

Optimization of a jet finding algorithm for the HL-LHC ATLAS L0 Trigger

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Introduction - Motivation

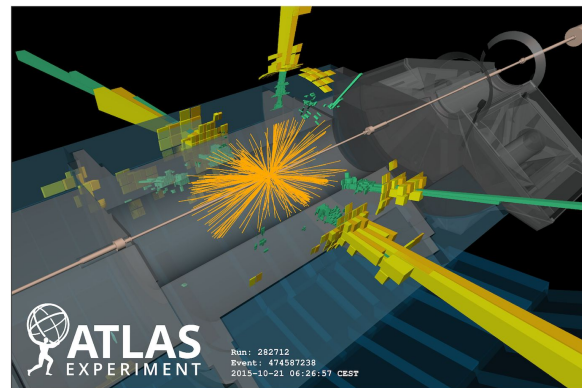
Trigger algorithms help us select events of interest.



Demanding challenge!

Jet identification in the current hardware level: Fixed-Cone.

(Not Ideal)

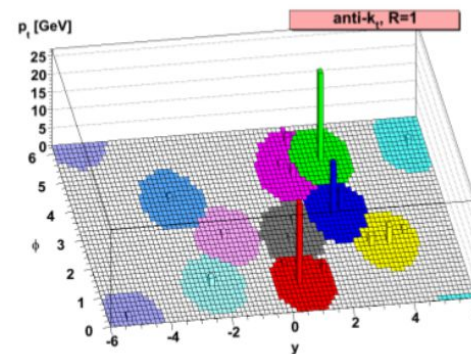


Preferably:

- It should provide highly-efficient jet identification with accurate reconstruction of jet parameters.
- It should reproduce jet finding done in analyses as accurately as possible.

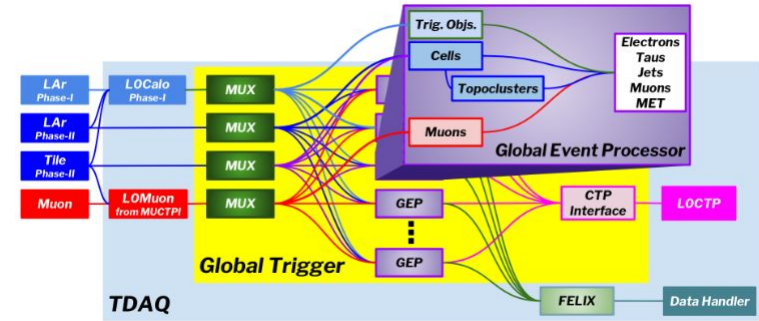
→ The anti- k_T algorithm solves this!

↓
So... Why isn't it currently implemented?



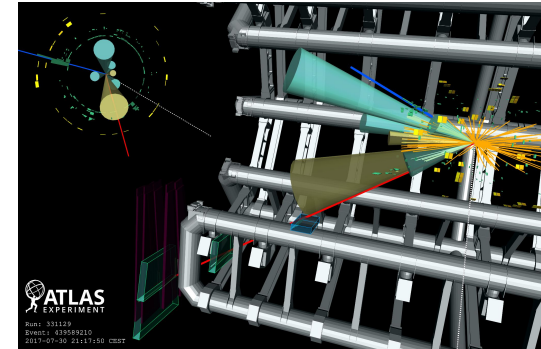
The HL ATLAS Global Trigger will allow more sophisticated algorithms.

→ A modified anti-kT was developed.



Specific signal topology:

- Multi-jet signals.
- Signals with jets that are spatially close together.



The anti-kT algorithm

$$d_{ij} = \min(p_{T,i}^{-2}, p_{T,j}^{-2}) \frac{\Delta R_{ij}^2}{R^2} \longrightarrow$$

$$d_{iB} = p_{T,i}^{-2}$$

Recombination of i and j objects via the
“E-Scheme”



We opt to use the “WTA” instead.

Algorithm inputs in our implementation:

Topoclusters from the GEP.

