Lifetimes of Three Low-Lying Excited States in ^{117}In†

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(Received 28 August 1967)

The lifetimes of three low-lying excited states in ^{117}In have been measured by delayed-coincidence techniques using a time-to-amplitude converter. These states at 748, 659, and 587 keV are fed by β^- decay from the $s_{1/2}$ ground state of ^{117}Cd (2.4 h). The measured half-lives are 4.6±0.3, 59.7±2.0, and 0.17±0.03 nsec, respectively. All three levels de-excite directly to the 314-keV $p_{1/2}$ isomeric state but not to the $g_{9/2}$ ground state of ^{117}In. A comparison of the partial half-lives with the corresponding single-particle estimates has been performed assuming $E1$, $M1$, or $E2$ character for the transitions. Higher multipolarities are ruled out by the short half-lives of the levels. Logft values of transitions from ^{117}Cd indicate negative parities for the three levels, and systematics of known γ-ray transition probabilities suggest $M1$-$E2$ character for all the transitions involved in their de-excitation. However, when considered as pure $E2$, the transitions from the 748- and 659-keV levels are delayed by factors ranging from about 3 to 20 compared with the single-particle transition probabilities, whereas when they are considered as pure $M1$ transitions, delays of the order of 10^4 result. On the other hand, the 274-keV transition from the 587-keV level is enhanced by a factor of about 60 when assumed as pure $E2$. The possibility of considering this level as a member of the doublet obtained by coupling the 2^+ phonon excitation of the ^{116}Cd or ^{118}Sn even-even core to the $p_{1/2}$ single-particle state is discussed.

I. INTRODUCTION

THE $s_{1/2}$ ground state and the $h_{11/2}$ isomeric state of ^{117}Cd β decay with half-lives of 2.4 and 3.4 h, respectively, to excited levels in ^{117}In.[1] In the course of studying the complicated γ-γ coincidences following the decay of these isomers, a delayed coincidence between the 89- and 345-keV γ rays was discovered. A preliminary estimate of the half-life of the 345-keV γ-ray transition was approximately 60 nsec. Using a time-to-amplitude converter, refined measurements of this and two other short half-lives of excited levels in ^{117}In were obtained.[2] The information on these half-life measurements, supplemented with other data, is presented here to elucidate the low-lying energy levels of ^{117}In.

II. EXPERIMENTAL PROCEDURES

The ^{117m}Cd and ^{117g}Cd samples were produced by 2–3-min irradiation of 97.2% enriched ^{116}Cd in the Oak Ridge Research Reactor. No chemical separation was performed on the sample. The radiations were detected with either NaI(Tl), Pilot-B, or Naton-136 scintillators (all 2.5×2.5-cm cylinders) coupled to Amperex 56AVP photomultipliers. Time measurements were performed with an Ortec (Model 263) time-to-height converter. The converter output was amplified and then analyzed with a 512-channel pulse-height analyzer (PHA). Single-channel analyzers were used to select the particular energy regions for the start and stop pulses. The usual fast-slow coincidence circuitry provided the gate pulse to the multichannel PHA.[2] The half-lives were determined from the slopes of the time spectra. All the data were analyzed, using a general least-squares computer program allowing for statistical weights.[3] The time calibration of the multichannel PHA was obtained by a least-squares linear fit of the centroid position of the prompt peaks, using various lengths of delay lines.

III. RESULTS

A. 659-keV (59.7-nsec) Level

The half-life of this level was measured, using two NaI(Tl) detectors, one gating on 89±20 keV for the start pulse and the other on 345±30 keV for the stop pulse. A γ-ray spectrum of ^{117}Cd with a NaI(Tl) detector in the energy range of interest here is shown in Fig. 1. The time spectrum of the 345-keV γ transition shown in Fig. 2 gives a slope corresponding to a half-life of 59.7±2.0 nsec. To obtain the shape of the prompt curve, the coincidence between the 511-keV annihilation radiation from ^{22}Na was observed with the same gate setting as used for the lifetime measurement.

