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Precision physics with lepton-proton and lepton-nucleus collisions at the EIC IVAN VITEV, Los Alamos Natl Lab — A future electron-ion collider will provide unprecedented opportunities to study the internal structure of nucleons and nuclei, carry out precision tests of QCD, and understand the physics of hadronization. To support such broad and impactful program, new theoretical developments are required. In this talk I will cover a spectrum of recent advances in the QCD description of lepton-proton and lepton-nucleus collisions at the EIC. In e+p reactions I will present the most accurate calculation of the transverse-energy-energy correlation event shape variable in deep-inelastic scattering. In the framework of soft-collinear effective theory the highest perturbative next-to-next-to-next-to-leading logarithmic accuracy matched with the next-to-leading order cross section for the production of a lepton and two jets has been achieved. This advancement provides a new way to precisely study TMD physics at the EIC. In e+A collisions the physics of hadronization and parton energy loss can be studied via heavy flavor meson production at the EIC. I will show the first calculation of D meson and B meson production in DIS reactions with nuclei. A detailed next-to-leading order analysis has allowed us to identify the center-of-mass energies and kinematic domains where nuclear effects are most pronounced. I will discuss the constraints on the transport properties of cold nuclear matter and the insights on in the non-perturbative physics of hadron formation that are not possible with light hadrons, such as the ones measured by the HERMES experiment at HERA.

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