Experiment E01-020

$(e, e'p)$ Studies of the Deuteron at High Q^2

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Experiment E01-020 will provide the first truly systematic study of the D$(e, e'p)$n reaction down to very short-distance scales. It includes kinematics from below to above the quasifree peak over a wide range of four-momentum transfers, Q^2.

For protons detected along $\vec{q}$ each kinematics will emphasize different aspects of the reaction. For energy transfers below the quasifree peak ($x > 1$), non-nucleonic effects (IC and MEC) are expected to be minimized since the energy transfer is relatively low. For protons detected along $\vec{q}$, FSI are also expected to be minimized since they would shift strength predominantly from high to low recoil momentum and the one-body response falls off sharply with recoil momentum. Thus, these kinematics are expected to be mainly sensitive to aspects of the deuteron's short-range structure.

By examining (for fixed Q^2 and recoil momentum) the angular distribution of neutrons in the final hadronic center-of-mass system, one can quantitatively study FSI. Such a quantitative study will be facilitated via comparison to a generalized eikonal approximation, expected to be especially valid at high momentum transfers (and consequent high neutron-proton relative energies in the final state). The angular distribution is expected to show a large peak near 90° about the $\vec{q}$ direction. The success of theories in predicting this shape will give us confidence in correcting for FSI effects in extracting the deuteron structure. This understanding will also be useful for studies of $(e, e'p)$ on heavier nuclei.

Finally, a separation of the R_{LT} interference response function will be performed in quasifree kinematics over a large range of Q^2 and recoil momentum to test the validity of relativistic models. Proper treatment of relativity is essential at the extreme kinematics where we will probe the short-range structure.