† Research sponsored by the U. S. Atomic Energy Commission under contract with the Union Carbide Corporation.
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[1] C. W. Tang, G. Chilosi, C. D. Coryell, and A. H. Wapstra, Massachusetts Institute of Technology, Laboratory for Nuclear Structure Chemical Progress Report, 1965 (unpublished); C. W. Tang, Ph.D. thesis, Massachusetts Institute of Technology, 1965 (unpublished).
[2] G. Chilosi, C. W. Tang, and J. R. Van Hise, Oak Ridge National Laboratory Report No. ORNL-3832, 1965 (unpublished); Bull. Am. Phys. Soc. 11, 67 (1966).
[3] W. R. Busing and H. A. Levy, Oak Ridge National Laboratory Report No. TM-271, 1962 (unpublished).

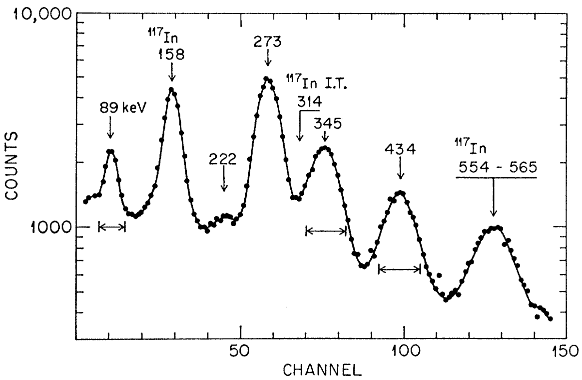

FIG. 1. γ-ray spectrum from the decay of ^{117}Cd isomers taken with a NaI(Tl) detector. Low-energy portion of interest for this work. The arrows indicate the γ-ray gating regions.

A search was made for a possible low-energy transition between the 89- and 345-keV cascade which might be responsible for the observed half-life. Using a krypton-filled proportional counter and a NaI(Tl) detector, we looked for prompt coincidences between γ rays in the 3- to 25-keV region and the 345-keV transition (resolving time $\sim$1 μsec). For γ rays above 25 keV, the proportional counter was replaced by a NaI(Tl) detector, and a standard "fast-slow" coincidence circuit ($\sim$80-nsec resolving time) was used. The results show only the expected 345-keV γ-ray coincidence with indium x rays arising from the internally converted 89-keV transition. Since a transition with energy smaller than 3 keV would very likely exhibit a longer half-life than the one observed, we conclude that the 345-keV transition originates from the level directly populated by the 89-keV γ ray. Experiments in which the gates on the single-channel PHA were moved off the 89- and 345-keV peaks showed that the lifetime measured was not due to a higher-energy γ ray whose Compton distribution fell within the single-channel gates.

B. 748-keV (4.55-nsec) Level

A γ ray of 434 keV has been identified in the γ-ray spectrum of ^{117}Cd obtained with a Ge(Li) detector.[1] Since the sum of the 89- and 345-keV γ rays equals 434 keV, the question arises whether the latter γ ray is a crossover transition of the former two.

A β group with end-point energy of 1.79 MeV has been observed to be in coincidence with the 434-keV transition.[1] Using a Pilot-B scintillator to detect β radiations and a NaI(Tl) crystal for the γ rays, the time spectrum obtained showed the 434-keV transition to have a half-life of 4.55±0.32 nsec (Fig. 3). The gates on the single-channel PHA's were set to accept only β rays of energy >900 keV and γ rays of energy 434±30 keV. The prompt curve was obtained with a ^{60}Co source, using the 1.17–1.33-MeV γ-γ coincidence.

Changing the γ-ray gate setting to 89±20 keV resulted in a time spectrum giving a half-life in agreement with the one measured for the 434-keV transition to within experimental errors. These results indicate that the 434- and 89-keV γ rays both originate from the same level and that the former is the crossover transition. In a recent work by Pandharipande *et al.*,[4] a value of 4.9±0.2 nsec is reported for the half-life of this level.

C. 587-keV (0.17-nsec) Level

The 273-keV γ ray has been observed to follow the 1303-keV γ ray in a strong-coincidence cascade.[1] This led to the attempt to measure the half-life of the 587-keV level which decays by the 273-keV γ ray. Because the expected half-life would be too short to use NaI(Tl) detectors, either Pilot-B or Naton-136 scintillators were used to detect the Compton electrons of the two γ rays. The time spectra obtained appear like prompt curves, except that they are consistently asymmetrical. A typical time spectrum is shown in Fig. 4. The slope of the delayed side of the curve gives an apparent but very short half-life for the 273-keV transition. Contributions from Compton electrons of other γ rays in the single-channel gates are negligible because of the strong intensities of the 273- and 1303-keV γ rays. Hence the time spectra obtained may essentially be attributed to the 1303–273-keV cascade.

