Polarization Transfer Measurement for d-p Elastic Scattering - a Probe for Three Nucleon Force Properties -

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Recent advance in computational resources has made it possible to obtain rigorous numerical Faddeev-type calculations for the three-nucleon scattering processes by using two-nucleon and three-nucleon forces. It has also allowed us to search for 3*NF* effects by direct comparison between such theoretical predictions and precisely measured data.

In Refs. [1],[2] we have reported the precise measurement of the cross section and the deuteron analyzing powers for d-p elastic scattering at incoming deuteron energies of 140, 200, and 270 MeV. The data have been compared with the Faddeev calculations with or w/o 3NFs. For the cross section, the large discrepancy between the data and the calculations w/o 3*NF*s has been found in the cross section minimum and it is essentially removed by taking into account 3*NF*s. The vector analyzing power A^d_y is also explained by the predictions incorporating 3*NF*s. However the tensor analyzing power data axe not reproduced by any theoretical prediction and these results indicate that the present day 3*NF* models have deficiencies in the spin parts. In order to assess further the study of 3NF effects, we have measured the deuteron-to-proton polarization transfer coefficients for *d-p* elastic scattering, which axe expected theoretically to have strong sensitivities to the spin dependent parts of 3*NF*.

The experiment was performed at the RIKEN Accelerator Research Facility using tensor and vector deuteron beams of 270 MeV. A liquid hydrogen (19.8 mg/cm^2) or polyethylene (93.4 mg/cm^2) target was bombarded and scattered protons were momentum analyzed by the magnetic spectrograph SMART. The polarizations of the scattered protons were measured with the focal-plane polarimeter DPOL. The measured observables were the deuteron to proton polarization transfer coefficients ($K^{y'}_y$, $K^{y'}_{xx}$ Y' - $K^{y'}_{yy}$, and $K^{y'}_{xz}$) in the angular range of $\theta_{c.m.} = 90^o - 180^o$. This measurement also yielded an induced polarization ($P^{y'}$) of the scattered protons. The statistical uncertainties are smaller than 0.03 for 0 the polarization transfer coefficients, and 0.01 for the induced polarization $P^{y'}$. The systematic uncertainties for the polarization transfer coefficients axe estimated to be 3% at most.

References

[1] H. Sakai et al., Phy. Rev. Lett. 84 (2000) 5288.

[2] K. Sekiguchi et al., Phy. Rev. C 65 (2002) 034003.