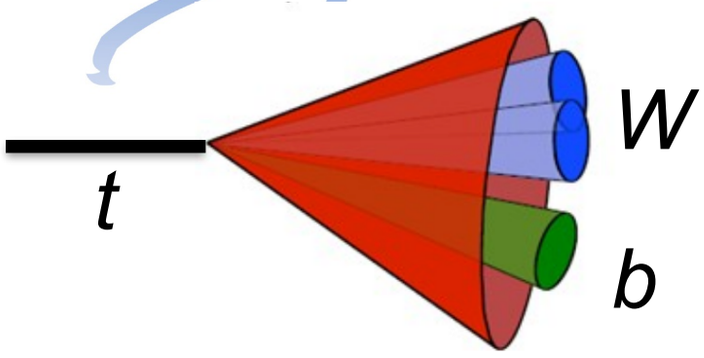
BOOST Poster Session - Paris, 16-20th July, 2018

Alternative Inputs and Grooming on Large-*R* Jets in Run 2 of the ATLAS Detector

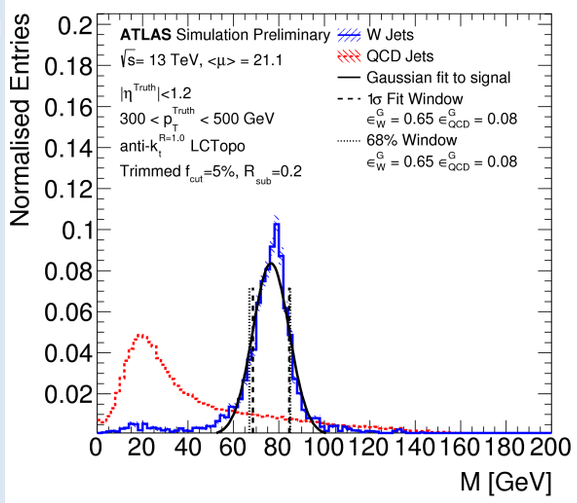


High-energy *pp* collisions at the LHC may produce massive hadronically-decaying particles (e.g. *W*/*Z*/*H* bosons or top quarks) with large transverse momenta (p_T), where the resulting decay products can be reconstructed as a single large-*R* jet.

