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Effects of 3N force and Coulomb interaction studied in deuteron breakup reaction

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Precise understanding of nuclear interaction is the basis for correct description of properties of nuclei and reactions involving them. Systems of three nucleons (3N) can be treated as a testing ground for the modern approaches to describe nuclear interaction, since for them exact theoretical calculations can be performed. At intermediate energies, observables for 3N systems are sensitive to subtle effects of the dynamics beyond the pairwise nucleon-nucleon force, so-called 3N-force, as well as to Coulomb interaction between protons and/or relativistic effects. Breakup of a deuteron in collision with a proton leads to the final state of three free nucleons, with a variety of possible kinematic configurations, revealing locally enhanced sensitivity to particular aspects of the dynamics. This feature makes the breakup reaction a very versatile tool for validation of the theoretical models. Database for the breakup reaction has recently been significantly enriched with precise differential cross section data, vector (proton) analyzing power and vector and tensor (deuteron) analyzing powers, collected with detection systems covering large parts of the phase space. A series of experiments performed at KVI Groningen and FZ-Juelich led to several important findings concerning the role of 3N-force and of Coulomb interaction, as well as indicating problems in description of polarization-related observables. The experimental program is continued at the new proton accelerator facility, Cyclotron Center Bronowice in Krakow, Poland.

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