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Groomed Jet Mass as a Precision Probe of QCD Radiation

Abstract

We study the Soft Drop groomed jet mass distribution in proton-proton collisions within perturbative QCD. By removing soft, wide-angle radiation through the Soft Drop condition, controlled by z_cut and β, the observable becomes less sensitive to the underlying event, pileup, hadronization, and non-global logarithms.

Using QCD factorization and all-order resummation, we compute the spectrum in terms of the jet mass ρ , resumming the large logarithms. We examine how the grooming parameters modify the soft-radiation phase space and improve perturbative stability.

The resummed predictions are compared with Pythia, Herwig, and Sherpa simulations, testing their robustness across different parton-shower and hadronization models. The results demonstrate that Soft Drop grooming yields a clean, theoretically controlled jet observable, well suited for precision QCD studies and comparisons with LHC measurements.