constrained with multijet events. Detailed studies are performed to correct for biases in the data-based methods due to differences with respect to the MC simulation in ISR+FSR as well as in jet p_{T} resolution.

The optional jet-flavor corrections derived from MC simulation are discussed in Section 7 together with the JEC flavor uncertainty estimates based on comparing PYTHIA 6.4 and HERWIG++2.3 predictions. These uncertainties are applicable to data vs. simulation comparisons regardless of whether or not the jet-flavor corrections are applied. The flavor corrections and their uncertainties for b-quark jets are checked in data with Z+b events. The consecutive steps of the JEC are illustrated in Fig. 2.

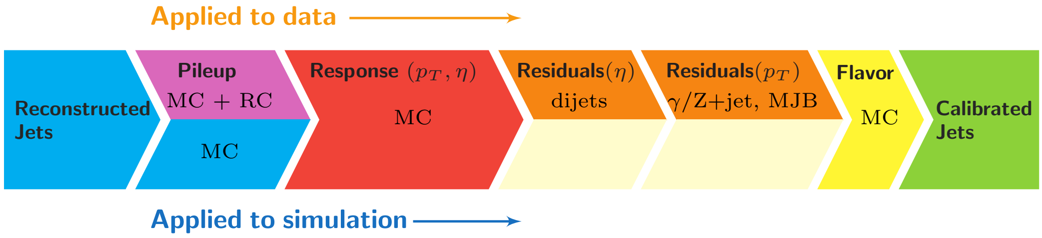

Figure 2: Consecutive stages of JEC, for data and MC simulation. All corrections marked with MC are derived from simulation studies, RC stands for random cone, and MJB refers to the analysis of multijet events.

The jet p_{T} resolutions are determined with both dijet and photon+jet events, as discussed in Section 8. The reference resolutions obtained from simulation are parameterized as a function of particle-level jet $p_{\mathrm{T,\,ptcl}}$ (defined in Section 2) and average number μ of pileup interactions in bins of jet η. Corrections for differences between data and MC simulation are applied as η-binned scale factors.

The JES uncertainties, discussed in Section 9, are provided in the form of a limited set of sources that allow a detailed statistical analysis of uncertainty correlations. The final uncertainties are below 1% across much of the phase space covered by these corrections at $p_{\mathrm{T}} > 10\,\mathrm{GeV}$ and $|\eta| < 5.2$. This sets a new benchmark for jet energy scale at hadron colliders.

In Section 10 we describe additional studies made by investigating the particle composition of reconstructed PF jets. These support the overall conclusions drawn from the determination of residual jet energy corrections to be applied on data.

2 The CMS detector and event reconstruction

The central feature of the CMS apparatus is a 3.8 T superconducting solenoid of 6 m internal diameter. Within the field volume are the silicon tracker, the crystal electromagnetic calorimeter (ECAL), and the brass and scintillator hadron calorimeter (HCAL). The muon system is installed outside the solenoid and embedded in the steel flux-return yoke. CMS uses a right-handed coordinate system, with the origin at the nominal interaction point, the z axis pointing along the direction of the counterclockwise beam, the y axis pointing up (perpendicular to the plane of the LHC ring), and the x axis chosen to make a right-handed coordinate system. The polar angle θ is measured from the positive z axis, and the azimuthal angle ϕ is measured in the x-y plane in radians.

The CMS tracker consists of 1 440 silicon pixel and 15 148 silicon strip detector modules, with full azimuthal coverage within $|\eta| < 2.5$. The ECAL consists of 75 848 lead tungstate crys-