1. Physics potential of polarized light ions with EIC@JLab

Principal Investigator: C. Weiss (JLab Theory)

Project Status

Project work continued into FY15 with the same personnel as in FY14 (JLab investigators, 50% FTE postdoc shared with Old Dominion U., visitors). Following demonstration of feasibility of spectator tagging in the 1st project year, 2nd year efforts so far focused mainly on physics extraction, strengthening the theoretical framework, and outreach. Theory agenda and schedule had to be reassessed because of the delay in getting permission for Dr. Guzey's visit; permission has meanwhile been granted, and he is presently at JLab working for the project. Accomplishments of the past 6 months include:

- Simulated realistic measurements of unpolarized and polarized neutron structure functions with *eD* scattering and spectator tagging at MEIC, including quantitative estimates of systematic errors (recoil momentum uncertainty, polarization, extraction procedure). Neutron pseudodata have been passed on to a global analysis of parton densities for further physics impact studies (beyond the LDRD project: N. Sato, W. Melnitchouk).
- Developed new conceptual model of final-state interactions in tagged eD scattering at small x, taking into account specifics of high-energy hadron production. Needed for assessment and control of theoretical precision in neutron structure extraction. Implementation in progress.
- Performed exploratory simulations of measurements of the EMC effect using *eD* deep-inelastisc scattering with spectator tagging (control of nuclear binding effects through recoil momentum dependence).
- Produced material (impact plots, slides) for EIC science presentations at the 2015 NSAC Long-Range Plan resolution meeting and the EIC Cost review. Plots available at project webpage https://www.jlab.org/theory/tag/
- Organized topical workshop "High-energy nuclear physics with spectator tagging," ODU, Norfolk, VA, March 9-11, 2015, covering spectator tagging as a physics topic and experimental technique common to JLab 6/12 GeV and EIC. More than 40 participants from the JLab User and nuclear theory communities, great interest. Disseminated project results and opened new leads for user involvement in future EIC R&D. http://www.jlab.org/indico/event/Tagging2015

Project Plan

Work in the remainder of FY15 will focus on completion and publication of the theoretical studies, publication of the overall physics results, and extension to other channels. This includes:

- Journal publication on neutron structure measurements with *eD* deep-inelastic scattering and tagging at EIC

- Implementation of the new theoretical model of final-state interactions, and the theory of diffractive *eD* scattering with tagging, publication
- Exploration of spectator tagging in DIS with 3He at EIC, such as the two-body breakup channel e + 3He -> e' + X + D
- Assessment of potential of tagged EMC effect measurements using realistic models of bound nucleon structure
- Structuring and documentation of the simulation tools (codes, technical reports)

The project is on track to meeting its 2nd year milestones of accessing bound nucleon structure and performing a comprehensive assessment of the physics potential of spectator tagging. The planned study of neutron DVCS will depend on the continuing availability of Dr. Guzey.

Budget

A special situation in the next 6 months will be that both Dr Guzey (as originally planned) and Dr Cosyn (approved as a backup while Dr Guzey was unable to visit JLab) are available for collaboration. Since Dr Guzey's contribution is critical and we have permission for a single visit, we have invited him for the maximum period for which he could arrange to come (6 weeks). We also want to continue the collaboration begun with Dr Cosyn, of course. Because the expenses for Dr Guzey's visit are still below the original estimates there is room in the overall budget to invite both collaborators. We are working with the budget analyst to track our spending and determine the exact amount of funding that will be available for Dr Cosyn's visit.

Publications

- C. Weiss, *Electron-deuteron deep-inelastic scattering with spectator tagging at EIC.* JLAB-THY-14-1997. Technical summary reference posted at https://www.jlab.org/theory/tag/

Workshops/Conferences

- W. Cosyn, *Final state interactions in inclusive and semi-inclusive DIS*, 4th International Workshop on Nucleon Structure at Large Bjorken x (HiX2014), Laboratori Nazionali di Frascati, Italy, 16 Nov - 21 Nov 2014, https://agenda.infn.it/conferenceDisplay.py?confId=7578
- P. Nadel-Turonski, *Physics at an electron-ion collider*, 4th International Workshop on Nucleon Structure at Large Bjorken x (HiX2014), Laboratori Nazionali di Frascati, Italy, 16 Nov - 21 Nov 2014, https://agenda.infn.it/conferenceDisplay.py?confId=7578
- C. Weiss, *High-Energy Nuclear Physics with Spectator Tagging.* High Energy Nuclear Physics With Spectator Tagging, Old Dominion University, March 9-11, 2015, http://www.jlab.org/indico/event/Tagging2015
- K. Park, *Neutron Structure with Tagging at MEIC.* High Energy Nuclear Physics With Spectator Tagging, Old Dominion University, March 9-11, 2015, http://www.jlab.org/indico/event/Tagging2015
- K. Park, *Neutron structure with (un)polarized deuterons and forward spectator tagging at the Electron-Ion Collider,* APS April Meeting, Baltimore, MD, April 12, 2015,http://meetings.aps.org/Meeting/APR15/Session/C4.2
- C. Weiss, *Quark-Gluon Structure of Light Nuclei with Spectator Tagging at EIC*, APS April Meeting, Baltimore, MD, April 12, 2015, http://meetings.aps.org/Meeting/APR15/Session/J15.2