Determination of the Jet Energy Scale and Jet Energy Resolution using data collected by the ATLAS detector in 2012

Jets are collimated sprays of hadrons coming from the fragmentation of quarks and gluons. They are formed from topologically related energy deposits in calorimeter cells (topo-clusters). The input topo-clusters can be calibrated either at the electromagnetic scale (EM) or with the local cluster weighting scheme (LCW), which tries to correct for the differences between electromagnetic and hadronic shower responses. Further corrections are applied in multiple steps using techniques driven by both Monte Carlo simulations and data. The Jet Energy Scale (JES) and Resolution (JER), and corresponding uncertainties are then evaluated.

Global Sequential Corrections
Quarks and gluons have different jet responses. Global sequential correction (GSC) is a sequence of corrections applied at the jet level that reduces the JES dependence on the flavor of the initiating parton. It also improves the JER.

Jet Energy Resolution

1. Measure $p_T$-asymmetry

\[ A = \frac{p_T^A - p_T^\gamma}{p_T^A + p_T^\gamma} \]

2. "bisector" method: uses the same principle after projecting the vector sum $p_T^A$ onto an orthogonal coordinate system.

Angular variables used in the bisector method

Fractional JER: is below 10% for jets with $p_T > 100$ GeV. JER is also being measured in other processes including $\gamma +$jet and $Z +$jet.

Final JES uncertainties

Jet response ratio of the data to the Monte Carlo simulation as a function of $p_T$ for three in situ techniques combined to determine the in situ energy scale correction.

JES uncertainty is less than 3% for jets with $p_T > 100$ GeV. Forward jet uncertainties are reduced to about 3% at 20 GeV.