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Open heavy flavor studies at the future EIC to probe final-state effects

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Heavy flavor (charm and bottom) production is a unique probe for testing perturbative Quantum Chromodynamics (pQCD) and for investigating the transport properties of nuclear matter. The identification of heavy flavor signals remains one of the most challenging measurements in collider experiments due to their extremely low production rate and substantial background contributions. The forthcoming Electron-Ion Collider (EIC) will employ high-luminosity, high-energy electron+proton ($e + p$) and electron+nucleus ($e + A$) collisions across a broad range of center of mass energies (29 - 141 GeV) to address several fundamental questions in QCD, including the mechanisms of hadronization. A series of studies on heavy flavor hadron and jet production at the EIC have been carried out using standalone simulations incorporating parameterized EIC detector performance. In this work, we present the projected heavy flavor jet reconstruction capabilities at the EIC, together with corresponding analyses of heavy flavor jet production and substructure, such as energy-energy correlator observables, compared with recent theoretical calculations. The implications of these studies for advancing our understanding of flavor dependent parton energy loss and the flavor dependent hadronization process will be discussed as well.

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