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The Global Sequential Calibration (GSC) is a sequential jet calibration based on transversal and longitudinal properties of the jet structure. It determines the jet energy scale and improve the energy resolution, allowing in this way to correct from the dead material and non compensation effects of the ATLAS calorimeters.

1 Introduction

Jet are experimental signatures of quarks and gluons, which are produced in high energy processes such as the hard scattering of partons in pp collisions. Jets are objects reconstructed from the energy signal deposited in the calorimeters by the particles coming from the hadronization of quarks and gluons. Its production cross section is really large, it means they are many channels with jets in the final state. Usually the energy deposited does not correspond to the initial energy carried by the particles, i.e. the response of the calorimeter is different from one. This is due to calorimeter effects as dead material, non compensation and crack regions and to jet reconstruction effects such as out of cone energy. As a consequence the determination of the jet energy scale and the achievement of the optimal jet energy resolution have become of crucial importance.

2 Global Sequential Calibration (GSC) description

ATLAS has developed several calibration schemes which make use of the different properties of the jets and calorimeter signals (clusters and towers). One of them is the Global Sequential Calibration (GSC)[1] [2] which uses transverse and longitudinal properties of the jet structure to reduce fluctuations in the jet energy measurement. It is divided in two steps: in the first one the jet response is calibrated using the so called EM+JES calibration. In this step calibration constants are calculated and applied as a function of the uncalibrated jet p_T and η, bringing the

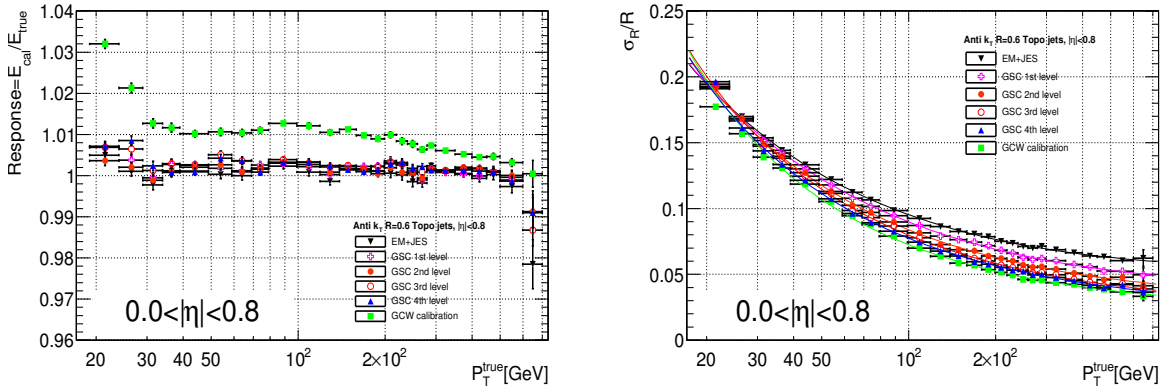
jet response (defined as the fraction of energy reconstructed from calorimeters signal and the truth energy carried by particles E_{reco}/E_{true}) to 1.

The goal of the second step is to improve the jet resolution (σ_R/R). It has been show that the jet response depends not only on its p_T and η but also on jet structure variables that we call x. Correcting this $x-$dependence of the jet response ameliorate the jet resolution, whereas the mean value of the response remains as it was after the EM+JES calibration).

Several variables can be used sequentially to achieve the optimal resolution, this give us the advantage that if some variable is not fully understood we can eliminate the associated correction. The calibration has been calculated in the whole eta range but for simplicity we show here the $|\eta| < 0.8$ range results, where a four-level correction is applied, the sequence of jet properties used are: fraction of energy deposited in the first layer of the hadronic calorimeter (f_{tile1}), in the third layer of the electromagnetic (EM) calorimeter (f_{em3}), in the presampler (f_{pres}) and the width of the jet.

3 Performance of the Calibration

Each step of the calibration can be performed using Monte Carlo simulation and/or data. The results presented here were obtained using exclusively dijet Monte Carlo samples. In the Figure 1a and 1b we present the jet response and resolution, respectively, as a function of p_T^{true}. Jets reconstructed with the anti$-k_t$ algorithm with a distance parameter $R = 0.6$ and built from topological clusters are used. From the plots we can see that after each level of the GSC the jet response keeps close to the unity at the 2% level and the jet energy resolution improves, been comparable to the resolution obtained with the Global Cell Weighting (GCW) calibration scheme (widely used in ATLAS) which is also shown for reference. The GSC provides a simple and competitive jet calibration scheme in ATLAS.



(a) (b)

Figure 1: Left: Response as a function of p_T^{true} after each level of the GSC calibration. Right: Resolution as a function of p_T^{true} after each level of the GSC calibration.

References

1. D. Lopez Mateos, E.W. Hughes and A. Schwartzman (ATLAS NOTE ATL-PHYS-INT-2009-051, 2009).
2. D. Lopez Mateos, E.W. Hughes and A. Schwartzman (ATLAS NOTE ATL-COM-PHYS-2010-058, 2010).
3. ATLAS collaboration (ATLAS CONF NOTE ATLAS-COM-CONF-2010-055, 2010).