THE GAMMA SPECTRUM OF La^{140} *IN THE ENERGY RANGE 2300–3900 kev*

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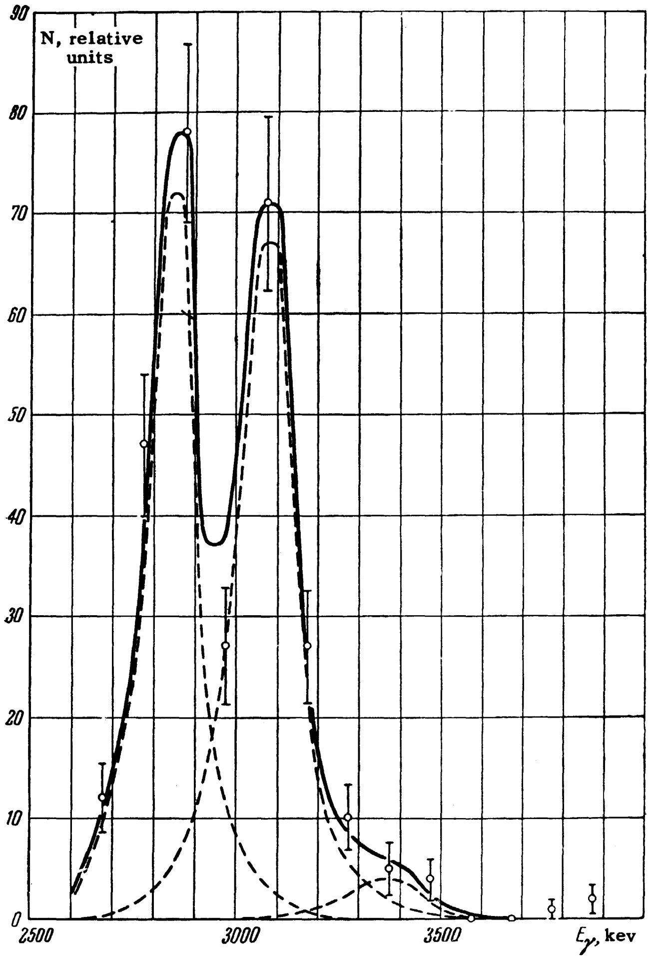
MANY investigations have been devoted to the study of the γ spectrum of La^{140}. The hardest γ rays observed until now in the radiation of La^{140} have an energy $h\nu \sim 2920$ kev. According to references 1 and 2 the mass difference $La^{140} - Ce^{140}$ amounts to ~ 3800 kev. Consequently, one can assume that the decay of La^{140} excites states of Ce^{140} with energies up to ~ 3800 kev, and transitions from higher excitation levels to the ground state can be observed.

Using the γ hodoscope of the Physics Research Institute of the Leningrad State University, a description of which was published elsewhere,[3,4] we investigated the hard γ radiation from La^{140}. Four series of measurements were carried out with different sources and at different values of the magnetic field intensity H. In series I and IV (H = 1159 and 1226 oe, respectively), the sources were two different La_2O_3 compounds, in which the isotope La^{140} was obtained from the reaction (n, γ). The activity of each source did not exceed 50 mC at the beginning of the measurements. In series II and III (H = 1011 and 1159 oe), the source was a mixture of Ba^{140} and La^{140} in equilibrium (activity not more than 25 mC at the start of the measurements).

Resolution of the spectrum into components, with allowance for the dependence of the instrument line shape on $h\nu$ and H in each series of measurements, has made it possible to separate four γ lines with the following energies (averaged over four series) 2530 ± 30, 2915 ± 30 (these lines are already known[5]), 3110 ± 50, and 3380 ± 70 kev; the latter two were observed by us for the first time.

The diagram shows the form of the γ spectrum of La^{140} after eliminating the background from the first series of measurements (dotted lines — resolution of the spectrum into components). The relative intensities of the γ transitions with $h\nu$ = 2915, 3110, and 3380 kev, determined from the areas of the lines of this series, amount to 1.0, 0.42 ± 0.07, and 0.019 ± 0.006 respectively. The errors in the determination of the relative intensities are due to



Experimental spectrum of γ rays from La^{140} in the range 2600 – 3900 kev. At H = 1159 oe, the probability of registration is optimum for $h\nu$ = 3705 kev; the observed 2915, 3110, and 3380 kev lines are attenuated by factors of 54, 2.4, and 1.4 respectively; the line $h\nu$ = 2530 kev is not registered at all under these conditions.

the inaccuracy in the knowledge of the spectral sensitivity, the statistical measurement errors, and the inaccuracy of the resolution of the spectrum into components. If it is assumed that the intensity of the 2915-kev γ transition is 7×10^{-4} quantum per decay,[5] then the intensity of the 3110 and 3380 kev transitions is respectively 2.9×10^{-4} and 1.3×10^{-5} quantum per decay.

