CEBAF EXPERIMENT 97-111

Systematic Probe of Short-Range Correlations via the Reaction

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We plan to measure cross sections for the reaction $^{4}(e,e'p)^{3}$ over the recoil momentum range $^{4}(e,e'p)^{3}$ MeV/*c* in a variety of electron kinematics.

Many calculations have predicted that there is a sharp minimum in the spectral function of 350 for proton removal to the ^{4} ground state. The location of this minimum, and the height of the second maximum, display sensitivity to the details of the nucleon-nucleon interaction input, but all ‘‘exact’’ calculations display this feature. This minimum has yet to be experimentally observed. Since so many calculations, using different techniques, predict this feature, it is of course very interesting to verify its existence.

This minimum also presents two interesting windows for studying phenomena of current interest. Firstly, since the spectral function goes to zero at some point in this region, any observed cross section must be entirely due to reaction dynamics such as final-state interactions, meson-exchange currents, and isobar configurations. Theorists can use this feature of our data to provide an unusually pure test of reaction-dynamics calculations. Our experiment will measure the same region of the spectral function in a variety of kinematical configurations, testing several proposals of how one should best suppress these reaction-mechanism contaminations.

Secondly, the minimum is predicted to occur at a relatively large value of p_m, indicating that it should be sensitive to details of the short-range part of the internucleon potential. Theoretical calculations appear to verify this; one would in principle like to verify the effect by checking the effect of intentional modification of the short-range forces. If we are successful in controlling the reaction-mechanism distortions to a manageable level, our data will provide a new testing ground for testing exact nuclear-structure calculations with realistic forces, especially in the short-range sector. This test will be unusual in that most tests of short-range correlations involve $(e,e'p)$ reactions at large (E_m,p_m) or $(e,e'NN)$ reactions.

The experiment uses the standard Hall A setup with the exception of the target.