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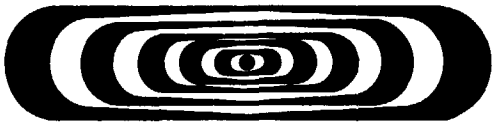

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DIRECTIONAL CORRELATIONS OF γ-TRANSITIONS IN ^{142}Ce *

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ABSTRACT

Angular correlations of coincident gamma transitions have been measured in ^{142}Ce following the β^- decay of fission product $^{142}La(T_{1/2}=$ 93 min) using a spectrometer consisting of a HPGe and a Ge(Li) detector. The measurements have been made on 14 direct and 13 skip cascades. Spin assignments were made to the levels at 2181 keV (3^+), 2727 keV (1^+),3612 keV (2^+) and 4043 keV (2^+). In addition several previous spin assignments to other levels were confirmed. The multipole mixing ratios δ for 23 transitions were determined from the present results.

CORRELAÇÕES ANGULARES PARA TRANSIÇÕES GAMA NO ^{142}Ce

RESUMO

A correlação angular das transições gamas no núcleo do ^{142}Ce foram medidas a partir do decaimento β^- do produto de fissão $^{142}La(T_{1/2} = 93$ min) utilizando um espectrômetro gama constituído por um detetor de HPGe e outro de Ge(Li). As medidas foram realizadas para 14 cascatas gamas diretas e 13 cascatas triplas. Os valores de spins e paridade são sugeridos para os níveis 2181 keV(3^+), 2727 keV(1^+), 3612 keV(2^+) e 4043 keV (2^+). Além disso os valores de spins para outros níveis foram confirmados. As misturas multipolares δ para 23 transições foram determinadas a partir dos presentes resultados.

INTRODUCTION

Transitional nuclei with neutron numbers $84 \leq N \leq 90$ are of interest as they are expected to show gradual change from vibrational structure of a near spherical nuclei to the rotational behaviour of the deformed region of rare-earth nuclei. The ^{142}Ce nucleus (N=84) thus provides a good opportunity for the study of the nuclear structure near magic number in this transitional region.

The β^- decay of ^{142}La to the levels in ^{142}Ce has been studied in the past by several workers [1-5]. The most complete study being that of

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Larsen et al [5] containing extensive Ge(Li)-Ge(Li) coincidence data. The levels in ^{142}Ce have also been studied by coulomb excitation [6,7] and ^{140}Ce (t,p) reaction [8].

The measurements of γ-γ angular correlations in the decay of ^{142}La were performed by Prestwich and Kennett [9] using two NaI(Tl) detectors and Basinger et al [10] using the combination of a Ge(Li) and six NaI(Tl) detectors. More recently Michelakakis et al [11] and Wolf et al [12] have used combination of Ge(Li) detectors for these measurements. All these studies resulted in a level scheme of ^{142}Ce with spin and parity assignments made to several levels. The results are summarized in Nuclear Data Sheets [13]. Despite a large number of gamma cascades measured by Michelakakis et al [11] several A_{kk} values are in serious disagreement with the results of Basinger et al [10] and Wolf et al [12] leading to conflicting conclusions regarding the spin assignments to some of the levels and multipole mixing ratios of several γ-transitions. In view of these discrepancies it was decided to reinvestigate the angular correlations using Ge(Li) and HPGe detectors and at the same time to obtain data with improved counting statistics in order to better define some of the spin assignments to the levels made in the previous studies. The levels and transitions in ^{142}Ce were studied by measuring a total of 27 gamma cascades populated by the β^- decay of ^{142}La.

EXPERIMENTAL

The radioactive sources of ^{142}La were prepared by chemically separating the barium activity from the fission products of uranium and later separating the lanthanum produced from the decay of barium. Approximately 1 g of Uranyl nitrate hexahydrate were irradiated with thermal neutrons for 2 min at a flux of $\sim 5 \times 10^{12} n/cm^2.s$ in the IEA-R1 reactor at São Paulo. The barium activity was separated from the fission products a few minutes after the end of irradiation using a procedure similar to one discribed by Minkkinen [14]. The barium chloride was finally dissolved in 5 ml of H_2O. The lanthanum carrier was added to this solution and lanthanum activity was allowed to grow for a period of 30 min, then separated from barium by precipitating $La(OH)_3$. The precipite was centrigued washed several times and finally dissolved in a drop of 1 M HCl. The dilute solution containing ^{142}La was transferred to a lucite source

holder and taken to the gamma-spectrometer for measurements. The source dimension was 2.5 mm x 5 mm.

The γ-γ spectrometer consisted of a HPGe detector with a volume of 89 cm^3 maintained fixed and a movable Ge(Li) detector with a volume of 45 cm^3. The γ-γ coincidences were recorded using a standard low noise fast coincidence system and a 4096 channel pulse height analyser. The measurements were carried out at angles of 90^0, 120^0, 150^0 and 180^0. The angular position of the movable detector was changed every 20 min and the coincidence spectrum observed through the HPGe detector was routed to an appropriate 1024 channel subgroup of the analyser memory for each angle. Counting from a single source continued through a period of 160 min after which a fresh source with approximately the same activity was used. A total of 100 sources were used for the entire experiment.

