PR12-17-012A: *Tagged EMC Measurements on Light Nuclei*

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This proposal was reviewed by me and C. Weiss in 2016. Our main concern was that the proposal contained an overstatement of the ability remove final state interactions (FSIs) entirely. The new proposal has sufficiently soften these claims. The have directly responded to our previous comments. Thus, we recommend that the experiment proceed. Apart from this issue, the rest of the proposal remains the same as in 2016, and our comments remain the same. Thus, we copy the previous report here:

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The proposal is to use spectator tagged deeply inelastic scattering to probe the theoretical treatments of nucleon off-shellness, final state interactions (FSIs), and their relationship to the EMC effect. The targets are light nuclei (D and ^{4}He) and the detected spectators are low energy p, ^{3}H and ^{3}He. The proposed strategy is to exploit the ALERT detector's capability to identify low energy and wide angle hadrons, and the large acceptance of CLAS12, to distinguish regions of phase space where FSIs are expected to be large from regions where it is small.

Model descriptions of the EMC effect rely on assumptions about nucleon off-shellness and on estimates of the rate of final state interactions. The typical physical picture is that of a single hard scattering off a single target nucleon, factorized from the nuclear remnants (the proposals' Fig. 1.1). To understand the EMC effect, it is crucial to test this picture. The proposed experiment aims to provide such tests by examining the ratio (R of Eq. (1.3)) of cross sections with the same remnant kinematics for the nuclear remnant but with different A.

The analysis of the proposed measurements relies on the validity of the spectator mechanism, which assumes that the nuclear modification of the $A \to A-1$ "tagged" structure function is entirely due to nuclear binding effects in the initial state and described by the nuclear momentum distribution. It is claimed that the observation of an intact $A-1$ recoil nucleus implies the absence of FSIs. These assumptions are generally not warranted. The DIS final state produced on the active nucleon contains slow hadrons (with momenta of approximately a few 100 MeV in the nuclear rest frame), which are fully formed inside the nucleus and interact with the remnant with hadronic cross sections. Initial-state modifications due to nuclear binding and FSI effects produced by such hadrons are generally of the same order. While FSIs can be minimized in backward kinematics, it remains unclear how effectively this can be done for a complex nucleus with many possible configurations of the active nucleon relative to the remnant system. The selection of "large" recoil momenta on the nuclear scale, P_{A-1} 100-400 MeV, with the goal of displaying the nuclear binding effects, generally put the active nucleon in configurations close to the remnant system, where FSI are not suppressed. While the proposed measurements would certainly be interesting, their interpretation is likely much more complex than envisioned in the proposal. It would require very substantial theory support in the form of modeling of the FSI and calculation of the $A \to A - 1$ decay functions in the presence of FSI. The proposal needs to state the science motivation more clearly.

The proposal also explains how methods for treating deuterium can be extended to heavier nuclei, and how the techniques can be utilized to test the flavor dependence of nuclear effects, particularly in the anti-shadowing regime.

To summarize, we believe the experiment will likely have important impacts on the theoretical picture of the EMC effect. However, the theoretical case needs to be sharpened.