Particle Flow Reconstruction Performance - Developing a Simplified Track Extrapolation Method as a Faster Alternative to Complete Offline Reconstruction at the HLT

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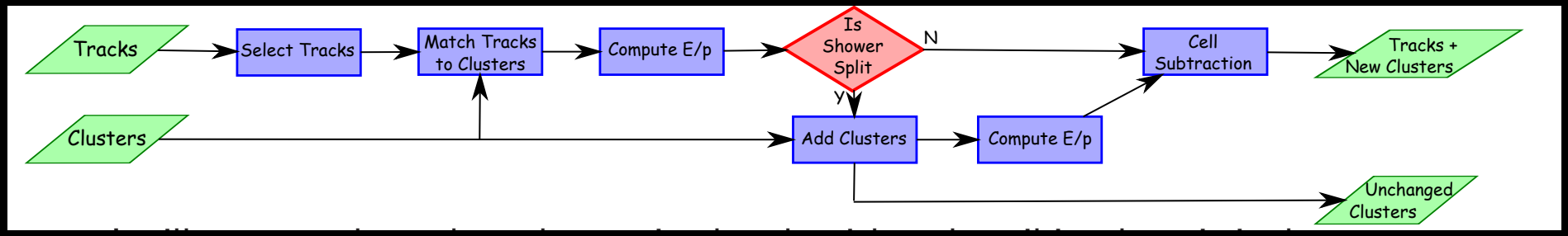
The Particle Flow Algorithm & Hadronic Jet Reconstruction in ATLAS

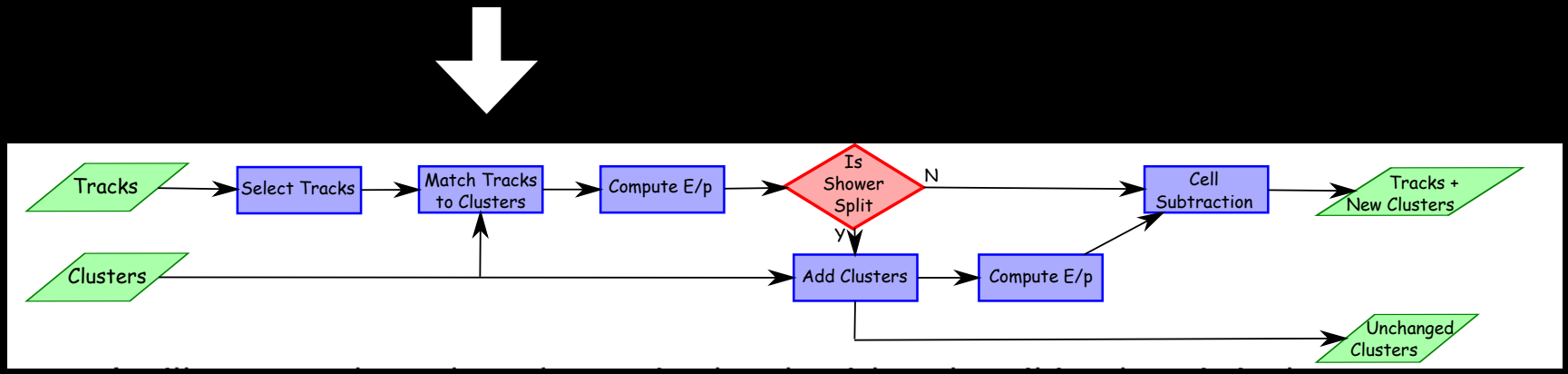
1. Run 1: ATLAS used either only track measurements or only calorimetric measurements to reconstruct hadronic jets
2. PFlow combines tracker and calo measurements by matching tracks to clusters and removing energy deposited from charged particles
3. Goal is to avoid double-counting deposited energy from pile-up
4. Shown to significantly improve jet resolution across entire p_T spectrum



