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Event Shape and Jet Substructure Measurements in high Q^2 Deep Inelastic Scattering at HERA

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Measurements of event shapes and jet substructure observables can serve as in-depth probes of the strong interactions. Data on deep-inelastic scattering collected at the HERA ep collider using the H1 detector have been analysed in the kinematic region of large momentum transfer $Q^2 > 150$ GeV^2. Various new measurements of the hadronic final state, as listed in the following, are presented and are confronted with QCD calculations and predictions from Monte Carlo generators. A precision measurement of the 1-jettiness event shape is presented as a triple-differential cross section in Q^2, y, and the event shape τ_1^b. The data are sensitive to parton distribution functions, to the strong coupling α_s, and to fragmentation effects. It is also interesting to study the effect of grooming techniques on event shapes in the clean environment of ep collisions. The grooming techniques investigated here are based on the novel Centauro jet algorithm, which has the advantage to suppress soft QCD radiation in the forward (proton) direction. Two groomed event shapes are studied for various settings of the grooming parameter: the invariant jet mass and the 1-jettiness. The groomed event shape measurements show sensitivity to fragmentation on one end and multi-jet production on the other end. As such, they serve as high-precision probes of the tested QCD models and predictions. Another class of observables presented here is related to jet substructure. A number of jet substructure variables such as jet charge, particle multiplicity, and higher moments of these, are unfolded (corrected for detector effects) in a simultaneous and unbinned machine-learning approach. The results are shown in four regions of Q^2. Due to the unbinned nature of the unfoldings, other observables and correlations could be studied in the future. Finally, jet substructure is also investigated in terms of a charge asymmetry, defined for the leading and subleading charged particles of the jet. The charge asymmetry is studies as a function of the formation time, which gives detailed insights on the fragmentation into hadrons.

In-person participation

Yes

Primary author: ZHANG, Zhiqing (IJCLab, Orsay)

Presenter: ZHANG, Zhiqing (IJCLab, Orsay)

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