lear resonance and the Rayleigh electronic scattering processes. We note the larger value of the resonance effect $(\epsilon = (N(v_{res}) - N(\infty))/N(\infty))$ for the first position, corresponding to ~400%.

Attention is called to the anomalous form of the Mossbauer line (Fig. 2b, left): a smoother decrease of intensity than in the case of a Lorentz line and a certain broadening, in qualitative agreement with the predictions of the theory [5].

In conclusion, we wish to note that we could determine in the present investigation in a direct manner the orientation of the magnetic moments in the hematite cell, in analogy with the result of the neutron-diffraction method [7].

The authors thank B. N. Samoilov, Yu. M. Kagan, and A. M. Afanas'ev for interest in the work and a discussion of the results, V. A. Balyakov, E. P. Stepanov, V. I. Ozhogin, and I. P. Perstnev for valuable advice, and M. A. Volkov for help with the measurements.

[1] V. V. Sklyarevskii, G. V. Smirnov, A. N. Artem'ev, B. Shestak, and S. Kadechkova, ZhETF Pis. Red. 8, 295 (1968) [JETP Lett. 8, 181 (1968)].
[2] A. M. Afanas'ev and Yu. M. Kagan, Zh. Eksp. Teor. Fiz. 48, 327 (1965) [Sov. Phys.-JETP 21, 215 (1965)].
[3] A. M. Afanas'ev, Yu. M. Kagan, and I. P. Perstnev, ibid. 54, 1530 (1968) [27, 819 (1968)].
[4] P. J. Black and J. P. Duerdoth, Proc. Phys. Soc. 84, 169 (1964).
[5] V. A. Balyakov and Yu. M. Aivazyan, ZhETF Pis. Red. 7, 477 (1968) [JETP Lett. 7, 368 (1968)].
[6] G. E. Bacon, Neutron Diffraction, Oxford, 1955.
[7] C. G. Shull, W. A. Strauser, and E. O. Wollan, Phys. Rev. 83, 333 (1951).
[8] R. A. Voskanyan and I. S. Zheludev, Kristallografiya 12, 539 (1967) [Sov. Phys.-Crystallogr. 12, 473 (1967)].

PHOTOFISSION OF EVEN-EVEN NUCLEI AND STRUCTURE OF THE FISSION BARRIER

S. P. Kapitza, N. S. Rabotnov, G. N. Smirenkin, A. S. Soldatov, L. N. Usachev, and Yu. M. Tsipenyuk.
Institute of Physics Problems, USSR Academy of Sciences
Submitted 12 December 1968
ZhETF Pis. Red. 9, No. 2, 128-132 (20 January 1969)

We present in this paper experimental data on the cross sections and angular distributions of photofission fragments; some of them were published earlier [1]. They are analyzed in connection with the problem of the double-hump barrier. This hypothesis, now under intense discussion [2,3], apparently explains certain experimental facts which are in sharp disagreement with the traditional picture.

Measurements of the angular distributions of the fragments of photofission of Th^{232}, U^{238}, Pu^{238}, Pu^{240}, and Pu^{242} were made with the 12-MeV microtron of the Institute of Physics Problems in the interval of end-point energies $E_{max} = 5 - 8$ MeV, with the aid of glass fragment detectors.

The anisotropy of the scattering of the fragments results from the fact that the height and the form of the fission barrier depends on the angular momentum I, on the parity π^-, and on the K-projection of the angular momentum on the symmetry axis of the nucleus, along which the fragments are scattered. In our case, the compound nucleus is apparently produced only in the states 1^- and 2^+ as a result of dipole and quadrupole photoabsorption respectively. The total angular distribution has therefore in the general case the form:

$$W(\theta) = a + b \sin^2\theta + c \sin^2 2\theta.$$

The relative values of the coefficients are determined by the ratios of the penetrabilities P of the fission barriers for different combinations of I^π and K:

$$b/a \approx P(1^-, 0)/P(1^-, 1), \qquad c/b \approx \frac{\sigma_{\gamma\ abs}^{2^+}}{\sigma_{\gamma\ abs}^{1^-}} P(2^+, 0)/P(1^-, 0)$$