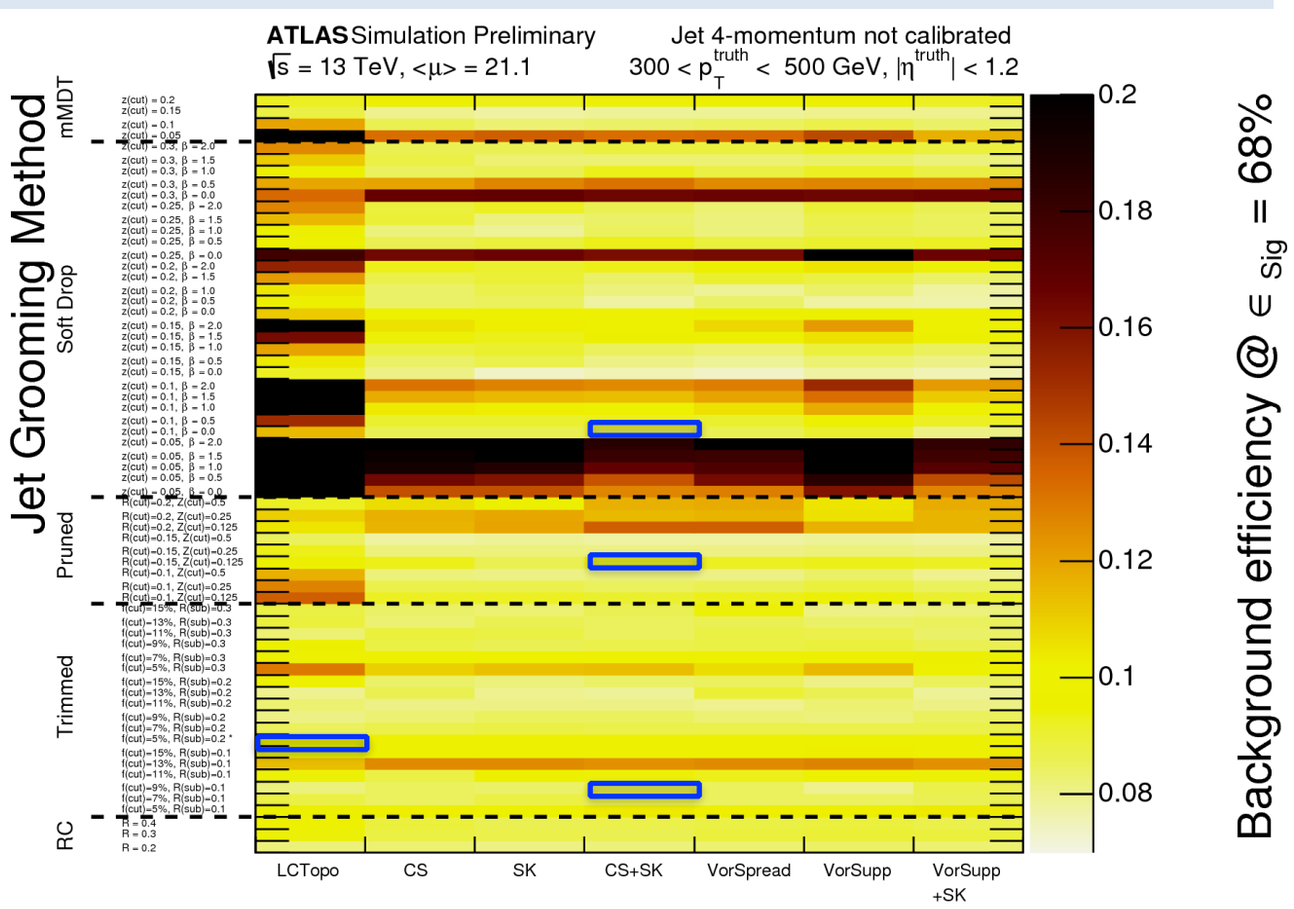
Large-*R* jet reconstruction in ATLAS was last optimised during Run 1 of the LHC. Since then, a wealth of theoretical developments in constituent subtraction and jet grooming have been proposed and investigated for large-*R* jets in Run 2.

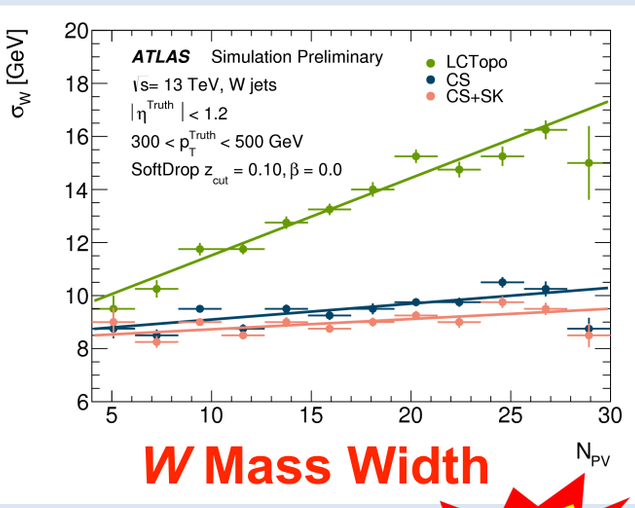
1. Inputs and Grooming Scan

- The impact of different groomers on *R* = 1.0 jets in ATLAS has been evaluated.
- Scanned 464 different jet definitions, using **Soft Drop**, **trimming**, **pruning**, the **modified mass drop tagger (mMDT)**, jet **reclustering**, and **constituent-subtraction** techniques.

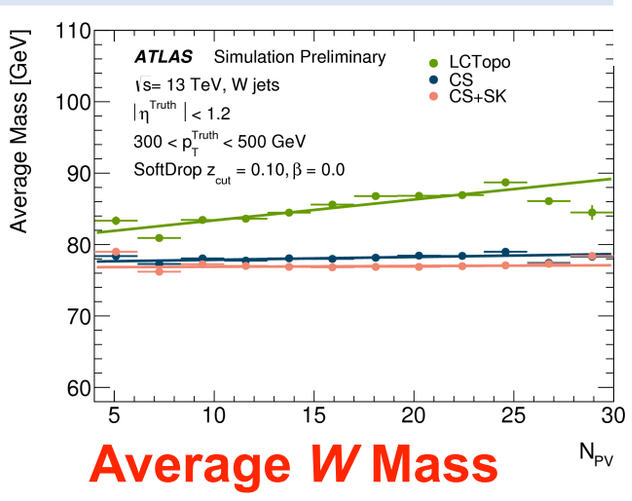


- Several metrics considered when investigating the performance of boosted *W* jets and quark/gluon-initiated light jets:
  - **The pile-up stability of the jet mass scale, resolution and D_2 observable.**
  - **The gluon/light-quark jet rejection capability of a 68% *W* jet efficiency mass-window cut.**





