Splitting Strip Detector Clusters in Dense Environments

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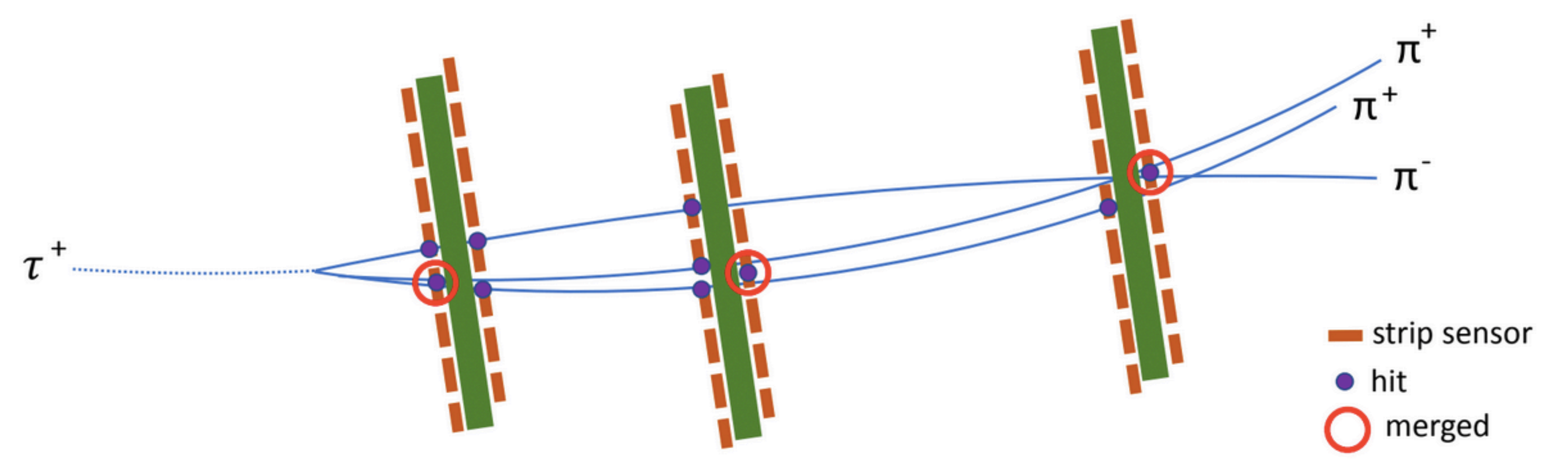
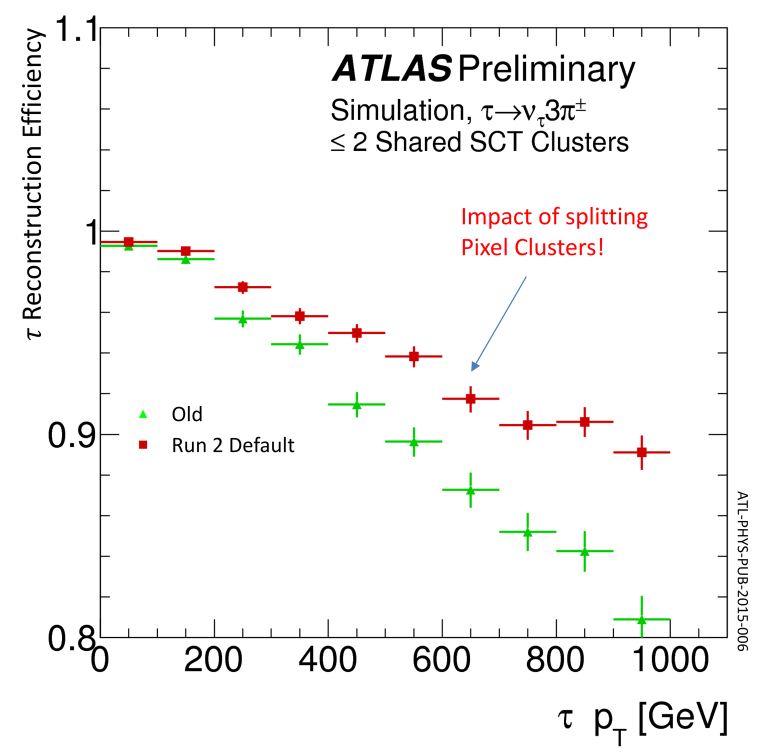
This poster illustrates the investigation of a new method of determining SCT-cluster merging and the impact of allowing merged clusters to be shared without penalty in the ATLAS track-selection workflow. The SCT is a silicon strip tracker consisting of four double-sided layers, comprising the fifth-eighth layers of the ATLAS inner detector. A merged cluster is one that arises from multiple truth particles. ATLAS selects final reconstructed tracks by performing ambiguity solving on sets of track- candidates.