The single channel analyser (SCA) window was set to accept the photopeak at 641 keV as seen in the Ge(Li) detector. An additional gate was placed adjacent to the main gate at higher energy side in order to determine the effects of Compton scattered radiation of higher energy gamma rays included in the window setting. The intensities of coincident gamma rays were measured from the HPGe detector spectra at various angles and corrected for the source decay during the measurements, effects of Compton scattered radiation of higher energy and chance coincidences. The chance coincidences were determined separately by introducing a delay of 1 μs in the signal pulses from one of the detectors before reaching the coincidence unit and recording the coincidence spectrum. The corrected photopeak areas were least square fitted to the polynomial $W(\theta) = 1 + A_{22}P_2(\cos\theta) + A_{44}P_4(\cos\theta)$ to determine the angular correlation coefficients A_{kk}.

RESULTS

The direct γ-ray spectrum in the decay of ^{142}La obtained with the HPGe detector is shown in Fig. 1(A). The γ-γ coincidence spectrum obtained with the 641 keV gate setting is shown in Fig.1 (B). The energy range is limited to 0-2.3 MeV and the coincidence spectrum represents the result of only a partial measurement not corrected for Compton contri-

butions and accidentals. The angular correlation coefficients A_{kk} corrected for the finite solid angle effects are given in Table I. The solid angle correction factors for the HPGe detector were determined by numerical calculations [15] and for the Ge(Li) detector they were taken from the tables of camp and Van Lehn [16]. The A_{kk} values for the gamma cascades measured by Basinger et al [10], Michelakakis et al [11] and Wolf et al [12] are included in this table for comparison.

The multipole mixing ratios for the gamma transitions are presented in Table II. These values were calculated using spin sequence found most consistent with the observed angular correlation data, the decay properties [5] and the results of reaction studies [6-8]. The mixing ratios were determined by the usual χ^2 analysis as a function of δ for the mixed transition. The convention of Becker and Steffen [17] was used for the definition of the mixing ratio. The multipole mixing ratios obtained in this study are compared with those of Basinger et al [10], Michelakakis et al [11] and Wolf et al [12]. A partial level scheme of ^{142}Ce taken from Nuclear Data Sheets [13] is shown in figure 2. Only γ-transitions of interest in this study are shown. The spin and parity assignments deduced from the present investigation are included in this figure.The parametric plots for some of the relevant spin sequences are shown in figures 3 and 4. The corrected values of A_{kk} coefficients with associated error bars have been displayed as (A_{22},A_{44}) points in these plots. In the cases of skip cascades where the intermediate unobserved transition is the 895 keV transition a value of $\delta(895) = -0.63$ has been used for the parametric plots.

The assignment of the ground state of ^{142}Ce is 0^+ as for all even-even nuclei and the 2^+ assignment for the 641 keV level follows from coulomb excitation [6,7], the (t,p) reaction [8] and the decay studies [5]. Since all gamma cascades studied involved the 641 keV γ-ray as the lowest $2^+ \longrightarrow 0^+$ transition, the spin assignment to most of the levels is relatively straightforward. The results of individual cascades and spin assignment to the levels are discussed below.

The spin and parity assignment of the 1219 keV level is believed to be 4^+ [13] being consistent with most of the previous studies [5,10,12] and also with the level systematics of the neighbouring even-even nuclei.The

only exception to this is the angular correlation result of Michelakakis et al [11] for the 578-641 keV cascade which supports a 2^+ assignment. The present result for this cascade is in good agreement with the A_{kk} coefficients expected for the 4-2-0 spin sequence.

The level at 1536 keV has a spin and parity of 2^+ [13]. The present angular correlation result of the 895-641 keV cascade is in excellent agreement with this assignment.

The spin and the parity of the 1652 keV level is known to be 3^- [13]. The results of the gamma cascades 1011-641 keV and 433-(578)-641 keV measured in the present work are in agreement with this assignment. The 1011 keV and 433 keV transitions are both predominantly dipole in character. The A_{22} coefficient for the 1011-641 keV cascade obtained by Michelakakis et al [11] although consistent with the 3-2-0 spin sequence is significantly different from the present value as well as that of ref.10.

The spin and the parity of the 2004 keV level is 2^+ [13]. The present A_{kk} values for the 1363-641 keV cascade are consistent with this assignment and agree with those of Basinger et al [10] but not with those of Michelakakis et al.

The 2030 keV level has been assigned a 0^+ spin and parity [13] based on the angular correlation result of the 1389-641 keV cascade [10,11]. As pointed out earlier [10] this cascade suffers from an interference from the single escape of an intense 1901 keV γ-ray and needs corrections.The present A_{kk} values are in fair agreement with both earlier results [10,11].

A spin and parity of 3^+ was indicated for the 2181 keV level from the angular correlation of the 962-(578)-641 keV cascade [10]. Results of Michelakakis [11] for this cascade allow 3^+ or $2^\pm$ assignment although these authors assumed a spin and parity of 2^+ for the 1219 keV level in their analysis. The present result for the above cascade clearly indicates a 3-2-0 spin sequence. Since the 962 keV transitions has a considerable quadrupole admixture the parity of the level is positive.

The spin of the 2187 keV level is 1 and its parity is probably negative[13]. The present result for the 1546-641 keV cascade is quite consistent with the 1-2-0 spin sequence. Since the 1546 keV transition is almost power dipole, nothing can be said about the parity of the level.

The spin of the 2364 keV level is indicated as 1 or 3 from the present result as well as the previous result [11] of the 1723-641 keV cascade. However the presence of a cross over transition to the ground state limits the spin value to 1. Since the 1723 keV transition shows a substantial quadrupole admixture the parity of the level is positive.

