the properties of space-time on matter and its motion.

The interpretation of the general theory of relativity as only a theory of gravitation, while rejecting the general principle of relativity as a law of nature, is unacceptable because it leads to a denial of the objective reality of the fields of inertial forces and all physical effects (mechanical, electrodynamic, etc.) caused by them.

The division of the theory of relativity into special and general has no fundamental significance, and results from practical considerations in using the theory in various degrees of approximation.

Translated by A. V. Bushkovitch
22

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The Electron Spectrum of U^{237}

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The electron spectrum of U^{237} was investigated on a $\pi\sqrt{2}$ focussing angle magnetic β spectrometer, beginning with electron energies of 1 kev. Two components of the spectrum were determined, with energy limits E_{OA}=84 kev (26%) and E_{OB}=249 kev (74%). The following γ transitions for Np^{237} were computed from the conversion electron lines; 26; 33; 43; 60; 69(?); 101(?) 124(?); 165; 193(?); 208; 267; 331; 370 and 436 kev. A tentative decay scheme of U^{237} is given.

The study of the decay of U^{237} has been clarified by several researches.[1-4] However, these investigations, with the exception of the last,[4] were not carried out with sufficient accuracy, and do not give the complete picture of the decay of U^{237}. We have undertaken to carry out more carefully the study of the electron spectrum of U^{237}, including the low energy region, on a spectrometer with increased resolving power and light sum.

APPARATUS

A magnetic β spectrometer with double focussing of the electrons at an angle of $\pi\sqrt{2}$ was employed for the study of the electron spectrum of U^{237}.[5] The radius of the central trajectory of the electrons was r_0=22.5 cm. The resolving power of the spectrometer, determined by the relative half width of the conversion line of Ba^{137} (Cs^{137}, $h\nu$= 661.6 kev) for a source width of 1.5 mm, coincided with the calculated value and equaled 0.3%.

The U^{237} source has the dimensions 1.5 x 25 mm^2; for it, the relative halfwidth of the conversion lines had a value > 0.3%. The deviation from the computed value (0.3%) is explained by the effect of the thickness of the source. The relative solid angle of the spectrometer amounted to about 0.43 % of 4π.

A vacuum of $\sim 10^{-5}$ mm was maintained in the spectrometer chamber. The intensity of the magnetic field at the central orbit was measured by the ballistic galvanometer method. The magnetic field of the spectrometer was calibrated by the conversion line of Ba^{137}.

The electrons were recorded by a single cylindrical Geiger-Muller counter. A window (dimensions 1.5 x 25 mm^2) was located on the lateral wall of the counter to admit electrons. The window was covered by a celluloid film of thickness $\sim 10^{-5}$ cm. The film was supported by a tungsten wire grid (φ= 0.04 mm, spacing $\sim$0.3 mm). The counter was filled with a gas mixture of argon and ethyl alcohol (10% alcohol, 90% argon). The pressure of the mixture was $\sim$50 mm mercury. The voltage level of the counter was 100-150 v. Pulses from the counter were recorded by the usual counting apparatus of the type PS-64.

