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**Abstract**

**Full Text**

**Physics**

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## **On the Triple Spontaneous Fission of Curium-242**

*(Presented by Academician B. P. Konstantinov, 11 VIII 1960)*

At the present time there are numerous works devoted to the complex fission of heavy nuclei—with the emission of a third long-range  $\alpha$  particle. The investigations are carried out mainly on nuclei fissioning under thermal neutrons:  $U^{235}$ ,  $U^{233}$ ,  $Pu^{239}$ . For the complex fission of  $U^{235}$ , the energy distribution of the  $\alpha$  particles, their angular distribution relative to the line of flight of the heavy fragments, and also the probability of this type of fission are known. It should be noted that almost all works give different values for the probability of complex fission of  $U^{235}$ , and only conditionally may one assume that the ratio of the number of triple fissions to the number of binary fissions is 1 : 350. For  $U^{233}$  and  $Pu^{239}$  the probability of complex fission is higher by approximately 20%.

There is some basis for believing that, with increasing neutron energy, the probability of complex fission decreases. True, the experimental data refer to the isotope  $U^{238}$ . Thus, for  $E_n = 2.5$  MeV this ratio is 1 : 600, and for  $E_n = 14$  MeV it is 1 : 1100–1 : 1300. It is of interest to estimate the possibility of complex spontaneous fission of nuclei.

In the present work, the spontaneous triple fission of curium-242 was investigated. The experiment was carried out by the photographic-plate method. The ratio  $T_f/T_\alpha$  for this isotope is unfavorable for introducing curium nuclei into the photosensitive layer.

For external irradiation, two layers of diameter 2 cm were prepared by the electrolytic method. The total amount of deposited material in the active layer was determined by the method of absolute  $\alpha$  counting and proved to be equal to 0.19 and 0.17  $\mu\text{g}$ .

For the registration of long-range  $\alpha$  particles, a fine-grained photographic emulsion of type P-9 was used. Irradiation of the photographic plates over the active layer was carried out through a platinum filter—a foil 7  $\mu$  thick. The residual range in the emulsion of  $\alpha$  particles of the natural radioactivity of curium that had passed through foil of this thickness is about 5  $\mu$  of photosensitive layer. The blackening of the surface of the photographic plate caused by this action is easily removed in the course of photographic processing. Thus, in the processed photosensitive layer only long-range  $\alpha$  particles can be registered.

Fig. 1

Figure 1: Fig. 1

**Fig. 1**

By the present time, 2 photographic plates have been scanned, and in them 182  $\alpha$  particles have been registered, having a residual range in the emulsion greater than  $30 \mu$ . For each of these particles the energy was calculated, taking account of losses in the filter. The resulting energy distribution (see Fig. 1, *a*) begins at  $E_{\alpha \text{ min}} = 11 \text{ MeV}$ —the limiting energy is determined by the experimental conditions—

momentum. This energy distribution was then corrected with allowance for the geometry of the experiment (Fig. 1, *b*). It apparently does not differ appreciably from the data for  $\text{U}^{235}$  with thermal neutrons, either in the position of the maximum or in the width of the distribution. The total number of complex-fission events was estimated both from the final energy spectrum of the  $\alpha$ -particles and from the angular distribution.

Knowing the number of complex-fission events, the total amount of active substance in the layer, and the exposure, one can obtain the probability of formation of  $\alpha$ -particles with energy greater than 11 MeV. The required ratio was found to be  $1 : 340 \pm 40$ . If the energy distribution is assumed to be symmetric with respect to the most probable  $\alpha$ -particle energy, then a correction can be introduced for the  $\alpha$ -particles with energy below 11 MeV that were not observed in our experiment. The probability then increases to approximately  $1 : 300$ .

We take this opportunity to express our deep gratitude to B. V. Kurchatov for his interest and great assistance in setting up the present work.

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**CITED LITERATURE**

<sup>1</sup> N. A. Perfilov, Yu. F. Romanov, Z. I. Solov'eva, *Uspekhi fizicheskikh nauk*, **71**, no. 3 (1960). <sup>2</sup> V. N. Dmitriev, L. V. Drapchinskii, K. A. Petrzhak, Yu. F. Romanov, *ZhETF*, **38**, 998 (1960). <sup>3</sup> Z. I. Solov'eva, *Atomic Energy*, **8**, 137 (1960). <sup>4</sup> N. A. Perfilov, Z. I. Solov'eva, *Atomic Energy*, **5**, 175 (1958).

*Note: Figure translations are in progress. See original paper for figures.*

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