Experimental studies of the deuteron-proton breakup reaction. *

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The nuclear force is a basis for understanding nuclear phenomena and therefore at the centre of experimental and theoretical nuclear physics. Scattering experiments in systems of three nucleons provide particularly rich and sensitive data for testing the state-of-the-art potentials of nuclear interactions. Studies of cross section for proton-deuteron elastic scattering demonstrated importance of dynamics beyond pairwise nucleon-nucleon interactions, called three-nucleon force (3NF). These findings have been further investigated in the reaction of deuteron breakup in collision with proton. Due to the momentum continuum of the three free nucleons in the output channel, experiments studying this reaction over a wide range of phase space have been a very useful tool for searches of dynamical effects. A series of experiments studying deuteron-proton breakup was performed with the use of large acceptance detectors: SALAD and BINA at KVI Groningen and CCB PAS Krakow, GeWall and WASA at FZ-Juelich. Differential cross section and, in some cases, vector and tensor analyzing powers were measured over a significant part of the reaction phase space and a wide range of beam energies, from 50 to 200 MeV/nucleon. The collected data provided a basis for systematic comparison with the state-of-the-art theoretical calculations, confirming the importance of 3NF, and demonstrating sensitivity of the breakup cross section to Coulomb interaction in the final state. The main results will be shown, with particular emphasis on the observed effects, as well as local discrepancies between experiment and theoretical description.

Generally, polarization observables reveal stronger sensitivity to details of the interaction potential. There are many challenges in describing them, both in the case of elastic scattering and breakup reaction, and introducing 3NF does not necessarily resolve these discrepancies [1],[2],[3],[4]. For breakup reaction, the database for polarization observables remains not very diverse. The new project to measure induced polarization P^y, in a number of configurations of the $^2\mathrm{H}(p,\vec{p}p)n$ breakup reaction at beam energy of 160 MeV, using the BINA detector equipped with the dedicated proton polarimeter, will be discussed.

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