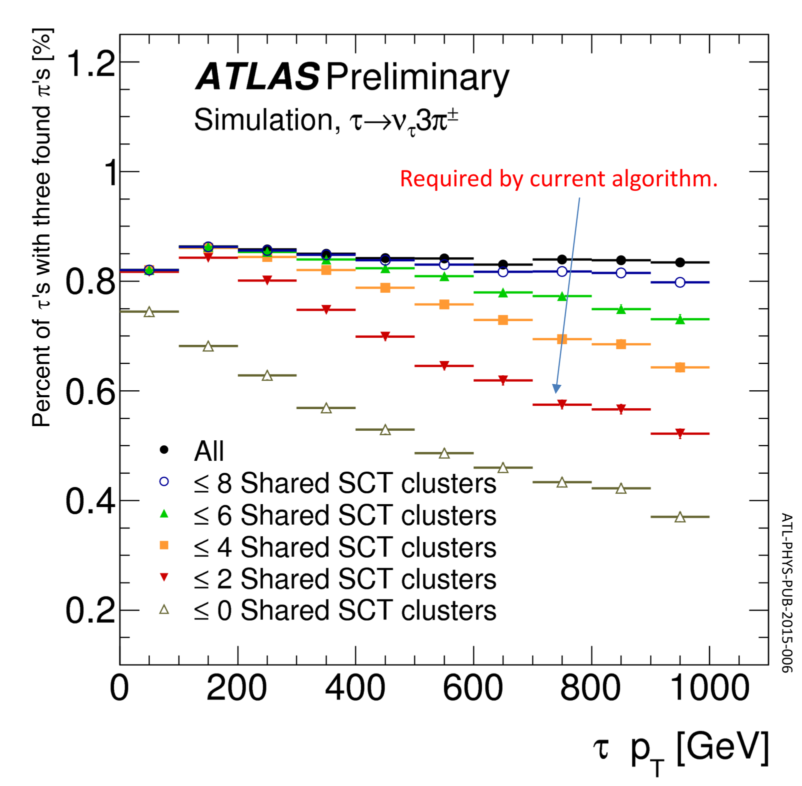


Why split clusters?



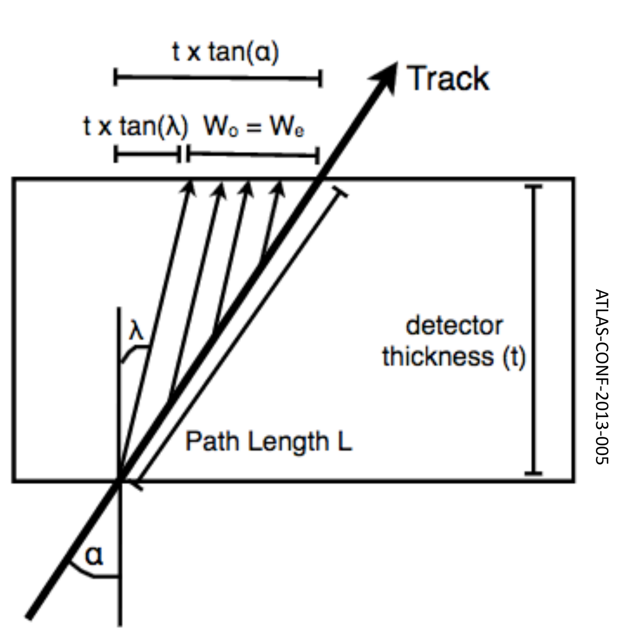
Cluster merging -> **significant** decrease **in tracking efficiency** in dense environments. ATLAS solution: algorithm to split pixel clusters.

And the SCT?



"**Shared**" cluster: used by more than one track. If we **find merged clusters and let them be shared**, what happens to efficiency and fake rate?