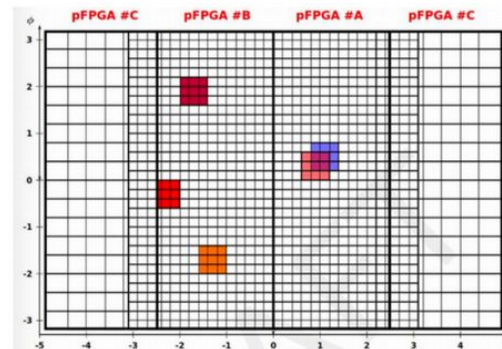
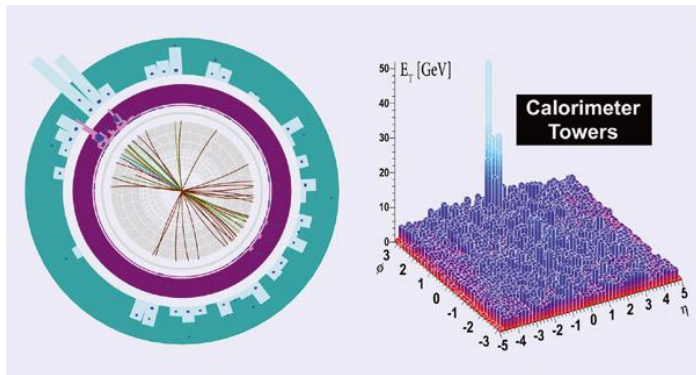


Regions of interest (RoIs)

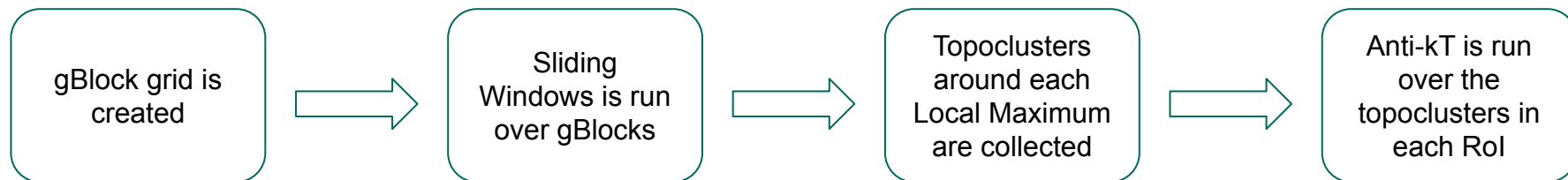
The total number of topoclusters is too high \longrightarrow

RoIs are defined using the
Sliding Windows algorithm

SW: Which inputs to use? Which windows size to use?

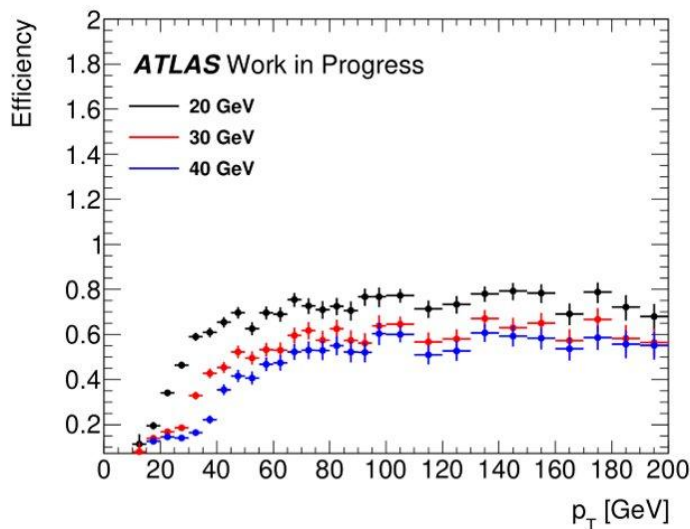


Algorithm workflow (Summary)



Algorithm performance: Last year results

MC samples used *Signal:* All-hadronic $Z' \rightarrow t\bar{t}$
Non-resonant $HH \rightarrow bbbb$ *Background:* Low p_T dijet events

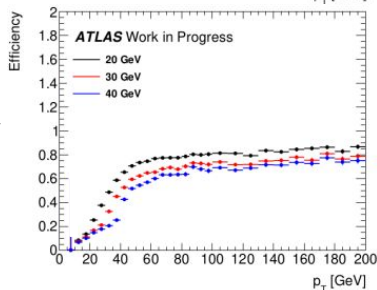
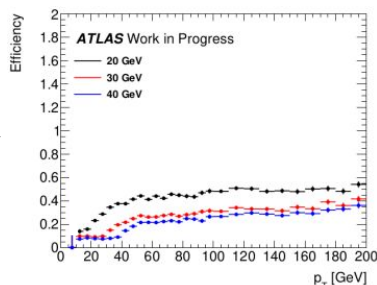


Trigger efficiency as a function of the 4th jet p_T for different trigger thresholds

Optimization needed!

