tion from the second Born approximation is dominant.

The author expresses his gratitude to K. A. Ter-Martirosyan for many helpful discussions.

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*The error in reference 1 consists of having the sum $[(p_1 \cdot J_1)(p_2 \cdot J_2) + (p_1 \cdot J_2)(p_2 \cdot J_1)]\, p_2 \cdot p_1$ instead of $2(p_2 \cdot J_2) \times (p_1 \cdot J_1)(p_2 \cdot p_1)$. It is easy to see that if $\hat{S}_1$, $\hat{S}_2$, $\hat{p}_1$ and $\hat{p}_2$ enter the square of the matrix element as factors only once it is impossible to obtain the second term of the sum.

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K-LEVEL X-RAYS FROM FISSION FRAGMENTS AND DISTRIBUTION OF FRAGMENTS BY CHARGES

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WE have observed earlier[1] that the 30-kev line appearing in the gamma-ray spectrum of U^{235} fission is not monochromatic; it has been supposed that this line represents K-level x-rays from heavy fission fragments with different Z, arising apparently in the internal conversion of the harder gamma rays due to fission. We report here the results of new measurements of the spectrum of soft gamma rays from the fission of U^{235}; these data have been used to estimate the widths of the distributions of the light and heavy fragments by charges.

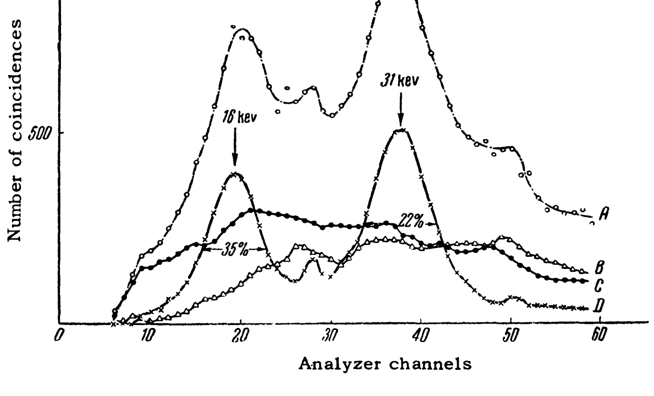
The experimental setup consisted of an ionization chamber with a layer of U^{235} placed in the thermal-neutron beam of the RFT reactor of the U.S.S.R. Academy of Sciences, and a xenon proportional counter for the gamma rays. The spectra of the gamma-ray pulses coincident with the fission-fragment pulses were measured with an ELA-2 amplitude analyzer.[2]

The diagram shows the gamma-ray spectrum of U^{235} fission in the 10 — 50 kev range. Curve A is the spectrum of all the γ-f coincidences, curve C the random-coincidence spectrum, and curve B the spectrum of true coincidences from hard gammas and fission neutrons. This curve was obtained by measuring the spectrum of the γ-f coincidences with an 180-μ lead absorber placed between the chamber and counter. Curve D was obtained by subtracting B and C from A.

Calibration was with the 32.2-kev barium K line, emitted from a Cs^{137} source, and the Np 17.7-kev L_β line emitted from an Am^{241} source. The Cs^{137} and Am^{241} sources were thin layers of the substance, deposited on aluminum disks. During the measurements these disks were placed in the same position relative to the counter as the U^{235} layer. The half-widths of the calibration 17.7 and 32.2 kev lines were 20 and 14% respectively.

As seen from the diagram, the spectrum contains two intense non-monochromatic lines, whose maxima correspond to 16 ± 1 and 31 ± 1.5 kev, and whose half-widths are 35 and 22%, respectively. There is no doubt that these lines represent the K-level x-rays from the fragments of the light and heavy groups.

