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1.51 Measurements of the Polarization Transfer in the $^{28}Si(\vec{d},\vec{p})^{29}Si$ g.s. Reaction

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To investigate the effects of the dueteron D-state and the tensor force, the angular distribution of the vector polarization transfer coefficient K_y^y in the $^{28}Si(\vec{d},\vec{p})^{29}Si$ g.s. reaction has been measured at 18 MeV.

A polarized deuteron beam from the Lamb-shift type ion-source[1]) was accelerated by the Kyushu University tandem accelerator and brought to a target chamber. A natural silicon wafer has been used for a target. The beam intensity on the target was about 300 nA and the degree of polalization was 65 %. The beam polarization was monitored continuously during the experiment by a down-stream polarimeter utilizing the $^3He(\vec{d},p)^4He$ reaction. This polarimeter is consisted of five sets of counter telescopes(one set at 0° and four sets at 127.5°).

Protons from the $^{28}Si(\vec{d},\vec{p})^{29}Si$ g.s. reaction were momentum-analyzed and focused on a target of liquid helium of the proton polarimeter by using a Q-D-Q magnetic lens system. Liquid helium was contained in a cell of 1 cm in thickness with mylar windows. To avoid the production of bubbles in the liquid target, it was cooled down to a super-fluid state. The protons passing through the helium target were detected by a Si-detector on the polarimeter axis. The sensitive area of this detector was divided into four quadrant sections to monitor the position of the incident protons. The protons scattered by the helium target were detected by four (up, down, left and right) Si-detectors placed at 52° with an angular spread of $\pm$ 7°. Backgrounds, which might have been induced by neutrons, were suppressed by the coincidence between a ΔE detector in front of the helium target and the four detectors. The energy of the proton incident on the polarimeter was decreased by an absorber to about 18 MeV. At this energy, the average analyzing power of the polarimeter is -0.4 and the efficiency (the ratio of the number of protons detected by the pair detectors, left and right, or up and down, to that of incident protons) is very high, 1/3700.

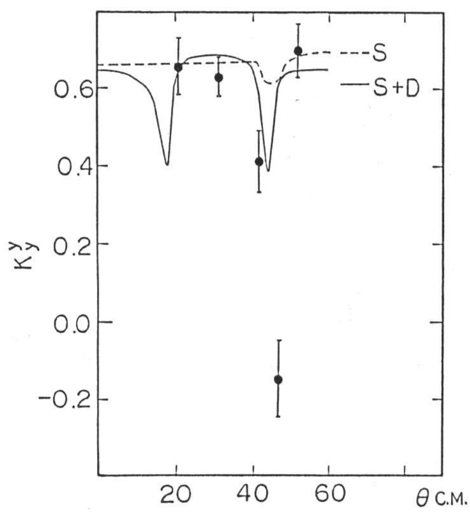

Fig. 1. The vector polarization transfer coefficient K_y^y in the $^{28}Si(\vec{d},\vec{p})^{29}Si$ g.s. reaction at 18 MeV. The curves are the results of the preliminary DWBA calculation with the deuteron in pure S-state (dashed curve) and in S + D(9%) state (solid one).

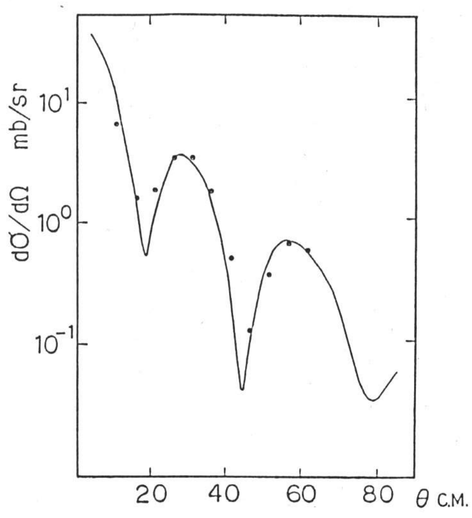

Fig. 2. The differential cross section of the $^{28}Si(d,p)^{29}Si$ g.s. reaction at 18 MeV. The results of the DWBA calculations with the deuteron in pure S-state and in S + D(9%) state coincide on the graph.

The experimental results of the polarization transfer coefficient K_y^y are shown in Fig. 1. Fig. 2 shows the cross sections obtained in other measurement using a usual scattering chamber. The error bars indicate the statistical ones only. The systematic errors are estimated to be less than 5 %. The angular spread is $\pm 1°$. The measurement of K_y^y at 46.8° which is the most interesting case in this experiment was done with a time of 1.5 days.

In Fig. 1 and Fig. 2 the results of a preliminary DWBA calculation are also shown. A dashed curve is a result for deuterons in the pure S state, and a solid one is for the S + D (9%) states. The difference of the cross sections between the pure S and the S + D states is so small that both curves coincide on the graph.

Most of a vector polarization transfer coefficients K_y^y in the $(\vec{d},\vec{p})$ or $(\vec{d},\vec{n})$ reactions at forward angles take the value of approximately 2/3, which is easily understood in a simple model with the pure S-state deuteron. The results of the DWBA calculation with the pure S-state also take the values of about 2/3 as shown in Fig. 1. If the deuterons were in the pure D-state, the value would be -2/3. The negative value of the K_y^y at 46.8° (-0.14 ± 0.10) indicates that the D-state effects play a dominant role at this angle. As shown in Fig. 2, the cross section is determined mainly by the S-state. It is considered that at the angle of the cross section minimum the S-state contribution is small compared to that from D-state.

Basak et al.[2] had measured the same quantity K_y^y in the $^{28}Si(\vec{d},\vec{p})^{29}Si$ reaction at the angle of first minimum of the cross section at 12 MeV, and discussed the D-state effect. The present data indicate that the same situation was found to occur at the angle of the second minimum of the cross section at 18 MeV.

References

1) A. Isoya et al., Proc. Int. Symp. on polarization phenomena in nuclear physics (Osaka, 1985)

2) A.K. Basak et al., Nucl. Phys. A275 (1977) 381