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Timelike Compton Scattering at ATHENA and the Electron-Ion Collider

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The Electron-Ion Collider (EIC), to be built at Brookhaven National Lab within this decade, will provide high-precision access to the gluon and sea-quark dominated region of the nucleon. With luminosities of 10^{33-34} $\mathrm{cm}^{-2}\mathrm{s}^{-1}$, centre of mass energies 20-140 GeV, highly polarised electron and proton / light-ion beams and hermetic detectors, the collider will enable measurements of rare, exclusive processes in a very large, previously-unchartered region of the nucleon phase space. One such process is Timelike Compton Scattering (TCS), in which a real photon scatters from a quark within a nucleon and a high-virtuality photon is released as a result, splitting into lepton pairs that can be detected. TCS gives access to Generalised Parton Distributions (GPDs), which can be interpreted as relating transverse position of partons to their longitudinal momentum. GPDs, which yield 3D tomographic images of the nucleon, map out its pressure distribution and shed light on the contribution of orbital angular momentum to nucleon spin, are the focus of much experimental effort in electron scattering, but they are currently minimally constrained far below the valence region. We present a study of the EIC potential for measurements of TCS in a wide range of phase-space, with a focus on full simulations for ATHENA (A Totally Hermetic Electron-Nucleus Apparatus), one of the proposed EIC detectors.

Submitted on behalf of a Collaboration?

Yes

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