Proc. Sixth Int. Symp. Polar. Phenom. in Nucl. Phys., Osaka, 1985
J. Phys. Soc. Jpn. 55 (1986) Suppl. p. 586-587

1.17 Measurements of the Depolarization Parameter for Elastic Proton Scattering from ^{25}Mg and ^{27}Al

M. Nakamura, H. Sakaguchi, H. Ogawa[†], M. Yosoi, T. Ichihara[††], N. Isshiki[†††], M. Ieiri, Y. Takeuchi, H. Togawa, T. Tsutsumi, S. Kobayashi, H. Sakamoto[*], T. Noro[**] and H. Ikegami[**]

Department of Physics, Kyoto University
* Institute of Physics, University of Tsukuba
** Research Center for Nuclear Physics, Osaka University

Measurements of the depolarization parameter for nucleons elastically scattered by nonzero-spin target nuclei were done to detect the effect of the spin-spin interaction terms in the optical potential.[1] Some ambiguity may exist in the interpretation of the data as a results of the fact that departure of the depolarization parameter from unity can be accounted for in terms of a compound nucleus[2] or a quadrupole spin flip effect.[3] Use of a higher energy proton beam is desirable to reduce contribution of a multistep or the compound nuclear process. From our systematic study on the elastic scattering of polarized protons at 65MeV, we observed the even-odd effect in the peak value of the analyzing power for the ^{24}Mg-^{25}Mg-^{26}Mg and the ^{26}Mg-^{27}Al-^{28}Si and obtained a potential with a quadrupole deformation.[4] The depolarization parameter K in the elastic scattering of 65 MeV polarized protons from ^{25}Mg and ^{27}Al was measured using the polarization spectrograph "DUMAS"[5] and the efficient proton polarimeter "MUSASHI"[6,7] at Research Center for Nuclear Physics, Osaka University. A polarized beam of 65 MeV protons from a cyclotron struck the primary target in a scattering chamber attached to the DUMAS. The targets were self-supporting foils of ^{24}Mg(natural, 32 mg/cm^2), ^{25}Mg(enriched to 97%, 30 mg/cm^2), ^{27}Al(natural, 26 mg/cm^2) and ^{28}Si(natural, 23 mg/cm^2). Typical beam intensity was 500 nA. The beam polarization was about 80% and it was monitored continuosly during the experiment with a beam polarimeter. Elastically and inelastically scattered protons were transferred to the first focal line (the dispersive focal line) of the DUMAS where they hit a multi-wire proportional chamber (MWPC), and their momenta were measured. The MWPC (named the tagging counter) tagged the magnitude of the momentum to the scattered protons. Typical position spectrum of the first focal line is shown in Fig.1. Overall energy resolution was about 450 keV (FWHM) near the elastic peak. Passed protons were then transferred to the second focal point (the achromatic focal point) of the DUMAS where they struck seven graphite sheet secondary targets (157 mg/cm^2 each). Protons scattered from these targets were detected in right and left MWPCs and ΔE(5mm)-ΔE(3mm)-E(25mm) plastic scintillators telescope stacks. Using the position information from the nearside and farside MWPCs, we got the second scattering position (the number of the graphite sheet target) and the second scattering angle. Using the energy information from the scintillators, we got the lost energy at the second scattering. From these proton lost energy spectra we extracted the number of counts of protons which were scattered elastically by the second carbon target.

We calculated the effective analyzing power of the polarimeter using the angular distributions of the cross section and the analyzing power for proton elastic scattering from carbon at energies of 35, 40, 45, 50, 55, 60, 65 and 70 MeV.[6,7] The analyzing power Ay of the first scattering and the polarization Py' that would result from the first scattering of an unpolarized beam were measured simultaneously with the depolarization K. The K data for ^{24}Mg(natural) are equal to unity within the errors (1.0040±0.0073 at 20.4° and 1.0015±0.0073 at 41.1°). The K data for ^{25}Mg deviate from unity as are shown in Fig. 2.[8] The effect of the quadrupole spin flip is estimated using the deformed optical potential which was obtained by fitting the cross section and the analyzing power. The calculated result is shown in Fig. 2 as a solid curve. There are some disagreements between the data and the curve. The effect of the coupling to the excited state(7/2+) does not change the result. The spin-spin interaction seems to affect the results. It is useful to compare the ^{25}Mg(neutron -odd) data to the ^{27}Al(proton-odd). Further analysis which include ^{27}Al are now in progress.

