SYSTEMATIC EXPLORATION OF MULTI-SCALE JET SUBSTRUCTURE IN $p+p$ COLLISIONS AT $\sqrt{s} = 200$ GEV BY THE STAR EXPERIMENT

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Jets are multi-scale objects that connect asymptotically free partons to confined hadrons. Jet substructure measurements in vacuum provide essential insight into the parton evolution and the ensuing non-perturbative processes.

In this study, we use the SoftDrop grooming technique, based on the angular-ordered Cambridge/Aachen reclustering algorithm, to probe correlations between jet substructure variables. Corrections for detector effects are carried out utilizing either a three dimensional correction procedure or a machine learning based framework called MultiFold, with the latter retaining the correlations across jet substructure observables.

A complementary observable with growing theoretical and experimental interest, the 2-point Energy Correlator (EEC), re-contextualizes jet substructure study by using the distribution of angular distance of all combinations of two final state particles within a jet to study jet evolution across different regimes.

In particular, we explore ensemble level and jet-by-jet correlations between substructure variables for jets of varying momenta and radii and fully corrected EEC in p+p collisions at $\sqrt{s} = 200$ GeV using the STAR detector. To study the evolution along the jet shower, we present splitting observables at the first, second, and third splits along the jet shower for various jet and initiator prong momenta. Finally, the measurements are compared to leading order Monte Carlo models, such as PYTHIA 6, PYTHIA 8 and HERWIG.

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