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Complete Set of Deuteron Analyzing Powers for dp Elastic Scattering at Intermediate Energies and Three Nucleon Forces

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Study of three nucleon forces (3NFs) is essentially important in clarifying nuclear phenomena. In addition to the first signals of the 3NF effects in the binding energies of the ^{3}H and ^{3}He, the significance of 3NFs has been recently pointed out for descriptions of discrete states in higher mass nuclei. Three nucleon scattering at intermediate energies ($E/A \sim 200$ MeV) is one attractive approach to investigate the dynamical aspects of 3NFs, such as momentum and/or spin dependences. With the aim of clarifying roles of the 3NFs in nuclei the experimental programs with polarized deuterons beams at intermediate energies are in progress at RIKEN RI Beam Factory (RIBF) [1]. As the first step, we have measured a complete set of deuteron analyzing powers in deuteron–proton (dp) elastic scattering at 70–300 MeV/nucleon.

The vector and tensor polarized deuteron beams were accelerated by three cyclotrons, AVF, RRC and the newly constructed cyclotron SRC. The measurement of deuteron analyzing powers for elastic dp scattering was carried out using the polarimeter BigDpol installed at the extraction beam line of the SRC. The deuteron beams bombarded a polyethylene (CH_2) target in the scattering chamber. Scattered deuterons and recoil protons were detected by plastic scintillators in kinematical coincidence conditions.

A part of the obtained data is shown in Fig. 1. The obtained high precision data are compared with the results of three-nucleon Faddeev calculations based on modern nucleon-nucleon (NN) potentials; $i.e.$ CD Bonn, Argonne V_{18}, Nijmegen I, and II, alone (a blue band in the figure) or combined with Tucson-Melbourne'99 3NFs (a red band). Large discrepancies between pure NN theory and data, which are not resolved by the current 3NFs, are found at the c.m. backward angles for almost all the deuteron analyzing powers with increasing an energy.

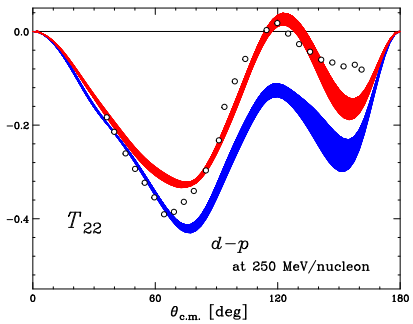

Figure 1: *Tensor analyzing power T_{22} for dp elastic scattering at 250 MeV/nucleon.*

[1] K. Sekiguchi et al., Phys. Rev. C 83, 061001 (2011).