PREPARATION OF THE RADIOACTIVE SOURCE

For the investigations, the preparation of U^{237},

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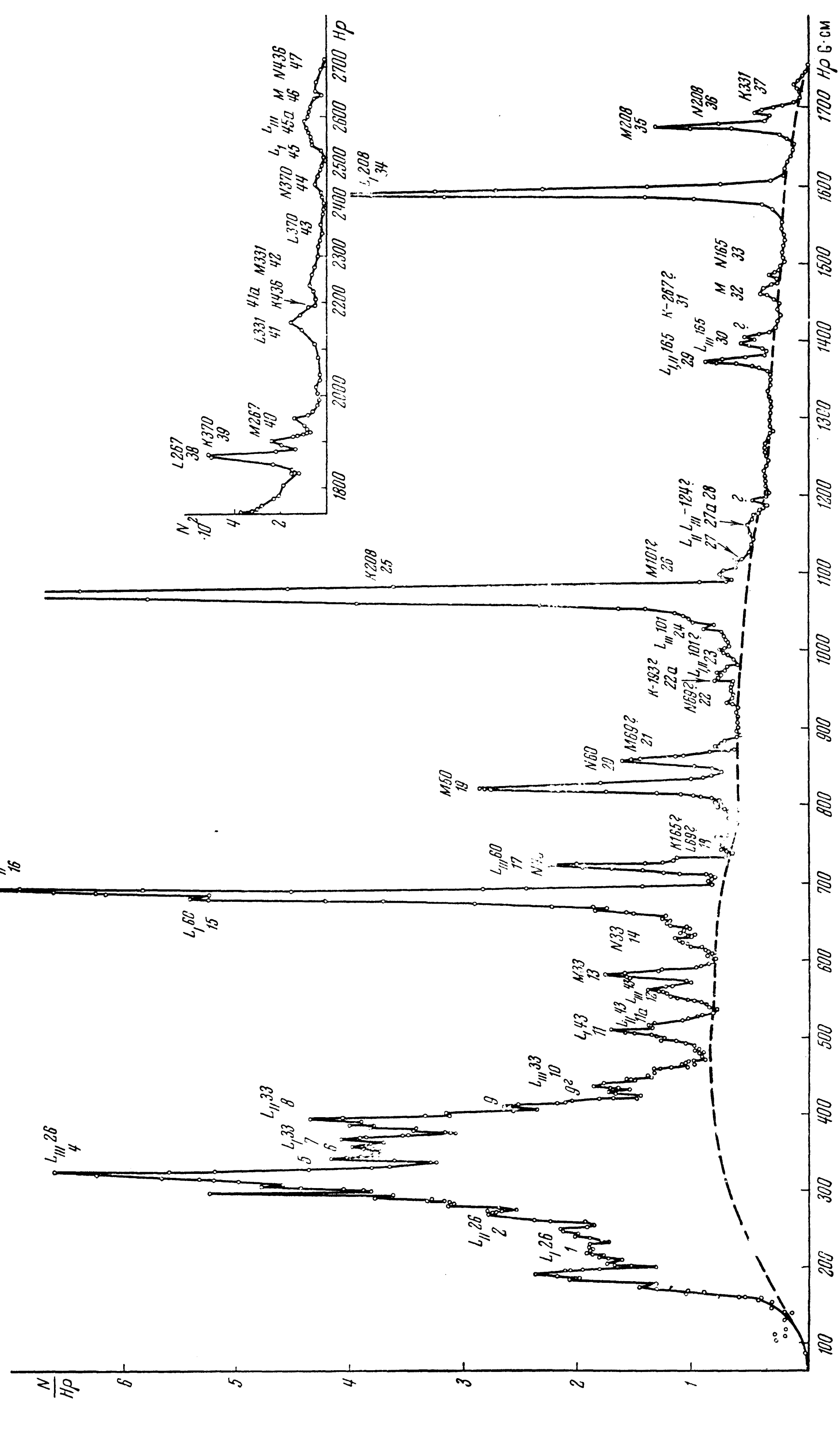

