Measurement of Cross Section and A_y of D(p,p)pn Reaction at 250 MeV

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3NF effects in Nd scattering have been widely investigated from low energy to intermediate energy. Complicated disagreements between experiments and calculations with 2π-exchange 3NF appear at higher energy. To see the origin of the disagreement, we made an experiment on pd breakup reaction at $E_p = 250$ MeV. At the energy the breakup cross section is about 10 times larger than Nd scattering cross section.

Cross section and A_y of D$(p,p)pn$ reaction at $E_p = 250$ MeV were measured at $\theta_{lab} =$ 7°,10°, 15° and 20°. A polarized p beam from RCNP ring cyclotron was incident on a liquid deuterium target, and outgoing continuum protons were detected by LAS (large acceptance spectrometer) having a broad range ($\Delta p/p = \pm 15\%$) focal plane.

The liquid deuterium target was thick as 150 mg/cm^2 and the target cell windows were made of thin (0.6 mg/cm^2) aramide foils. The background spectra were also measured by evaporating and evacuating the deuterium target. The number of protons from the $p-d$ breakup reaction overwhelmed the number of background protons from the foils.

The beam polarization was measured during the experiment by a beam-line polarimeter using $p-p$ scattering. The absolute cross section was determined using a CD_2 target of 10 mg/cm^2 in thickness which was calibrated by a $p-d$ scattering experiment at Kyushu University.

In Fig.1, experimental results of pd breakup cross section are compared with nd breakup cross section calculation by H. Witala[1] based on CD Bonn NN potentials and TM3NF.

We notate the reaction as D$(p0,p1)p2n$. At E_{p0} >200 MeV where $p2-n$ final state interaction (FSI-I) and $P1-P2$ and $p1-n$ quasi-free scattering (QFS) occur, experiment and calculation agree well. Around $E_{p0} = 110$ MeV where $p1-n$ and $p1-p2$ FSIs (FSI-II) take place, calculation underestimates the experimental cross section. Large discrepancy at forward angles can not be explained by TM3NF. Similar discrepancy was seen also for A_y.

If we presume $p1-n$ FSI as pd inelastic scattering, $p1-n$ FSI at forward angles corresponds to pd inelastic scattering at backward angle. In pd scattering at the same 250 MeV, large discrepancies appear in the cross section and A_y at backward angles[2]. Below 135 MeV, such discrepancies do not appear.

Both in elastic and inelastic scattering, momentum transfer becomes large at backward angle and high incident energy. One possible story is that the discrepancies found in pd scattering and pd breakup at 250 MeV reflect relativistic effects that have not been included in the calculation.

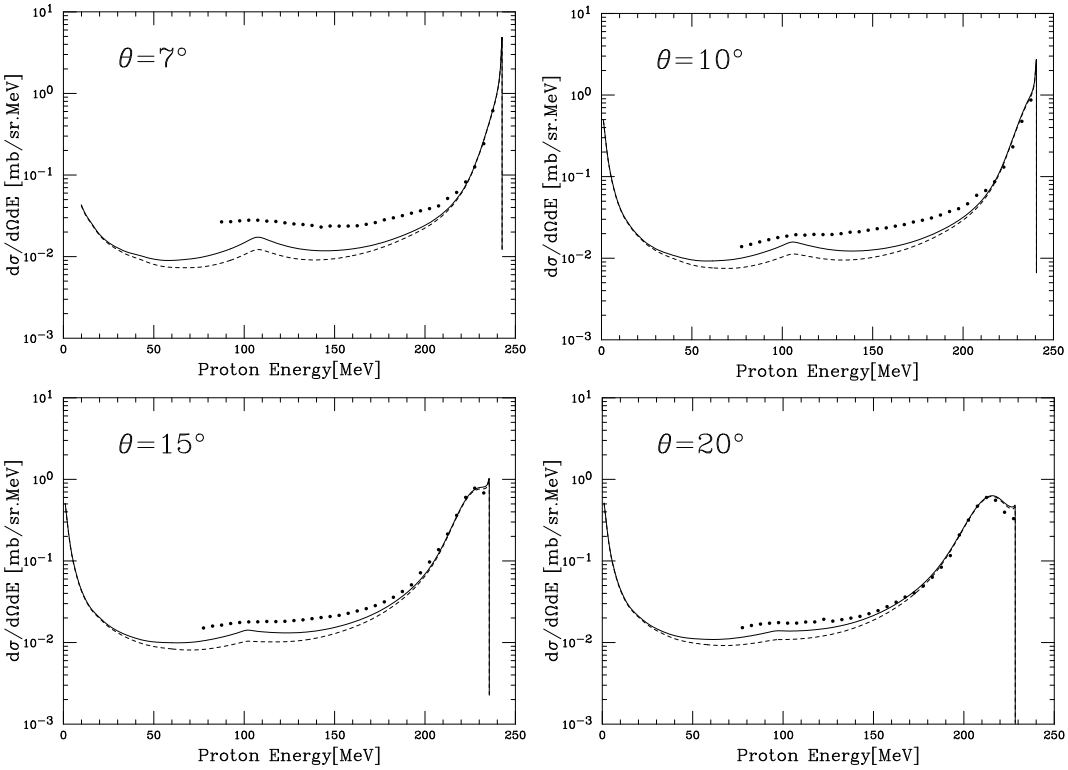

Figure 1: Cross section of D$(p,p)pn$ reaction at $E_p = 250$ MeV. Curves are calculations[1] for D(n,n)np reaction using CD Bonn NN potential with (solid) or without (dashed) TM3NF.

References

[1] H. Witala et al., private communication.
[2] K. Hatanaka et al., Phys. Rev. **C66** (2002) 044002.