to relate the masses of members of an unbound isospin quartet. The $T=\frac{3}{2}$ states in ^{7}He, ^{7}Li, and ^{7}Be can be used to predict a mass excess for ^{7}B of 27.76 ± 0.17 MeV, which is seen to be in good agreement with experiment. This agreement is interesting since, unlike the earlier investigations involving bound isospin quartets,[2-4] the members become increasingly unbound to allowed decay modes in moving from ^{7}He to ^{7}B, so that their wave functions could be quite different. Unfortunately, no theoretical estimates are available concerning the magnitude of expected deviations from the IMME in such multiplets.

We wish to thank Dr. Fay Ajzenberg-Selove for her generous gift of the ^{10}B and ^{11}B targets used in these experiments.

†This work performed under the auspices of the U. S. Atomic Energy Commission.

*Work supported in part by the National Science Foundation.

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STUDY OF COLLECTIVE LEVELS IN TIN-116, TIN-120, AND TIN-124 BY INELASTIC ELECTRON SCATTERING

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We have observed the inelastic scattering of 150-MeV electrons from tin-116, tin-120, and tin-124. The main 2^+ and 3^- states have been studied. By comparison of the reduced transition probabilities $B_{\text{exp}}(L \to 0)$ with the corresponding single-particle estimates $B_I(L \to 0)$, we have measured the collective character of these levels which changes appreciably from one isotope to another.

We have carried out an experiment on tin-116, tin-120, and tin-124 by inelastic electron scattering in order to study the electromagnetic properties of the $E2$ and $E3$ collective transitions in these nuclei. We used the electron beam of the linear accelerator of the Ecole Normale Supérieure at Orsay. The measurements were carried out with 150-MeV electrons and the total experimental energy resolution was 0.35%.

The electric multipole transitions are analyzed with transition charge densities[1] which are the convolution of

$$\rho_2(i,f) = \delta(r-R), \quad \rho_1 = (2\pi g^2)^{-3/2} \exp(-r^2/2g^2) \quad (1)$$

and are proportional to the radial derivative of the static charge density. An analysis of the elastic scattering has given the values of the parameters R and g.[2] Thus, these transition charge densities are described by a smeared δ function situated at the surface of the nucleus; they do not correspond exactly with those given by the microscopic model of the nucleus.[3] In Born approximation, this leads to a form factor

$$|F_{IN}|^2 = \beta_L j_L^2(qR_B) \exp(-q^2 g_B^2) = \beta_L \mathfrak{F}_L. \quad (2)$$

where R_B and g_B are parameters given by an analysis of the elastic scattering with Born approximation. In order to determine the experimental form factor we use the phase-shift point cross section as a reference. By normalization to the reduced experimental data we

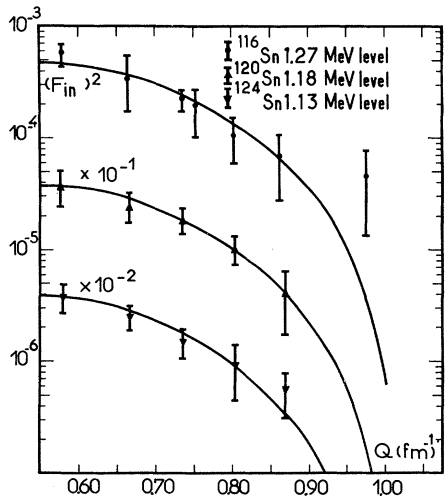

FIG. 1. Experimental form factors for the $E2$ transitions.

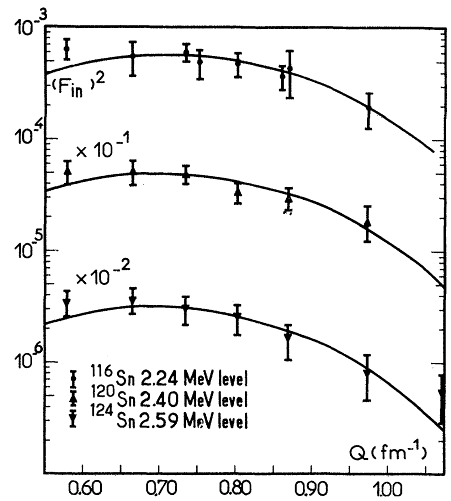

FIG. 2. Experimental form factors for the $E3$ transitions.

determine the value β_L of the ratio $|F_{IN}|^2/\mathfrak{F}_L$. In Figs. 1 and 2, we may see that the experimental data for $E2$ and $E3$ transitions are in fairly good agreement with the phenomenological form factor.