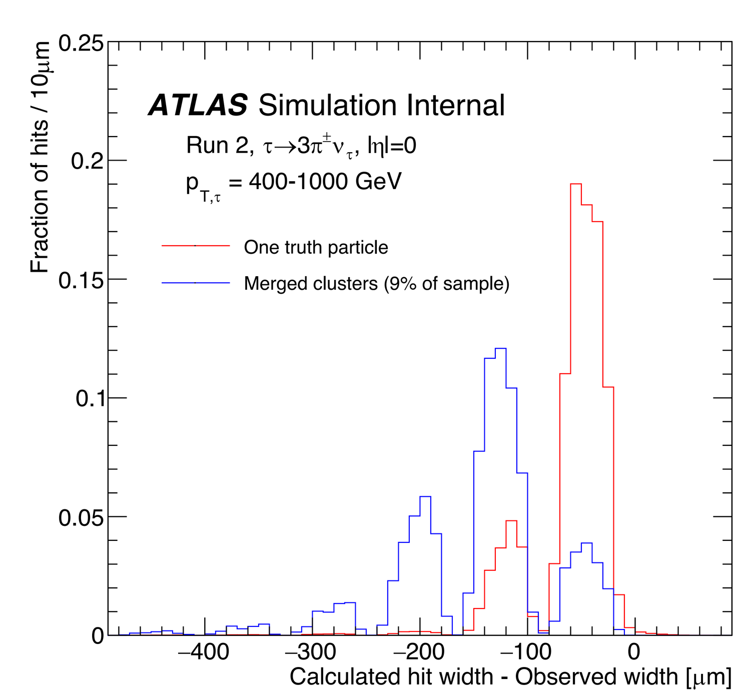
How to split?



Expectation from track alone

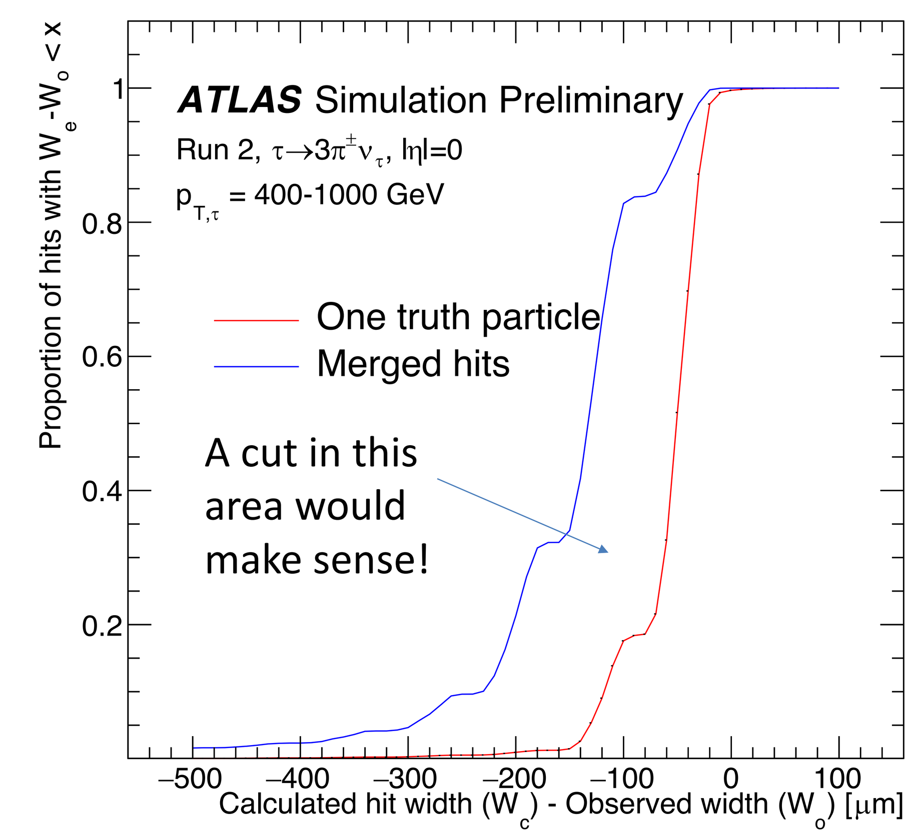
Predict cluster's W_e **from track info + geometry**. Merged clusters -> **wider** than expected!