If, in accordance with the hypothesis of A. Bohr [4], the fission threshold satisfies the relations $E_f(1^-, 1) > E_f(1^-, 0) > E_f(2^+, 0)$, then the energy dependence of the angular distributions should reduce qualitatively to the following: the ratios b/a and c/b increase with decreasing excitation energy. This agrees with the observed picture. At high energies, both ratios tend to zero, but in the subbarrier region b/a reaches a value ~100 (Th^{232}, E_{max} = 5.4 MeV), and c/b ~ 3 (Pu^{240}, E_{max} = 5.2 MeV). However, attempts at a quantitative explanation encounter a serious difficulty. The ratio of penetrabilities of the two barriers, which have different heights and different peak curvatures, has in general a nonmonotonic energy dependence and reaches a maximum value at an energy coinciding with the peak of the lower of the barriers. The total photofission cross section near threshold amounts to $\sigma_f \approx \sigma_{\gamma\ abs}^{1^-} P(1^-, 0)/[P(1^-, 0) + \alpha]$, where $\alpha = 2\pi P_\gamma/\bar{D} \ll 1$ below the neutron binding energy ($\bar{D}$ - distance between the compound-nucleus levels). σ_f is approximately comparable with the cross section for the production of a compound nucleus, and consequently, exhibits a plateau at $P(1^-, 1) \ll P(1^-, 0) \approx \alpha \ll 1$, i.e., at an energy (observed threshold T_f) which is somewhat lower than $E_f(1^-, 0)$. This situation is found schematically in Fig. 1a. The upper part of Fig. 2 shows directly the experimental results in the form of plots of the yields of fragments corresponding to different components in the angular distributions against the maximum energy of the bremsstrahlung spectrum. These curves were used to reconstruct the energy dependences of the partial components of the photofission cross sections when recalculated to monochromatic quanta. The lower part of Fig. 2 shows the corresponding energy dependences of b/a, c/b, and σ_f. From the point of view of the simple representations just presented, it seems paradoxical that the value of the energy at which the anisotropy (the ratio b/a) reaches a maximum lies almost 1 MeV lower

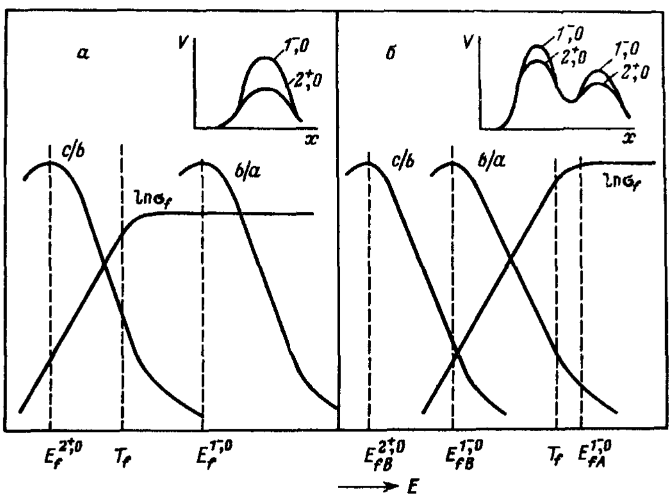

Fig. 1. Schematic diagram of the energy dependences of the anisotropy and the photofission cross section for the cases of a single-hump (a) and a double-hump (b) barrier.