W Mass Width



Average *W* Mass

2. First Results (2017)

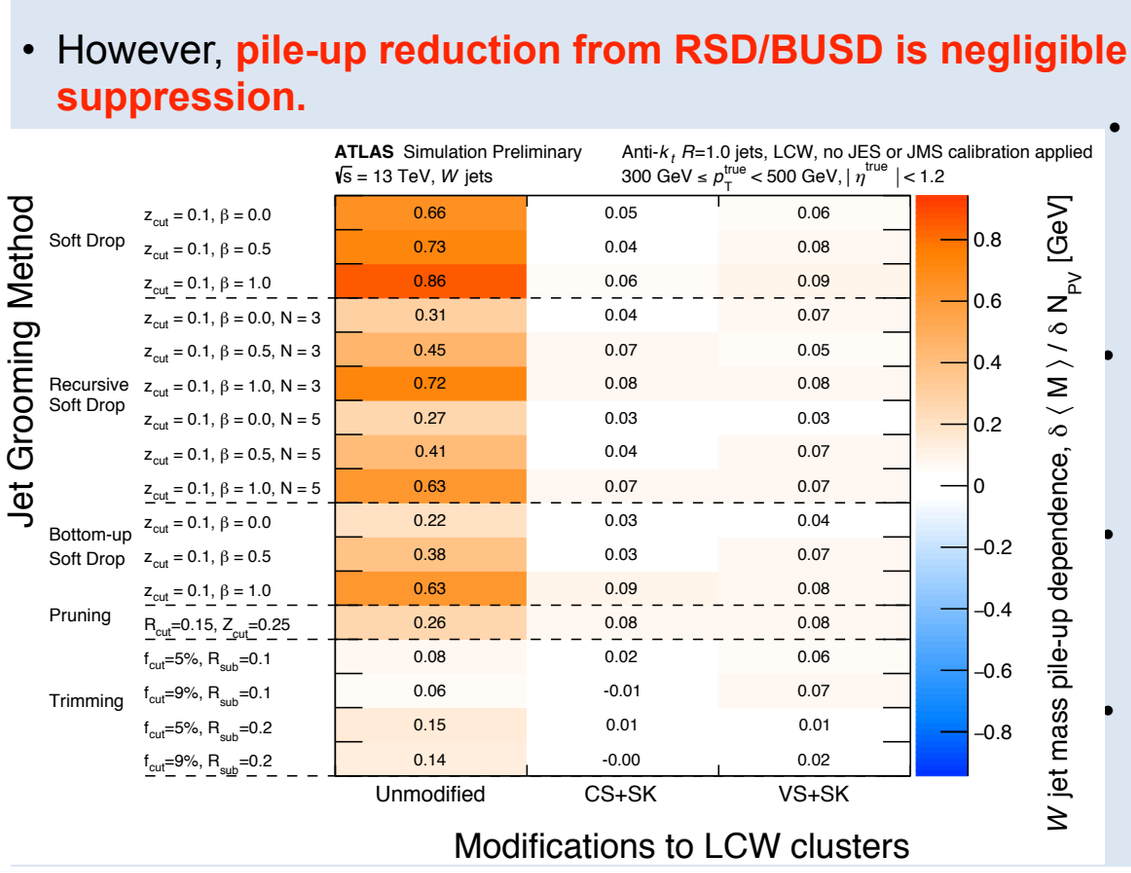
- **Constituent subtraction + SoftKiller (CS+SK)** pile-up mitigation noted to increase the pile-up stability of large-*R* jets without degrading tagging performance, regardless of the grooming procedure.