The 3110 and 3380 kev γ rays found by us are produced during transitions from the corresponding excited levels of Ce^{140}, heretofore unknown, to the ground state. We observed no harder γ rays in the radiation of La^{140}.

We consider it our duty to express deep gratitude to O. V. Chubinskiĭ for furnishing us with data on the spectral sensitivity of the instrument, to N. D. Novosil'tseva for providing us with sources, and to L. V. Gustova for help with the measurements.

[1] B. S. Dzhelepov and L. K. Peker, Схемы распада радиоактивных ядер (Decay Schemes of Radioactive Nuclei), U.S.S.R. Acad. Sci., M-L, 1958.

[2] J. Riddell, A Table of Levy's Empirical Atomic Mass, Chalk River, Ont., 1057.

[3] B. S. Dzhelepov, Izv. Akad. Nauk SSSR, Ser. Fiz. **21**, 1580 (1957), Columbia Tech. Transl. p. 1569.

[4] O. B. Chubinskiĭ, Izv. Akad. Nauk SSSR, Ser. Fiz. **21**, 1583 (1957), Columbia Tech. Transl. p. 1572.

[5] V. P. Prikhodtseva and Yu. V. Khol'nov, Izv. Akad. Nauk SSSR, Ser. Fiz. **22**, 176 (1958), Columbia Tech. Transl. p. 173.

Translated by J. G. Adashko
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ANISOTROPIC DISTRIBUTION OF INTERNAL BREMSSTRAHLUNG IN K CAPTURE BY POLARIZED NUCLEI

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ANISOTROPY in the angular distribution of internal bremsstrahlung in K capture by polarized nuclei occurs if parity is not conserved in weak interactions. Experimental investigation of this phenomenon yields in principle the same information on the constants of the β-decay interaction as do experiments on the angular distribution of electrons in the β decay of polarized nuclei. From the experimental point of view the measurement of anisotropy of internal bremsstrahlung in K capture by polarized nuclei can be more convenient since in this case the observed effect is less dependent on the thickness of sources in which scattering of the radiation involved can take place. We also note that the anisotropy coefficient of internal bremsstrahlung does not depend on the energy of the γ quanta.

We calculated this effect for allowed transitions according to the usual method of the Born approximation in the Coulomb field of the nucleus. The angular distribution has the form

$$W = 1 + P\alpha\cos\theta, \qquad (1)$$

where $P = \langle J_z \rangle / J$ is the polarization of the nucleus, J and J_z are respectively the spin and the projection of the spin of the nucleus in the ground state, and θ is the angle between the direction of polarization of the nucleus and the momentum of the bremsstrahlung. For interactions of the general type $S + T + V + A$ the anisotropy coefficient is given by the formulas:

$J \rightarrow J$ (no) transition

$$\alpha = \frac{\frac{1}{J+1}\left[(g_T g_T'^* + g_T' g_T^*) - (g_A g_A'^* + g_A' g_A^*)\right]\langle\|\sigma\|\rangle^2 + \frac{2J}{\sqrt{J(J+1)}}\mathrm{Re}\left\{\left[(g_S g_T'^* + g_S' g_T^*) - (g_V g_A'^* + g_V' g_A^*)\right]\langle\|1\|\rangle\langle\|\sigma\|\rangle\right\}}{\left[(|g_S|^2 + |g_S'|^2) + (|g_V|^2 + |g_V'|^2)\right]\langle\|1\|\rangle^2 + \left[(|g_T|^2 + |g_T'|^2) + (|g_A|^2 + |g_A'|^2)\right]\langle\|\sigma\|\rangle^2}, \qquad (2)$$

$J \rightarrow J-1$ (no) transition

$$\alpha = \frac{(g_l g_l'^* + g_l' g_T) - (g_A g_A'^* + g_A' g_A^*)}{(|g_T|^2 + |g_T'|^2) + (|g_A|^2 + |g_A'|^2)}, \qquad (3)$$

$J \rightarrow J+1$ (no) transition

$$\alpha = \frac{J}{J+1}\,\frac{-(g_T g_T'^* + g_T' g_T) + (g_A g_A'^* + g_A' g_A^*)}{(|g_T|^2 + |g_T'|^2) + (|g_A|^2 + |g_A'|^2)}. \qquad (4)$$

Here $\langle\|1\|\rangle$ and $\langle\|\sigma\|\rangle$ are the nuclear matrix elements for the Fermi and Gamow-Teller parts of the interactions.

For the (V-A) interaction, with strict invariance under time reversal and with two-component neutrinos (polarized with spin opposite to the momentum direction in K capture) we have

$$J \rightarrow J-1 \ \text{(no)} \quad \alpha = +1, \qquad (5)$$

$$J \rightarrow J+1 \ \text{(no)} \quad \alpha = -J/(J+1), \qquad (6)$$

$J \rightarrow J$ (no)

$$\alpha = \left[\frac{1}{J+1}R^2B^2 - \frac{2J}{\sqrt{J(J+1)}}RB\right] \Big/ (1 + B^2R^2), \qquad (7)$$

where[1] $R = |g_A/g_V| = 1.19 \pm 0.02$; $B = \langle\|\sigma\|\rangle / \langle\|1\|\rangle$.

