lectroexcitation of giant multiple resonances in Zn and ^{124}Sn nuclei

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(Submitted August 25, 1977)
Pis'ma Zh. Eksp. Teor. Fiz. **26**, No. 7, 569–574 (5 October 1977)

Results are presented of the investigation of giant multiple resonances in the nuclei ^{64}Zn and ^{124}Sn with the aid of inelastic scattering of electrons, performed in Khar'kov with the LUÉ-300 linear electron accelerator.

PACS numbers: 24.30.Cz, 25.30.Cg, 27.50.+e, 27.60.+j

To obtain information on the region of the giant resonance, the initial spectrum was first rrected for the radiative elastic-scattering effects, and next for radiative and ionization losses at ch point of the remaining spectrum. For the ^{64}Zn nucleus we subtract also the contribution of the screte levels with excitation energies from 0.99 to 10.6 MeV, which were determined in[1,2]. No

0021-3640/77/2607-0422$00.60

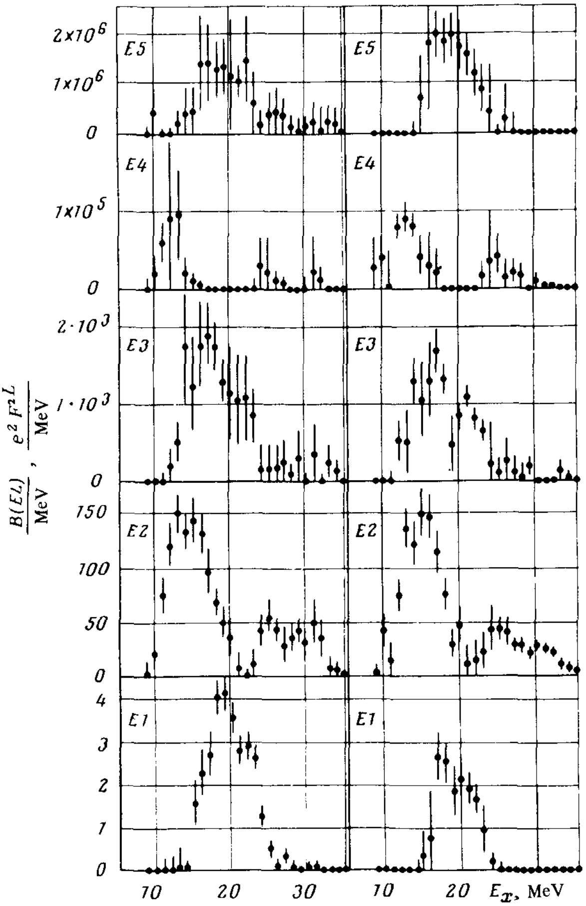


FIG. 1. ^{64}Zn. Dependence of the relative probabilities of transitions with multipolarities $L = 1$–5 o the excitation energies. Left—Helm's model, right—high-energy approximation.

