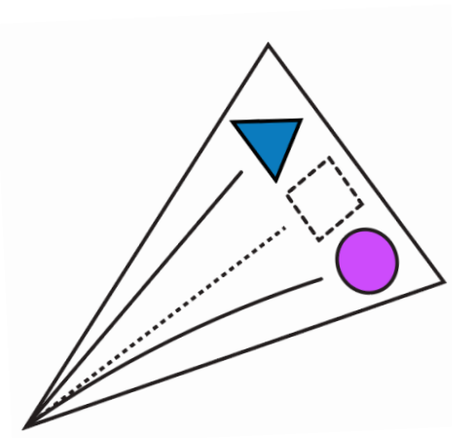
IMPACT OF ALTERNATIVE INPUTS AND GROOMING METHODS ON LARGE-R JET RECONSTRUCTION IN ATLAS

High-energy *pp* collisions at the LHC may produce massive hadronically-decaying particles (e.g. *W*/*H*/*Z* bosons or top quarks) with large transverse momenta (p_T). The progeny of these objects may be reconstructed as a single jet with a large radius parameter, *R*.

Large-*R* jet reconstruction in ATLAS was last optimised during Run 1 of the LHC. Theoretical improvements to grooming algorithms and changes in the LHC running conditions have prompted a reassessment of the available options for large-*R* jet reconstruction during Run 2.



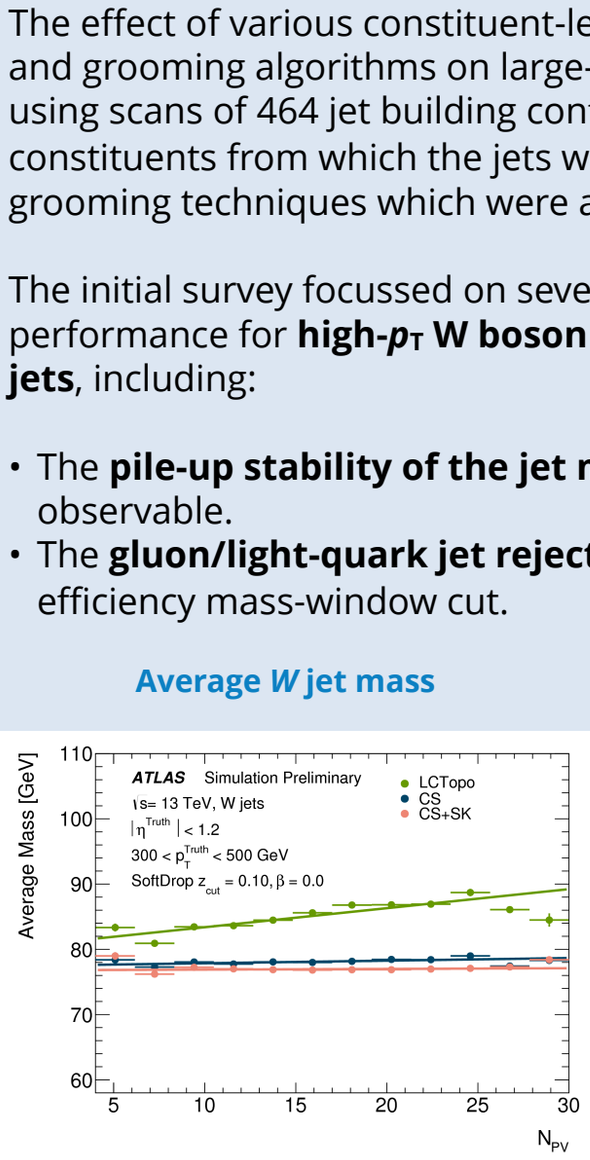
Survey & Performance Metrics

The effect of various constituent-level pile-up mitigation techniques and grooming algorithms on large-*R* jet performance was evaluated using scans of 464 jet building configurations, which varied the constituents from which the jets were built and parameters of grooming techniques which were applied.