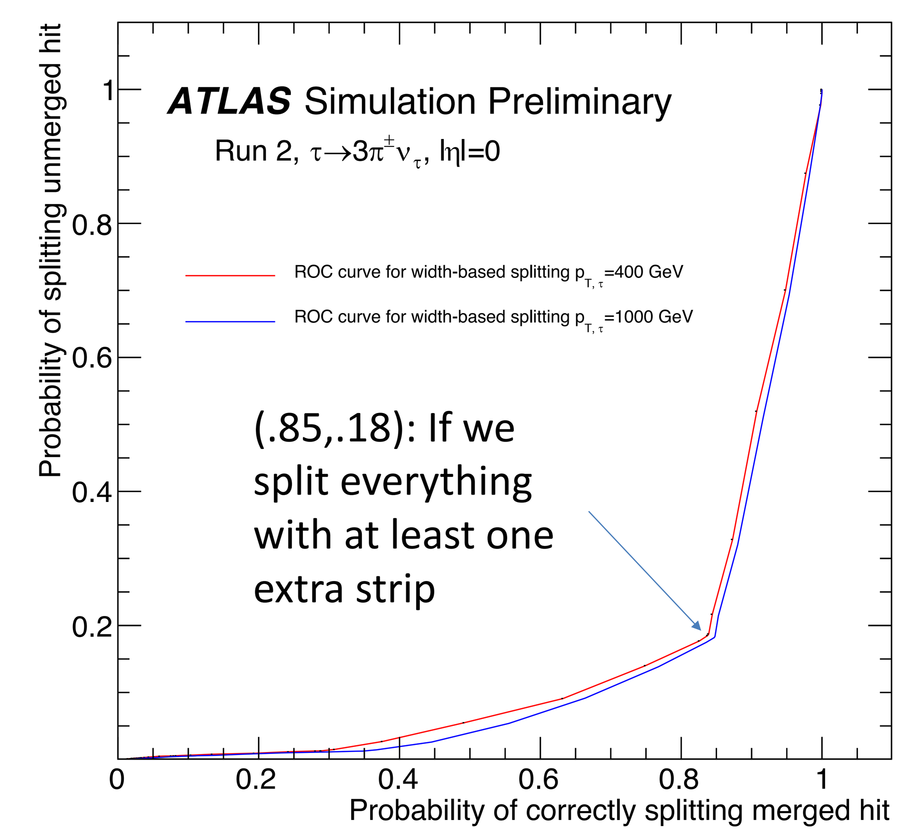
Width difference



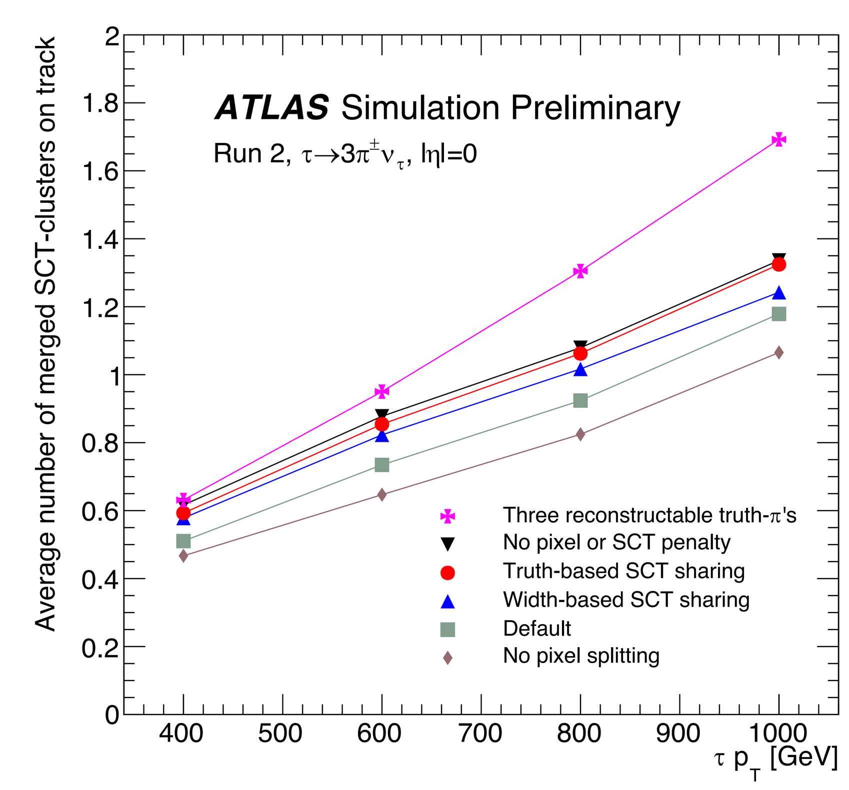
Most merged clusters have extra strip; most single-particle clusters do not! (SCT strip pitch = 80 μm; peaks correspond to extra strips.)