The spin and the parity of the 2398 keV level is 1^+ [13] based on the previous angular correlation results of the 1757-641 keV cascade [10-12]. The present A_{kk} values for this cascade are in excellent agreement with the earlier results [10-12] and confirm the 1^+ spin assignment. The present result for the 862-(895)-641 keV cascade lends additional support for this assignment.

While Larsen et al [5] assigned a spin and parity of 2^+ for the 2542 level from the decay study, the results of (t,p) reaction [8] and angular correlation of the 1901-641 keV cascade [10,11] suggested a spin of 1 for this level. As discussed earlier the spin of the 1219 keV level is now known to be 4^+ and since the 2542 keV level decays to the 1219 keV level through the 1323 keV transition an assignment of spin 1 for the 2542 keV level is ruled out. The present results for the 1901-641 keV and 1323-(578)-641 keV are in good agreement with those of Wolf et al [12] and clearly support a 2^+ assignment for the 2542 keV level.

A spin and parity of 2^+ is known for the 2667 keV level [13]. The present angular correlation results of the 2026-641 keV and 1131-(895)-641 keV cascades are in agreement with the previous results [10,11] and clearly indicate a spin of 2^+ for the level.

The angular correlation results of three gamma cascades: 2055-641 keV, 1160-(895)-641 keV and 1044-(1011)-641 keV serve to define the spin of the 2696 keV level. The result of the 2055-641 keV cascade are quite unambiguous indicating the 2-2-0 spin sequence. However contrary to the results of Michelakakis et al [11] the quadrupole admixture of the 2055 keV transition is much higher suggesting a positive parity for the level. The results of 1160-(895)-641 keV and 1044-(1011)-641 keV cascades are also consistent with the above spin assignment.

Two gamma cascades 2086-641 keV and 1191-(895)-641 keV de-exciting the 2727 keV level were measured in the present study. The result of the

2086-641 keV cascade provide a clear indication of the 1-2-0 spin sequence. Since the 2086 keV transition has a considerable quadrupole admixture the parity of the level is positive. The result of the 1191-(895)-641 keV cascade although consistent with this assignment can not exclude other spin values.

The spin of the 2742 keV level is 1 [13], derived from the angular correlation results of the 2100-641 keV cascade [10,11]. The present results for this cascade are in very good agreement with this assignment. The multipole mixing ratio of the 2100 keV transition $\delta(2100) = -0.50 \pm 0.05$ indicates > 17% quadrupole admixture suggesting a positive parity for the level.

The spin and parity of the 2767 keV level is known to be 0^+ [13] based on the angular correlation of the 2126-641 keV cascade [11]. The present A_{44} value for this cascade although does not cover the theoretical value expected for the 0-2-0 sequence, it is large enough to exclude other spin sequences.

Michelakakis et al [11] suggested the spin and parity of the 3420 keV level as 0^-, 1^- or 2^- from their angular correlation result of the 1233-(1546)-641 keV cascade. The present result for this cascade is consistent with 1^- or 2^- spin and parity assignments but not 0^- (in fact the $A_{22} = -0.252 \pm 0.088$ obtained by Michelakakis et al [11] is also not consistent with the 0^- spin, theoretical value for the 0-1-0 sequence being + 0.5).

The spin and parity of the 3612 keV level was limited to $1^\pm$ or 2^+ from the angular correlation of the 2076-(895)-641 keV cascade [11]. The present A_{kk} values for this cascade differ considerably from those of Michelakakis et al [11] (Table I) and clearly indicate a spin of 2 for the 3612 keV level. A considerable quadrupole admixture in the 2076 keV transition ($\delta = -0.68 \pm 0.33$) suggests a positive parity for the level.

The spins and the parities of the 3675 keV and 3717 keV levels are known to be 1^+ for both cases [13]. The present A_{kk} values for the 2139-(895)-641 keV and 2181-(895)-641 keV although quite different from those of Michelakakis et al clearly indicate a 1-2-2-0 spin sequence. The present results therefore confirm 1^+ assignment for both levels.

The angular correlation of the 2039-(1363)-641 keV cascade measured by Michelakakis et al [11] allows any of the $1^{\pm}$, $2^{\pm}$, $3^{\pm}$ possible value for the spin and parity of the 4043 keV level. The present results for the above cascade are quite unambiguous, indicating a spin of 2 for the level. Since the quadrupole admixture of the 2039 keV transition is quite large the parity of the level is positive.

DISCUSSION

The low lying excited states of even-even nuclei in the mass range $60 < A < 150$ are usually described as vibrations about a spherical equilibrium shape, as rotations of a soft deformed core or as excitations of two particles (quasi-particles) from ground state. These various models lead to quite different predictions for the electromagnetic transition probabilities. A systematic investigation of quantities such as the multipole mixing ratios $\delta(E2/M1)$ for γ-transitions is therefore important in providing an understanding of the structure of these nuclei in terms of collective or single particle effects.