FIG. 1. Electron spectrum of U^{237}

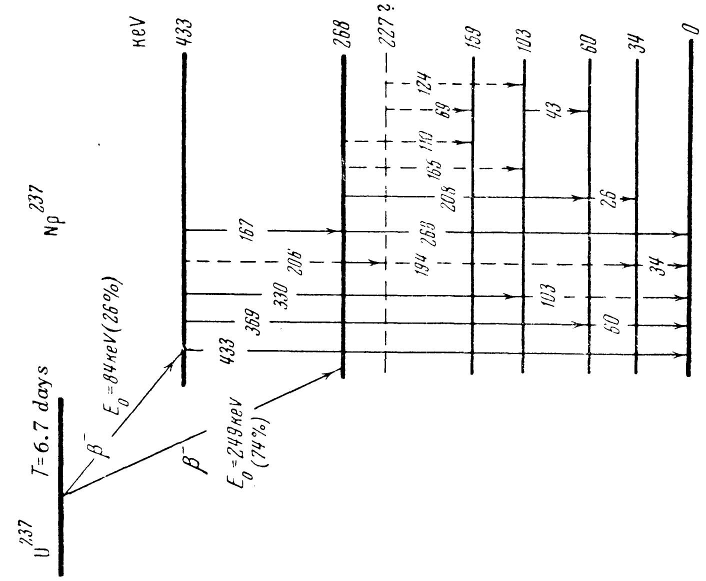

FIG. 3. Decay scheme of U^{237}

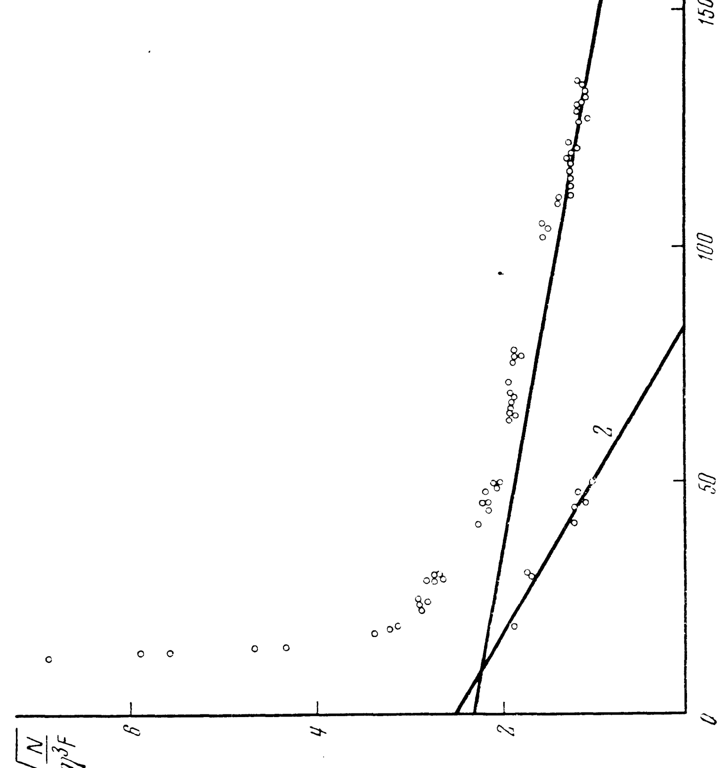

FIG. 2. Kurie graph of the spectrum of U^{237}. *1* — $E_{0A} = 249 \pm 5$ kev, 2 — $E_{0B} = 84 \pm 5$ kev

which decays with a halflife of $T = 6.7$ days, was obtained as the result of exposure of the isotope U^{236} to neutrons, the reaction being U^{236} (n, γ) U^{237}. Isotopic analysis of the product showed that it contained $\sim 91\%$ U^{236} (by weight). The amount of U^{238} was negligible.

The irradiated specimen was "seasoned" for some time before chemical purification, in order that any U^{239} (formed as a result of the presence of a small amount of U^{238}) might decay (halflife= 23.5 min). After this the specimen was carefully purified chemically, to remove Np^{239} and other foreign radioactive isotopes not belonging to uranium.

The radioactive source U^{237} was prepared from the nitrate salt of uranium, by precipitating it from a water solution on a thin organic film (thickness 10^{-5} cm). A narrow (1.5 x25mm^2) semi-transparent strip of aquadag was first placed on the latter. The aquadag guaranteed a good wetting of the film and the necessary conductivity of the source. This source had a surface density in the active layer of ~ 20 gm/cm^2.

RESULTS OF MEASUREMENT

The electron spectrum of U^{237} is shown in Fig. 1. As is seen from the drawing, a number of lines of Auger electrons are observed in the soft part of the spectrum. A series of conversion lines, not previously observed, were also discovered.

Analysis of the β spectrum with the aid of a Kurie graph (Fig. 2) permitted us to separate two partial spectra with bounding energies and intensities, respectively equal to 249 ±5 kev (74%) and 84 ±5 kev (26%). For the given β transitions, lg ft ≈ 6. The transitions under consideration are evidently related to transitions of first order of forbiddenness (tensor variant, $\Delta I = 0$; ±1), having spectra which coincide in form with resolved spectra. A small number of experimental points in the intervals between the conversion peaks do not permit us to draw any conclusion as to the actual form of the partial spectra.

Beta transitions with $E_0 > 260$ kev were not discovered. The number of observed electron lines amounted to more than 50, whereas the number given in the work by Wagner et al[4], was about 20.

Multiple recording of the electron spectrum showed that all the conversion lines coincide with the halflife of U^{237} ($T = 6.7$ days). This once again verifies the purity of the preparation used. The results of claculation of the kinetic energy of the conversion electrons, and also the value of the energy of the β transitions are given in the table. Here there are also given the relative intensities of the conversion lines and the multiplicities of some transitions. The interpretation of the lines

Interpretation of electron lines

No. of electron line	Energy of electrons in kev	Conversion shell	Transition energy in kev and multiplicity		Intensity relative to β spectrum $E_0 = 249$ keV	Intensity in arbitrary units
1	4,1	L_I	26,5	26,4	Lines appear to be Auger electrons	
2	4,8	L_{II}	26,4			
4	8,8	L_{III}	26,4			
7	10,8	L_I	33,2	33,3	lines appear to be Auger electrons	
8	11,7	L_{II}	33,3			
10	15,8	L_{III}	33,4			
13	27,7	M_I	33,4		$1,9 \cdot 10^{-2}$	0,68
14	32	N	33,5			
11	21,1	L_I	43,5	43,5 $E2 + M1$	$2,7 \cdot 10^{-2}$	0,97
11a	22	L_{II}	43,6			
12	25,8	L_{III}	43,4		$1,6 \cdot 10^{-2}$	0,57