A total of five independent runs was made in the measurement of this half-life. For reference, prompt curves of ^{60}Co using the Compton distributions of the 1.17- and 1.33-MeV γ rays were obtained for each run, both before and after the run, to check the stability of the equipment. Care was taken to ensure that the

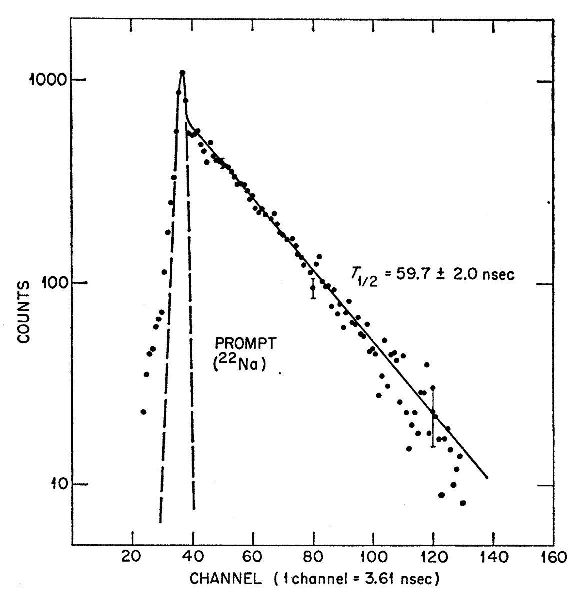

FIG. 2. Time spectrum from coincidences between the 89±20- (start) and the 345±30-keV (stop) γ rays. The detectors used were two 2.5×2.5-cm NaI(Tl) crystals.

[4] W. R. Pandharipande, K. G. Prasad, R. M. Singru, and R. P. Sharma, Phys. Rev. 142, 740 (1966).

counting rates of the ^{117}Cd sources did not exceed that of the ^{60}Co standard.

The slopes of both the delayed and prompt curves were analyzed by the computer. In every case, the half-life obtained from the slope of the delay curve is 15–20% higher than that obtained from the corresponding prompt curve. The average of the five experiments gives a half-life of 0.17 ± 0.03 nsec.

IV. DISCUSSION

Figure 5 shows that portion of the decay scheme relevant to this discussion.[1]

All three levels measured in this work are populated by the decay of the 2.5-h $s_{1/2}$ ^{117}Cd ground state. Moreover, all three de-excite to the 314-keV $p_{1/2}$ isomeric state of ^{117}In; hence they correspond to excited states at 589 keV (0.17 nsec), 659 keV (59.7 nsec), and 748 keV (4.55 nsec).

The logft values (7.5) of the β transitions to the three levels are consistent with first-forbidden or "unique" first-forbidden types. Therefore negative parities and possible spins $\frac{1}{2}$, $\frac{3}{2}$, and $\frac{5}{2}$ are assigned to these levels. The γ transitions to the $p_{1/2}$ isomeric state should then have $M1+E2$ character; however, the experimental transition probabilities are considerably lower than the single-particle estimates for $M1+E2$ mixtures, except for the 273-keV transition originating from the 589-keV level.

A more detailed discussion of the three states is presented below.

A. 587-keV State (0.17 nsec)

The 587-keV level decays to the 314-keV $p_{1/2}$ isomeric state by emitting a 273-keV γ ray. No 589-keV γ transition to the $g_{9/2}$ ground state was observed. The 589-keV level is strongly fed by a 1303-keV γ transition.