Considering that the nucleus of ^{142}Ce has only two neutrons more than the closed shell of N=82 one might attempt to explain some of the energy levels in terms of vibrational model. In this context the 641 keV (2^+) level would be the one-phonon state and levels at 1219 keV (4^+) and 1536 keV (2^+) the members of a two-phonon triplet (0^+,2^+,4^+). The 0^+ level at 2030 keV is too high in energy to be the member of two-phonon triplet, being rather more appropriate for a three-phonon state. The 1536 keV (2^+) level decays exclusively to the 641 keV level. The absence of a crossover transition to the 0^+ ground state is surprising. This transition although forbidden in the simple vibrational model usually occurs with reduced intensity (at least a few percent of that of the stopover transition). The mixing ratio of the 895 keV $2^+_2 \longrightarrow 2^+_1$ transition was deduced to be $-0.63 + 0.10$. The corresponding transitions in the neighbouring N=84 isotones $^{140}Ba(\delta = -1.1 \pm {}^{0.14}_{0.10})$ [18] and $^{144}Nd(\delta = -1.6 \pm 0.5)$ [19] show some what larger quadrupole content but have the same sign for the mixing ratio.

The 3^- state at 1652 keV is known to be of collective nature [6] and

most probably corresponds the one-octupole phonon vibration. Identification of the three-quadrupole-phonon states (0^+,2^+,3^+ 4^+ and 6^+) is difficult. The levels at 2004 keV (2^+), 2030 keV (0^+) and 2181 keV (3^+) have right energy for the three-phonon states, however the decay characteristics of the 2^+ and 0^+ states suggest that the obably do not correspond to the three-phonon multiplet.

The main difficulty in this type of interpretation arises when one considers the electromagnetic properties of the γ-transitions between the levels. The present results show that a large number of transitions in ^{142}Ce have considerable M1 admixture and these are difficult to explain in terms of simple vibration model. In particular the $2^+_2 \longrightarrow 2^+_1$ transition is forbidden as M1 if the states are considered pure phonon states. It appears therefore that the interpretration of the excited states of ^{142}Ce in terms of simple vibrational model is of limited value. More refined calculations which take into account the interaction between collective and quasi-particle effects may be necessary to explain the level structure and electromagnetic transitions in this nucleus. In the present work angular correlations of 27 gamma cascades were measured and multipole mixing ratios of 23 transitions were determined. Spin and parity assignments to the levels at 2181 keV (3^+), 2727 keV (1^+), 3612 keV (2^+) and 4043 keV (2^+) are suggested. In addition many previous spin assignments to other levels were confirmed.

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TABLE I - Results of Directional Correlation Measurements of Transitions in ^{142}Ce

	Gamma-Cascade (keV)	A_{22}	A_{44}	
1	578-641	0.102 ± 0.024	0.042 ± 0.037	
		0.101 ± 0.021	-0.040 ± 0.030	a
		-0.055 ± 0.024	0.070 ± 0.043	b
		0.094 ± 0.055	-0.003 ± 0.060	c
2	895-641	0.510 ± 0.015	0.087 ± 0.025	
		0.320 ± 0.020	0.010 ± 0.030	a
		0.325 ± 0.016	-0.020 ± 0.032	b
		0.417 ± 0.034	0.089 ± 0.036	c
3	1011-641	-0.074 ± 0.018	-0.006 ± 0.026	
		-0.182 ± 0.022	0.006 ± 0.040	b
		-0.023 ± 0.045	-0.049 ± 0.050	c
4	1363-641	0.118 ± 0.027	-0.009 ± 0.042	
		-0.053 ± 0.046	0.087 ± 0.084	b
		0.181 ± 0.044	-0.004 ± 0.047	c
5	1389-641	0.232 ± 0.105	0.868 ± 0.235	
		0.182 ± 0.217	0.995 ± 0.447	b
		0.231 ± 0.281	1.436 ± 0.332	c
6	1546-641	-0.206 ± 0.024	-0.030 ± 0.034	
		-0.295 ± 0.033	-0.008 ± 0.060	b
		-0.257 ± 0.045	-0.037 ± 0.049	c
7	1723-641	0.173 ± 0.035	-0.118 ± 0.054	
		0.067 ± 0.039	-0.107 ± 0.070	b
		0.138 ± 0.055	-0.033 ± 0.062	c
8	1757-641	0.571 ± 0.025	-0.534 ± 0.041	
		0.570 ± 0.070	-0.440 ± 0.110	a
		0.528 ± 0.056	-0.355 ± 0.097	b
		0.519 ± 0.043	-0.401 ± 0.047	c

(cont.)

TABLE I - (continuation)

	Gamma-Cascades (keV)	A_{22}	A_{44}	
9	1901-641	-0.176 ± 0.018	0.065 ± 0.026	
		-0.130 ± 0.040	0.010 ± 0.050	a
		-0.223 ± 0.019	-0.031 ± 0.034	b
		-0.133 ± 0.024	-0.055 ± 0.026	c
10	2026-641	-0.353 ± 0.051	0.142 ± 0.071	
		-0.343 ± 0.061	0.204 ± 0.110	b
		-0.291 ± 0.154	-0.056 ± 0.173	c
11	2055-641	0.512 ± 0.030	0.074 ± 0.046	
		0.266 ± 0.039	0.057 ± 0.070	b
		0.455 ± 0.047	0.077 ± 0.053	c
12	2086-641	0.362 ± 0.079	-0.169 ± 0.123	
		0.015 ± 0.128	-0.215 ± 0.276	b
13	2100-641	0.286 ± 0.052	-0.107 ± 0.081	
		0.183 ± 0.053	-0.196 ± 0.100	b
		0.192 ± 0.085	-0.097 ± 0.108	c
14	2126-641	0.207 ± 0.196	0.841 ± 0.450	
		-0.052 ± 0.254	1.022 ± 0.535	b
15	433-(578)-641	-0.216 ± 0.043	0.050 ± 0.062	
16	962-(578)-641	0.261 ± 0.062	-0.089 ± 0.096	
		0.152 ± 0.163	-0.016 ± 0.293	b
		0.346 ± 0.095	-0.094 ± 0.102	c
17	1323-(578)-641	0.168 ± 0.063	0.030 ± 0.098	
		0.24 ± 0.06	0.085 ± 0.070	a
18	862-(895)-641	-0.082 ± 0.024	-0.014 ± 0.036	
		-0.290 ± 0.041	-0.017 ± 0.074	b
		-0.029 ± 0.036	-0.004 ± 0.040	c

(cont.)

