LETTERS TO THE EDITOR

LOW ENERGY PART OF THE α PARTICLE SPECTRUM FROM TRIPARTITION OF ^{235}U

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Measurement of the low-energy part of the spectrum of α particles emitted in thermal neutron fission of ^{235}U was performed with a telescope counter.

The upper limit for the cross section of the ^{235}U $(n, \alpha)^{232}$Th reaction, was estimated to be 3 mb for the transition to the ground state and 2 mb for the transition to the excited state up to 5 MeV.

The low-energy part of the energy distribution of long-range α particles is interesting from two points of view whether it is of Gaussian shape like the upper part of the spectrum [1] and if there is a contribution from the ^{235}U$(n, \alpha)^{232}$Th reaction as was suggested in ref. [2], [3], [4]. The data on the low energy part of the α spectrum from the tripartition of ^{235}U are very inaccurate, because the background in this energy region is high [2], [3]. The high background of other particles, mainly protons and tritons requires the use of a particle identification technique. Unfortunately such measurements usually suffer from the high energy cut-off [1], [5] or from poor statistics [6].

In order to register the particles in this part of the spectrum, a telescope with a proportional counter as a "ΔE" detector was used. The counter was filled with Kr+5% CO_2 under 70 mm Hg pressure. A Si—Au detector as an "E" counter was placed inside the proportional counter. The equivalent thickness of the mica window was 2.9 mg/cm^2 of aluminium; the thickness of the aluminium foil protecting the "ΔE" detector from fission fragments was 2.1 mg/cm^2. The rest of the experimental set-up was identical with that reported in Ref. [1].

The results of the measurements are shown in Fig. 1. The low energy cut off is about 5 MeV, but the undistorted spectrum spreads from 6 to 17.5 MeV.

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The Gaussian distribution was fitted by the least squares method (see: Fig. 1). The fit is almost as good as in the case of previous measurements in the interval of 12—32 MeV, but gives slightly different parameters of the energy distribution. The fit was performed for two intervals of energy and the results are presented in Table I.

TABLE I

The parameters of Guassian distribution fitted to the measured spectrum of α particles

Fit interval [MeV] \ Parameters of Gaussian distribution	Most probable energy [MeV]	Full width at half maximum [MeV]	
6—17.5	16.2±0.5	12±1	present work
10—17.5	15.7±0.5	11±1	
12—27.2	15.7±0.3	9.8±0.4	Ref. [1]

ACTA PHYSICA POLONICA Vol. XXXV (1969) Fasc. 1

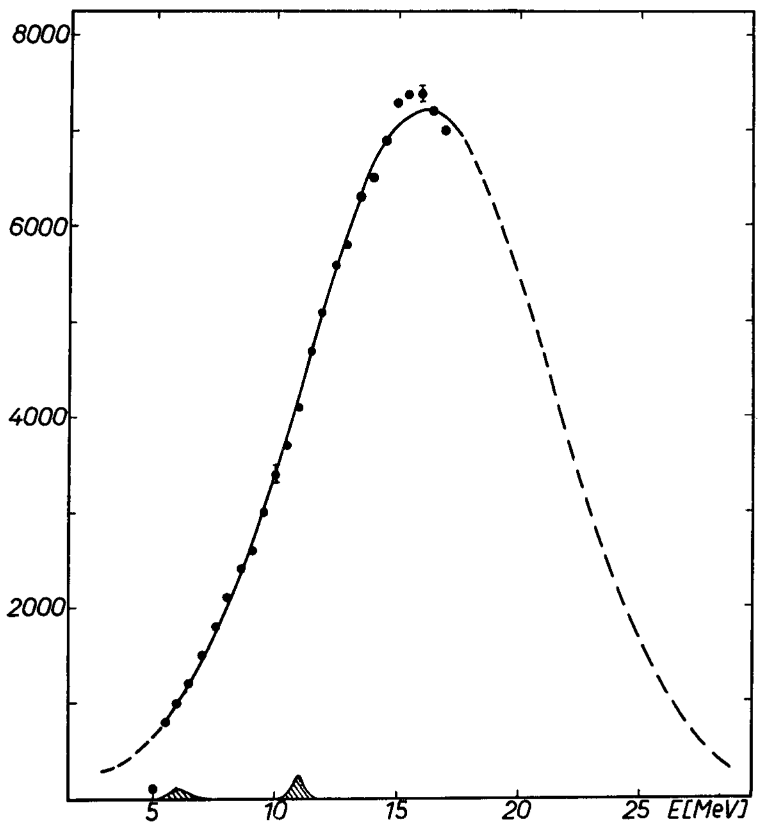

Fig. 1. The energy distribution of α particles with the Gaussian fit. Solid line indicates the interval of fit. The superimposed profiles concern the yields of eventual $^{235}U(n, \alpha)^{232}Th$ reactions

The experimental distribution obtained allows us to estimate the upper limit of the cross-section of the $^{235}U(n, \alpha)^{232}Th$ reaction. It is expected that the energy of α particles from this reaction should be 10.7 MeV for the transition to the ground state of ^{232}Th and appropriately less for transitions to excited states. To estimate the upper limit for the cross section of $^{235}U(n, \alpha)^{232}Th$ reaction, the expected α peaks were superimposed in appropriate places of the measured spectrum (shadowed places in Fig. 1). Their widths were chosen taking into account the self-absorption in the target layer and the straggling in the aluminium foil. Such deviation from smooth distribution would be noticed without any doubts. From the ratio of areas under the indicated profiles and measured spectrum we estimated (with the confidence level 0.995) that the upper limit amounts to 3 mb for the transition to the ground state and 2 mb for eventual transitions to any single excited state up to 5 MeV.

In Ref. [5] the upper limit for the ground state transition was estimated (with the confidence level 0.95) to be 2.5 mb, but such estimation has not been done for transitions to excited states. Our results contradict those presented in Ref. [2], where the peak near the energy of 8 MeV has been attributed to the particles from the (n, α) reaction. The reason of this mistake was the complex nature of the background in the low energy part of the spectrum measured in this type of measurement.

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