and taking into account that the (γ, n) reaction is roughly 1.9 times more probable than the (γ, p) reaction[2], we obtain

$$\int_{5.7}^{19} \sigma_{\gamma n}(E_\gamma)\, dE_\gamma \approx (9.2 \pm 4.3) \text{ MeV-mb}.$$

Since the integrated cross section of all reactions with neutron emission is 21 MeV-mb, then

$$\int_{3.7}^{19} \sigma_{\gamma np}(E_\gamma)\, dE_\gamma \approx (6.9 \pm 4.9) \text{ MeV-mb}.$$

In the region Ep < 6 MeV in Fig. 1, the dashed curve shows the total calculated energy distribution of protons produced in the reactions $Li^6(\gamma, p)He^5 \rightarrow He^4 + n$ and $Li^6(\gamma, n)Li^5 \rightarrow He^4 + p$. The calculation was carried out using the approximate excitation functions cited above and taking into account kinematic processes. For E_p = 3—5 MeV the calculated spectrum approximately exhausts the observed number of protons. The number of protons in the calculated spectrum with energies 0—3 MeV, as it turns out, amounts in all only to 25—30% of the number of protons of the same energy in the experimental spectrum. The contribution of tritons, α particles, He^3 nuclei, and protons from the $Li^7(\gamma, p)He^6$ reaction amount to roughly 15% in this region of the spectrum. Consequently 55—60% of the protons with energies $\leq$ 3 MeV most probably arise from the (γ, np) reaction. This number of protons agrees with the approximate evaluation given above of the integrated cross section for the $Li^6(\gamma, np)He^4$ reaction. The peak in the excitation function for the (γ, np) reaction, in agreement with the observed position of the large proton peak at $E_p \approx 1.9$ MeV, should occur at E_γ = 7—9 MeV.

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HALF LIFE OF Tb^{157}

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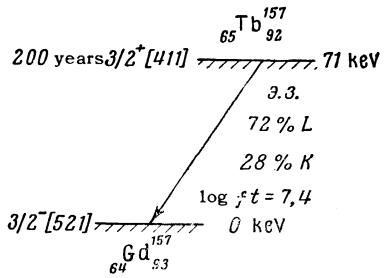
RADIOACTIVE Tb^{157} results from the decay of its parent Dy^{157}. Available estimates indicate that its half-life is $T_{1/2} > 100$ years[1].

In the present investigation we determined the half-life of Tb^{157} from the number N_0 of radioactive nuclei contained in the source and from the decay rate $dN/dt = -N_0 \log(2/T)$. The radioactive Tb^{157} was obtained as the decay product of Dy^{157} produced by irradiating tantalum with 660-MeV protons on the synchrocyclotron of the Joint Institute for Nuclear Research. N_0 was determined from the decay rate of the parent isotope Dy^{157}. A double-focusing β spectrometer with $\pi\sqrt{2}$ angle was used to measure the internal-conversion K line having the strongest period in the decay of Dy^{157}, with energy 327 keV. This transition occurs in 98% of decays with multipolarity E1 and with conversion coefficients $\alpha_c = 0.0113$ and $\alpha = 0.0136$. The transmission of the apparatus was estimated by measuring the 662-keV K-conversion line of the transition in Ba^{137} under the same condition, using a Cs^{137} standard compound. The number of accumulated Tb^{157} nuclei, equal to the number of the decaying Dy^{157} nuclei, was $N_0' = (1.18 \pm 0.26) \times 10^{13}$. Fourfold chromatographic purification yielded a sufficiently pure Tb^{157} compound. The losses during the chemical operations amount to (66 ± 7)%, and the number of nuclei in



Decay scheme of Tb^{157}.

the Tb^{157} compound was $N_0 = (4.0 \pm 1.3) \times 10^{12}$. A measurement of the activity of the compound made four months later showed that it emits 5300 ± 500 K-quanta per minute. Taking the ratio of L to K capture to be L/K = 2.64[2], we obtain for the decay rate $dN/dt = (1.9 \pm 0.2) \times 10^4$ decays per minute. Thus, the value of the half-life of Tb^{157} is $T_{1/2} = (2.8 \pm 1.2) \times 10^2$ years.

After the completion of the present work a paper was published by the Japanese physicists Iwata et al.[3], containing the result of a measurement of the half life of Tb^{157}, namely $T_{1/2}$ = 160 ± 40 years. This number agrees with our data within the limits of error.

The calculated value of log ft = 7.4 ± 0.2 is somewhat higher than in other cases, when the transition goes between the states $3/2^+$ [411] and $3/2^-$ [521], viz.: $Sm^{153} \rightarrow Eu^{153}$, $Sm^{155} \rightarrow Eu^{155}$, $Dy^{159} \rightarrow Tb^{159}$ $Gd^{159} \rightarrow Tb^{159}$, $Tb^{161} \rightarrow Dy^{161}$, and $Eu^{156} \rightarrow Gd^{156}$.

The introduction of corrections for superfluidity explains in part the difference in the values of ft. The figure shows the decay scheme of Tb^{157}.

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ANGULAR AND ENERGY CHARACTERISTICS OF U^{235} FISSION NEUTRON EMISSION

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In contrast to the work of Nefedov [1] and our own earlier investigation [2], in the present study we have experimentally determined the energy spectrum of neutrons in the center-of-mass system (c.m.s.) (referred to as the emission spectrum) for thermal neutron fission of U^{235}. This spectrum has then been used to calculate the angular and energy distributions in the laboratory system (l.s.). The results of these calculations have been compared with experimental distributions measured in more detail than those previously reported [1,2].

In the first part of the work, using the time-of-flight method, we made simultaneous measurements of the velocities of a fission fragment and a neutron emitted by this fragment at an angle of 15° to its direction of motion. From the vector difference in these velocities we calculated the c.m.s. neutron velocity (it was assumed that the neutrons are emitted by fragments moving with their full velocities). As a result we obtained a neutron emission spectrum ($\bar{\varepsilon}$ = 1.28 MeV) which can be numerically represented in the form

$$F(\varepsilon) = \Sigma \alpha_i T_i^{-3/2} \sqrt{\varepsilon} \exp(-\varepsilon/T_i),$$

where $\alpha_1 = 0.696$, $T_1 = 1.0$ MeV, $\alpha_2 = 0.310$, $T_2 = 0.5$ MeV, $\alpha_3 = -0.006$, and $T_3 = 0.1$ MeV. The emission spectra from light and heavy fragments turned out to be identical within the limits of accuracy of the experiment ($\bar{\varepsilon}_L - \bar{\varepsilon}_H < 0.02$ MeV).