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Exploring Three Nucleon Forces via Few Nucleon Systems

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A main interest of nuclear physics is to understand the forces acting between nuclear constituents. Few nucleon systems offer good opportunities to investigate these forces. A recent topic of present day few-nucleon system studies is to explore the properties of three-nucleon forces (3NFs) acting in systems with more than A=2 nucleons. Indication of 3NF for the three-nucleon scattering was first pointed out in the cross section minima for nucleon–deuteron (Nd) elastic scattering at intermediate energies ($E/A \sim 100$ MeV) by Witala *et al.*[1] in 1998. Since then experimental studies of elastic proton–deuteron (pd) and neutron–deuteron (nd) scattering at intermediate energies have been performed intensively at RIKEN, RCNP, KVI and IUCF and provided precise data of various observables. Cross section data for elastic pd scattering have shown large disagreement between data and rigorous Faddeev calculations with modern NN forces. Combination of these NN forces and 2π–exchange type 3NFs removes this discrepancy and leads to a good description of the measured cross sections. However spin observables are not always explained by addition of the 3NFs. To describe these spin observables, theoretical approaches, such as addition of 3NFs other than 2π exchange types, and/or relativistic treatment, and completely new approach based on chiral effective field theory are now in progress. Measurements for the Nd–breakup and radiative capture processes are also underway to provide a solid basis to test current and/or future coming theoretical approaches. In the presentation, an overview of recent advances of 3NF study via few-nucleon systems will be given. In particular, the results of Nd elastic scattering and the Nd breakup reactions obtained at RIKEN will be discussed.

1. H. Witala, et al., Phys. Rev. Lett. **81**, 1183 (1998).