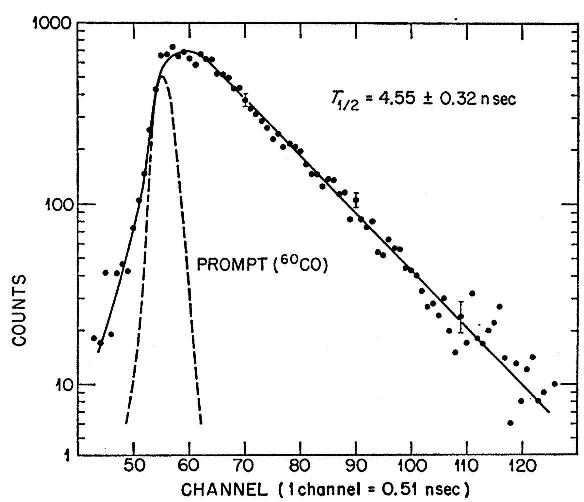

FIG. 3. Time spectrum from coincidences between β rays with energy $\geq$900- (start) and 434 ± 30-keV (stop) γ rays. A 2.5×2.5-cm pilot-B crystal was used as the β-ray detector and a NaI(Tl) crystal for the γ rays.

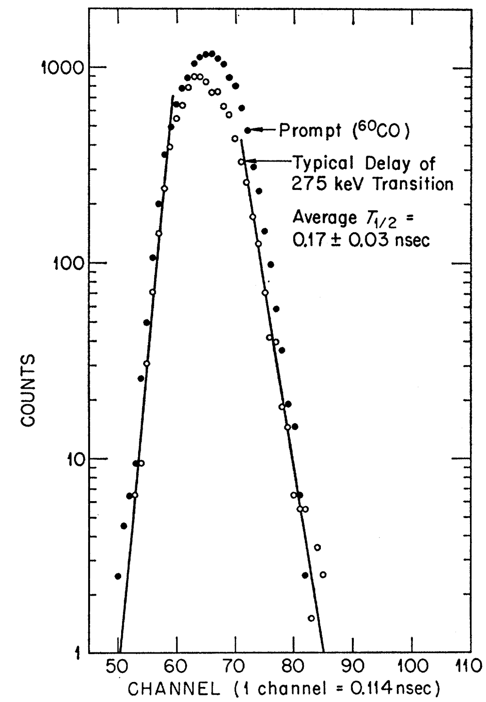

FIG. 4. Time spectrum from coincidences between the 1303- (start) and the 275-keV (stop) γ rays. Two 2.5×2.5-cm Naton-136 crystals were used as γ-ray detectors.

Angular correlations for the 1303–273-keV cascade have recently been measured by Mancuso and Arns,[5] who obtained $A_2=0.20\pm0.01$ and $A_4=0$ within experimental error. Their results suggest spin sequences of $\frac{1}{2}\rightarrow\frac{3}{2}\rightarrow\frac{1}{2}$ and $\frac{3}{2}\rightarrow\frac{3}{2}\rightarrow\frac{1}{2}$. Although their decay scheme is oversimplified,[6] the corrections to be made on the angular correlations of the very strong 1303–273-keV coincidence are believed to be small, and hence leave their A_2 and A_4 values essentially unchanged.

The logft values from the new decay scheme of Tang *et al.*[1] are compatible with the sequence $\frac{3}{2}^+$ or $\frac{1}{2}^+(E1,M2)\frac{3}{2}^-(M1,E2)\frac{1}{2}^-$. However, the new decay scheme favors the assignment of $\frac{5}{2}^-$ to the intermediate state at 589 keV. Therefore, we shall consider the angular correlations of the sequence $\frac{3}{2}^+(E1,M2)\frac{5}{2}^-(E2)\frac{1}{2}^-$, and compare the results with the data of Mancuso and Arns. For this sequence, we obtain a mixing ratio $\delta\approx0.17$ for the $\frac{3}{2}^+\rightarrow\frac{5}{2}^-$ transition, corresponding to $A_4\approx-0.06$. The present case where the A_4 coefficient is very small but not exactly zero is therefore not inconsistent with the data of Mancuso and Arns. We have to point out, however, the rather high $M2$ mixture ($\delta\approx0.17$) in the $E1$ transition required for consistency with the angular-correlation data.

[5] R. V. Mancuso and R. G. Arns, Nucl. Phys. **68**, 504 (1965).
[6] In a more complete study of the ^{117}Cd decay schemes, Tang *et al.* (Ref. 1) found five γ rays instead of just one in the 1260–1340-keV region, using Ge(Li) detectors.