Since experiments on K-capture radiation are best done with nuclei which decay directly to the ground state so that the background of nuclear γ rays does not interfere with the investigation of the bremsstrahlung, we list below values of the anisotropy coefficient α_{VA} for several such nuclei:[2]

ERRATA TO VOLUME 10

page	reads	should read
Article by A. S. Khaĭkin		
1044, title	. . . resonance in lead	. . . resonance in tin
6th line of article	~ 1000 oe	~ 1 oe
Article by V. L. Lyuboshitz		
1223, Eq. (13), second line	$\ldots - \mathrm{Sp}_{1,2}\mathscr{E}(e_1)$	$\ldots - \mathrm{Sp}_{1,2}\mathscr{E}(e_2)\ldots$
1226, Eq. (26), 12th line	$\cdots\{(p+q, p$	$\cdots\{(p+q, p)-(p+q, n)\cdot(pn)\}$
1227, Eqs. (38), (41), (41a) numerators and denominators	$(p^2 - q)$	$(p^2 - q^2)^2$
1228, top line	$m_2 = \frac{q_1 - p_1}{q_1 - p_1}$	$m_2 = [m_3\, m_1]$

ERRATA TO VOLUME 12

page	reads	should read
Article by Dzhelepov et al.		
205, figure caption	54	5.4
Article by M. Gavrila		
225, Eq. (2), last line	$-2\gamma\Theta^{-4}\,{}^1\!/_8$	$-2\gamma\Theta^{-4} - {}^1\!/_8$
Article by Dolgov-Savel'ev et al.		
291, caption of Fig. 5, 4th line	$p_0 = 50 \times 10^{-4}$ mm Hg	$p_0 = 5 \times 10^{-4}$ mm Hg.
Article by Belov et al.		
396, Eq. (24) second line	$\ldots - (4 - 2\eta)\sigma_1 + \ldots$	$\ldots + (4 - 2\eta)\sigma_1 + \ldots$
396, 17th line (r) from top	. . less than 0.7	. . less than 0.07
Article by Kovrizhnykh and Rukhadze		
615, 1st line after Eq. (1)	$\omega_{0e}^2 = 2\pi e^2 n_e/m_e$,	$\omega_{0e}^2 = 4\pi e^2 n_e/m_e$,
Article by Belyaev et al.		
686, Eq. (1), 4th line	$\cdots b_{\rho_2 m_2}(s_2') + \cdots$	$\cdots b_{\rho_1 m_1}(s_1') + \cdots$
Article by Zinov and Korenchenko		
798, Table X, heading of last column	$\sigma_{\pi^- \to \pi^+} =$	$\sigma_{\pi^- \to \pi^-} =$
Article by V. M. Shekhter		
967, 3d line after Eq. (3)	$\varepsilon \equiv 2m_pE + m_p^2$	$\varepsilon \equiv (2m_pE + m_p^2)^{1/2}$
967, Eq. (5), line 2	$+(B_V^2 + B_A^2)\ldots$	$+(B_V^2 + B_A^2)\,Q\ldots$
968, Eq. (7)	$\ldots(C_V^2 + C_A^2)$.	$\ldots C_V^2 + C_A^2 - Q^2(B_V^2 + B_A^2)$.
968, line after Eq. (7)	for $C_V^2 + C_A^2 \equiv \ldots$	for $C_V^2 + C_A^2 - Q^2(B_V^2 + B_A^2) \equiv \ldots$
Article by Dovzhenko et al.		
983, 11th line (r)	$\gamma = 1.8 \pm$	$\gamma = 1.8 \pm 0.2$
Article by Zinov et al.		
1021, Table XI, col. 4	−1,22	1,22
Article by V. I. Ritus		
1079, line 27 (1)	$-\Lambda_\pm(t)$,	$\Lambda_\pm(t)$,
1079, first line after Eq. (33)	$\frac{1}{2}(1+\beta)$.	$\frac{1}{2}(1\pm\beta)$.
1079, 3d line (1) from bottom	$\ldots\mathfrak{N}(q'p;\, pq')\ldots$	$\ldots\mathfrak{N}(p'q;\, pq')\ldots$
Article by R. V. Polovin		
1119, Eq. (8.2), fourth line	$U_{0x}u_xg(\gamma) - [\gamma\cdots$	$-U_{0x}u_xg(\gamma)\,[\gamma\cdots$
1119, Eq. (8.3)	$\cdots$sign u.	$\cdots$sign u_g.
Article by V. P. Silin		
1138, Eq. (18)	$\cdots + \frac{4}{5}c^2k^2$	$\cdots + \frac{6}{5}c^2k^2$.