Where to split





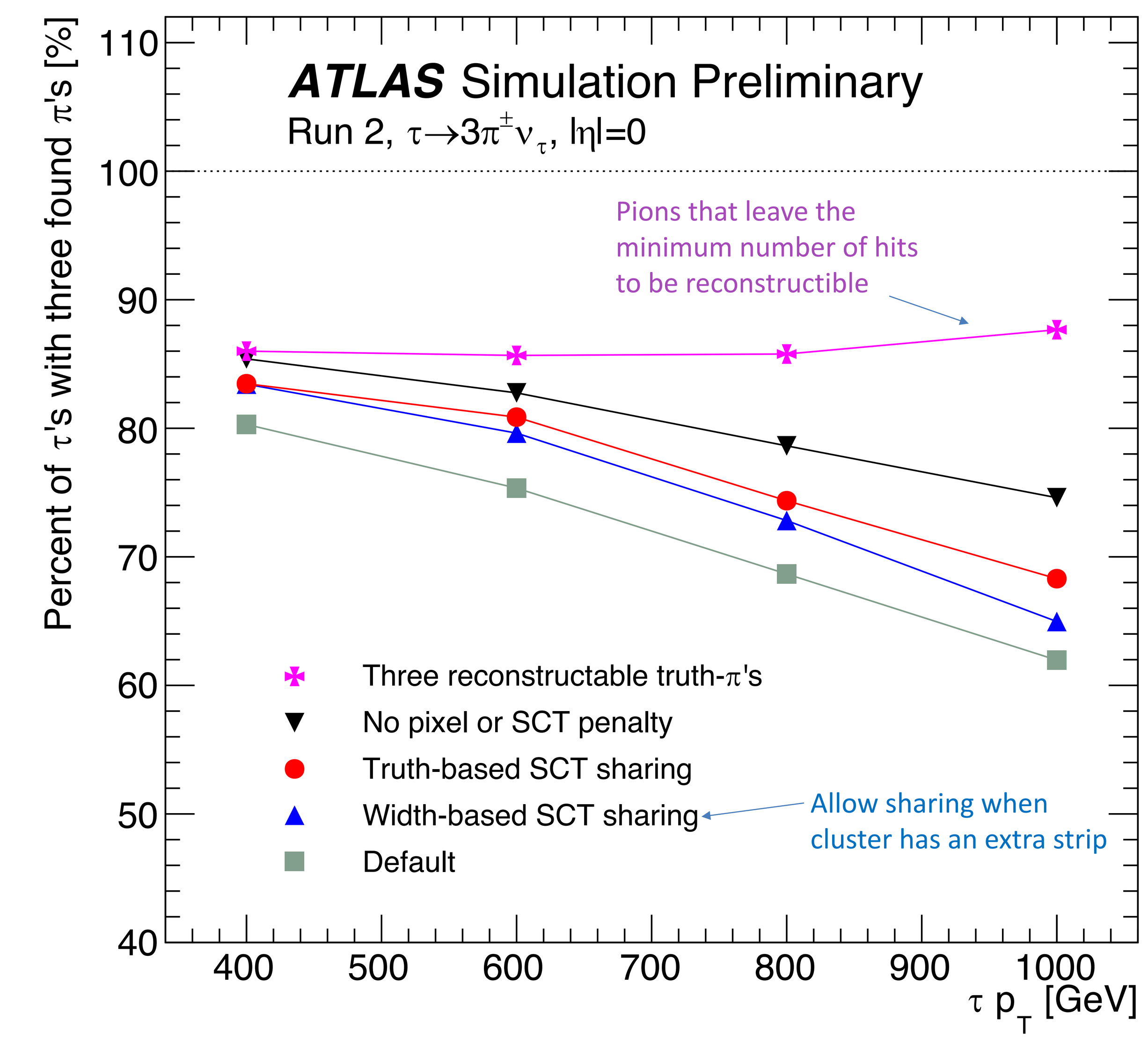
Merging Rate



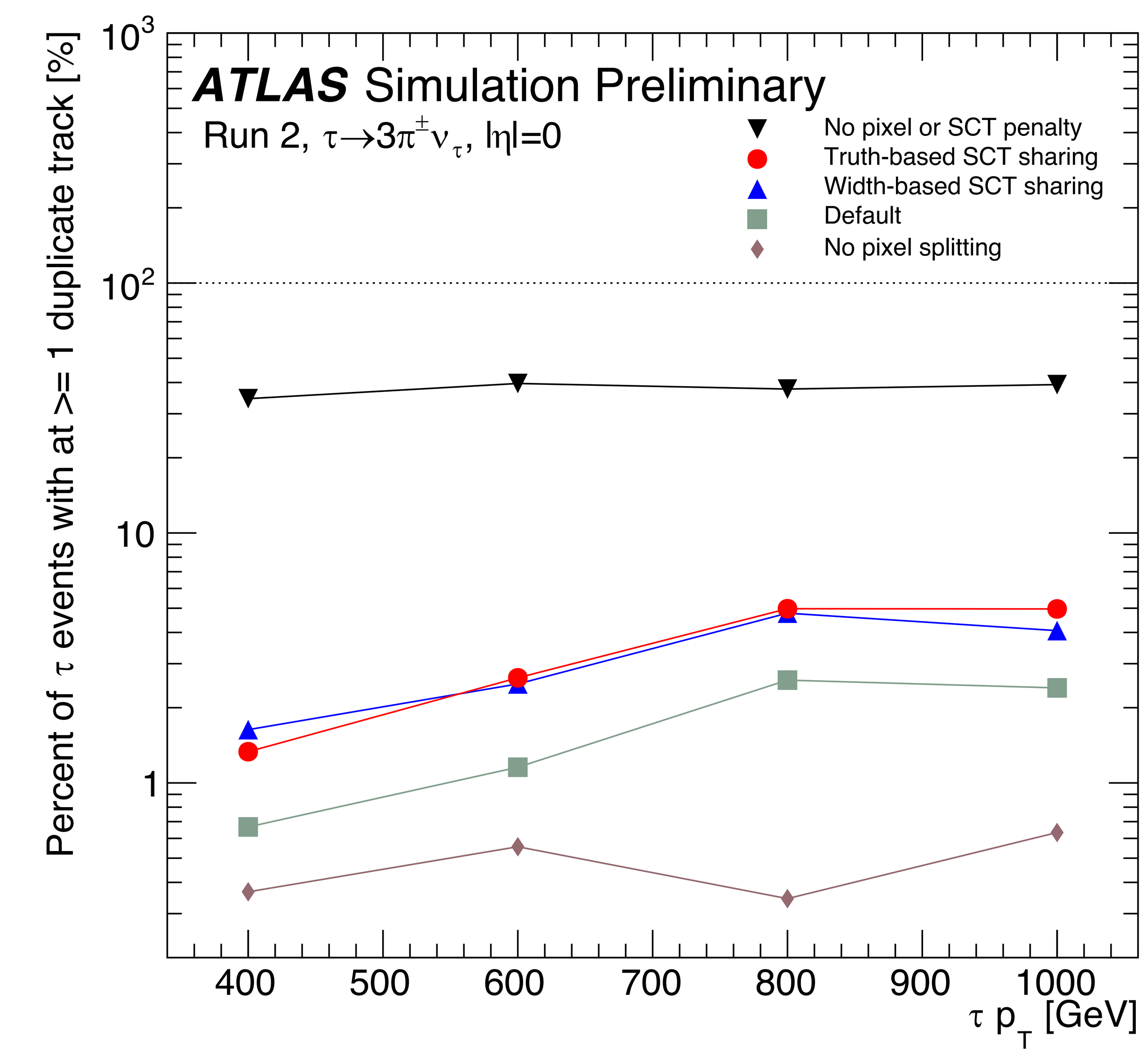
Merging increases with τ pT. At ~TeV, average pion at the sharing limit! Reconstructed tracks **should** have all their π's merged clusters (ideally).

Efficiency and Duplicates

Signature of a high-quality algorithm: **improved efficiency** with a **low duplicate rate**.



4-6% improvement in tracking efficiency when **splitting based on extra strips**, approaching efficiency when splitting **based on the number of truth particles** in the cluster.



Turning off sharing penalty -> **high duplicate rate**. Duplicate rate when splitting based on extra strips stays **below 5%**.

This will **improve searches and measurements** that use tracks inside τ's and jets

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