TABLE I. Results for the three spin sequences of the 1303–273-keV cascade (for details, see text). The $B(E2, J \rightarrow j_f)$ values are compared with those corresponding to the de-excitation of the first 2^+ states in the neighboring even-even ^{116}Cd and ^{118}Sn, as inferred by Coulomb excitation.[a]

Sequence considered	^{117}In %$E2$; 273 keV	$B(E2; j \rightarrow j_f)$	$B(E2)_{sp}$	^{118}Sn $B(E2; 2^+ \rightarrow 0^+)$	^{116}Cd $B(E2; 2^+ \rightarrow 0^+)$
$\frac{3}{2}^+(E1)\frac{3}{2}^-(M1+E2)\frac{1}{2}^-$	0.25±0.25 80 ±1	0 0.116			
$\frac{1}{2}^+(E1)\frac{3}{2}^-(M1+E2)\frac{1}{2}^-$	24.5 ±1.5 99.5 ±0.5	0.036 0.15	0.0034	0.046	0.120
$\frac{3}{2}^+(E1+M2)\frac{5}{2}^-(E2)\frac{1}{2}^-$	100	0.15			

[a] Reference 7.

For the $\frac{3}{2}^+ \rightarrow \frac{3}{2}^- \rightarrow \frac{1}{2}^-$ and $\frac{1}{2}^+ \rightarrow \frac{3}{2}^- \rightarrow \frac{1}{2}^-$ possible sequences, the 589-keV level has spin $\frac{3}{2}$, and the 273-keV transition is of $M1+E2$ character. Assuming the 1303-keV transition from the 1890-keV level to be purely $E1$, and using the angular-correlation result to obtain the $E2$ contribution to the 273-keV transition, we calculated the corresponding reduced transition probabilities $B(E2)$ for the 273-keV transition, using the measured half-life of 0.17 nsec. Table I summarizes the results for the three spin sequences considered above. The $B(E2, J \rightarrow j_f)$ values are compared with those corresponding to the de-excitation of the first 2^+ states in the neighboring even-even ^{116}Cd and ^{118}Sn nuclei, as measured by Coulomb excitation.[7]

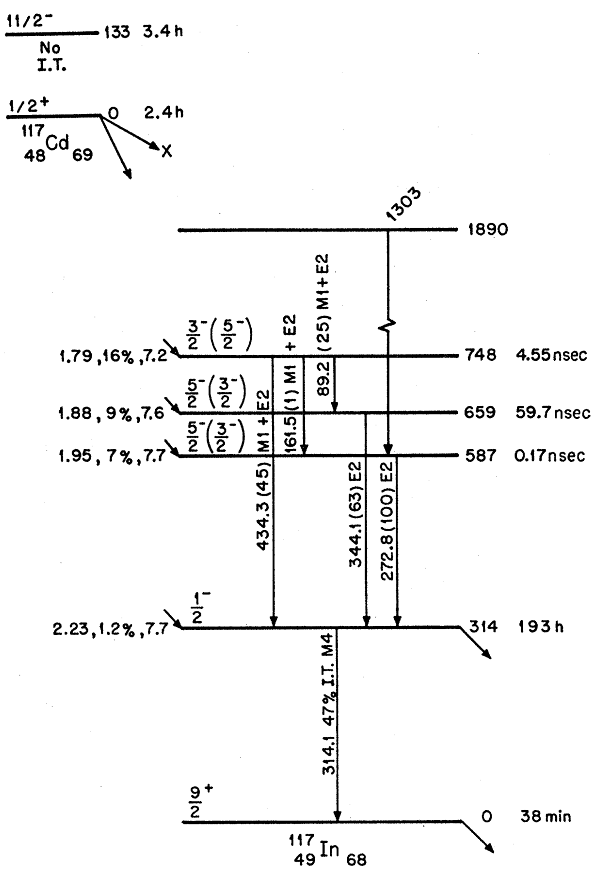

FIG. 5. Partial decay scheme of ^{117}Cd. All energies are in keV. The numbers in parentheses refer to γ-ray intensities. The three numbers on the β-ray branchings are end-point energies in MeV, percentage β branching, and logft values, respectively.

This comparison is made in attempting to interpret the 589-keV level in ^{117}In as arising from a "core excitation," i.e., coupling of the $p_{1/2}$ single-particle or hole state to the 2^+ phonon excitation of the even-even core.[8] If the level concerned is a purely core-excited state, then its de-excitation corresponds to the phonon transition ($2^+ \rightarrow 0^+$) of the core, and the measured $B(E2)$ value should agree with the $B(E2)$ value of the first $2^+ \rightarrow 0^+$ transition of the neighboring even-even nucleus.

