Contribution ID: **12** Type: **not specified**

Measurement of the 1-jettiness event shape observable in deep-inelastic electron-proton scattering at HERA

Wednesday 26 March 2025 14:00 (20 minutes)

The H1 Collaboration reports the first measurement of the 1-jettiness event shape observable τ_1^b in neutral-current deep-inelastic electron-proton scattering (DIS). The observable τ_1^b is equivalent to a thrust observable defined in the Breit frame. The data sample was collected at the HERA ep collider in the years 2003–2007 with center-of-mass energy of $\sqrt{s} = 319$ GeV, corresponding to an integrated luminosity of 351.1 pb^{-1}. Triple differential cross sections are provided as a function of τ_1^b, event virtuality Q^2, and inelasticity y, in the kinematic region $Q^2 > 150$ GeV^2. Single differential cross section are provided as a function of τ_1^b in a limited kinematic range. Double differential cross sections are measured, in contrast, integrated over τ_1^b and represent the inclusive neutral-current DIS cross section measured as a function of Q^2 and y. The data are compared to a variety of predictions and include classical and modern Monte Carlo event generators, predictions in fixed-order perturbative QCD where calculations up to $\mathcal{O}(\alpha_s^3)$ are available for τ_1^b or inclusive DIS, and resummed predictions at next-to-leading logarithmic accuracy matched to fixed order predictions at $\mathcal{O}(\alpha_s^2)$. These comparisons reveal sensitivity of the 1-jettiness observable to QCD parton shower and resummation effects, as well as the modeling of hadronization and fragmentation. Within their range of validity, the fixed-order predictions provide a good description of the data. Monte Carlo event generators are predictive over the full measured range and hence their underlying models and parameters can be constrained by comparing to the presented data.

Eur.Phys.J.C 84 (2024), 785 [arxiv:2403.10109]

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Session Classification: WG4: QCD with Heavy Flavors and Hadronic Final States

Track Classification: QCD with Heavy Flavors and Hadronic Final States