Differential measurements of jet sub-structure observables and their correlation in p+p collisions at $\sqrt{s} = 200$ GeV in STAR

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Jets are collimated sprays of hadrons created by the fragmentation of high energy partons, and serve as an experimental tool for studying quantum chromodynamics. In particular, we can explore the properties of parton showers and jet evolution by measuring jet sub-structure. One of the techniques that allows experimental access to the parton shower is the jet grooming technique called SoftDrop. This analysis extends recent measurements of the jet sub-structure observables based on the SoftDrop algorithm in p+p collisions at $\sqrt{s} = 200$ GeV in the STAR experiment, including groomed radius (R_g) and shared momentum fraction (z_g). We present fully unfolded multi-differential measurements of jet sub-structure observables at the first split and their corresponding correlations via z_g vs. R_g for jets of different transverse momenta and radii. We show that z_g has a strong dependence on R_g and a weak dependence on jet transverse momentum. To further explore the jet sub-structure, we present the first measurement of the jet shower at the first, second and third splits via the iterative SoftDrop procedure. For each of these splits, we measure the fully corrected z_g and R_g. We compare our measurements to the state-of-the-art Monte Carlo models. We discuss the impact of variations in parton shower (perturbative) and hadronization/underlying-event (non-perturbative) modeling on the measured correlations between sub-structure observables. We will also preview upcoming measurements that explore the splitting scale (k_T) and groomed mass fraction (μ) in our differential framework.