Jet energy calibration chain in the CMS experiment

Jets are experimental signatures of energetic quarks and gluons produced in high-energy processes. The jets are reconstructed from energy deposits in various CMS subdetectors (energy clusters in electromagnetic and hadronic calorimeters, and tracks in tracker). This makes them complex objects, and challenging to calibrated to infer four-momenta of the original quarks and gluons. A factorized approach is employed to correct the jet energy scale (JES) for various physics and detector effects. The first step corrects for the effect of pileup in hadronic collisions. In the second step, transverse momenta of reconstructed jets are corrected to match that of particle level jets using simulated multijets events. The third step is applied on data

Jet energy resolution

The jet energy resolution is quite large compared to the resolution of other physical objects. Applying the proper smearing to the jets energy in simulation is therefore capital in numerous analysis to avoid biases.

We define the particle level JER ($\sigma_{JER}$) as the width of $\gamma_T$. The JER is measured from the width of the responses distribution, after extrapolation to zero additional activity:

$$\sigma_{JER} = \sqrt{\sigma_{JER,raw}^2 - \sigma_{JER,O2T}^2}$$

We also define the particle-level imbalance, extracted from simulation, as $\rho_{PLI} = \frac{\Delta p_T}{p_T}$ which accounts for underlying event and out of time pileup effects. The main sources of uncertainties in the JER computation arise from ISR and FSR correction, particle-level imbalance, and non-Gaussian tails in the responses.

References