Three-Nucleon Interaction Dynamics Studied via the Deuteron-Proton Breakup

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Experimental investigations of deuteron-proton breakup in large phase space region provide basis for exploring details of nuclear interactions. Differential cross section for this process measured at 130 MeV deuteron beam energy reveals sensitivity to various aspects of the system dynamics, like the so-called three-nucleon force (3NF), Coulomb interaction between protons or subtle influences of relativistic effects. Magnitude of these effects changes substantially depending on kinematical region under study [1,2]. On the other hand, vector analyzing powers at this energy are much less sensitive to these ingredients of the system dynamics. They can be very well described by pairwise nucleon-nucleon interactions expressed in terms of realistic potentials or within Chiral Perturbation Theory at the next-to-next-to-next-to-leading order, even though 3N graphs at this order are not yet included. According to theoretical predictions, tensor analyzing powers should be more sensitive to 3NF and Coulomb interaction. However, including the model 3NF (TM99 or Urbana) into calculations leads in certain kinematical regions to poorer description of A_{xy}. In spite of general consistency of data and calculations for A_{xx} and A_{yy}, certain problems can be also observed for these observables (or the related observable in the spherical representation, ReT_{20}, c.f. Ref. [3]), though they are limited to very small kinematical regions, usually characterized by the lowest relative energies of the two protons.

Precise experimental data for the ^{1}H($\vec{\mathrm{d}}$,pp)n breakup reaction measured at 130 MeV deuteron beam energy will be also confronted with preliminary results obtained at a lower energy of 100 MeV and with the results of the measurements of the ^{2}H($\vec{\mathrm{p}}$,pp)n reaction at various energies of the proton beam [4,5].

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