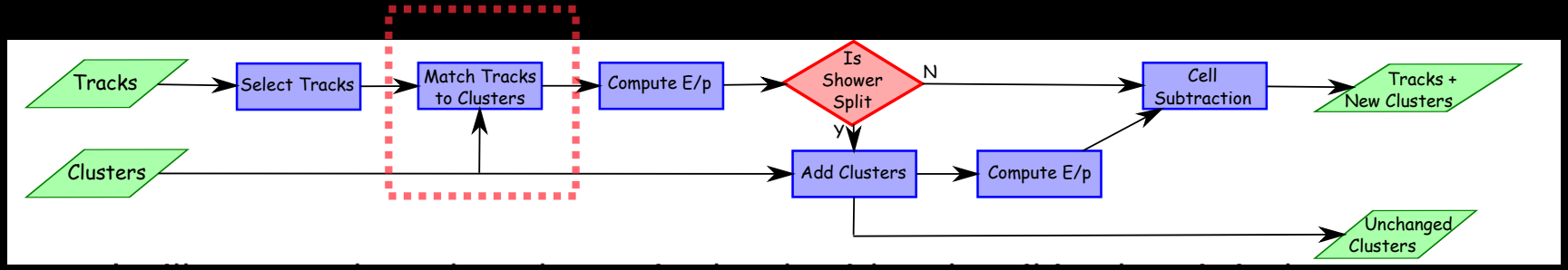
Taken from "Jet Reconstruction and Performance Using Particle Flow with the ATLAS Detector," *ATLAS Paper*

The Problem: HLT Timing Constraints

1. Detailed offline track reconstruction using PFlow techniques is too time consuming
2. CPU timing constraints in the HLT require that event selection be done in 150-200 ms
3. The major bottleneck: standard track extrapolation takes 1.5 s



Matching Tracks to Topo-Clusters



1. In order to remove calorimeter energy contributing from pile-up, tracks are matched to 'best-match topo-cluster' (either leading topo-cluster or second closest) by extrapolating tracks to EM2 ($r = 1.6m$), where $\Delta\phi$ and $\Delta\eta$ are computed for each topo-cluster.
2. Topo-clusters are ranked based on the metric $g_{ij} = \frac{1}{\sigma_i \sigma_j}\delta_{ij}$, where $i, j \in \{\phi, \eta\}$.

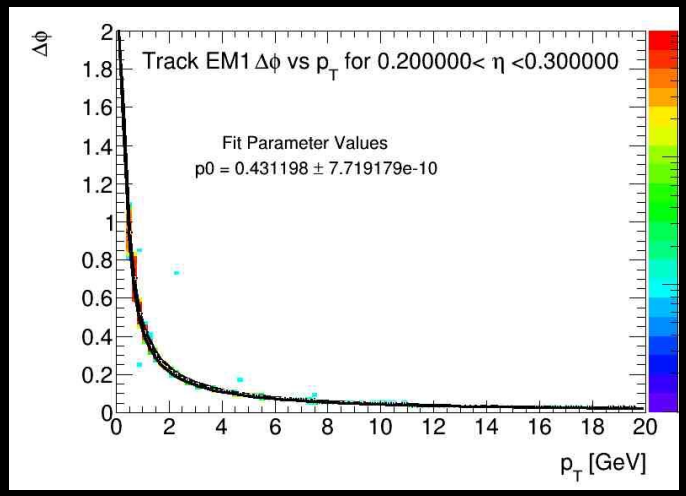
Questions

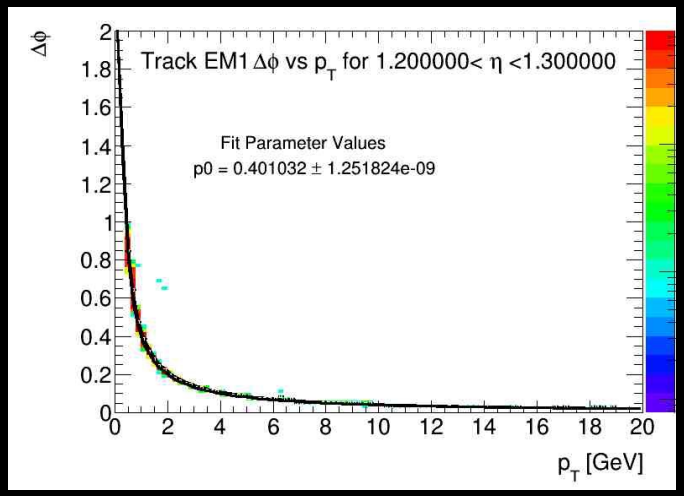
How does jet reconstruction depend on
the precision with which track extrapolation is carried out?

