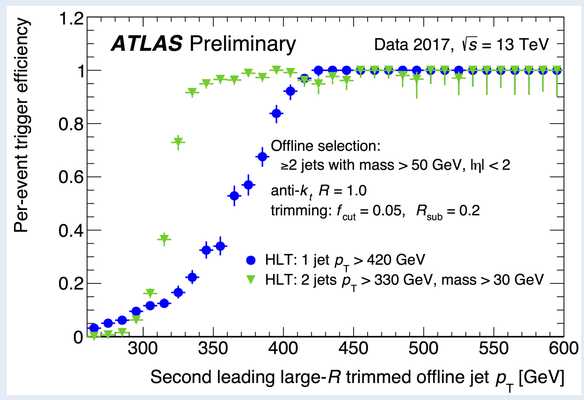
Jet trigger performance and developments



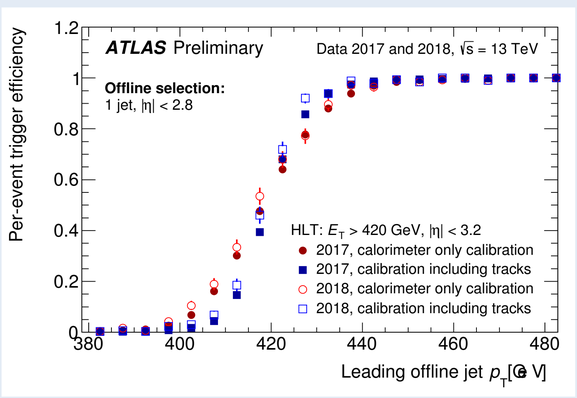
▲ Turn on curves for single-jet trigger with R=0.4 using three different sets of calibrations in 2016 & 2017 data.[1]

- HLT jet triggers typically run after finding a relevant L1 RoI.
- There is a sizable performance gain from combining calorimeter and tracking information, using HLT tracks computed for b-tagging to apply the GSC.
- Trigger efficiency turn on curves indicate the relative resolution difference between HLT and offline jets.
- Better resolution (HLT vs offline) means lower trigger threshold can be run within rate limitations.

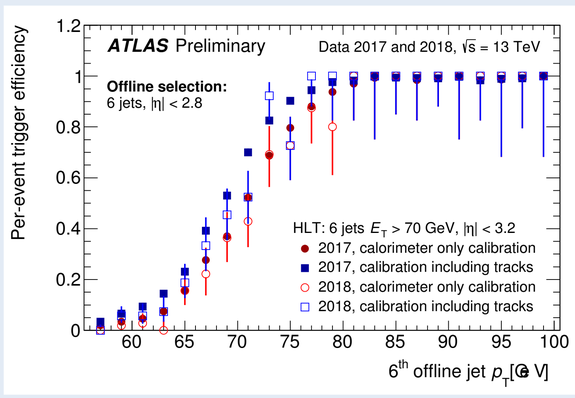
- In 2017/2018, the level one topological trigger system (L1Topo) has been used to improve the L1 trigger for jets with real structure (multiple subjets).
- Applying a mass cut on groomed jets rejects many QCD jets while retaining W/Z/top jets.
- The application of jet grooming techniques (trimming) greatly reduces pileup effects.



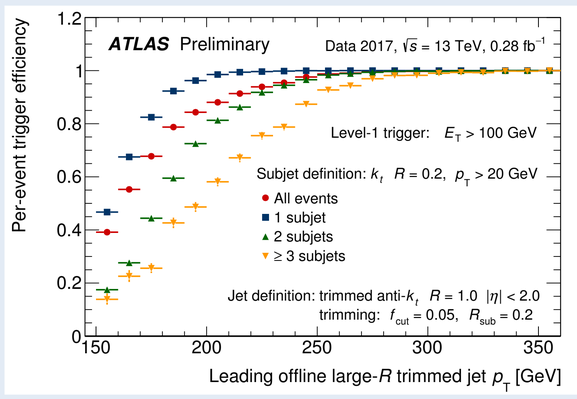
▲ Turn on curves for jet trigger with R=1.0 as a function of second-leading offline trimmed jet pT. [1]



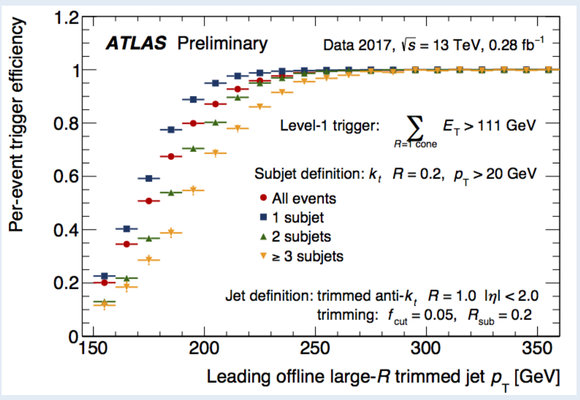
▲ Turn on curves for single-jet trigger with R=0.4 using two different sets of calibrations for 2017 & 2018 data.[1]



▲ Turn on curves for multi-jet trigger with R=0.4 using two different sets of calibrations for 2017 & 2018 data.[1]



