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Precision three-dimensional imaging of nuclei using recoil-free jets

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In this study, we explore the azimuthal angle decorrelation of lepton-jet pairs in e-p and e-A collisions as a means for precision measurements of the three-dimensional structure of bound and free nucleons. Utilizing soft-collinear effective theory, we perform the first-ever resummation of this process in e-p collisions at NNLL accuracy using a recoil-free jet axis. Our results are validated against Pythia simulations. In e-A collisions, we address the complex interplay between three characteristic length scales: the medium length L, the mean free path of the energetic parton in the medium λ, and the hadronization length L_h. We demonstrate that in the thin-dilute limit, where $L \ll L_h$ and $L \sim \lambda$, this process can serve as a robust probe of the three-dimensional structure for bound nucleons. We conclude by offering predictions for future experiments at the Electron-Ion Collider within this limit.

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