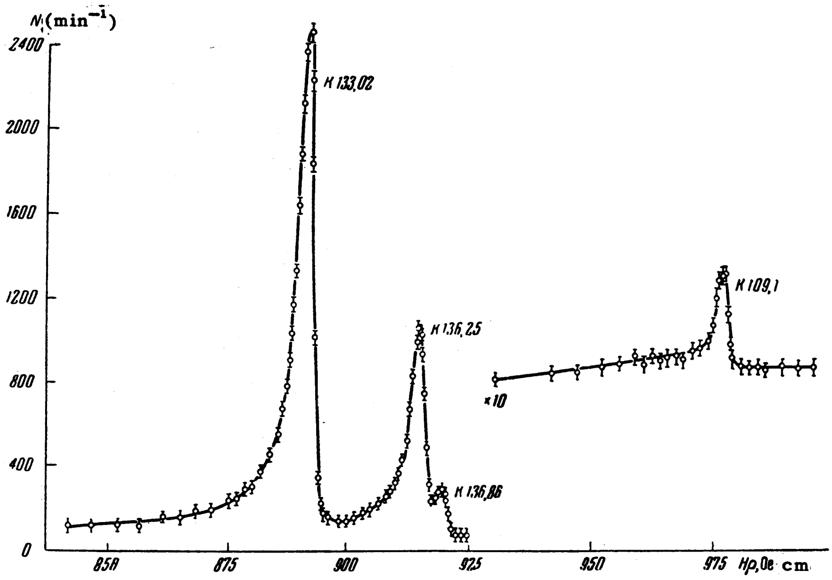

Hughes and Harvey[2] lists cross sections of 1.0 ± 0.3 and 5 ± 3 barns.

In the present investigation we measured the cross section for the production of the isomer state of Te^{125} with spin $^{11}/_2$ via the (n, γ) reaction. The cross section was determined by comparison with the cross section of the Hf^{180}(n, γ) Hf^{181} reaction, which were taken to be 10 ± 3 barns, as in reference 2. Separated Te^{124} and Hf^{180} sources were prepared for the measurements and irradiated simultaneously in the neutron beam.

The internal-conversion electron spectrum of Te^{125m} and Ta^{181}, produced in the β^- decay of Hf^{181}, was investigated with a beta spectrometer. The figure shows the internal-conversion electron K lines of the gamma transitions of energies 133.02, 136.25, and 136.85 kev (Ta^{181}) and 109.1 kev (Te^{125m}, for which the ordinate scale is magnified ten times). By determining the intensity ratio of the 109.1 and 133.02 kev K lines, it is possible to calculate the cross section for the production of Te^{125m} via the (n, γ) reaction; it was found to be 40 ± 25 millibarns.

According to reference 1, the cross section for the production of the ground state of Te^{125} via the (n, γ) reaction is 6.5 ± 1.2 barns. The ratio of the Te^{125m} (spin $^{11}/_2$) and Te^{125} (spin $^1/_2$) cross sections is 0.006.

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THE REACTION T(p, n) He^3 *AT 7—12 Mev PROTON ENERGY*

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Submitted to JETP editor November 17, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 633-636 (February, 1959)

THE reaction T(p, n) He^3 is a convenient source of monochromatic neutrons and is widely used in many laboratories. From the results of the study of the reaction in the proton energy range from the reaction threshold (1.019 Mev) to 7 Mev,[1,2] it was possible to deduce the existence of excited levels of the α particle at 22 Mev and 24 — 25 Mev.[1,3] Several experimental works have been published recently[4] confirming the existence of excited states of the α particle.

The cross section and the angular distribution of neutrons in the reaction T(p, n) He^3 in the proton energy range 7 — 12 Mev were measured in the course of the present experiment. It was also attempted to measure the polarization of the neutrons.