TABLE I - (continuation)

	Gamma-Cascades (keV)	A_{22}	A_{44}	
19	1131-(895)-641	0.007 ± 0.048	-0.162 ± 0.073	
		-0.009 ± 0.116	-0.431 ± 0.202	b
20	1160-(895)-641	0.030 ± 0.027	0.013 ± 0.041	
		0.041 ± 0.048	0.013 ± 0.087	b
		-0.016 ± 0.043	0.015 ± 0.049	c
21	1191-(895)-641	0.056 ± 0.059	0.034 ± 0.090	
		0.197 ± 0.191	-0.195 ± 0.335	b
22	2076-(895)-641	0.174 ± 0.051	-0.063 ± 0.80	
		-0.090 ± 0.102	0.057 ± 0.192	b
23	2139-(895)-641	0.109 ± 0.066	0.094 ± 0.099	
		-0.328 ± 0.141	0.495 ± 0.275	b
24	2181-(895)-641	0.195 ± 0.074	0.091 ± 0.114	
		-0.398 ± 0.141	0.721 ± 0.287	b
25	1044-(1011)-641	-0.185 ± 0.021	-0.022 ± 0.031	
		-0.311 ± 0.031	0.104 ± 0.056	b
		-0.143 ± 0.041	0.057 ± 0.046	c
26	2039-(1363)-641	0.228 ± 0.050	-0.092 ± 0.077	
		-0.064 ± 0.078	0.034 ± 0.143	b
27	1233-(1546)-641	-0.138 ± 0.044	-0.007 ± 0.064	
		-0.252 ± 0.088	-0.030 ± 0.158	b

a) Results from Ref. 12

b) Results from Ref. 11

c) Results from Ref. 10

TABLE II - Multipole Mixing Ratios of Gamma Transitions in ^{142}Ce

Level (keV)	Transition (keV)	$I_i^\pi - I_f^\pi$	Mixing Ratio δ this Work	Mixing Ratio δ Previous Work	
1219	578	4+ - 2+	E2		
1536	895	2+ - 2+	-0.63 ± 0.10	-0.11 + 0.02 - 0.03	b
				0.61 ± 0.18	c
1652	1011	3- - 2+	-0.01 ± 0.03	-0.14 ± 0.03	b
				0.06 ± 0.06	c
	433	3- - 4+	0.10 ± 0.06		
2004	1363	2+ - 2+	0.16 ± 0.04	0.41 ± 0.07	b
				-0.09 ± 0.06	c
2030	1389	0+ - 2+	E2		
2181	962	3+ - 4+	-0.56 ± 0.05	1.01 + 2.08 - 0.46	c
2187	1546	1(-) - 2+	-0.05 ± 0.05	0.04 ± 0.04	b
				-0.01 ± 0.04	c
2364	1723	1+ - 2+	-0.38 ± 0.04	-0.28 + 0.03 - 0.04	b
				0.35 ± 0.05	c
2398	1757	1+ - 2+	-1.57 ± 0.10	-0.93 + 0.28 - 0.22	b
				1.06 ± 0.13	c
	862	1+ - 2+	0.03 ± 0.05	ε (0.26,0.36)	b
				0.12 ± 0.12	c
2542	1901	2+ - 2+	0.65 ± 0.05	0.55 + 0.40 - 0.54	a
				0.02 ± 0.02	b
				-0.10 ± 0.30	c
	1323	2+ - 4+	E2		
2667	2026	2+ - 2+	1.33 ± 0.30	ε (2.54,1.02)	b
				0.60 ± 0.05	c

(cont.)

TABLE II - (continuation)

Level (keV)	Transition (keV)	$I^{\pi}_{i} - I^{\pi}_{f}$	Mixing Ratio δ this Work	Mixing Ratio δ Previous Work
	1131	2+ - 2+	$-5.56 \begin{smallmatrix} +1.99 \\ -6.97 \end{smallmatrix}$	ε(-2.5,2.95) c
2696	2055	2+ - 2+	-0.63 ± 0.10	-0.02 ± 0.06 b
				0.55 ± 0.27 c
	1160	2+ - 2+	0.20 ± 0.05	0.22 ± 0.13 b
				-0.49 ± 0.30 c
	1044	2+ - 3-	0.02 ± 0.03	0.18 ± 0.04 b
				0.03 ± 0.04 c
2727	2086	1+ - 2+	-0.60 ± 0.10	-0.23 ± 0.13 b
	1191	1+ - 2+	-0.43 ± 0.10	ε(-0.23,-0.6) b
2742	2100	1+ - 2+	-0.50 ± 0.05	0.04 ± 0.06 b
				0.40 ± 0.09 c
2767	2126	0+ - 2+	E2	
3420	1233	1- - 1-	0.45 ± 0.05	ε(0.48,2.12) b
			or 2.24 ± 0.25	
		2- - 1-	0.40 ± 0.78	ε(0.44,8.24) b
			or $11.0 \begin{smallmatrix} +27.0 \\ -5.0 \end{smallmatrix}$	
3612	2076	2+ - 2+	-0.68 ± 0.33	ε(0.30,1.31) b
3675	2139	1+ - 2+	-0.56 ± 0.10	ε(0.89,1.88) b
3717	2181	1+ - 2+	$-1.19 \begin{smallmatrix} +0.29 \\ -0.45 \end{smallmatrix}$	ε(0.65,2.71) b
4043	2039	2+ - 2+	-0.99 ± 0.20	ε(0.28,-6.9) b

a) Values from ref. 12

b) Values from ref. 11

c) Values from ref. 10 (the signs of mixing ratios have been changed to be consistent with the present sign convention).