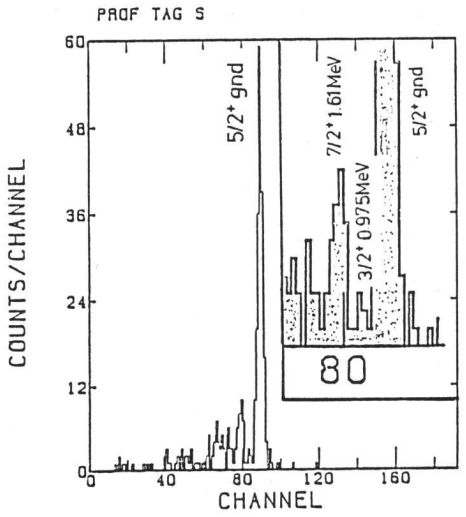

Fig.1 Tagging counter position spectrum.

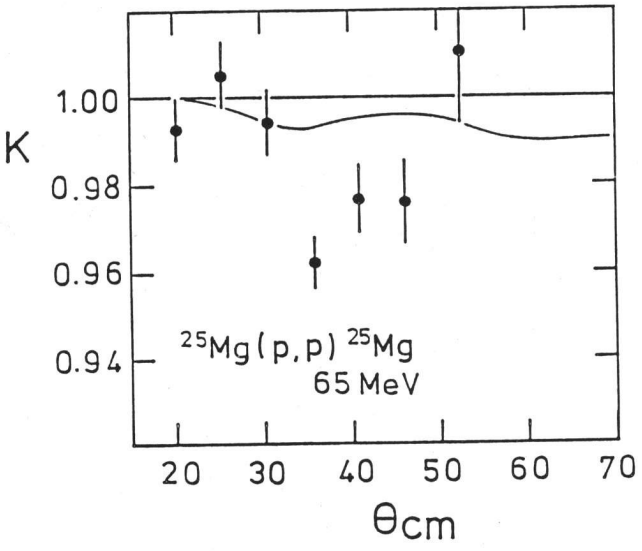

Fig.2 Results of depolarization parameter K for the elastic scattering from ^{25}Mg at 65 MeV. Curve shows the calculated result using a deformed optical model.

†Present address: Department of Physics, Nara Women's University
††Present address: Institute of Physical and Chemical Research
†††Present address: Research Center, SANYO Electric Co., Ltd.

References

1) R. Beurtey et al., J. Phys. (Paris) 31 Supp. No.5-6, C2 (1970) 96.
C.J. Batty and C. Tschlar, Nucl. Phys. A143 (1970) 151.
2) K. Katori et al., J. Phys. Soc. Japan 28 (1970) 1116.
W.J. Thompson, Phys. Lett. 62B (1976) 245.
3) J. Birchall et al., Phys. Lett. 53B (1974) 165.
4) M. Nakamura et al., RCNP Annual Report 1979 p.20.
5) H. Ikegami et al., RCNP Annual Report 1981 p.179.
T. Noro et al., RCNP Annual Report 1983 p.176.
6) M. Ieiri et al., RCNP Annual Report 1983 p.176.
7) S. Kato et al., Nucl. Instrum. Meth. 169 (1980) 589.
8) The data are slightly different from the preliminary data which were distributed at the conference. The peak fitting method for the spectrum of protons elastically and inelstically scattered by the second target (the graphite sheet) has been improved. The multihit loss and the dead time loss of the MWPC have taken into account more carefully. Finally the K data for ^{24}Mg are equal to unity with a high accuracy. The details will be described elsewhere.