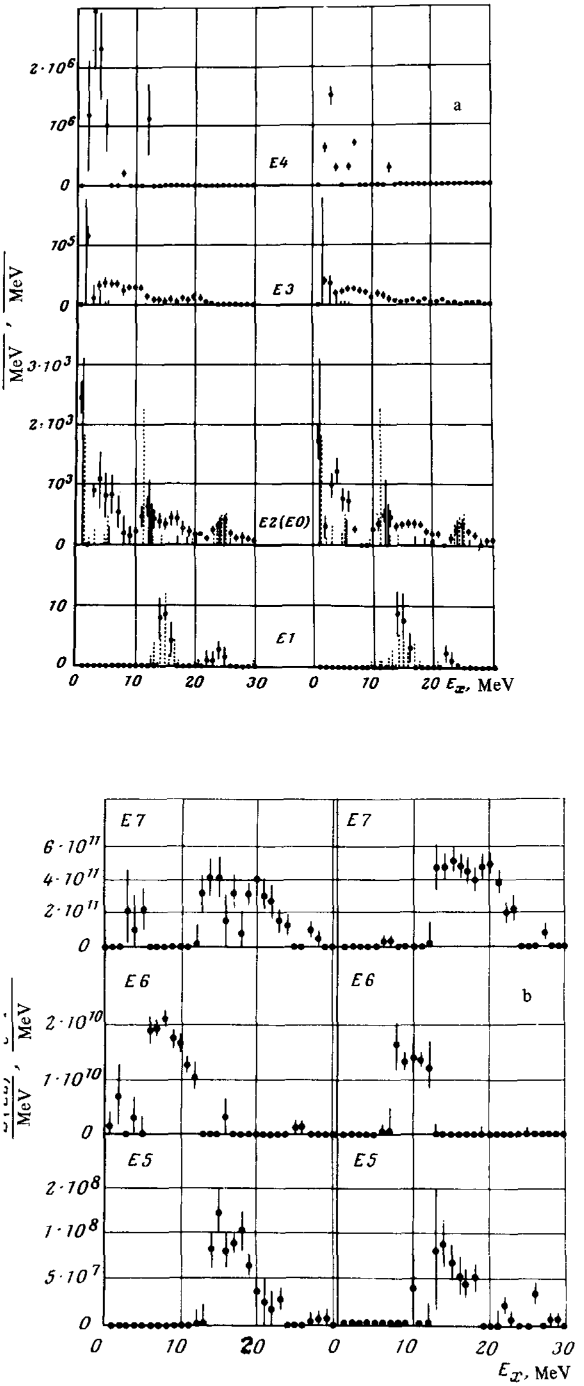
such subtraction was carried for ^{124}Sn. The contribution of a quasielastic scattering cross sectic was estimated by us on the assumption that this cross section is described within the framework (the single-particle cell model with allowance for the distortion of the electron and proton waves. The calculated curve was normalized to the point of the spectrum in the excitation-energy regio $E_x \sim 35$ MeV.

After subtracting quasielastic scattering cross sections we carried out a multiple analysis (the remaining parts of the spectra. To this end, the spectra was broken up into bands 1 MeV wic and the form factor of each band was obtained. The form factor of each band was then represente as a sum of five multiple form factors for ^{64}Zn and seven form factors for ^{124}Sn,

$$F^2 = \sum_{L=1}^{N} \beta_L F_{EL}^2$$

where β_L are fit parameters, and the multiple form factors are taken from Helm's model and fro the high-energy approximation.

The parameters of the charge distribution in the ground state, used in the calculations, ar given in Table I.



G. 2. ^{124}Sn. Dependence of the relative probabilities of the transitions of multipolarities $L = 1$–4 (a) d $L = 5$–7 (b) on the excitation energy. Left—Helm's model, right—high-energy approximation.

TABLE I.

Nucleus	R, F	G, F	c, F	β, F
^{64}Zn	4.5 [4]	0.921 [4]	4.183 [6]	0.603 [6]
^{124}Sn	5.78 [5]	1.264 [5]	5.490 [6]	0.534 [6]

This fit made it possible to separate the excitations with different multipolarities L, a knowledge of the dependence of β_L on E_x has made it possible to plot the E_x-dependence of t relative probabilities of the transitions B(EL).

TABLE II.