ε ( ) indicates lower and upper limits.

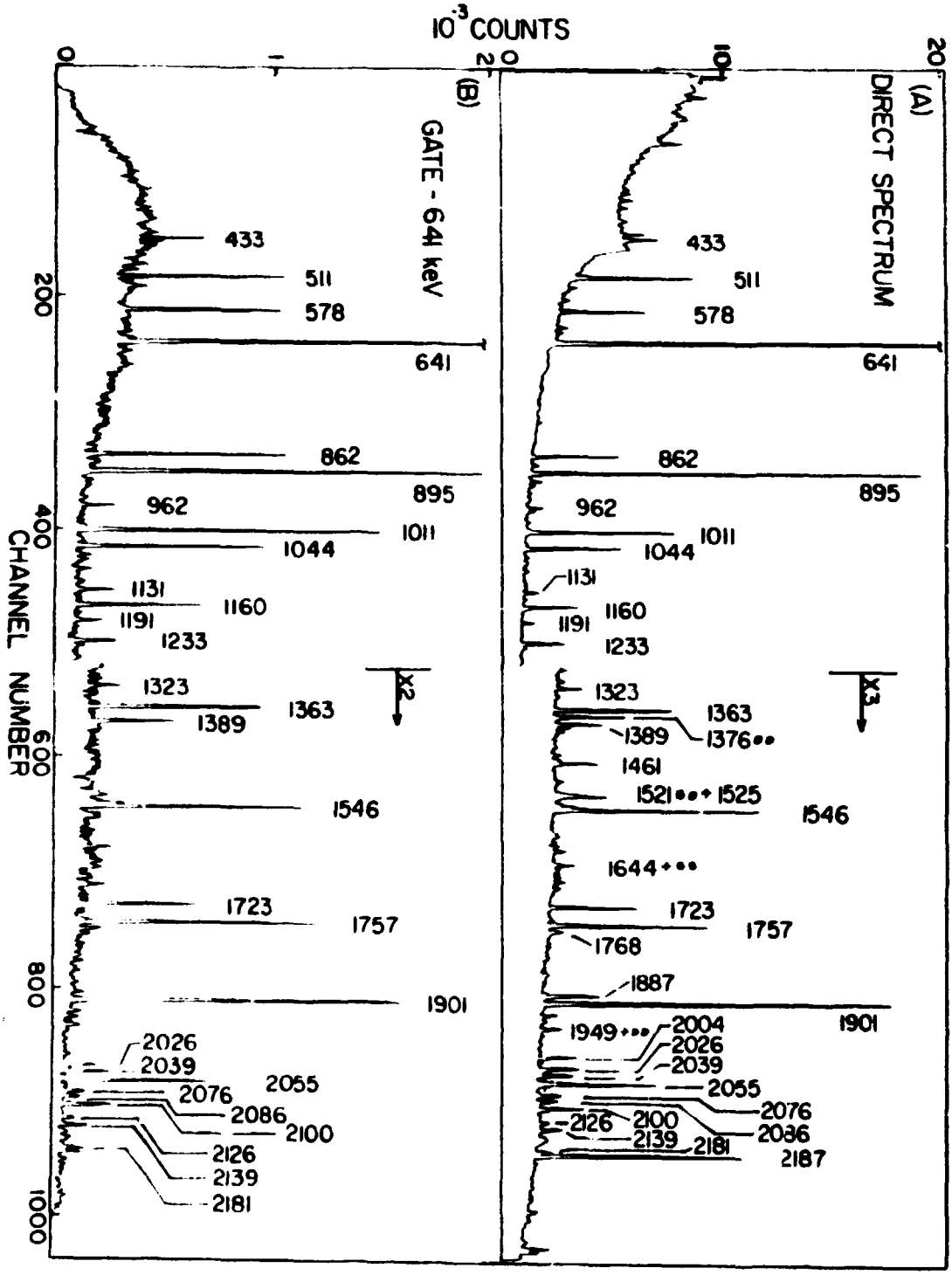

FIGURE 1 - Direct γ-ray spectrum up to 2.3 MeV in the decay of ^{142}La observed with HPGe detector (A) and γ-ray spectrum in coincidence with the photopeak 641 keV (B). Symbols * and SE represent the background peaks and single escape peaks.