From Table I it can be seen that if the 589-keV level has spin $\frac{3}{2}$, then either ^{118}Sn or ^{116}Cd may be considered as the "core" of the ^{117}In nucleus, depending on which of the two possible $B(E2)$ values is correct. If the spin of the 589-keV level is $\frac{5}{2}^-$, the $B(E2)$ value is consistent only with a ^{116}Cd core.

A conclusive choice cannot be made from our measurements. In his theoretical treatment of levels in odd-A single-closed-shell-minus-one nuclei (e.g., ^{115}In), Silverberg[9] considered the core-excited states as single-hole states coupled to the 2^+ phonon excitation of the neighboring even-even closed-shell nuclei. However, de-Shalit,[8] in dealing with odd-A thallium isotopes, found better agreement with experiments in interpreting the cores as even-even mercury nuclei rather than as the magic lead nuclei. A similar situation in ^{117}In would correspond to core properties given by ^{116}Cd rather than by ^{118}Sn.

B. 659-keV State (59.7 nsec)

The 659-keV level is populated by an intense 89-keV γ ray, by β rays, and by other weak γ transitions. This level de-excites via a 345-keV γ ray to the $p_{1/2}$ isomeric state. No transition from this level to the ground state has been observed.

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[7] P. H. Stelson and F. K. McGowan, Phys. Rev. **110**, 489 (1958); F. K. McGowan, R. L. Robinson, P. H. Stelson, and J. L. C. Ford, Nucl. Phys. **66**, 97 (1965).
[8] R. D. Lawson and J. L. Uretsky, Phys. Rev. **108**, 1300 (1957); A. de-Shalit, *ibid.* **122**, 1530 (1961).
[9] L. Silverberg, Arkiv Fysik **20**, 341 (1961).

Angular correlations for the 89–345-keV cascade have been measured by Mancuso and Arns.[5] In their decay scheme, however, they have erroneously inverted the positions of the two γ rays in the cascade, and they were unaware of the rather long lifetime of the 345-keV transition.

The sample which Mancuso and Arns used was a liquid source (CdO dissolved in very dilute nitric acid); hence we could assume the attenuation of the correlation coefficients to be negligible. In the following analysis, their measured values of $A_2=0.36\pm0.01$ and $A_4=0$ to within experimental errors will be used without correction for attenuation.

A spin of $\frac{5}{2}$ for the 659-keV level, which implies $E2$ character for the 345-keV transition, is suggested by the decay-scheme work of Tang *et al.*[1] If we assume that the A_4 coefficient is small but not zero, and that the spin of the intermediate state is indeed $\frac{5}{2}$, then the only spin sequence consistent with log*ft* values is $\frac{3}{2}^-(M1,E2)$-$\frac{5}{2}^-(E2)\frac{1}{2}^-$. Taking into account only the solution with small A_4 ($A_4\approx0.01$), we obtain a mixing ratio $\delta\approx0.4$ for the 89-keV transition.

The angular-correlation data, however, are also compatible with the sequences $(\frac{1}{2},\frac{3}{2},\frac{1}{2})$, $(\frac{3}{2},\frac{3}{2},\frac{1}{2})$, and $(\frac{5}{2},\frac{3}{2},\frac{1}{2})$. Furthermore, log*ft* values suggest an $M1+E2$ character for both transitions in the three sequences considered. Hence none of these three sequences could be definitely ruled out. In Table II, single-particle estimates of half-lives, assuming various multipolarities, have been given for the 345-keV transition and compared with the experimental value. Corrections for internal conversion have been neglected.

The spin of the 659-keV state is limited to a value $\leq\frac{5}{2}$ by its short half-life and the absence of the crossover transition to the $\frac{9}{2}^+$ ground state of ^{117}In. The multipolarity of the 345-keV transition cannot be higher than 2. Moreover, $M2$ character is ruled out for it; otherwise one would expect substantial 659-keV $E2$ transition to the ground state. Of the remaining possibilities, the $E1$ choice is not consistent with the log*ft* value of ~7.6, which suggests a negative parity for the 659-keV state.