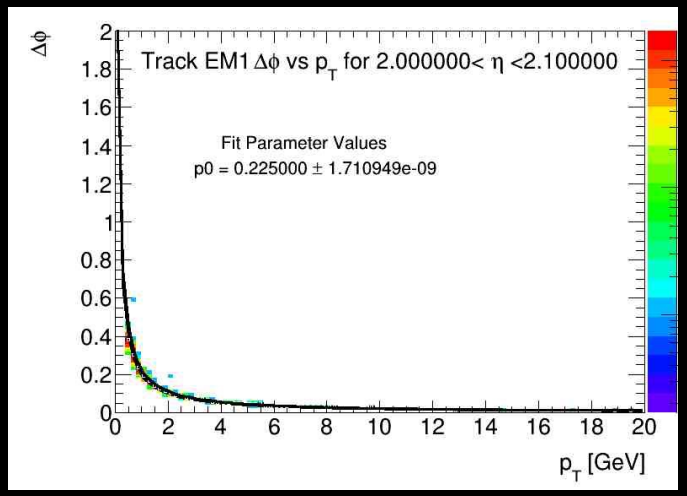
Can we develop a simplified track extrapolation method
that matches the benefits of the full blown extrapolation?

Developing a Simplified Track Extrapolation Method & Assessing Performance Loss

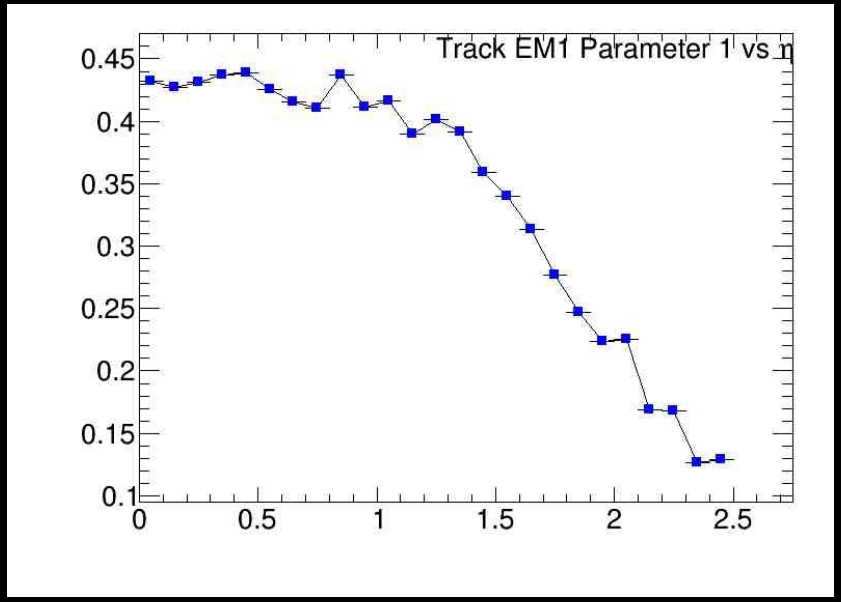
1. Begin by finding a parametrization for $\Delta\phi$ as a function of p_T and η for ID tracks from offline reconstruction
2. Once we have such a parametrization at trigger, can compare resulting PFLow object properties
3. Can then assess precision loss by matching PFlow jets to truth jets with $p_T > 4$ GeV and compute the jet response and jet resolution