A solid tritium-zirconium target of 20 μ thickness was bombarded by 12 Mev protons from a cyclotron. The neutron flux was measured by a telescope consiting of four proportional counters,[5]

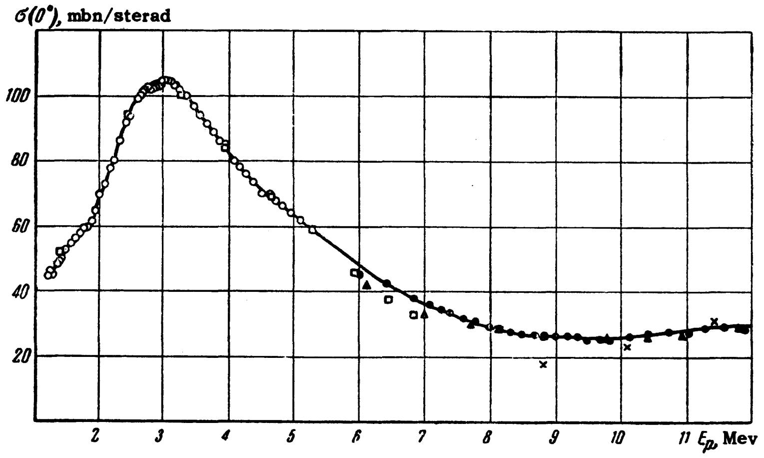
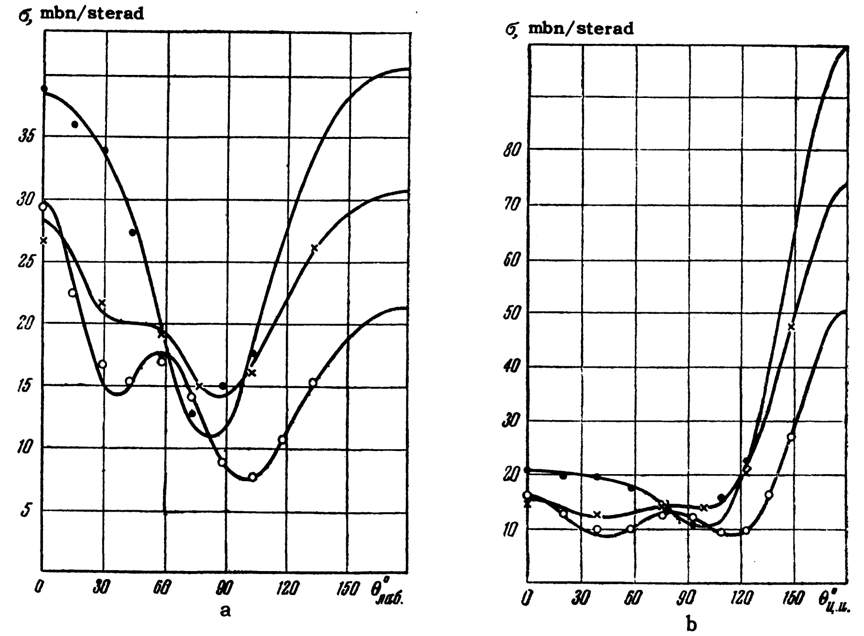


FIG. 1. The cross section of the reaction T (p, n) He^3 at the angle 0°, ● – telescope of proportional counters, ▲ – time-of-flight spectrometer, ○ – data of reference 2, □ – data of reference 1, × – data of reference 8.

E_p, Mev	A	B	C	D	E	σ_t (mbn)
6.8	11.1	11.3	24.4	—51.4	25.3	305
8.9	13.3	1.0	1.3	—28.4	27.3	241
12.0	13.0	7.5	—23.7	—24.9	44.6	176

FIG. 2. Angular distribution of neutrons from the reaction T (p, n) He^3. a – in the laboratory system of coordinates, b – in the c.m.s., ● – E_p = 6.8 Mev, × – E_p = 8.9 Mev, ○ – E_p = 12 Mev.



and was also analyzed by a time-of-flight spectrometer.[6,7] The accuracy of the cross section measurements amounted to 10%.

The reaction cross section measured at 0° and those measured in the energy range 1 — 7 Mev (published earlier[1,2]) are shown in Fig. 1. In the energy range under investigation, the cross section is approximately constant and increases slightly at 11 — 12 Mev. Three experimental points taken from the work of Steward et al.[8] are also shown in Fig. 1. The discrepancy between the results of that work and our results lies outside the limits of errors.