No definite spin assignment can be made with the present information, although a spin and parity of $\frac{5}{2}^-$ (implying $E2$ character for the 345-keV transition) is more consistent with all the available data. This slow $E2$ transition, retarded by a factor of 18, may be compared with similar delayed $E2$ transitions in the Sn and Sb region.[10]

C. 748-keV State (4.55 nsec)

An intense β-ray group of 1790 keV populates the 748-keV level. This level de-excites via transitions of 434 (63.2%), 161 (1.5%), and 89 (35.3%) keV, respectively, to the $p_{1/2}$ isomeric, 587- and 659-keV states. The absence of a direct transition to the $g_{9/2}$ ground state sets an upper limit of $\frac{5}{2}$ to its spin value.

TABLE II. Single-particle estimates for different multipolarities for the 345-keV transition compared with the experimental value, neglecting the small correction for conversion.

345-keV transition $-T_{1/2}(\mathrm{exp})=59.7$ nsec				
Multipolarity	$E1$	$M1$	$E2$	$M2$
$T_{1/2}(\mathrm{sp})$ (nsec)	6.84×10^{-6}	4.59×10^{-3}	3.32	278
$T_{\mathrm{exp}}/T_{\mathrm{sp}}$	8.7×10^{6}	1.3×10^{4}	18	2.1×10^{-1}

The 89–345-keV angular correlations, previously discussed with reference to the 659-keV level, are consistent with any of the following spin assignments: $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, for the 748-keV level, if the intermediate level has a $\frac{3}{2}$ spin. On the other hand, for a $\frac{5}{2}$ spin assignment to the 659-keV level, the spin of the 748-keV level would be $\frac{3}{2}$, and the corresponding 89-keV transition would have a mixing ratio $\delta=0.17$.

The experimental and single-particle half-lives for the transitions depopulating the 748-keV level are given in Table III. In the following discussion we will assume a spin $\frac{5}{2}$ for the 659-keV level and consequently a spin $\frac{3}{2}$ for the 748-keV level.

As mentioned before, in order to be consistent with log*ft* values, the 587-, 659-, and 748-keV levels must all have negative parity. Furthermore, in the case of the $\frac{3}{2}$ spin assignment to the 748-keV level, a positive parity would be difficult to explain in this energy region in terms of pure coupled intrinsic and collective excitation. We are therefore, led to consider all the γ transitions originating from the three levels under discussion as $M1$ or $E2$.

With the exception of the 89-keV transition, Tables II and III show the other transitions to be retarded in comparison with the single-particle estimates for $M1$ or

TABLE III. Data concerning the experimental and single-particle transition probabilities for the transitions depopulating the 748-keV level.

Energy (keV)	Multi-polarity	$T_{1/2}$(sec) (exp)[a]	$T_{1/2}$(sec) (sp)	$T_{\mathrm{exp}}/T_{\mathrm{sp}}$
	$E1$	1.40×10^{-8}	3.87×10^{-13}	3.6×10^{4}
	$M1$	1.61×10^{-8}	3.09×10^{-11}	5.2×10^{2}
89	$E2$	2.39×10^{-8}	1.6×10^{-6}	1.5×10^{-2}
	$M1$ 97.1%	1.65×10^{-8}		5.3×10^{2}
	$E2$[b] 2.9%	0.56×10^{-6}		0.35
	$E1$		6.68×10^{-14}	2.59×10^{6}
161	$M1$	3.98×10^{-7} [c]	5.32×10^{-12}	3.2×10^{4}
	$E2$		1.53×10^{-7}	8.0
	$E1$		3.46×10^{-15}	5.96×10^{6}
435	$M1$	8.96×10^{-9} [c]	2.80×10^{-13}	7.48×10^{4}
	$E2$		1.12×10^{-9}	2.6

[a] $T_{1/2}$ (exp) is calculated neglecting the corrections for conversion relative to the 161- and 435-keV transitions.
[b] Adopting a mixing ratio $\delta\approx0.17$ from angular-correlation data (see text) when we consider the succession $3/2\rightarrow5/2\rightarrow1/2$.
[c] The experimental half-life is calculated assuming $M1$ character for the 89-keV transition.

[10] H. Ikegami and T. Udagawa, Phys. Rev. **124**, 1518 (1961); H. H. Bolotin, A. Li, and A. Schwarschild, *ibid.* **124**, 213 (1961); E. der Mateosian and M. L. Sehgal, *ibid.* **129**, 2195 (1963); H. Ikegami and T. Udagawa, *ibid.* **133**, B1388 (1964).

