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Experiments of Few-Nucleon Scattering to Explore Three-Nucleon Forces

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Understanding the nuclear properties from bare nuclear forces is one of the main topics in nuclear physics. The importance of three-nucleon forces (3NFs), which appear when more than two nucleons interact, has been indicated in various nuclear phenomena, such as few-nucleon scattering, binding energies of nuclei, and equation of state of nuclear matter.

Nucleon-deuteron (Nd) scattering, where numerically exact solutions of the corresponding Faddeev equations for any $2N$ - and $3N$ -forces are feasible, offers a good opportunity to study dynamical aspects of 3NFs, that are momentum, spin, and isospin dependences. Indeed the last two decades have witnessed the extensive experimental and theoretical investigations of the Nd scattering performed in a wide range of incoming nucleon energies up to $E \sim 300$ MeV/nucleon.

The four-nucleon ($4N$) systems could also play an important role for the study of 3NFs. 3NF effects are expected to be sizable in the four-nucleon system. In addition, while the Nd scattering is essentially a pure isospin $T = 1/2$ state, tests of the $T = 3/2$ channel in any 3NFs can be performed in a $4N$ system such as proton- ^3He scattering.

With the aim of exploring the 3NFs experimental programs of Nd scattering as well as proton- ^3He scattering using the polarized beam and target systems are on going at RIKEN, RCNP, and CYRIC in Japan.

In this conference we review these experiments and touch upon our future plan.

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