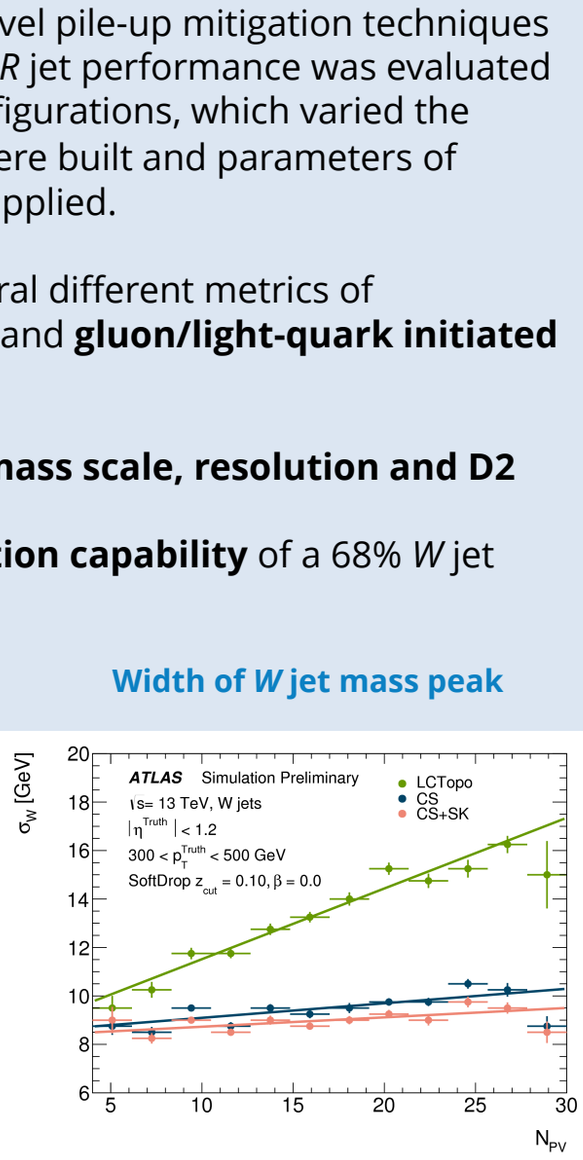
The initial survey focussed on several different metrics of performance for **high-p_T W boson** and **gluon/light-quark initiated jets**, including:

- The **pile-up stability of the jet mass scale, resolution and D2** observable.
- The **gluon/light-quark jet rejection capability** of a 68% *W* jet efficiency mass-window cut.

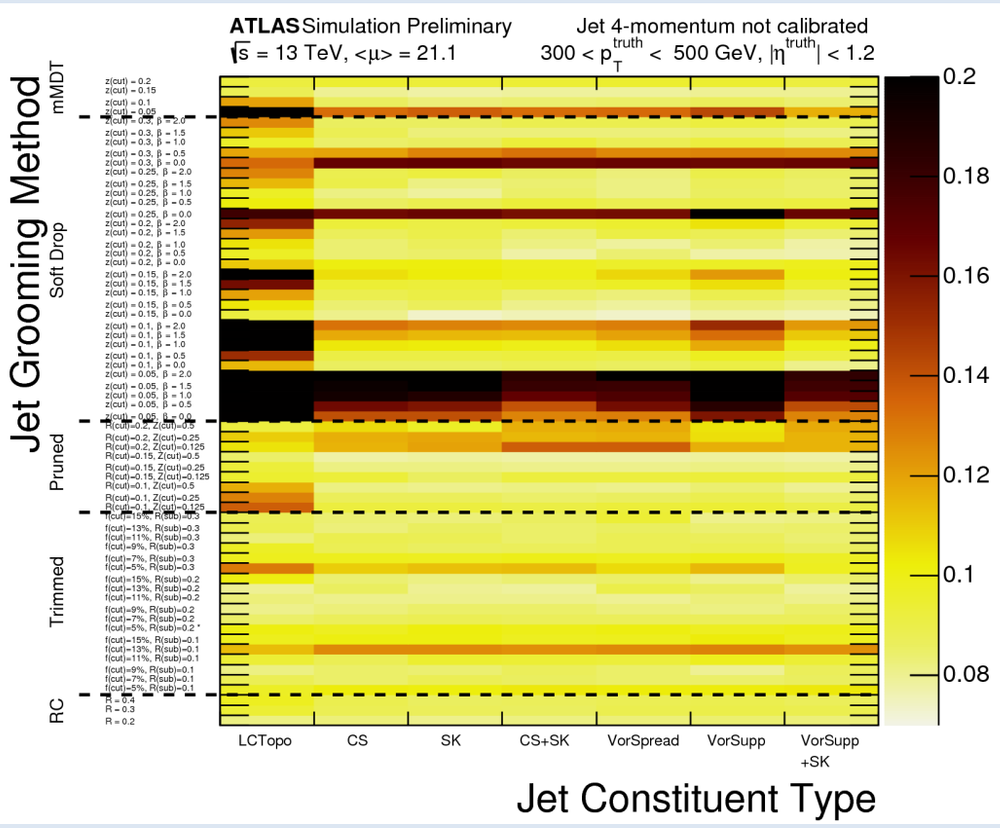
Average *W* jet mass



Width of *W* jet mass peak



The combined application of the **constituent subtraction + SoftKiller (CS+SK)** pile-up mitigation algorithms was noted to increase the pile-up stability of large-R jets without degrading their tagging performance, regardless of the grooming procedure. Several configurations which use area-based **Voronoi subtraction (VS, VorSupp)** algorithms were also studied.

