ELASTIC SCATTERING OF DEUTERONS. III

Yu. V. GOFMAN and O. F. NEMETS

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

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Angular distributions of 13.6-MeV deuterons elastically scattered on $Ni^{58,60,62,64}$ isotopes are obtained. No difference in large-angle scattering similar to that for protons has been observed in the case of deuterons.

In the study of elastic scattering of protons with energies of 6.8 MeV on $Ni^{58,60,62,64}$ isotopes, an important difference was discovered in the differential cross sections for large-angle scattering.[1] A similar difference in the behavior of the cross sections was also obtained in a study of scattering of protons with energies of 7.5 and 17 MeV on nuclei with nearby values of Z.[2,3] In this connection, it was of interest to ascertain whether a similar difference appears in the case of deuterons; in such a case, it can be thought that the reason for it lies in the change in the shape of the potential at the surface of the nucleus as a consequence of the change in the number of neutrons in the latter.

With the aim of finding additional experimental information, we carried out measurements of the angular distribution of 13.6-MeV deuterons scattered elastically on the same nickel isotopes.

The particles were sorted by simultaneous measurement of the energy E and the specific energy loss dE/dx of the scattered particle, using an ionization chamber with collecting electrodes.

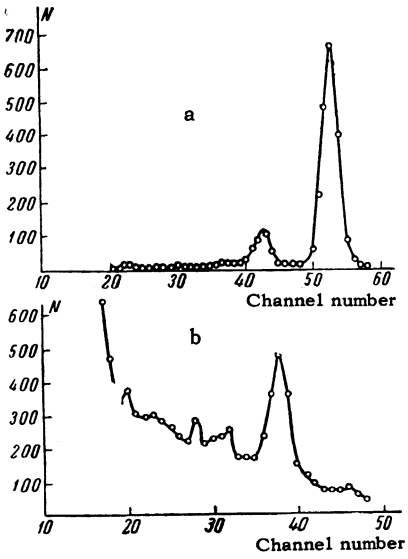

FIG. 1. Spectrum of deuterons scattered by Ni^{58} at an angle of $\theta = 85°$; a – with selection of deuterons, b – without selection (N is the number of counts.)

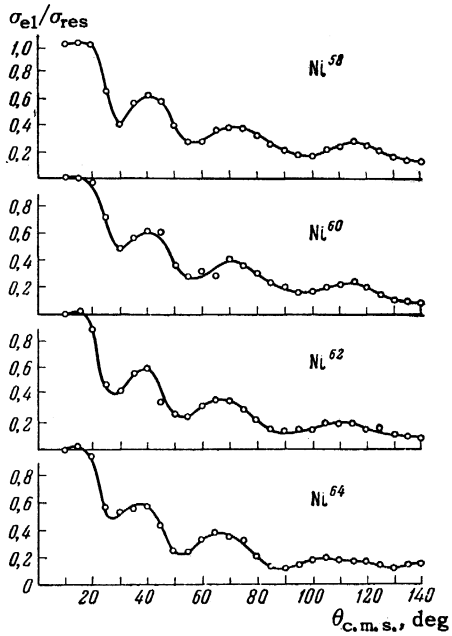

FIG. 2. Angular distribution of deuterons elastically scattered by nuclei of nickel isotopes.

A description of the method is given in[4], together with the plotted spectrum of the product EdE/dx, obtained by irradiative Be^9 target with deuterons.

The deuteron spectrum taken with Ni^{58} at an angle 95° is shown in Fig. 1. For comparison, the spectrum of pulses from a "long" collecting electrode, without sorting by measurement of EdE/dx, is also shown. As is seen, the separation of particles is quite satisfactory.

Isotopic targets of $Ni^{58,60,62,64}$ obtained from the laboratory of A. P. Klyucharev in the Khar'kov Physico-Technical Institute had an enrichment of 94—98 per cent. The target thicknesses were within the range 2.16—3.37 mg/cm^2. Measurements were carried out on the extracted deuteron beam of the cyclotron of the Physics Institute of the Ukrainian S.S.R. Academy of Sciences. The statistical measurement errors generally did not exceed 2.3 per cent for angles up to 90° and 5 per cent for angles greater than 90°.

The angular distributions obtained are plotted in Fig. 2 in the form of curves of σ_{el}/σ_{res} as a function of angle. As can be seen from the drawing, the curves do not show any significant differences in the region of large angles. This shows that the shape of the potential at the surface of the nucleus does change with increase in the number of neutrons, but not enough to be observed in the scattering.

On the other hand, Klyucharev (private communication) has shown that the change in the cross sections of elastic scattering of protons at large angles is due to changes in the (p, n) reaction thresholds on going from isotope to isotope and, consequently can be explained as the result of the competing action of these reactions. If this interpretation is valid, then the deuteron angular distributions should not show noteworthy differences in scattering on the various isotopes, as is indeed confirmed by experiment. However, in this case, it must be accepted that in the elastic scattering of protons, a significant part of this process proceeds via formation of a compound nucleus. Inasmuch as this circumstance is supported by other experiments,[3] it can be thought that this explanation is valid.

In conclusion, the authors express their gratitude to A. P. Klyucharev for furnishing the targets.

[1] Val'ter, Zalyubovskiĭ, Klyucharev, Pasechnik, Pucherov and Chirko, JETP **38**, 1419 (1960) Soviet Phys. JETP **11**, 1025 (1960).

[2] J. Dayton and G. Schrank, Phys. Rev. **101**, 1358 (1956).

[3] W. Waldorf and N. Wall, Phys. Rev. **101**, 1602 (1957).

[4] Gofman, Dobrikov, Zaika and Nemets, Izv. Akad. Nauk SSSR, ser. fiz. **25**, 1305 (1961), Columbia Tech. Transl. in press.

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