It is obvious that the energy distribution of the K-level x-rays of the fragments, W(E), is connected with the charge distribution of the fragments, W(Z). It is therefore possible to estimate the width of W(Z) from the results obtained. For such an estimate we can assume that the distributions W(E) and W(Z) are Gaussian with total widths at half height δ_E and δ_Z. Then $\delta_Z = \delta_E dZ/dE$ and, since $Z \approx 10\, E^{1/2}(\text{kev}) + 1$, where E is the energy of the K-level x-rays from an atom with



charge Z (Moseley formula), $\delta_Z/Z_0 = \delta_E/2E_0$, where E_0 corresponds to the position of the maximum on the distribution relative to E; the values of E_0 are 16 ± 1 and 31 ± 1.5 kev, and the values of Z_0 are 40 ± 1.5 and 56 ± 1.5.

It is necessary, in the determination of δ_E, to take into account the instrument line width. Since the line shape, for a proportional counter, can be assumed Gaussian with a half-width δ_k, the connection between the value of δ_E and the experimental line width, δ_{exp}, is given by $\delta_E = (\delta_{\text{exp}}^2 - \delta_k^2)^{1/2}$. From the experimental values of δ_{exp}/E_0, 35 ± 4 and 22 ± 2 percent for the 31 and 16 kev lines respectively, and from the values of δ_k/E_0, which are 20 ± 2 and 14 ± 1 percent for the corresponding calibration lines, we get values of δ_Z/Z_0 of 14.5 ± 1.5 and 17 ± 3 percent respectively for the light and heavy group. These values are approximately the same as the known half-widths of the fragment mass distribution, which are 17% for the light group of fragments and 11.5% for the heavy one.[3]

It has been assumed in the foregoing analysis that the probability ν of emission of a K line is the same for fragments with different Z, which, in general, is not correct. In our paper devoted to the measurement of capture gamma-ray spectra,[4] we determined the yields of x-ray K radiation for several rare-earth elements:

Element	Eu_{63}	Gd_{64}	Dy_{66}	Ho_{67}	Er_{68}	Hf_{72}
Number of x-ray quanta to capture one neutron	0.34	0.15	0.15	0.8	0.45	0.39

The above data show that ν is not a monotonic function of Z, and that its deviations from the mean value reach ± 70%. For fission gamma rays, ν should vary in a much narrower range than for capture gamma rays, since the fission gammas are emitted by a wide range of isotopes, while the capture gammas are emitted in most cases by essentially one isotope. Nevertheless, this factor makes it possible to consider the values obtained for the widths of the fragment charge distribution as a mere estimate.

The intensity of the 16-kev line was found to be 0.10 ± 0.03 quantum per fission. This value is obtained from the ratio of the areas under the 16 and 31 kev lines and from the value of the intensity of the 31-kev line, which is 0.42 ± 0.12, obtained with a NaI crystal.[1]

The authors express their deep gratitude to V. M. Strutinskii for valuable advice.

Note added in proof (November 26, 1958). We were recently made aware (through Dr. R. B. Litchman at the Second International Conference on Peaceful Uses of Atomic Energy, Geneva, 1958) of the results of Carter, Wagner, and Wayman, who observed in the gamma-ray spectrum of U^{235} fission (measured with a scintillation spectrometer with a NaI crystal) 18 and 32 kev peaks corresponding K-level x-rays from the fission fragments. In the spectrum measured with an argon-filled proportional counter, they found 2.1 and 3.6 kev peaks, corresponding to L-level x-rays from the fragments. No data are given on the intensities of these rays.

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CONCERNING A 100-kev TRANSITION IN THE SPECTRUM OF Ce^{144}

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ALTHOUGH the radiation from Ce^{144} has been investigated by many authors, there is still no established $Ce^{144} - Pr^{144}$ decay scheme.

Conversion transitions between certain levels of Pr^{144} on different shells give very close electronic lines. This feature makes it difficult to interpret the conversion spectrum of Ce^{144} and makes the existence of certain transitions doubtful. In particular, there is no unequivocal answer to the question of whether a 100-kev transition is present.[1-4] This is a low-intensity transition between the 134 and 34 kev levels. The electron line ob-