From the normalization factors β_L, we may deduce the reduced transition probabilities by the expression

$$\frac{B_{\exp}(L\to 0)}{e^2}=\frac{\beta_L Z^2 R^{2L}}{4\pi(2L+1)}. \tag{3}$$

Table I. (a) Values of the fitting parameters β_L with the Born approximation inelastic form factors. (b) Values of the reduced transition probabilities $B_{\exp}(L\to 0)$ compared with the single-particle estimate of Moszkowski,[4] $B_I(L\to 0)$; their ratio is also indicated and compared with values obtained by other methods.

	ε (MeV)	J^π	$\beta_L\times 10^2$	$B_{\exp}/e^2$	B_I/e^2	$G=B_{\exp}/B_I$ (e,e')	G_c Coulomb Excitation	G_j Nuclear Scattering of γ rays.	G_N (α,α')
^{116}Sn	1.27	2^+	0.85	291 ± 43 fm^4	24.7 fm^4	11.8 ± 1.8	12	14.2	24
^{120}Sn	1.18	2^+	0.69	247 ± 41 fm^4	25.7 fm^4	9.6 ± 1.6	13	8.75	14
^{124}Sn	1.13	2^+	0.69	266 ± 45 fm^4	27.7 fm^4	9.6 ± 1.6	12		10
^{116}Sn	2.24	3^-	2.38	17130 ± 2100 fm^6	504 fm^6	34 ± 5	38		22
^{120}Sn	2.40	3^-	2.12	16190 ± 1975 fm^6	535 fm^6	30 ± 4	22		12
^{124}Sn	2.59	3^-	1.27	10840 ± 1530 fm^6	597 fm^6	18 ± 3	22		5
^{124}Sn	2.18	4^+	0.78	160000 ± 28800 fm^8	13400 fm^8	12 ± 2			

We can compare the results with the single-particle estimate of Moszkowski[4]:

$$\frac{B_I(L\to 0)}{e^2}=\frac{1}{4\pi}\left(\frac{3}{3+L}\right)^2 R^{2L}.$$

The value $G=B_{\exp}/B_I$ gives a measure of the collective character of the excitation. To take into account the deformation of the wave function in the vicinity of the nucleus, we must introduce in formulas (1) and (2) the exact value of R given by the phase-shift analysis of the elastic data. Our results are given in Table I and compared with those given by Coulomb excitation[5] and by nuclear resonance scattering of γ rays.[6,7]

Our study emphasizes the electromagnetic properties in spherical nuclei with an incomplete neutron shell. These properties are proportional to the components of the proton wave functions in the closed shells and vary appreciably from one isotope to another. From this point of view, although electromagnetic and nuclear interactions are different, it is interesting to compare collective multipole excitations given by inelastic scattering of electrons and α particles.[8]

We wish to thank Professor A. Blanc-Lapierre for the use of the facilities of his laboratory. We thank V. Gillett for stimulating discussions and personal interest in this work.

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QUANTITATIVE STUDIES OF NUCLEAR STRUCTURE THROUGH ISOBARIC ANALOG RESONANCES*

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(Received 10 November 1967)

Since the discovery of isobaric analog resonances in heavy nuclei,[1] it has been realized that important nuclear-structure information could be derived from a study of the various decay widths of these resonances.[2] In particular, the elastic proton width is expected to be simply related to the spectroscopic factor of the corresponding parent analog state. In this Letter we present a method suitable for the quantitative extraction of spectroscopic factors and apply it to study the low-lying states in ^{209}Pb. The analysis is done in two steps: First, a single-particle potential is found that gives an adequate description of the low-lying states in ^{209}Pb. This potential, together with a charge-exchange term of known strength, completely determines the potentials occurring in the Lane equations,

$$\{K+U_0+\Delta_C+\tfrac{1}{2}(T_0-1)V_1-E_p\}\varphi_{nA}=-(\tfrac{1}{2}T_0)^{1/2}V_1\varphi_{pC}, \tag{1a}$$

$$[K+U_0+V_C-\tfrac{1}{2}T_0V_1-E_p]\varphi_{pC}=-(\tfrac{1}{2}T_0)^{1/2}V_1\varphi_{nA}. \tag{1b}$$

Here U_0 stands for a Saxon-Woods potential with a spin-orbit term. The charge-exchange interaction is taken to be $(\vec{t}\cdot\vec{T}_0)V_1(r)$ with $\vec{t}$ and $\vec{T}_0$ denoting the isospin operators of the extra nucleon and core nucleus, respectively. Finally, the Coulomb displacement energy is denoted by Δ_C and the Coulomb potential by $V_C(r)$. These equations have been solved numerically by a number of authors.[3]

Instead of resorting directly to numerical methods, we first replace the coupled equations by the