CEBAF EXPERIMENT 94-102

Electron Scattering from a High-Momentum Nucleon In Deuterium

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One of the most fundamental unsolved questions in Nuclear Physics concerns the interplay between the internal (quark-) structure of nucleons and the nuclear force between them. Especially for tightly bound nucleon pairs (where the nucleons are close together and, because of the Uncertainty Relation, have therefore high relative momenta) one expects significant changes in the internal structure of the nucleons involved. These changes can lead to differences in the inclusive electron scattering cross section on a nucleon that is part of such a pair, relative to the cross section on a free nucleon. By measuring this cross section on a bound nucleon as a function of the relative nucleon momentum one can draw conclusions on the kind of changes that occur. In an extreme case, the electron scatters no longer off a single nucleon, but on a 6-quark bag made out of the two overlapping partners. This leads to a drastically different behavior of the measured cross section as a function of all kinematic variables.

The simplest (best understood) nuclear system where one can have a nucleon pair is deuterium, the target chosen for this experiment. To determine the relative momentum of the two nucleons at the moment of the scattering, we will detect the second nucleon and measure its momentum. Assuming that this nucleon is only a spectator in the scattering process, we can "tag" the relative momentum of the two nucleons before the scattering. By restricting ourselves to protons emitted in the backward hemisphere relative to the momentum transfer we can minimize the influence of final state interactions. In this way, we can study electron scattering on the forward-going neutron in the elastic, resonance and deep inelastic region as a function of the relative nucleon momentum.

In summary, we will measure inelastically scattered electrons in coincidence with protons emitted backwards relative to the virtual photon direction in the reaction d(e,e'p)X. Using a 6 GeV electron beam and the CLAS detector, we will study this reaction for a large range of proton momenta (0.25 - 0.6 GeV/c) and electron kinematics (Q^2 = 1 - 6 $(GeV/c)^2$, x=0.2 -1). The experiment will run for 16 days at the highest luminosity available in CLAS (10^{34} $s^{-1}cm^{-2}$). These data will give us statistically significant information on the wave function of the deuteron, on the off-shell behavior of the elastic and inelastic cross section, and on the presence of 6-quark objects in deuterium.

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A Proposal for an Experiment using the CEBAF Large Acceptance Spectrometer

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