Next-generation nuclear DIS with EIC: Polarized light ions and spectator nucleon tagging

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- Physics questions

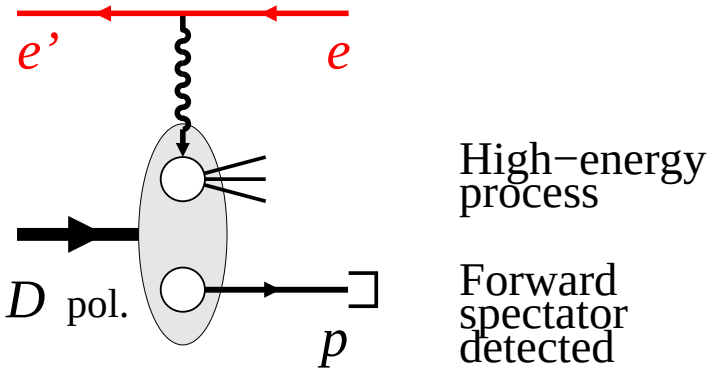
  Neutron partonic structure: Flavor decomposition of sea, nucleon spin

  Bound nucleon in QCD: EMC effect on sea quarks and gluons,
  QCD origin of NN interaction, non-nucleonic degrees of freedom

- New capabilities with EIC

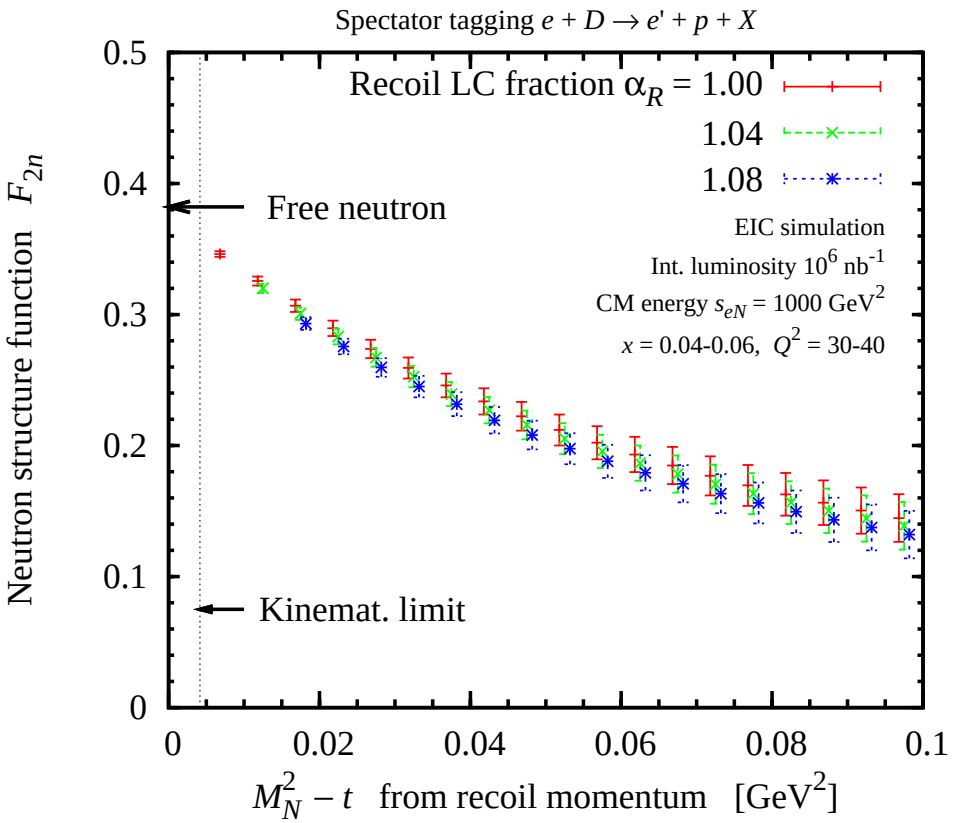
  Polarized light ion beams $D, {}^3\mathrm{He}, \ldots$
  Deuteron polarization with MEIC Figure–8 layout

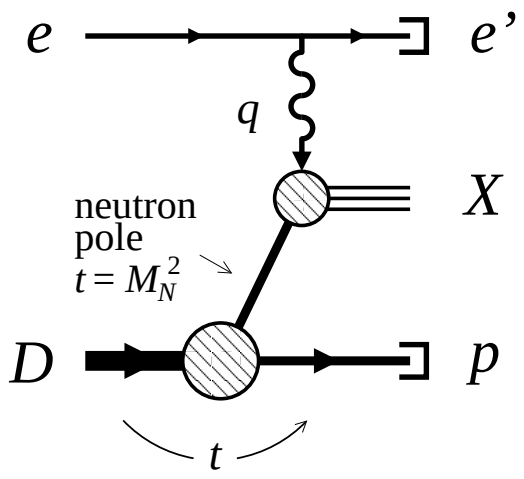
  Forward spectator detection with
  excellent coverage and resolution
  MEIC forward protons $\delta p/p \sim 10^{-4}$



- High-energy eD scattering with spectator tagging
  Identify active neutron, control its quantum state

Physics with spectator tagging at EIC





Conditional DIS $e + D \to e' + p + X$,
measure recoil momentum dependence

- Free neutron structure from on-shell extrapolation
  Eliminates nuclear binding, final-state interactions. Feasibility demonstrated
- Bound neutron structure from recoil momentum dependence
  Selects nuclear configuration, controls binding strength
- Neutron spin structure from polarized scattering
  → **Contribution Ch. Hyde**

Proposed resolutions

- Next-generation high-energy scattering experiments at EIC with polarized light ions (D, $^3\mathrm{He}$) and spectator proton tagging can precisely determine the partonic structure of the free neutron and its modification by fundamental QCD effects in the nucleus.

- Further theoretical and experimental efforts (modeling, simulations, detector design) should be supported to develop the full potential of spectator tagging with EIC.

Wider context

- Natural extension of JLab 6/12 GeV nuclear physics program: Valence quark EMC effect, short-range NN correlations
  CLAS BoNuS 6/12 GeV fixed-target spectator tagging experiment

- Connections with low-energy nuclear structure: Nuclear spectral functions, final–state interactions at input
  Low Energy Nuclear Physics Town Meeting, Texas A&M, August 21-23, 2014

Resources

V. Guzey et al., `http://arxiv.org/abs/arXiv:1407.3236`
JLab 2014 LDRD project `https://eic.jlab.org/wiki/index.php/Forward_Tagging`
Physics models, event generators, simulation results available