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Review of the experimental activity at RIKEN to explore the three-nucleon interactions

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, nuclei binding energies, and state equation 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. It provides not only cross sections but also a variety of spin observables at different incident nucleon energies.

Signatures of 3NF effects in the Nd elastic scattering was pointed out for the first time by Wita{\l}a et al., in 1998 [1]. Clear signals from 3NFs were found around the cross section minimum occurring at the center of mass angle around 120 degrees for incident energies above 70 MeV/nucleon. Since then, we have performed the measurements of elastic deuteron-proton scattering with a RIKEN polarized deuteron beam, providing precise data of the cross section (70 and 135 MeV/nucleon), all deuteron analyzing powers (70, 100, 135, 190, 250, 300 MeV/nucleon), and polarization transfer coefficients (135 MeV/nucleon).

In the workshop, I review the experimental activity at RIKEN to explore the three-nucleon interactions and touch upon our future plan.

[1] H. Wita{\l}a et al., Phys. Rev. Lett. 81, 1183 (1998).

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