$E2$ transitions. Moreover, the amounts of retardation of each of these transitions are similar. This suggests a possible interpretation of the 748- and 659-keV levels as the single-particle states $p_{3/2}$ and $f_{5/2}$, respectively. The 589-keV level could be the $\frac{5}{2}$ member of the doublet derived from coupling the $p_{1/2}$ intrinsic state to the 2^+ core excitation. However, it is difficult to explain the large retardation factor (7.5×10^4) for the 434-keV shell-model-allowed $M1$ transition ($p_{3/2}\rightarrow p_{1/2}$), compared with a factor of 5.2×10^2 for the 89-keV shell-model-forbidden $M1$ transition ($p_{3/2}\rightarrow f_{5/2}$). Configuration mixing could be invoked to allow the forbidden transition to proceed, but the present information precludes us from making a conclusive interpretation.

A similar situation exists in ^{115}In, where a half-life of 5.9 nsec for the 829-keV state has been reported by Tandon and Devare.[11] In the ^{115}In level scheme given by Graeffe *et al.*,[12] it appears that the 864- and 829-keV levels in ^{115}In correspond to the 748- and 659-keV levels in ^{117}In.

[11] P. N. Tandon and H. G. Devare, Phys. Letters **10**, 113 (1964).
[12] G. Graeffe, C. W. Tang, C. D. Coryell, and G. E. Gordon, Phys. Rev. **149**, 884 (1966).

The occurrence of retarded $E2$ transitions in nuclei is predicted by the pairing-plus-quadrupole-force model.

No detailed theoretical calculations are available in the literature for the levels of ^{117}In. Calculations by Silverberg[9] for ^{115}In gave the $p_{1/2}$, $f_{5/2}$, and $p_{3/2}$ proton-hole levels as the low-lying excited states above the $g_{9/2}$ ground state. If these were accurate descriptions, then the possibility of a similar situation extending to ^{117}In, giving support to the interpretation that the 659- and 748-keV states are, respectively, the $f_{5/2}$ and the $p_{3/2}$ proton-hole states, is certainly attractive.

ACKNOWLEDGMENTS

The authors wish to express their gratitude to Professor C. D. Coryell for many fruitful discussions and encouragement, to the nuclear-chemistry group of ORNL for their kind help and hospitality during our stay there, to Dr. A. R. Brosi, in whose laboratory a good portion of this work was carried out, to J. R. Tarrant for help in the electronics, and to Dr. E. Eichler for editorial help.

Errata

Elastic Electron Scattering from Li^6 and Li^7, L. R. Suelzle, M. R. Yearian, and Hall Crannell [Phys. Rev. **162**, 992 (1967)]. Equations (18) and (19) should both be divided on the right side by a factor of 4 and should then read

$$\left(\frac{d\sigma}{d\Omega}\right)_{C2'}=\left(\frac{d\sigma}{d\Omega}\right)_{\rm Mott}[\langle j_2\rangle D(1+Gq^2)]^2\frac{F_N{}^2(q^2)}{4}, \quad (18)$$

and

$$S_{C2'}{}^2(q^2)\equiv\left(\frac{d\sigma}{d\Omega}\right)_{C2'}\bigg/Z^2\left(\frac{d\sigma}{d\Omega}\right)_{\rm Mott}=\frac{1}{4Z^2}\times[\langle j_2\rangle D(1+Gq^2)]^2F_N{}^2(q^2). \quad (19)$$

The values given in Table II remain unchanged. In Eq. (41), a minus sign was omitted in the exponential. Equation (41) should read

$$F_{C0}=\left(1-\frac{Z-2}{6Z}q^2a_0{}^2\right)\exp\left[-\frac{q^2a_0{}^2}{4}\left(1-\frac{1}{A}\right)\right]F_N(q). \quad (41)$$

The authors express their appreciation to Professor F. Bumiller for pointing out these corrections.

Threshold Photoneutron Cross Section for Be^9, B. L. Berman, R. L. Van Hemert, and C. D. Bowman [Phys. Rev. **163**, 958 (1967)]. In Table II under column E_R-Q, cases b and c values are interchanged. These should be

b -0.115,
c -0.078.