No. of electron line	Energy of electrons in kev	Conversion shell	Transition energy in kev and multiplicity		Intensity relative to β spectrum E_0=249 keV	Intensity in arbitrary units
15	37	L_I	59,6	59,7 $E1+M2$	0,17	6,1
16	38,1	L_{II}	59,7		$2{,}8 \cdot 10^{-2}$	1,0
17	42,2	L_{III}	59,8		$5{,}2 \cdot 10^{-2}$	2,85
19	54	M_I	59,7		$2{,}2 \cdot 10^{-2}$	0,79
20	58,3	N	59,8			
18	46,8	L_I	69,2	69 (?)	very weak lines	
21	~62,0	M_I	~68,0			
22	~69,0	N	~69,0			
23	~79,0	L_I	~101	~101 (?)	very weak lines, possibly Auger electrons	
24	~83,0	L_{III}	~101			
26	~96,2	M	~101			
27	~100	L_{II}	~123	~124 (?)	very weak lines, possibly Auger electrons	
27a	~107	L_{III}	~125			
18	46,8	K	165,0	165,4 $E2+M1$	$1{,}1 \cdot 10^{-2}$	0,39
29	143,8	L_{II}	165,4		$6{,}6 \cdot 10^{-3}$	0,24
30	148,2	L_{III}	165,8			
32	159,7	M_I	165,4		$3{,}5 \cdot 10^{-3}$	0,12
33	163,9	N_I	165,4			
22a	~75	K	~193	~193 (?)	Possible Auger electrons	
25	90,0	K	208,2	208,2 $M1$	0,35	12,3
34	185,6	L_I	208,0		$9{,}0 \cdot 10^{-2}$	3,2
35	202,7	M_I	208,4		$2 \cdot 10^{-2}$	0,72
36	206,2	N_I	207,7		$7{,}6 \cdot 10^{-3}$	0,27
31	149,3	K	267,5	267,5	very weak lines	
38	244,6	L_I	267,0			
40	262,5	M_I	268,1			
37	213,3	K	331,5	331,5	very weak lines	
41	308,8	L_I	331,2			
42	326,3	M	332			
39	251,4	K	369,6	369,5	very weak lines	
43	346,7	L_I	369,1			
44	370	N	371			
41a	317,8	K	436	~436	very weak lines	
45	413,2	L_I	436,6			
45a	418,7	L_{III}	436,3			
46	428,3	M	~434			
47	433,8	N	~435,3			

of the Auger electrons (soft) was not carried out.

The tables show that the observed lines are determined by the following transitions of the Np^{237} nucleus: 26.4; 33.3; 43.5; 59.7; 69 (?); 101 (?); 124 (?); 165; 193 (?); 208, 268; 331; 370 and 436 kev.

On the basis of the experimental results here, and of data on the investigation of the electron and α spectra of Am^{241}, a tentative scheme of the levels of the nucleus Np^{237} was constructed, and is shown in Fig. 3.

The problem of the spins and even energy levels are discussed in another work.*

We consider it our duty to thank G. N. Iakovlev for carrying out the chemical part of this research and also P.S. Samoilov who furnished assistance in the taking of the β spectrum of U^{237}

*Note added in proof. The work was published in 1955[6]. The results of the cited and present researches permit us to determine the spin of the ground state of U^{237}. It is equal to $\pm 1/2$.

[6] S. A. Baranov and K. N. Shliagin, Sessions of the Academy of Sciences, U.S.S.R., on the peaceful application of atomic energy, June 21-5, 1955, sitting OFMN, p. 251.

Translated by R. T. Beyer
43

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Nucleomesodynamics in Strong Coupling. I. Approximate Method. Spin-Charge Motion

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In the approximation of infinitely heavy nucleons and strong interaction with the meson field, we develop an approximate method and the associated mathematical apparatus which makes possible explicit determination of the wave functions and energy eigenvalues of the system. The mesons are assumed to be pseudoscalar, the coupling to be symmetric pseudovector (gradient) coupling, and the nucleon is assumed to be an extended source. Using the approximation method, the Hamiltonian of the system is simplified, and the spin-charge part of the system wave function is separated off and determined along with the corresponding energy.

1. INTRODUCTION

IN previous papers on this same subject[1,2], it was assumed that the spin-charge and translational motion of the nucleon follow the relatively slow oscillations of the meson field adiabatically. To solve the problem, mathematical methods were used which are similar to those in the theory of polarons. Further investigations showed that in the most important case of nucleons and π-mesons the interaction is actually not as strong as is necessary to make the translational motion follow the meson field oscillations adiabatically. Quite the contrary, the vibrations of the meson field are adiabatic relative to the translational motion of the nucleon. Therefore, in zeroth approximation, we should consider the spin-charge motion and the oscillations of the meson field for the case of a fixed (infinitely heavy) nucleon. This is done in this and the succeeding paper.

Thus, in contrast to the above-mentioned earlier papers, we shall assume that only the spin-charge motion follows the meson field adiabatically, and shall, as before, use the methods of the theory of polarons[3] in treating this motion. In an earlier paper[4] it was shown, without the use of any ap-

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[4] S. I. Pekar, J. Exptl. Theoret. Phys. (U.S.S.R.) 29, 599 (1955).