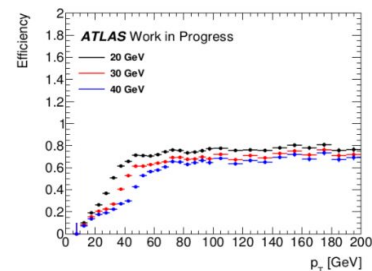
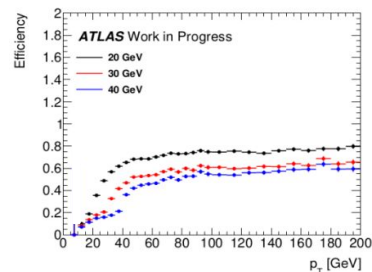
Parameter tweaking

Minimum E_T of the Local Maxima

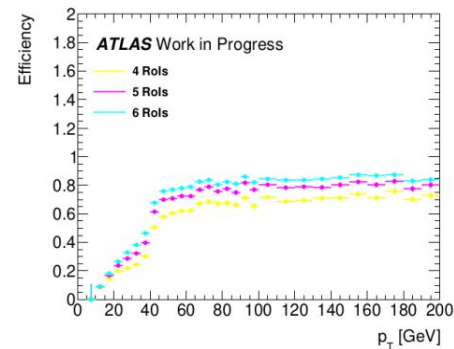


Minimum E_T of the topoclusters

No cut



Number of RoIs



(40 GeV Threshold)

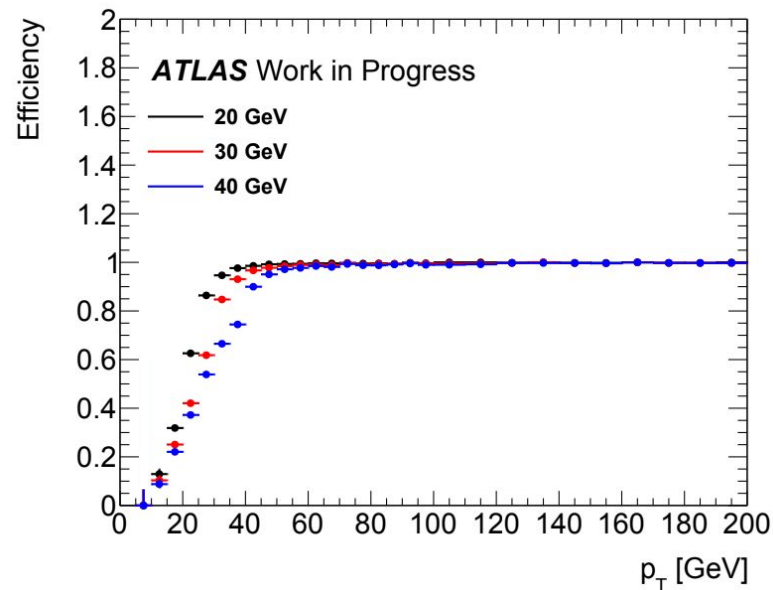
Algorithm optimization

- Partially reconstructed jets:

Number of jets reconstructed with the base anti- k_T was higher.

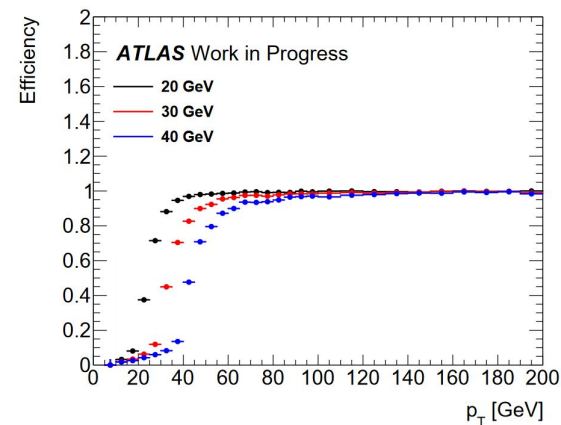


We need to increase the number of jets reconstructed with our algorithm.



