Performance studies of single-particle uncertainties and Local Hadronic Calibration for Particle-Flow jets in ATLAS

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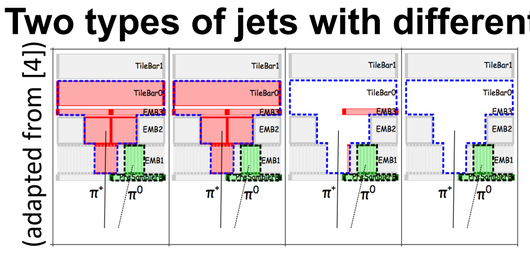
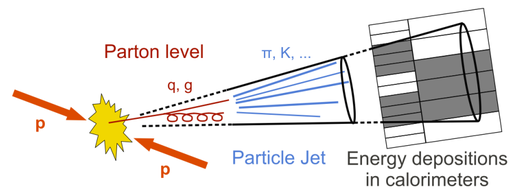
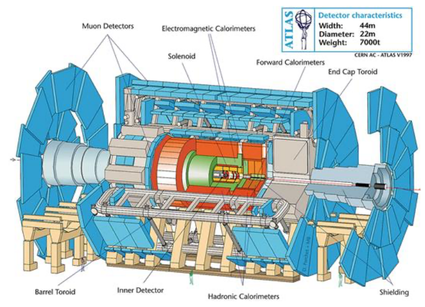
Introduction

Jets play a central role in many physics analyses in ATLAS. It is thus crucial that the jet energy is well calibrated and understood. Jets used in these studies are built with the anti-k_t algorithm [1] with a radius parameter R = 0.4.
Two types of jets with different inputs are considered:



1. **Topo jets:** 3D clusters of topologically-connected calorimeter [2] cells with large signal to noise ratio (TopoClusters [3])
2. **Particle Flow (PFlow) jets [4]:** combination of TopoClusters and Inner Detector [2] tracks

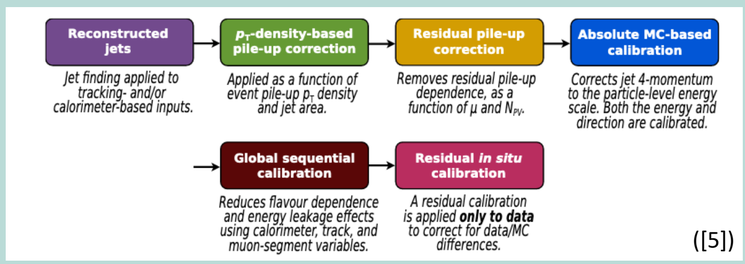




If the Local Hadronic Calibration (LCW) is (not) applied, they are referred to as LCTopo (EMTopo) and LCPFlow (EMPFlow) jets. As PFlow jets found increasing application, the EMTopo jet calibration methods need to be tested for EMPFlow jets. Two studies are presented.

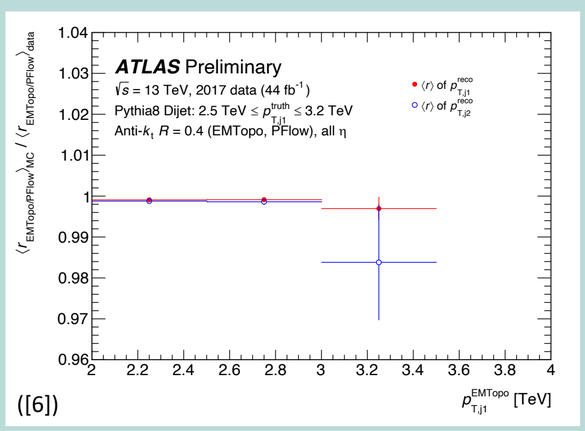
Performance studies of single-particle uncertainties for PFlow jets

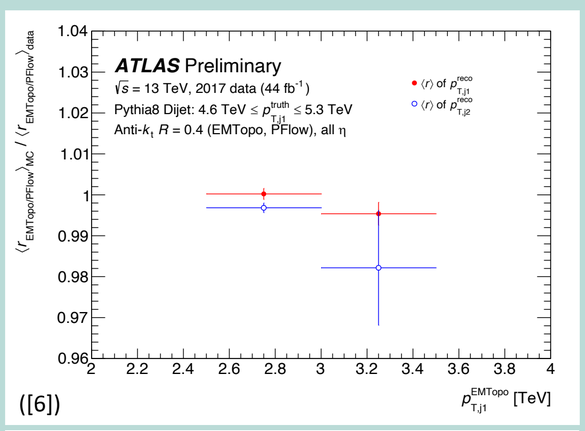
Single-particle uncertainties are part of the residual **in-situ calibration** of the Jet-Energy-Scale calibration [5] chain.

