Measurement of p-d elastic scattering at E_p=392 MeV

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From recent high precision measurements of the p-d elastic scattering and much progress of the Faddeev calculations using modern nucleon-nucleon (NN) forces, a clear signature of three-nucleon force (3NF) effects has been found in the differential cross section data at intermediate energy, *e.g.* E_d=270 MeV (135 MeV/nucleon) [1]. By adding the Tucson-Melbourne (TM) 3NF, the differential cross section and deuteron vector analyzing power have been excellently reproduced, while the fits are deteriorated for tensor analyzing powers when the 3NF is included. At a higher energy of E_p=250 MeV, differential cross section and proton analyzing power at backward angles are not reproduced by the Faddeev calculations even when including the 3NF [2].

For the purpose of obtaining systematic data concerning various spin dependent observables, we planned to measure p-d elastic scattering data at E_p=392 MeV at the Research Center for Nuclear Physics. In this plan, the two outgoing particles, p and d, are detected by using the magnetic spectrometers, Grand Raiden and LAS, and the polarization of both particles are simultaneously measured by using two focal plane polarimeters. The three-spin correlation coefficient $C_{y(p)}^{y'(p),y'(d)}$ and two-spin correlation coefficient $C^{y'(p),y'(d)}$ are planned to be measured with a good statistical accuracy in addition to the proton analyzing power, induced proton (and deuteron vector) polarizations, and proton to proton (and to deuteron vector) polarization transfer coefficients.

During a calibration measurement of the outgoing deuteron polarimeter in this year, we have obtained differential cross sections ($d\sigma/d\Omega$), proton analyzing powers ($A_{y(p)}$), induced deuteron vector polarizations ($P^{y'(d)}$), and proton to deuteron polarization transfer coefficients ($K_{y(p)}^{y'(d)}$). The results are plotted in Fig. 1 with statistical errors in comparison with the results of Faddeev calculations incorporating (solid curve) and not incorporating (dotted curve) the TM-3NF [3]. The CD-BONN potential is used as the two-nucleon force (2NF) in the calculation.

As can be seen in the figure, the differential cross sections are well reproduced by the Faddeev calculation incorporating the 3NF. However there exists large discrepancy in the analyzing powers at backward angles. The deviation seems to become systematically larger as increasing the bombarding energy. The Faddeev calculation cannot reproduce $P^{y'(d)}$ and $K_{y(p)}^{y'(d)}$ at all. The reason of the deficiency is not clear at present. The elements which should be considered are: relativistic effect, the effect of the pion-production channel, and deficiency the description of the 3NF and 2NF. More systematic data concerning various spin observables are required to further discuss the observed discrepancy.

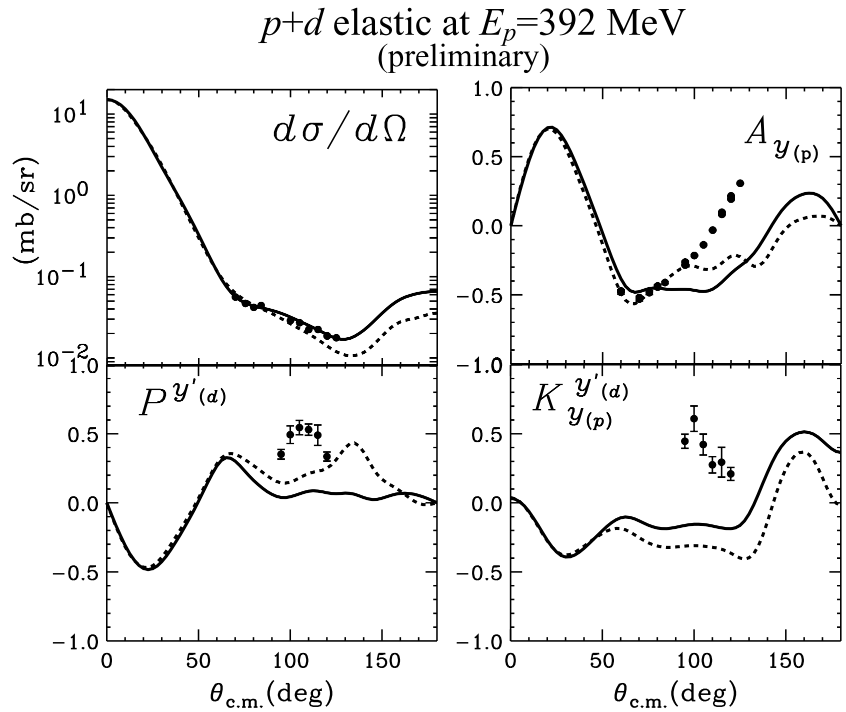

Figure 1: Measured differential cross sections ($d\sigma/d\Omega$), proton analyzing powers $A_{y(p)}$, induced deuteron polarizations $P^{y'(d)}$, and proton to deuteron polarization transfer coefficients $K_{y(p)}^{y'(d)}$ with statistical errors. The solid (dotted) curves represent the results of the Faddeev calculations with CD-BONN two-nucleon force incorporating (not incorporating) TM-3NF [3].

References

[1] K. Sekiguchi, *et al.*, Phys. Rev. C **65**, 034003 (2002).
[2] Y. Shimizu, private communication.
[3] H. Kamada, private communication.