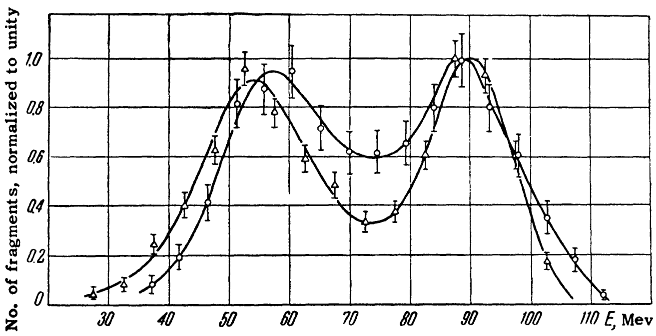

FIG. 2. Comparison of energy spectra of fragments from: ⊙ – photofission and Δ – spontaneous fission of U^{238}.

the slow neutron fission of U^{235}, determined, by the way, both in the present work and in reference 2.

Owing to the different thicknesses of the preparations (the surface density of the preparation in reference 2 amounted to 0.15 mg/cm^2), the neutron fission spectra differ somewhat among themselves. The main difference consists in the most probable energies of the spectrum in the present work being 2 Mev less, on the average, than those of the spectrum found in reference 2. Moreover, the increase of the thickness of the preparation is connected with an additional distortion of the spectrum, which consists in each peak obtaining some spread and becoming more asymmetrical at the expense of the appearance of a "tail" in the low-energy region. It is evident that if the neutron fission spectrum undergoes a distortion, then the photofission spectrum will undergo a similar distortion. However, the two neutron fission spectra do not differ from each other in form within the limits of error. Therefore the corrections to the distortions of the spectrum form caused by the large preparation thickness were not introduced into the photofission spectrum. In the comparison of the photofission and spontaneous fission spectra they were shifted with respect to one another so as to guarantee the best superposition of the U^{235} neutron fission spectra obtained in both cases. Thus the influence of the difference in the surface densities of the preparations was eliminated.

Comparison of the spectra shows that they differ mainly in the ratio of the notch height to the height of the light fragment peak. For the photofission spectrum this quantity is 0.60, and for the spontaneous fission spectrum it is 0.33.

This difference may depend both on the large excitation of the nucleus in photofission and on the superposition of fluctuations of the compensated gamma background. These fluctuations are due to a differential effect between the gamma pulses in the two parts of the chamber. The average magnitude of the pulse fluctuations on a pulse amplitude scale graduated in fragment energy units is about 4 Mev. The fluctuation pulses were superposed on the fragment pulses, producing a small broadening of the energy spectrum peaks. However, an estimate showed that the increase of the half-widths of the photofission spectrum peaks from this cause consisted of not more than 1 Mev, which can lead to an increase of the ratio of the notch height to the peak height of approximately 0.05. Hence, the main increase in the ratio of the notch height to the peak height by 0.22 should be carried at the expense of an increase in the number of symmetric fissions due to the high excitation of the fissioning nucleus in photofission.

Notwithstanding the considerable excitation energy, there is no essential increase observed of the most probable fragment energies and of the total kinetic energy in photofission compared with spontaneous fission. One can note also a certain pulling together of the photofission spectrum peaks compared with those of the spontaneous fission spectrum.

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THE BETA SPECTRA OF F^{20} *AND* F^{17}

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THE beta spectrum of F^{20} has been investigated with the aid of a beta-ray spectrometer with a magnetic lens. A beam of 4-Mev deuterons, accelerated in the cyclotron of the Research Institute for Nuclear Physics, Moscow State University, was led into the chamber of the beta-ray spectrometer. The arrangement of the experiment was described by us earlier.[1] LiF of about 0.4 mg/cm^2 served as a target. The beta spectrum obtained by us is a superposition of the beta spectrum of F^{20} (produced by the reaction $F^{19}(d, p)F^{20}$) on the beta spectrum of Li^8 (produced by the reaction $Li^7(d, p)Li^8$). Since the upper limit of the Li^8 beta spectrum exceeds that of F^{20} by more than a factor of two, approximately half of the area under the Li^8 beta spectrum curve lies beyond the upper limit of the F^{20} beta spectrum.