^{64}Zn

EL	E_x, MeV	Γ_x, MeV	B(EL), e^2F^{2L}	ΔT	Lim. of EWSR, %		$E_x \cdot A^{1/3}$, MeV	
					total	ΔT = 0.1	our data	others
E1	17,7 ± 0,6	4,3 ± 0,8	9,5 ± 2,1	1	-	63 ± 16	71 ± 3	78-82
	21,4 ± 0,6	3,5 ± 0,8	4,5 ± 1,2		-	40 ± 11	86 ± 3	
E2	0 - 11	-	1380 ± 90	0	-	10 ± 1	-	
				-	4,7 ± 0,5	-		
	15,0 ± 0,2	6,0 ± 0,4	600 ± 70	0	-	49 ± 6	60 ± 1	58-65
				-	23 ± 3	-		
	25,1 ± 0,7	3,7 ± 1,6	90 ± 50	1	-	11 ± 6	100 ± 4	
				-	6 ± 3	-		
	30,4 ± 0,8	5,0 ± 1,7	110 ± 50	1	-	16 ± 7	121 ± 3	111-140
				-	9 ± 4	-		
E3	0 - 11	-	44100 ± 1200	0	-	18 ± 2	-	
				-	8,6 ± 0,8	-		
	16,6 ± 0,4	4,2 ± 1,4	8500 ± 1800	-	5,5 ± 1,2	-	66 ± 2	70-82
	21,4 ± 2,6	6,5 ± 3,1	6500 ± 2200	-	5,4 ± 2,0	-	86 ± 10	105-158
E4	0 - 11	-	$(1,3 \pm 0,2)10^6$	-	4,0 ± 0,2	-		
	12,9 ± 0,5	3,2 ± 1,1	$(2,8 \pm 1,2)10^5$	-	2,0 ± 1,2	-	52 ± 2	
	25,4 ± 0,8	2,5 ± 1,4	$(4,4 \pm 2,5)10^4$	-	0,7 ± 0,3	-	102 ± 4	
E5	0 - 35	-	$(1,0 \pm 0,5)10$	-	2,0 ± 1,0	-		
^{124}Sn								
E1	14,8 ± 0,3	2,3 ± 0,5	20,8 ± 8,0	1	-	69 ± 26	74 ± 2	78-82
	23,8 ± 0,9	2,5 ± 1,1	4,6 ± 3,4		-	25 ± 18	119 ± 5	
E2	0 - 8	-	6800 ± 870	0	-	54 ± 5	-	
				-	22 ± 2	-		
	11,7 ± 0,5	3,0 ± 1,0	1580 ± 880	0	-	50 ± 28	58 ± 3	58-65
				-	20 ± 11	-		
	24,9 ± 0,2	3,2 ± 0,5	1300 ± 260	-	36 ± 7	-	124 ± 1	111-140
				1	-	60 ± 12		
	16,5 ± 1,0	6,4 ± 1,8	2400 ± 1100	-	44 ± 12	-	82 ± 5	
E0			1490 ± 700	0	-	54 ± 25		58-82
E3	0 - 8	-	$(22,0 \pm 2,1)10^4$	-	17 ± 3	-	-	
				0	-	42 ± 7		
	10,8 ± 0,3	4,0 ± 0,6	$(6,7 \pm 1,3)10^4$	-	8 ± 2	-	54 ± 2	70-82
	18,9 ± 0,5	6,3 ± 1,2	$(5,2 \pm 1,2)10^4$	-	13 ± 3	-	94 ± 3	105-158
E4	0 - 30	-	$(6,3 \pm 1,2)10^6$	-	5 ± 1	-		
E5	0 - 30	-	$(6,0 \pm 1,8)10^8$	-	19 ± 6	-		
E6	0 - 30	-	$(1,0 \pm 0,2)10^{11}$	-	21 ± 5	-		
E7	0 - 30	-	$(1,3 \pm 0,8)10^{12}$	-	18 ± 4	-		

Figure 1 shows the dependence of the relative transition probabilities on the excitation energy for ^{64}Zn. The same dependence for ^{124}Sn is shown on Figs. 2(a) and 2(b).

Figure 2(a) shows the results of the theoretical calculations for E1 and E2 excitations within e framework of the theory of finite Fermi systems (dotted lines)[7] and for E2 and E3 excitations the random-phase approximation method[8] (solid lines). Calculations of the E1 excitations re carried out for ^{124}Sn, and of E2 and E3 excitations for ^{120}Sn, since there are no such published lculations for ^{124}Sn. Nor are there theoretical calculations of the values of the EL excitations for n. The calculations of the E3 excitations were carried out for $E_x=0$–10 MeV.

The presence of resonances above the particle-emission threshold has made it possible to bdivide the resolved excitations into individual sections. For the E1, E2, E3, and E4 excitations e cross section in this region was represented as a combination of two or three Gaussians, with rameters E_x, Γ_x, and $B(\mathrm{EL})$ fitted by least squares to the experimental points. This fitting has ade it possible to determine, with fair accuracy, the energy position, the half-widths, and the lative probabilities of the transitions and of the coverage of the energy-weighted sum rules WSR) for giant multiple resonances. The averaged value of the fit in accordance with the two odels is shown in Table II. The values of $\langle r^2\rangle$ and $\langle r^{2L-2}\rangle$ were taken from the elastic-scattering ta.[6]

An examination of the E1—E3 resonances shows that the positions of the resonances agree ll with the results of calculations in accordance with the dynamic collective model,[9] in accornce with the random-phase approximation,[8,10] and by the method of finite Fermi systems,[7] as ll as with calculations based on the sum rule.[9] The results of these calculations are given in the t column of the table.

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