JET SUB-STRUCTURE MEASUREMENTS IN $\sqrt{s} = 200$ GEV COLLISIONS WITH STAR ABSTRACT FOR BOOST 2021

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Jets are algorithmic proxies of hard scattered partons, i.e. quarks/gluons, in collisions of high energy particles. Jets derived from clustering algorithms contain information regarding the parton shower, which can be accessed via the SoftDrop algorithm and the Cambridge/Aachen de-clustering. The STAR collaboration has recently measured jet sub-structure observables in *pp* collisions at $\sqrt{s} = 200$ GeV including the jet mass (M), SoftDrop groomed jet mass (M_{g}), groomed jet radius (R_{g}) and shared momentum fraction (z_{g}) for jets with varying radius and momentum. To further explore the jet sub-structure, we present two sets of novel multi-dimensional fully corrected measurements of the jet shower. We first present the inherent correlation between the z_{g} and R_{g} for jets of varying momenta. Given that the sub-structure extends beyond the first split, we also present fully corrected sub-structure observables at the first, second and third splits determined via the iterative SoftDrop procedure. For each of these splits, we measure the fully corrected z_{g} and R_{g} distributions and showcase a gradual variation in both the angular and momentum scales which can theoretically be related to virtuality evolution. These recursive measurements of the jet shower allow us to test the self-similarity of the splitting kinematics across different splits. We also measure the formation time defined as $\tau_f \equiv \frac{1}{2Ez(1-z)(1-\cos\theta_{1,2})}$ where E is the parent's energy, z is the momentum fraction and $\theta_{1,2}$ is the opening angle. We compare the formation times for SoftDrop splits $\tau_{\mathrm{f}}^{\mathrm{split}}$ to the formation time calculated via the two highest-p_{T} charged constituents within the jet to study the onset of non-perturbative region of the jet shower. We compare our measurements to state-of-the-art Monte Carlo models, providing stringent constraints on model parameters related to the parton shower and non-perturbative effects such as hadronization, that become increasingly significant as we travel further along the jet shower.

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