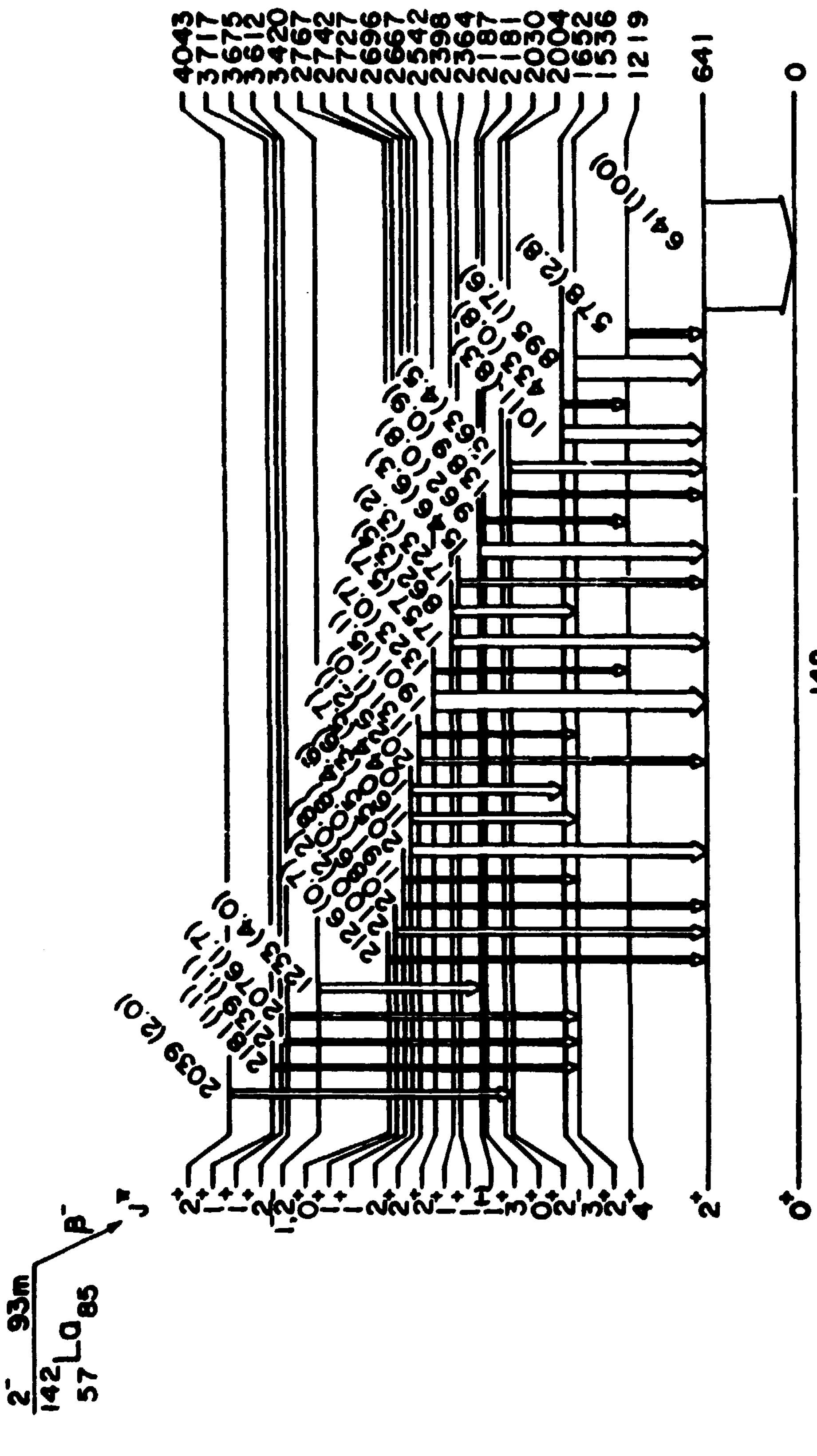

FIGURE 2 - A partial decay scheme of ^{142}La to the levels in ^{142}Ce.