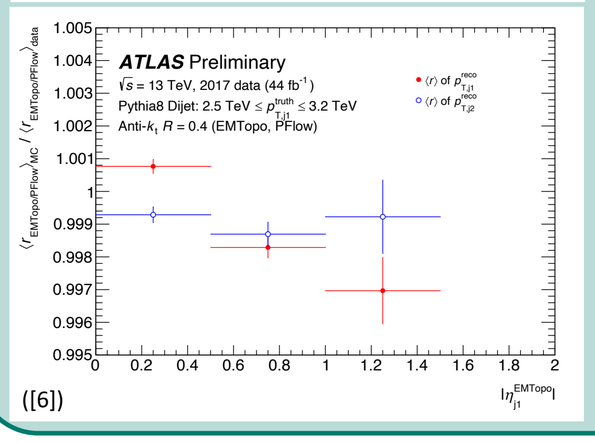


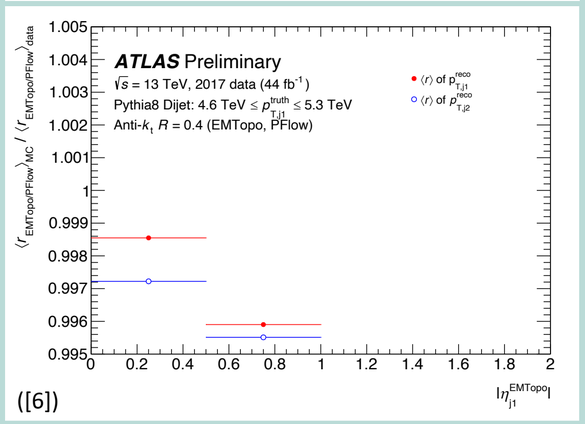
They are used to determine its uncertainties in a **high** transverse momentum $\mathbf{p_T}$**-regime** (> 2 TeV) based on the calorimeter response to single hadrons. **Jets are viewed as a collection of particles.** The sum of their appropriately smeared energies compared to the unsmeared energy of the jet gives the uncertainty.

The **study investigates the data-MC agreement between the average $\mathbf{p_T}$-ratios of EMPFlow and EMTopo jets** in bins of the pesudorapidity $|\eta|$ and the transverse momentum p_T. A percent-level agreement is found which is stable with respect to η and p_T as well as in different p_T-regimes. Thus, **single-particle uncertainties can be used very well for EMPFlow jets**.



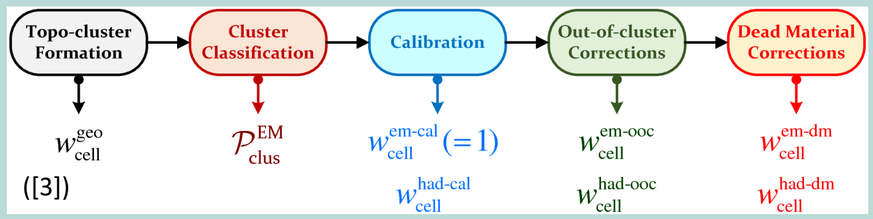






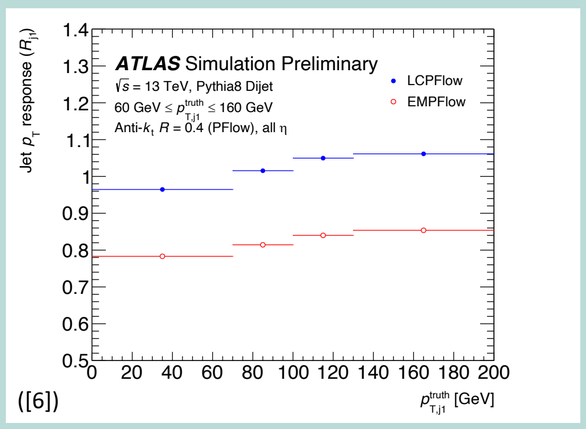
Performance studies of Local Hadronic Calibration (LCW) for PFlow jets