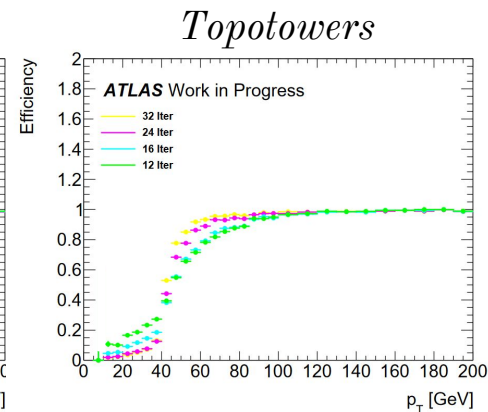
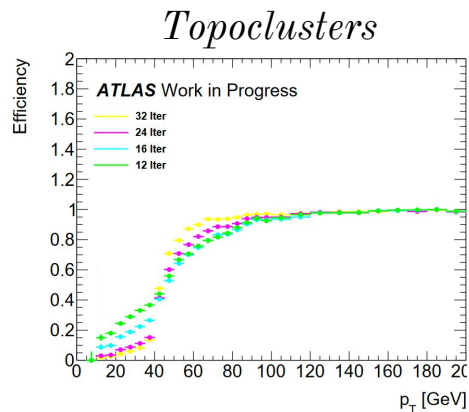
- **Overlap removal:**

Non-zero acceptance for events below the p_T threshold. \longrightarrow Removal of duplicated jets.

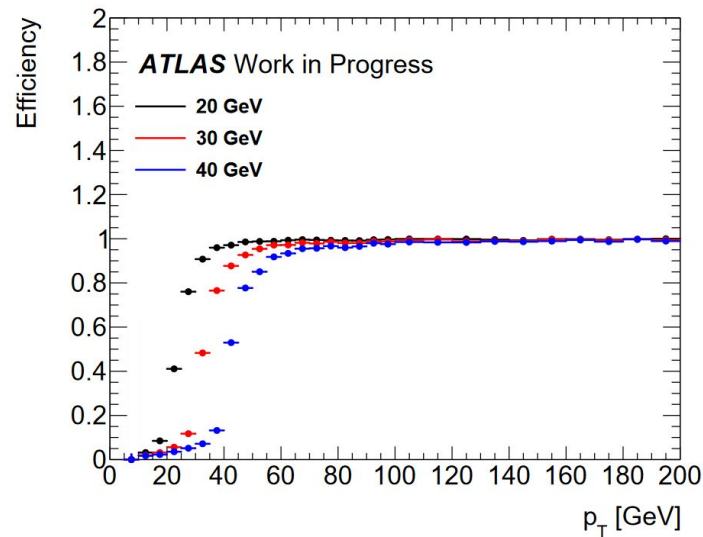
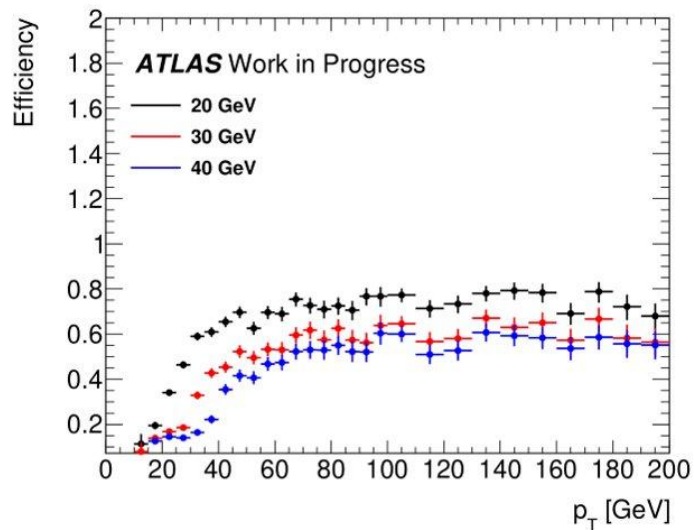


- **Topotowers:**

Need to get more information in the established number of iterations. \longrightarrow Use groups of topoclusters as an input.



Optimization results



Trigger rates - What comes next?

