PROBING THREE- AND FOUR-NUCLEON INTERACTIONS WITH DEUTERON BREAKUP

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Few-body systems provide a testing ground for models of the NN interaction, reaction mechanism and for models of nuclei. In a medium energy domain the properties of few-nucleon systems are successfully modeled with the use of the realistic potentials, coupled-channel (CC) calculations with realistic potential including non-nucleonic degrees of freedom or Chiral Perturbation Theory (ChPT). At a certain level of experimental precision, subtle effects can be studied, for example Three Nucleon Force (3NF). The calculations, in order to correctly describe the system dynamics include the model of 3NF (e.g. Tucson Melbourne TM force) and/or the Coulomb force [4]. Recently, also the relativistic treatment of the breakup reaction in 3N system was developed and the approach has been already applied for calculations including 3NF [2]. Depending on the investigated part of the phase space, one can study the influence of these effects separately and also their mutual interplay. All those effects vary with energy and appear with different strength in certain observables, therefore systematic (over beam energies) and precise data are needed to distinguish between, sometimes, very subtle effects.

In a medium energy region the 3NF effects are generally small and hard for experimental study. The data obtained so-far [1,3-5] have not brought any firm conclusions concerning the role of the 3NF in the 3N interaction. The situation can change for heavier systems where sensitivity to the 3NF effects become higher. The simplest ensemble which reveals the complexity of heavier systems, e.g. variety of entrance and exit channels, various total isospin states etc., is the one composed of four nucleons. In expectation of the precise calculations for 4-nucleon systems at medium energies, our experimental group has made a step forward and measured the deuteron-deuteron scattering at 160 MeV [5] with use of the BINA detector at KVI Groningen. The search for the 3NF effects is planned to be continued with the use of the p-^{3}He scattering at medium energies at the new facility - Cyclotron Center Bronowice (CCB) in Poland. The project assumes the measurement of vector analyzing power and differential cross section for protons scattered on a polarized ^{3}He target.

In the poster I will present how, from the experimental point of view, one can trace the different dynamical effects predicted by theory in the 3- and 4-nucleon systems. As the outlook plans of utilizing the polarized ^{3}He target at CCB will be presented.

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