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), shared momentum fraction (z_g) and splitting scale (k_T). 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 and z_g vs. k_T for jets of different transverse momenta and radii. With these measurements, we present the correlations between the physics scales involved with jet evolution for the first time. 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.