STRIPPING REACTION ON Mo^{97} *AND* Te^{125}

N. I. ZAIKA and I. E. SANZHUR

Physics Institute, Academy of Science, Ukr. S.S.R.

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The angular distributions of protons from the (d, p) reactions on Mo^{97} and Te^{125} are measured for 13.6-MeV deuterons. The angular momenta transferred to the nucleus are determined. The angular distributions of protons characterized by $l_n = 0$ are compared for nuclei with atomic masses ranging from 12 to 125.

In studies of (d, p) reactions on Zr^{91} [1] and Mo^{95} [2] it was observed that on going over to the first excited states (2^+) of the final nuclei the selection rules that follow from the shell model of the nucleus play an important role. The angular distributions of the protons from the reaction $Zr^{91}(d, p)Zr^{92}$ are described by a theoretical curve with angular momentum $l_n = 2$, whereas according to the selection rules of the stripping-reaction theory[3], the allowed values of the angular momentum are 0, 2, and 4, and the lowest of the allowed values should manifest itself most intensely. The absence of a component with $l_n = 0$ in the angular distribution indicates a forbiddenness imposed on the value of the angular momentum by the shell model, such as pointed out by Bethe and Butler[4], who gave examples for the transitions to the ground state. In the case of Mo^{95}, two components appear in the angular distributions, $l_n = 0$ and $l_n = 2$.

In the present note we present the results of measurements on still another nucleus of this class, Like Zr^{91} and Mo^{95}, the nucleus Mo^{97} has a spin and parity $5/2^+$ [2,5] and on going to the first excited state of Mo^{98} (2^+) with energy $E^* = 0.66$ MeV, the smallest allowed angular momentum is $l_n = 0$. As can be seen from Fig. 1a, the angular distribution contains along with the component $l_n = 2$ (dashed curve) also a component corresponding to $l_n = 0$ (continuous curves); the circles denote the experimental data and the curves the theoretical calculations by Butler's theory[3]. This may be connected with the larger number of neutrons in the Mo^{96} and Mo^{98} in excess of the closed shell (50 neutrons) than in the case of Zr^{92}. As regards the angular distribution of the protons corresponding to the ground state of Mo^{98}, it is described by the curve for $l_n = 2$ (Fig. 1b) and corresponds to the capture of a neutron in the state

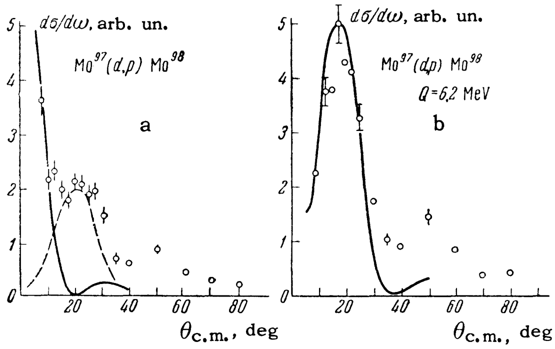

FIG. 1

$d_{5/2}$, which is filled here in accordance with the shell model. Since Mo^{98} is an even-even nucleus, the most probable of the possible characteristics 0^+ to 5^+ is 0^+.

The angular distribution of the protons from the $Te^{125}(d, p)Te^{126}$ reaction was obtained for the transition to the Te^{126} ground state. In the region of the principal maximum, it is well described by the theoretical curve for $l_n = 0$, that is, the neutron is captured in the state $s_{1/2}$. Recognizing that the

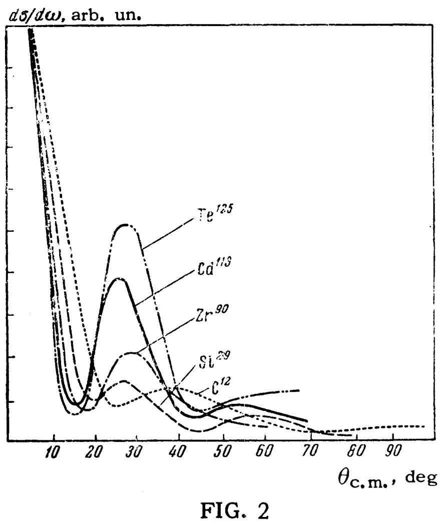

FIG. 2

ground state of Te^{125} has spin and parity $1/2^+$ [5], the possible spins and parities of the ground state of Te^{126} are to 0^+, 1^+ (but 1^+ must be excluded since the final nucleus is even-even).

We present the obtained angular distribution in Fig. 2, which shows also the experimental data obtained in our laboratory [1,6,7] for the capture of a neutron with zero orbital angular momentum by lighter nuclei. All the angular distributions were "fitted together" at the point with angle 5°. What is striking is the increase in the relative value of the secondary maximum with increasing atomic weight, which apparently is connected with the increase in the distortion due to the Coulomb and nuclear interaction.

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