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Probing few-body nuclear dynamics via 3H and 3He (e,e' p) cross-section measurements at Jefferson Lab

While great progress has been made toward understanding the strong nucleon-nucleon (NN) interaction, there is still substantial uncertainty about the short-distance behavior of the nuclear force. Specifically, Quantum Monte Carlo (QMC) calculations using different state-of-the-art NN potential models can still make vastly different predictions at distance scales below 1 fm (small-r). Nucleon pairs at this separation distance are called Short-Range Correlations (SRCs). As a result of their repulsive small-r interaction, nucleons in an SRC pair fly apart from one another with high momenta (high-k). The study of SRCs is a powerful tool to constrain the NN interaction at small-r and high-k, and has significant implications not only nuclear structure, but to other fields as well, such as the astrophysics of neutron stars and the behavior of cold atomic gasses. In this talk, I will present results from the first measurement of the 3He and 3H(e,e'p) reactions in Hall A of the Thomas Jefferson National Accelerator Facility in kinematics in which the measured cross sections are expected to be sensitive to the underlying nucleon momentum distributions in the range 40 to 500 MeV/c. The resulting absolute cross sections were compared to precise cross-section calculations. These results defy the expectation of a 3He/3H ratio approaching unity for protons at high-k. This forces us to re-evaluate our understanding the reaction mechanism, of the A=3 wave function, and even of the NN interaction. The extracted absolute cross sections can be used to understand the shortcomings of current 3He and 3H cross section calculations and as a benchmark for future ones. Including the effects of outgoing nucleon rescattering improves agreement with the data at high missing momentum and suggests contributions from charge-exchange (SCX) rescattering. The isoscalar sum of 3He plus 3H is described by calculations to within the accuracy of the data over the entire pmiss range. This
validates current models of the ground state of the three-nucleon system up to very high initial nucleon momenta.

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