The beta spectrum of F^{20} was obtained as a result of subtracting the beta spectrum of Li^8 from the beta spectrum of Li^8 and F^{20}, the corresponding section of which was obtained by us separately (see Fig. 1. $H\rho$ in kilogauss-cm).

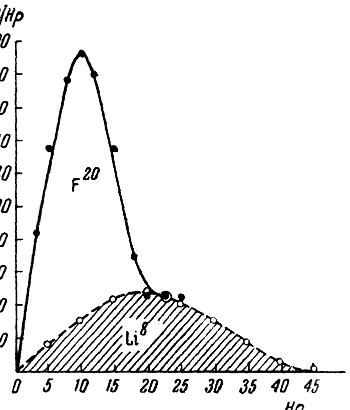

FIG. 1

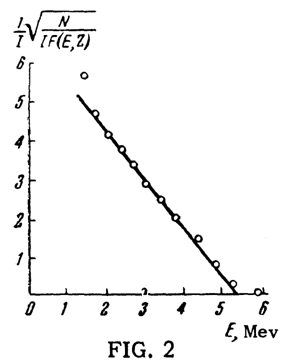

FIG. 2

A Kurie plot for F^{20} is presented in Fig. 2. As is obvious from the figure, the Kurie plot obtained is a straight line. The upper limit of the F^{20} beta spectrum is (5.45 ± 0.05) Mev. An estimate of the half-life made for the region of the spectrum around 1840 kev by separation in the beta-ray spectrometer gave the value (12.5 ± 2) sec. The results obtained were found in agreement with the data of Wong,[2] Alburger,[3] and Littauer[4] who investigated the F^{20} beta spectrum with the aid of magnetic spectrometers.

When a thin target of LiF is irradiated with deuterons, the relative number of radioactive Li^8 and F^{20} nuclei in the target and, hence, the relative intensity of their beta radiation in radioactive equilibrium is proportional to the ratio of the total cross-sections of the reactions $Li^7(d, p)Li^8$ and $F^{19}(d, p)F^{20}$. Since the half-lives of Li^8 and F^{20} are sufficiently short and the target current during the experiment varied only slightly and slowly, one can assume that the measurements have been made under equilibrium conditions. Consequently, taking the isotopic composition of the target into account, one can determine $\sigma(F^{19})/\sigma(Li^7)$ from the ratio of the areas (normalized to $H\rho = 20$ kilogauss-cm, i.e., beyond the upper limit of the F^{20} beta spectrum) under the beta spectra curves of Li^8 and F^{20}. This ratio turns out to be about 1.5 for deuteron energies around 4 Mev.

We also plotted the beta spectrum of F^{17} (produced according to the reaction $O^{16}(d, n)F^{17}$). The target used was celluloid film $(C_6H_{10}O_5)_x$ about 0.5 mg/cm^2 thick rather than the lead oxide usually used in such cases. The advantage of the celluloid film over a film of lead oxide is that the former contains no heavy elements, hence the positron scattering effect appears much weaker. The deviation from a straight line Kurie plot for F^{17} begins at approximately 800 kev, i.e., at approximately the same energy at which a deviation is observed in those cases when lead oxide is used as a target. Therefore the deviation from a straight line Kurie plot for F^{17} is apparently not connected with the scattering of positrons in the target. On the other hand, in the beta decay of F^{17} to the ground level of O^{17} the total spin of the nucleus does not change, $\ln \tau f = 3.38$, i.e., the transition must be allowed, and, consequently, the Kurie plot must be a straight line. One may suppose that the beta spectrum of F^{17} is a superposition of two partial spectra and that the decay also proceeds to an excited level which the nucleus has at 880 kev. However, this supposition requires further experimental verification. Besides, the change of the total nuclear moment in the decay to the excited level is $2(5/2 - 1/2)$, which strongly decreases the probability of such a beta transition. The half-life and the upper limit have the previous values.[1]

We shall make use of this opportunity to express our gratitude to Yu. M. Shirokov for valuable discussions, to B. M. Makun' and Z. I. Tikhomirovaya for help in the work, and to the cyclotron crew, particularly G. V. Koshelyaev, A. A. Danilov, V. P. Khlapov, and A. P. Ozyabkin.

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