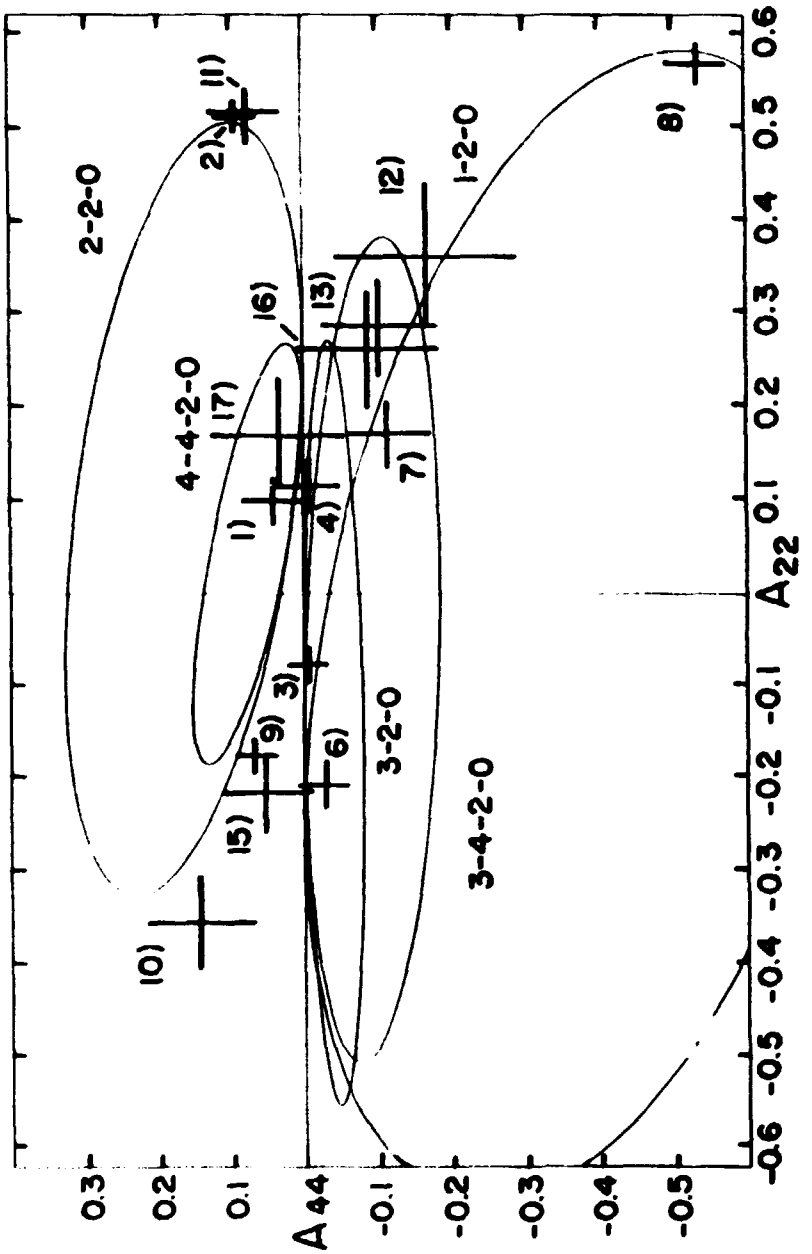

FIGURE 3 - Parametric plots for various spin sequences for direct cascades and skip cascades involving 578 keV intermediate transitions.

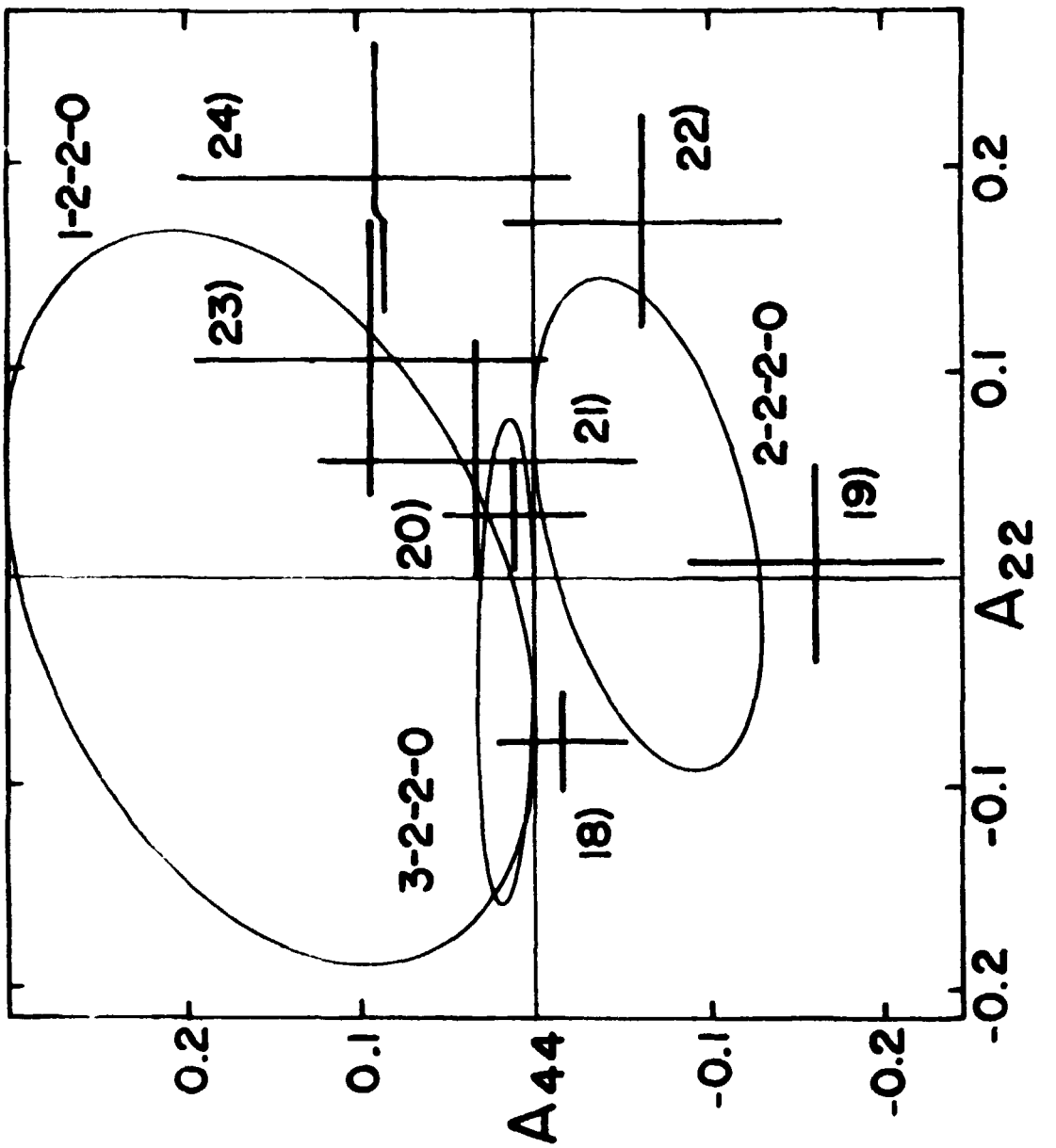

FIGURE 4 - Parametric plots for various spin sequences for skip cascade involving 895 keV intermediate transitions.