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Exploring Three-Nucleon Forces in Three- and Four Nucleon Scattering

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Nucleon-deuteron (Nd) scattering, the three-nucleon ($3N$) scattering system, offers a good opportunity to study dynamical aspects of 3NFs, which are momentum,
spin and isospin dependent, since it provides not only cross sections but also a variety of spin observables at different incident nucleon energies. Direct comparison between the experimental data and the rigorous numerical calculations in term of Faddeev theory based on the realistic bare nuclear potentials provides information on 3NFs. 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 $4N$ 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-^{3}He scattering. In recent years, there has been a large progress in solving $4N$ scattering problem with realistic Hamiltonian even above four-nucleon breakup threshold energies [4], which opens up new possibilities to approaching to properties of 3NFs.

With the aim of exploring the 3NFs experimental programs of deuteron–proton scattering as well as proton-^{3}He scattering using the polarized beam and target systems are in progress at RIKEN, RCNP, and CYRIC in Japan.

In the conference we introduce recently conducted experiments and present the
results of comparison between the experimental data and the theoretical
predictions based on the realistic bare nuclear potentials. Parts of the results are published in Ref. [5].

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