The angular distributions of neutrons of 6.8, 8.9, and 12 Mev are shown in Fig. 2a. The same angular distributions in the center-of-mass system are shown in Fig. 2b. The forward-backward anisotropy indicates a strong interference of states with different parity. The curves in the figures correspond to expressions of the form

$$\sigma(\theta) = A + B\cos\theta + C\cos^2\theta + D\cos^3\theta + E\cos^4\theta$$

in the c.m.s. The coefficients in these expressions have been obtained by the least-squares method and are given in the table. The values of the total cross section for the reaction T (p, n) He^3 obtained by the integration of these equations are also given in the table.

The dependence of the total reaction cross section on energy is shown in Fig. 3.

The study of the polarization of neutrons produced in the reaction T (p, n) He^3 is of great importance for the study of the excited states of the

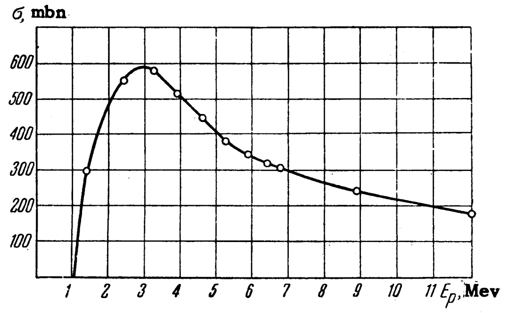


FIG. 3. Dependence of the total cross section for the reaction T (p, n) He^3 on proton energy.

α particle. The method of inverse reactions proposed by Barshall[9] was used for the measurement of the polarization. In our case, the inverse reaction is the reaction $He^3(n, p)T$. A chamber filled with He^3 to a pressure of 10 atmospheres was placed at an angle θ_1 to the beam of neutrons originating from the reaction $T(n, P)He^3$, and the right-left asymmetry of the proton yield from the reaction $He^3(n, p)T$ was measured by the proportional-counter telescope[5] at an angle θ_2. In the c.m.s., a single angle $\theta_{c.m.}$ corresponds to the angles θ_1 and θ_2. The angle θ_1 was chosen from the condition of equality of the excitation energy of the intermediate nucleus He^4 in the direct and inverse reactions. This angle is uniquely determined by the energy of the reaction Q = − 0.764 Mev and by the energy E_p of protons bombarding the tritium target:

$$\cos\theta_1 = (6E_p - 5.348) / \sqrt{12E_p(3E_p - 3.056)}.$$

Such a method makes it possible to measure the absolute values of the polarization without an analyzer of known properties.

Polarization measurements require a very exact geometry, since the measured azimuthal asymmetry may be due to the inequality of the right and left deviation angles with respect to the neutron beam. To check the geometry of our experimental setup, we measured the scattering of neutrons on hydrogen by means of recoil protons under the same geometrical conditions. In order to increase the angle sensitivity, the detection of recoil protons was carried out on the falling portion of the spectrum, where the counting rate decreases with the angle, both owing to the decrease in intensity and owing to the decrease in energy.

The measurements showed that, for $E_p \lesssim 10$ Mev, the asymmetry at angles corresponding to the condition of Barshall is not larger than 5%. For the angle $\theta_1 = \theta_2 = 40°$, large asymmetry has been found indicating that the neutrons are polarized.

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ISOTOPIC SHIFT OF THE CURIE POINT IN URANIUM HYDRIDE AND DEUTERIDE

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Submitted to JETP editor November 18, 1959

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 636-637
(February, 1959)

THE observed ferromagnetism of uranium hydride and deuteride[1-3] makes possible an investigation of the isotopic shift of the Curie temperature.

One possible cause of such a shift is the difference in distance between the uranium ions in these two compounds. Actually, crystallographic investigations[4] have shown that the constants a of the cubic lattices of uranium hydride and deuteride are equal to 6.6310 and 6.625 A respectively. So noticeable a distance between the lattice constants of the two compounds should undoubtedly influence the value of the volume integral with which the value of the Curie temperature is directly connected.

There exist several methods capable of deter-