Constituent Type	Grooming Algorithm	Parameter Choice
CS+SK	Soft Drop	$z_{\text{cut}} = 0.1,\ \beta = 0$
CS+SK	Pruning	$z_{\text{cut}} = 0.15,\ R_{\text{cut}} = 0.25$
CS+SK	Trimming	$R_{\text{sub}} = 0.1,\ f_{\text{cut}} = 9\%$
LCTopo	Trimming	$R_{\text{sub}} = 0.2,\ f_{\text{cut}} = 5\%$
EMTopo	Reclustering	$R(small\text{−R}) = 0.4,\ f_{\text{cut}} = 5\%$

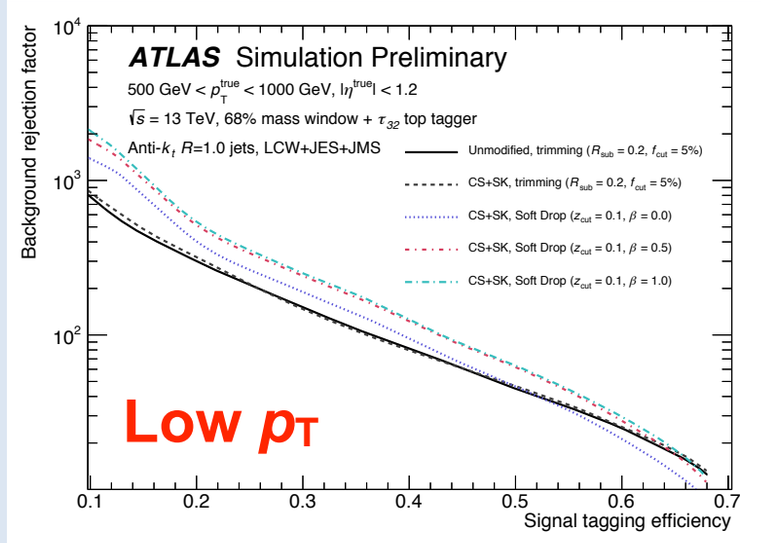
3. Latest Results ! (2018)

New!

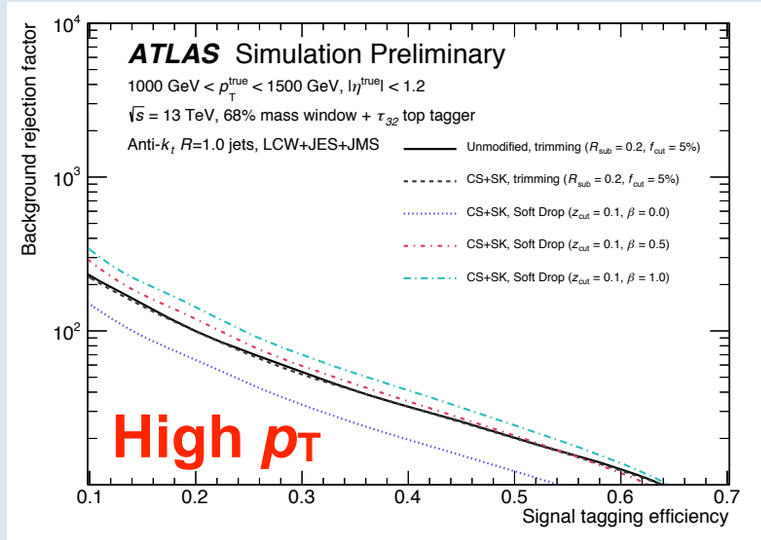
- **Recursive** and **Bottom-up Soft Drop** (RSD/BUSD) now added to the grooming scan.
- RSD/BUSD offer reduction in *W* jet mass pile-up dependence with respect to 'vanilla' Soft Drop.
- However, **pile-up reduction from RSD/BUSD is negligible after constituent-level pileup suppression.**



- Simple **mass cut + τ_{32} top-tagger** made for the different **CS+SK Soft Drop jets**, applied to a sample enriched in top jets.
- Substantial improvement in background rejection from the **β = 1.0 Soft Drop jets**.
- Suggests we can improve upon our current grooming definition, with largest gains at high p_T.
- Similar improvements seen for *W* tagging at low p_T (similar performance to trimming at high p_T).



Low p_T



High p_T

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on behalf of the **Jet Inputs and Grooming Team** and **ATLAS Collaboration**

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