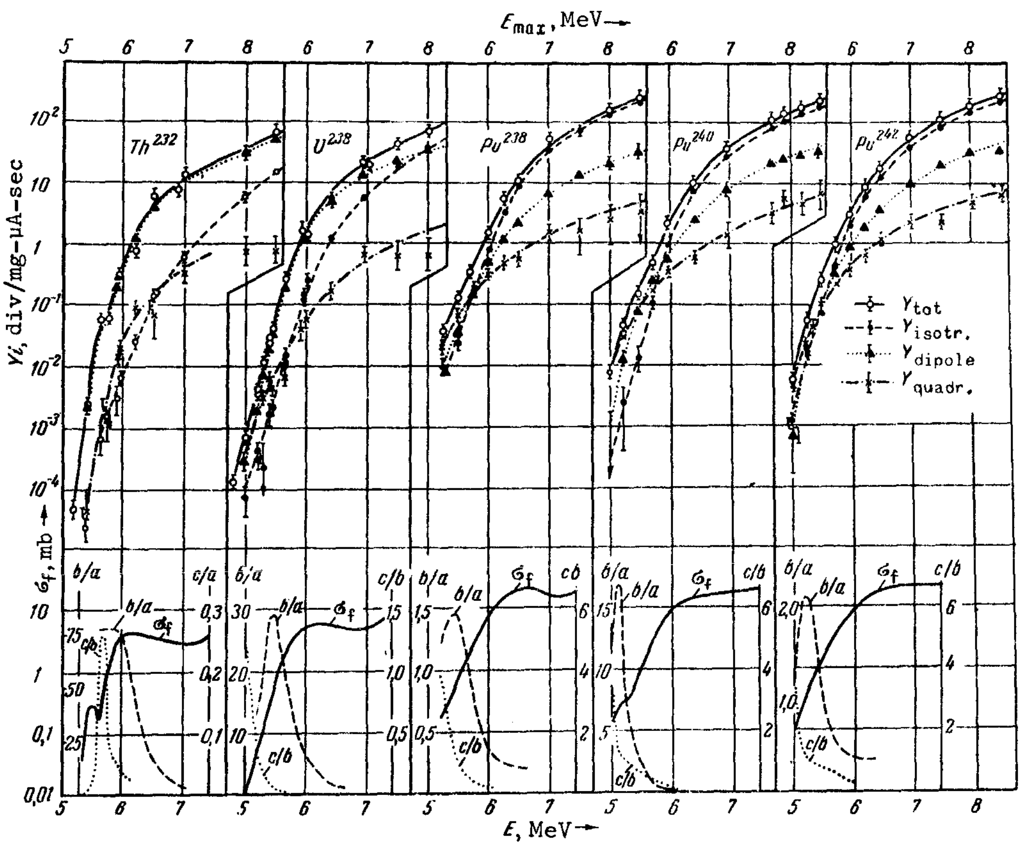

Fig. 2. Results of measurements of the fragment yields corresponding to different components of the angular distribution, as functions of the end-point energy of the bremsstrahlung spectrum (upper plots) and fission cross section and values of the ratios b/a and c/b as functions of the energy of the γ quanta, obtained as a result of the reduction of the experimental data (lower plots).

in the case of plutonium isotopes than the observed threshold T_f. Quantitatively, the discrepancy is quite large: at the maximum value of b/a, the photofission cross section should approximately coincide with its value on the plateau and with $\sigma_{\gamma\ abs}^{1^-}$, whereas actually it is smaller by a factor of about 100. So long as we considered spectral yields, this fact was not so strongly pronounced, but nonetheless it was noted by us earlier as difficult to explain within the framework of the traditional concepts, and we had advanced two hypotheses [1], in accordance with which $E_f^{1^-} \sim T_f$ and not $>T_f$. However, after the differentiation whose results are discussed in the present paper, it became clear that $E_f^{1^-} < T_f$, and the difference exceeds the limits of any possible errors. This is precisely to be expected, as will be shown, in the model of the double-hump barrier if $E_A > E_B$ (see Fig. 1b).

The solution of the one-dimensional quasiclassical problem on the penetrability of the double-hump barrier shows that the average penetrability of this barrier is such as if only the barrier A were to be present, i.e., the position of the observed threshold in the cross section is determined by the higher of the barriers, A. The mechanism of occurrence of anisotropy in this case, according to Strutinskii and Bjornholm [3], consists in the following: after overcoming the first barrier, the nucleus stays in the second well long enough to "forget" that value of K with which it passed through the first barrier. Therefore, when $E_{fB}^{1^-,0} < E < E_{fA}^{1^-,0} < E_{fA}^{1^-,1}$, the nuclei fall into the second well via the channel 1^-, 0 on the barrier A, since this is energetically inconvenient, after which they fission, and the angular distribution is determined by the position of the excitation energy relative to the channels of the barrier B. In this case F_f (i.e., the observed fission threshold) approximately coincides with $E_{fA}^{1^-,0}$ for barrier A (or is somewhat lower than this threshold), and the maxima of the ratios b/a and c/b are approximately at energies $E_{fB}^{1^-,0}$ and $E_{fB}^{2^+,0}$ for the barrier B (see lower Fig. 2). The experimental picture agrees quite satisfactorily with such a description, and the following thresholds are obtained from its analysis:

	$E_{fB}^{2+,0}$	$E_{fB}^{1-,0}$	$T_f (\lesssim E_{fA}^{1-,0})$	Δ_{AB}
Th^{232}	5.7	5.9	5.9	0
U^{238}	<5.0	5.4	5.6	0.2
Pu^{238}	<5.2	5.4	6.1	0.7
Pu^{240}	<5.0	5.1	6.0	0.9
Pu^{242}	<5.0	5.2	6.1	0.9

$\Delta_{AB} = T_f - E_{fB}^{1^-,0}$ increases from thorium to plutonium in accordance with the predictions of [3]. Since in most cases c/b increases monotonically with decreasing energy, the upper limiting values are listed in the table for $E_{fB}^{2^+,0}$, which is determined from the position of the maximum of this ratio.

The authors are deeply grateful to P. L. Kapitza for support of this research.

[1] N. S. Rabotnov, G. N. Smirenkin, A. S. Soldatov, L. N. Usachev, S. P. Kapitza, and Yu. M. Tsipenyuk, Physics and Chemistry of Fission, vol. 1, IAEA, Vienna, 1965, p. 135; Phys. Lett. 26B, 218 (1968).
[2] V. M. Strutinskii, Nucl. Phys. A95, 420 (1967).
[3] V. M. Strutinskii and S. Bjornholm, Paper at Internat. Symposium on Nuclear Structure, Dubna, 1968.
[4] A. Bohr, Internat. Conf. on Peaceful Uses of Atomic Energy, Geneva, 1955.

POSSIBLE UNSTABLE OSCILLATIONS OF A NEUTRON STAR

Yu. V. Vandakurov
A. F. Ioffe Physico-technical Institute, USSR Academy of Sciences
Submitted 19 September 1968
ZhETF Pis. Red. 9, No. 2, 133-136 (20 January 1969)

It is known that the criterion of conductive instability is written in the form

$$\rho'/\rho - p'/\gamma p \leq 0, \tag{1}$$

where $\gamma(p, \rho)$ determines the relation between the Lagrangian components of the pressure and