MEASUREMENT OF ASYMMETRY IN THE N^{14}(d, p)N^{15} *REACTION WITH ELASTICALLY SCATTERED DEUTERONS*

Yu. V. GOFMAN, V. N. DOBRIKOV, N. I. ZAIKA, A. V. MOKHNACH, and O. F. NEMETS

Institute of Physics, Academy of Sciences, Ukrainian S.S.R.

Submitted to JETP editor April 23, 1963

J. Exptl. Theoret. Phys. (U.S.S.R.) 45, 1317-1318 (November, 1963)

The vector polarization of 13.6-MeV deuterons elastically scattered by Ta was investigated. The (d, p) reaction on N^{14} was used as the analyzer. Within the limits of statistical error, the left-right proton asymmetry measured for the angular interval in the first scattering between 30° and 90° is zero.

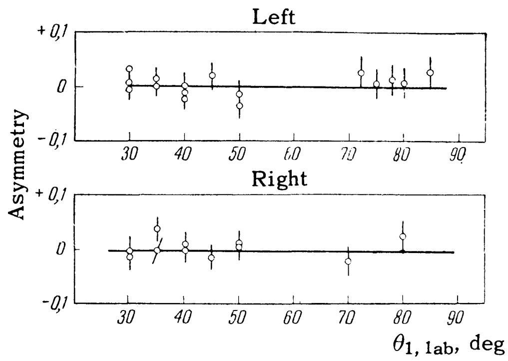
In view of the fact that the deuteron spin is equal to unity, the description of the polarization of deuterons includes vector and tensor parts. The cross section for the second elastic scattering of deuterons is described by the following expression:[1]

$$\sigma = \sigma_0 [1 + \langle T_{20}\rangle^2 + 2(\langle T_{21}\rangle^2 + |\langle T_{11}\rangle|^2)\cos\varphi + 2\langle T_{22}\rangle^2 \cos 2\varphi],$$

where σ_0 is the elastic scattering cross section for unpolarized deuterons, T_{ij} are the components of the spin tensor and $\langle T_{ij}\rangle$ are their mathematical expectations, and φ is the angle between the planes of the first and second scatterings. The angles and energies of the deuterons in the first and second scatterings are taken to be the same.

In a single experiment on double scattering the quantities $\langle T_{21}\rangle^2$ and $\langle T_{11}\rangle^2$ cannot be separated and it is necessary to carry out additional experiments. When it is possible to neglect the spin-orbit interaction, the vector part of the polarization P_d can be found from measurement of the right-left asymmetry in the stripping reaction:[2] $\sigma = \sigma_0(1 + 3P_pP_d)$.

In order to measure the asymmetry in the stripping reaction, we constructed an arrangement consisting of a scattering chamber, two double-crystal scintillation spectrometers, and electronic circuits. The deuterons of energy 13.6-MeV were scattered elastically on a tantalum target, impinged on a dicyandiamide ($C_2H_4N_4$) target, and produced the reaction N^{14}(d, p)N^{15}. Protons corresponding to the ground state of N^{15} were recorded by the double-crystal spectrometers located at ±20° relative to the direction of the scattered beam. Pulses from the first and second



crystals [0.8 and 1.4 mm CsI(Tl)], after amplification and clipping, were fed to a gating circuit and then to a multichannel pulse-height analyzer. To take into account any spurious asymmetry, the measurements were carried out to the left and to the right of the primary deuteron beam.

The measured asymmetry, as is seen from the figure, is small and does not exceed the limits of statistical error in the range of angles for the first scattering θ_1 = 30—90°. The absence of an asymmetry for the angles $\theta_1 \leq 50°$ is in agreement with the results of a previous experiment [3] in which the behavior of the differential cross section for elastic scattering of deuterons by heavy nuclei at these angles could be accounted for simply by Rutherford scattering and the electric splitting of the deuterons. The absence of an asymmetry at large angles ($\theta_1 \leq 70°$) can be connected both with the small value of the vector polarization of the deuterons in scattering on Ta and with the small value of the proton polarization in the reaction N^{14}(d, p)N^{15} (ground state). No experimental data on the latter appear in the literature. Further, along with the study of the asymmetry in stripping reactions for deuterons scattered by other nuclei, it is suggested that measurements be made of the asymmetry in double elastic scattering of deuterons for the complete determination of the polarization.

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[2] G. R. Satchler, Nuclear Phys. 6, 543 (1958); G. L. Vysotskiĭ and A. G. Sitenko, JETP 36, 1143 (1959), Soviet Phys. JETP 9, 812 (1959).
[3] Yu. V. Gofman and O. F. Nemets, JETP 39, 1489 (1960), Soviet Phys. JETP 12, 1035 (1961).

Translated by E. Marquit
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