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Exploring free and bound nucleon structure using deuteron DIS with spectator tagging at the EIC

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Measurements of deep inelastic scattering on the deuteron with detection of the spectator nucleon in the final state (spectator tagging) represent a unique method for extracting the free nucleon structure functions and studying the nuclear modifications of bound nucleons. The detection of the spectator nucleon (with typical momenta ~ 100 MeV/c in the deuteron rest frame) fixes the nuclear configuration as a function of $(\alpha_{spect.}, p_{T,spect.})$ during the DIS process and permits differential studies of the nuclear modifications. In electron + deuteron measurements at the EIC the spectator nucleon moves forward with $\sim 1/2$ the beam momentum and can be detected using detectors in the so-called “far-forward” region ($\eta > 4.5$). We study the feasibility of tagged DIS measurements with the baseline EIC far-forward detector design using realistic detector simulations for both proton and neutron detection. We then use data from the full GEANT4 simulations to study the extraction of the free neutron structure through on-shell extrapolation in the spectator proton momentum and the characterization of bound nucleon structure with tagging at the EIC.

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