Correlations and Currents in ^{3}He Studied with the $(e, e'pp)$ Reaction

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Nucleon-nucleon correlations, especially those of short-range character, can be well studied with electron-induced two-nucleon knockout reactions at intermediate electron energies. However, these reactions are not only driven by one-body currents, *i.e.*, coupling of the virtual photon to one of the nucleons of a correlated pair, a process that directly probes NN-correlations. Also two-body currents, resulting from intermediate Δ-excitation and coupling to exchanged mesons, as well as final state interactions, influence the experimental cross section. Exclusive measurements of the three-body breakup of ^{3}He offer the opportunity to compare data to microscopic calculations. The relative importance of competing two-proton knockout mechanisms can be investigated by varying the energy and momentum of the virtual photon.

The experiment was performed with the electron beam extracted from the Amsterdam Pulse Stretcher (AmPS) at NIKHEF; the incident electron energy was 564 MeV. A cryogenic, high-pressure ^{3}He gas target was used with a thickness of 270 mg/cm^2. Scattered electrons were detected in the QDQ magnetic spectrometer and both emitted protons in the HADRON plastic scintillator arrays. Cross sections were determined for three values of the three-momentum transfer of the virtual photon (q=305, 375, and 445 MeV/c) at an energy transfer value ω of 220 MeV. At q=375 MeV/c, measurements were performed over a continuous range in energy transfer from 170 to 290 MeV. The data are compared to results of continuum-Faddeev calculations performed by Golak *et al.*, that account for rescattering among the emitted nucleons. Various potential models were used in the calculations: Bonn-B, CD-Bonn, Nijmegen-93 and Argonne v_{18}.

Presentation of the data as a function of the missing or neutron momentum, p_m, shows that the cross section decreases exponentially as a function of p_m. Calculations performed with only a one-body hadronic current operator show fair agreement with data obtained at $p_m \lesssim 100$ MeV/c at $\omega = 220$ MeV for all q-values. It can therefore be concluded that at ω=220 MeV and $p_m < 100$ MeV/c the cross section is dominated by direct knockout of two protons via a one-body hadronic current.

At higher neutron momentum values, data and theoretical predictions differ up to a factor of five for all values of ω. Within the range of energy transfer values probed in this experiment, the high p_m domain is expected to be strongly influenced by intermediate Δ excitation in the proton-neutron pair.

Within specific regions of phase space, where two nucleons are emitted with comparable momentum vectors, rescattering processes strongly influence the cross section. For a such a region, measured at q=445 MeV/c, good agreement was found between data and the continuum-Faddeev calculations as a function of the pn momentum difference in the final state.

Information on the wave function of ^{3}He may be obtained in the domain $\omega \approx 220$ MeV and $p_m < 100$ MeV/c by representing the cross section as a function of $p_{diff,1}$, which can be related to the relative momentum of the constituents of the two-proton pair in the initial state. The observed decrease of the cross section reflects the behaviour of the wave function and is well reproduced by calculations. At present, the data do not permit to express preference for any one of the potential models considered.