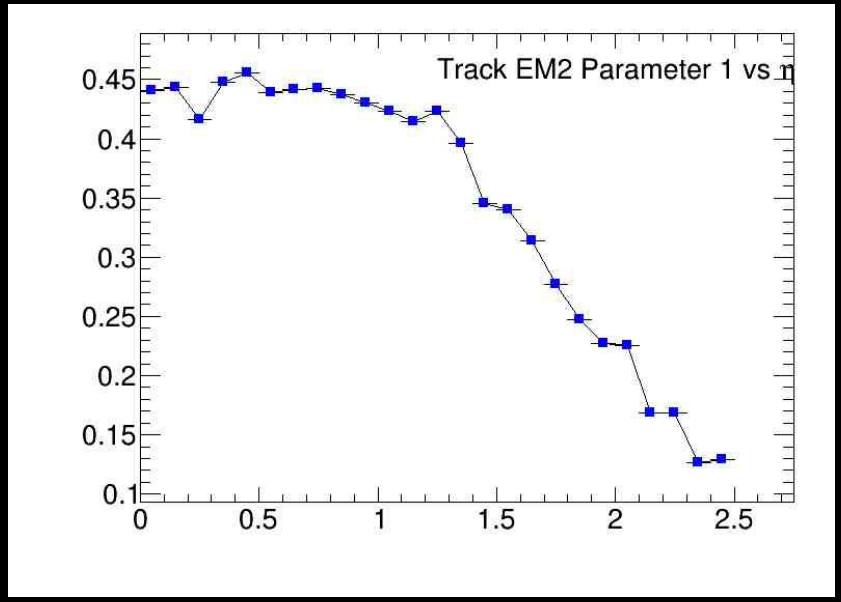




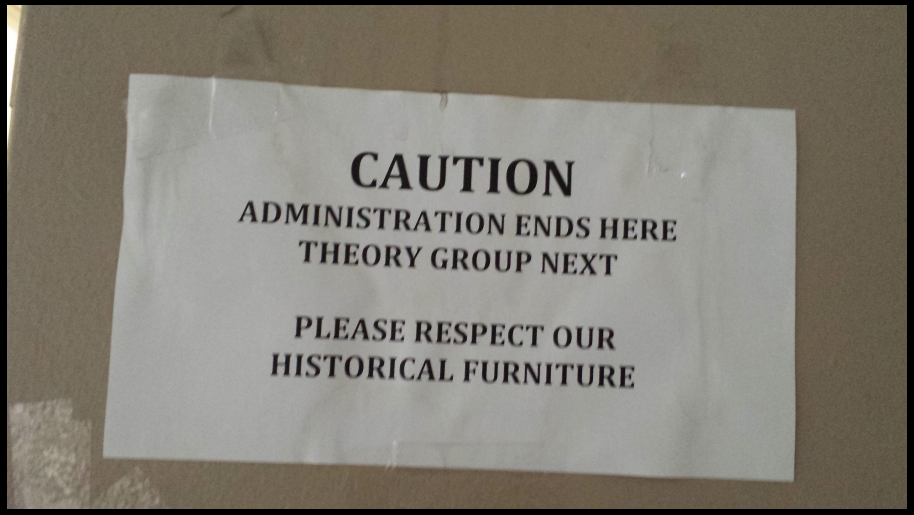


Fit parametrizations in p_T for various bins in η





Parameter dependence on η in EM1 and EM2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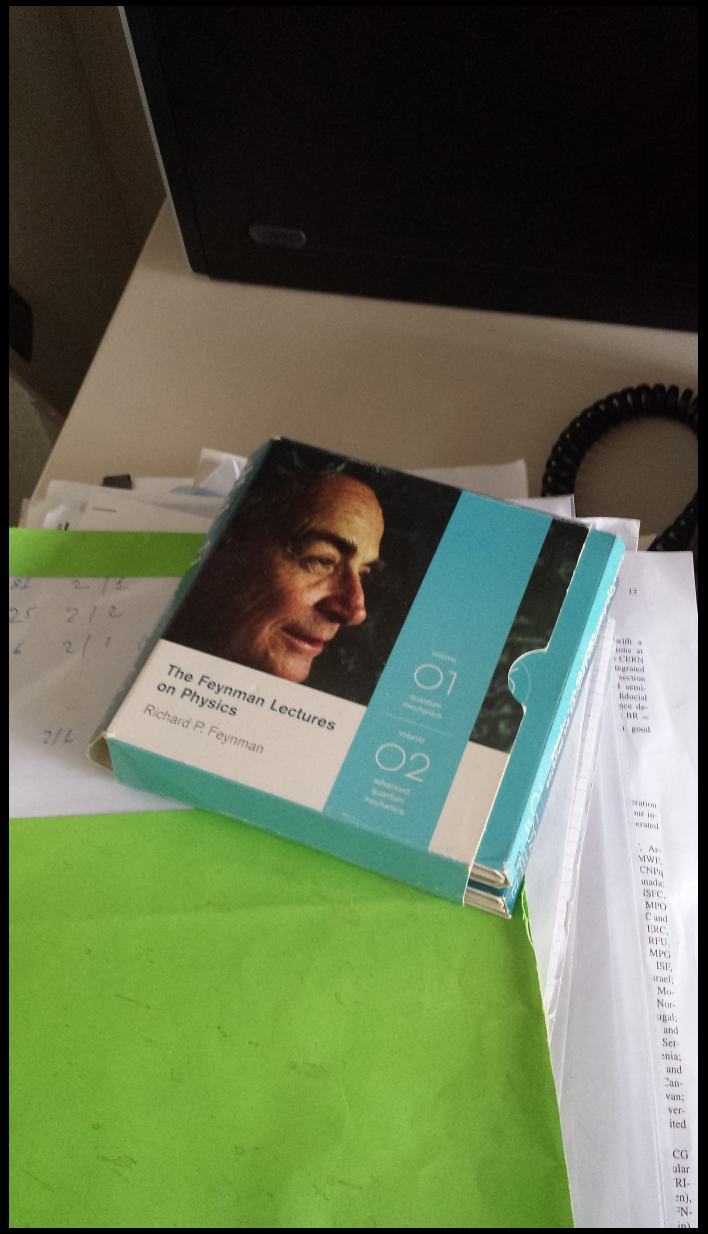
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