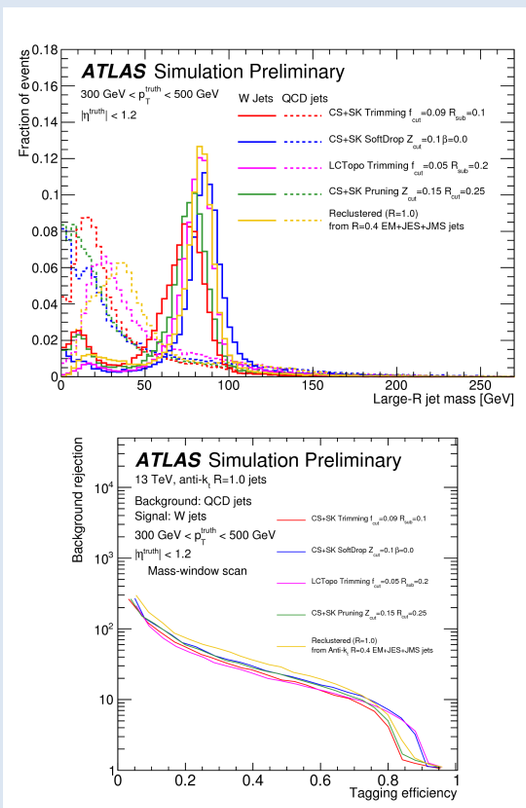


Performance

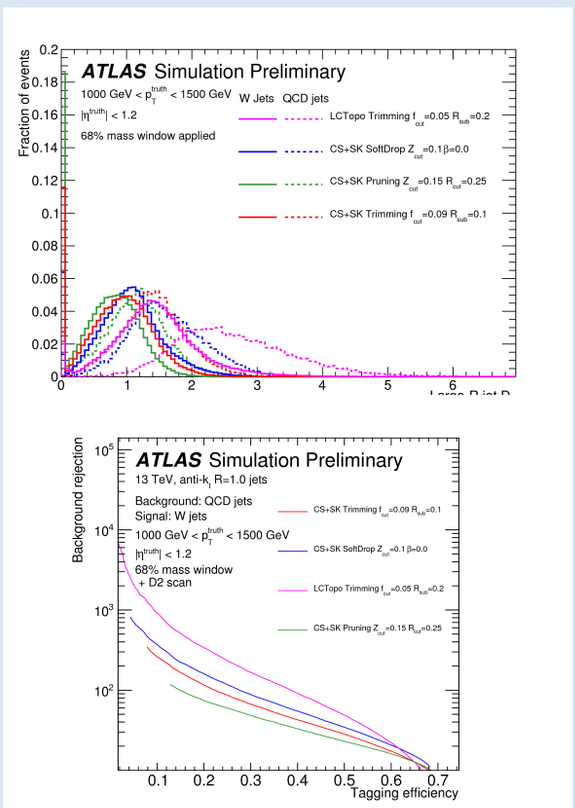
The performance of mass-based tagging may be improved by more aggressive grooming algorithms, though such treatment may also destroy more detailed jet substructure information.

For jets with p_T between 300 and 500 GeV, **reclustering** calibrated R=0.4 jets is noted to be a competitive option for mass reconstruction. At higher p_T, the substructure information retained by the **nominal ATLAS trimming configuration** leads to significant performance gains.

Simple mass-window tagger



Mass window + *D2* tagger



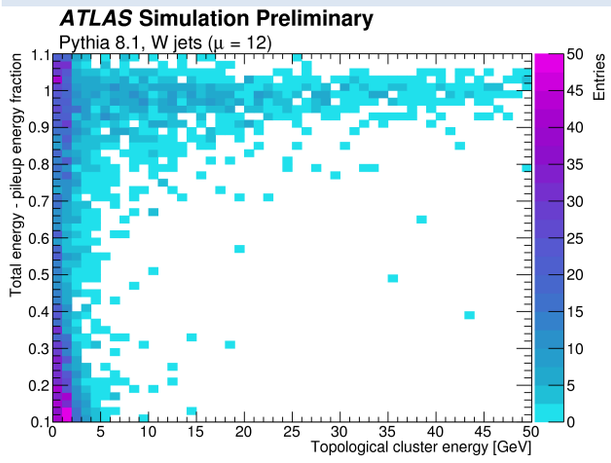
Digitisation Studies

Propagation of the fraction of energy per-cell which originates from the hard-scatter process allows for new types of studies which demonstrate the impact of grooming algorithms on jets.

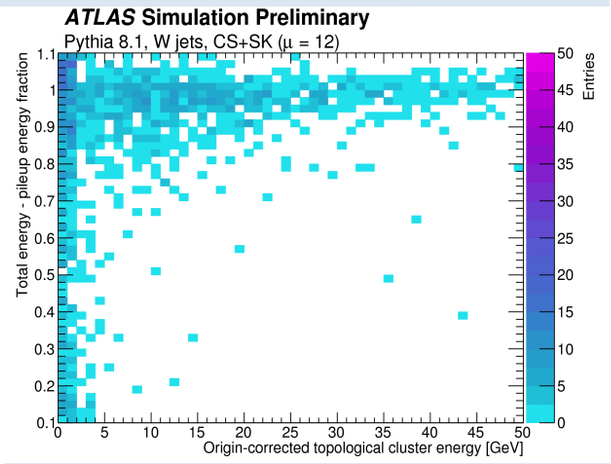
Calorimeter topological clustering appears to result in distinct populations of clusters dominated by pile-up and hard scatter energy

For the first time, **grooming techniques have been shown to preferentially remove pile-up dominated clusters** from jets.

Ungroomed *R*=1.0 LCTopo Jets



Trimmed *R*=1.0 LCTopo Jets



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