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

MONIKA ROBOTKOVA
(FOR THE STAR COLLABORATION)

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 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 on a jet-by-jet basis. A complementary observable with growing theoretical and experimental interests, the 2-point Energy Correlator (EEC), re-contextualizes the jet substructure measurement. This observable provides insight into the parton evolution from perturbative to non-perturbative QCD regime by measuring the distribution of angular distances for all combinations of two final state particles within a jet.

In this talk, we present both ensemble level and jet-by-jet correlations between substructure variables 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.

Date: February 2, 2023.