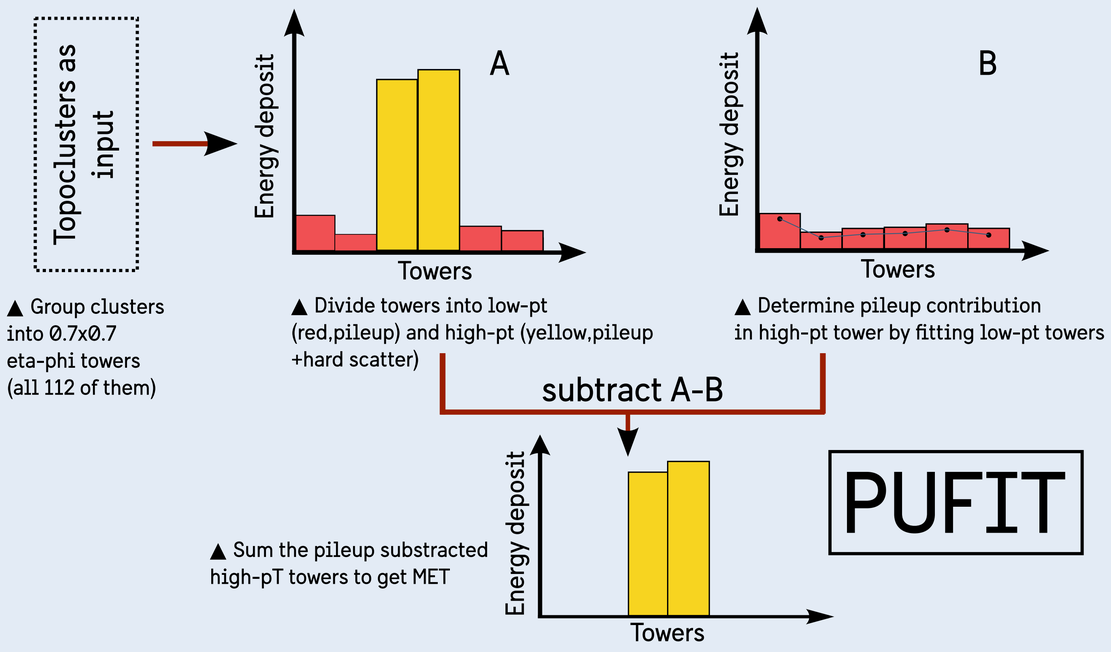
▲ Efficiency curve for L1 trigger with Et > 100 GeV.[1]



▲ Efficiency curve for L1Topo trigger with Et > 111 GeV.[1]

MET trigger performance and developments

- Missing Et (MET) triggers are built using only calorimeter information. In 2017/2018, they now use the pile-up fit (pufit) algorithm to significantly reduce pileup effects.



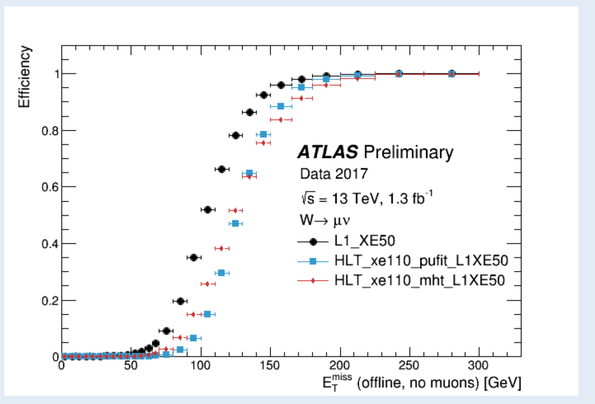
▲ Group clusters into 0.7x0.7 eta-phi towers (all 112 of them)

▲ Divide towers into low-pt (red,pileup) and high-pt (yellow,pileup +hard scatter)

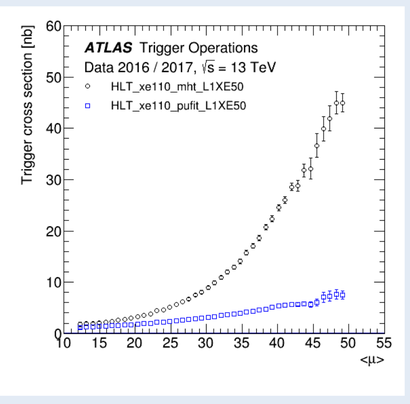
▲ Determine pileup contribution in high-pt tower by fitting low-pt towers

▲ Sum the pileup substracted high-pT towers to get MET

- Pufit has a better efficiency and significantly reduces the pileup dependence of the MET trigger as compared to the mht algorithm (the previously used algorithm, which is calculated as the sum of HLT jets).



▲ Combined MET trigger efficiency with pufit and mht as well as its corresponding L1 trigger. [2]



▲ Comparison of trigger cross section measured in trigger rate between pufit and mht.[2]

References: [1] https://twiki.cern.ch/twiki/bin/view/AtlasPublic/JetTriggerPublicResults [2] https://twiki.cern.ch/twiki/bin/view/AtlasPublic/MissingEtTriggerPublicResults

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