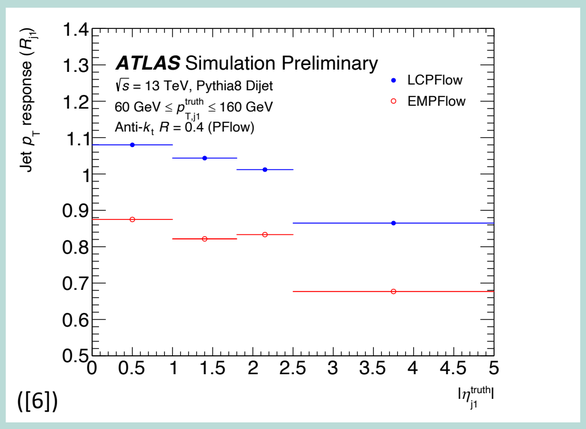
The **Local Hadronic Calibration (LCW) [3]** corrects for calorimeter non-compensation on cluster-level**.**



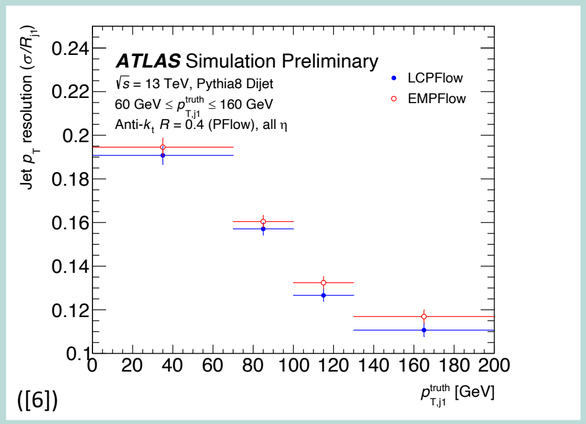
This **study investigates the performance of the LCW calibration for PFlow jets (LCPFlow) in comparison to PFlow jets at the electromagnetic scale (EMPFlow)**.
Jet response and jet resolution are studied in bins of the pseudorapidity $|\eta|$, the transverse momentum p_T and pile-up. For the latter the average number of interactions per bunch crossing μ and the number of primary vertices N_{PV} have been considered**.** It yields **very promising results**:

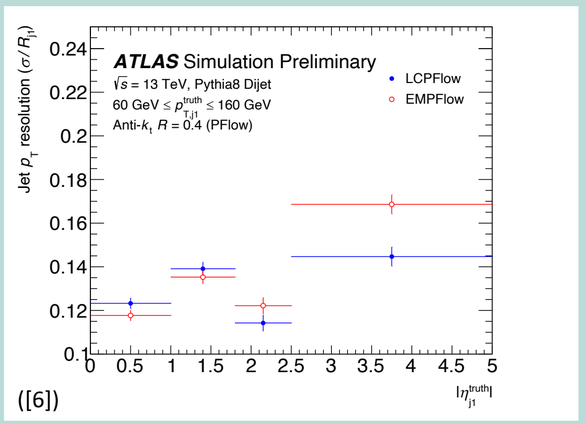
1. <u>Jet response:</u> significantly closer to 1 for LCPFlow jets





2. <u>Jet resolution:</u> in general better for LCPFlow jets (except low η-bins as well as large pile-up)

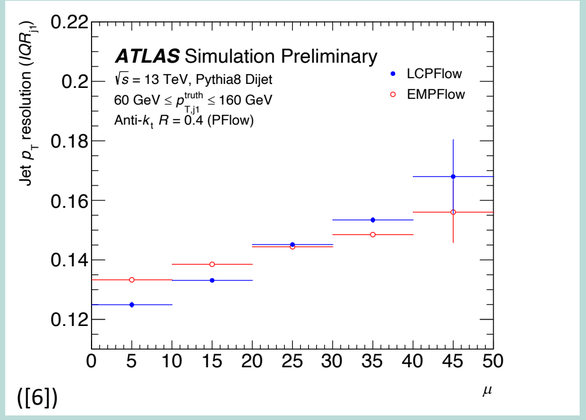




Conclusion and Outlook

The **two performance studies** test if the EMTopo jet-calibration approaches can also be used for EMPFlow jets. The **results are very positive**:

1. The approach of **single-particle uncertainties can be applied very well to EMPFlow jets**. Only deviations in the per-mille range are found.
2. Application of the **LCW calibration to EMPFlow jets is very promising**: A closer agreement with truth jets and an overall better jet resolution is found. Future investigations aim at improving the low η and large pile-up performance.



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[6] https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PLOTS/JETM-2022-001/