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Table of Total Beta-Disintegration Energies*†

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INTRODUCTION

IN order to make the information on β decay readily available for the study of mass differences, the total disintegration energies of all reasonably well-established decays have been compiled and tabulated.

The primary purpose of this table is to offer "best" values of mass differences as determined from β-decay data. It is envisaged that the values in this compilation will be used in conjunction with reaction data, as these become available, for a better evaluation of mass differences.

An effort has been made to exhibit the reasons for the present choices of the disintegration energies (or Q values). Thus all observations of the existence of $\beta\gamma$ or $\gamma\gamma$ coincidences or the absence of any γ's are listed explicitly. In cases where complex decays are involved, the branch whose energy is most accurately known is used to compute the Q value. This is most often the highest energy β branch. There are, however, several cases where the lower energy branches are quite intense and hence better determined. When no data are available to determine the transition energy in electron capture, the highest energy γ associated with the decay is listed to provide a lower limit for the Q value. The various branches which are not used in the computation of the Q value, but which offer support to the value adopted because of the energy match, are mentioned in the comment column. The percent branching is also indicated.

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The experimental evidence available is often not sufficient to determine a unique decay scheme. It is natural in such cases to turn to comparative half-lives, the shell model, and general structure considerations for guidance in making the most plausible interpretation of the data. Such guidance is frequently quite strong. For example (i) a transition to an excited state is indicated if the shell model is explicit in predicting a parity change between the ground states of the parent and daughter, and the ft value for the transition is allowed; (ii) help in establishing certain decay schemes comes from the consideration that transitions connecting the ground states of two even-even nuclei through a common state of an odd-odd nucleus should be of the same character and have similar ft values. In particular, if an odd-odd nucleus undergoes both β^- and β^+ decay with similar ft values for the two transitions and it is known that one of the transitions is to the ground state of its even-even daughter, then a decay between ground states for the other transition is implied.

Arguments of this kind are most clear when all the decay data for a given A are studied as a whole together with the log ft values and spin assignments. For this reason the table is arranged by A rather than Z and log ft values and spin and parity assignments are listed. With the inclusion of these quantities it is believed that arguments of the kind just given as examples are obvious at a glance. When more complicated arguments are thought to support the adopted Q value, they are noted in the comment column.

The data used[1] are those on file with the Nuclear Data Group of the National Research Council as of May 1, 1954.

[1] National Bureau of Standards Circular 499 and its supplements. Nuclear Science Abstracts, Vol. 6, 24B (1952 cumulation), Vol. 7, 24B (1953 cumulation), and Vol. 8, 12B (1954 semi-annual cumulation). Hollander, Perlman, and Seaborg, Revs. Modern Phys. **25**, 469 (1953).

Disintegration	Adopted Q		Half-life	Decay Data						Comments
	Mev	Error		Type	Mev	Error	%	Method	Ref.	
$_{21}Sc_{25} \xrightarrow{46} {}_{22}Ti_{24}$	2.362	4	84^{d}	β^-	0.357	4*		s	53Y3	Energy match provided by 1.25 β^-(0.1 %$^-$) + 1.12γ (54K4, 53W6).
4^+ 6.2 4^+					0.360	5	> 99 %$^-$	s	48P2	
11.3 2^+					0.358	4*		s	47F2	
0^+					0.36	1		s	47M9	
				γ_1	0.885	2		s	53L12	
					0.89	1*		s	50P71	
					0.88	1*		s	50M62	
					0.883	9*		s	47F2	
				γ_2	1.119	2		s	53L12	
					1.12	1*		s	50P71	
					1.12	1*		s	50M62	
					1.116	11*		s	47F2	
				(0.36 β^-)γ					48M9, 48J7	
				$\gamma\gamma$					48M9, 48J7	
				$\gamma_1\gamma_2(\theta)$					48B18, 50N5, 50M18	

FIG. 1. Illustrative example of item in table.

EXPLANATION OF TABLE

Column 1 lists the nucleus undergoing β decay and its daughter. The left subscript of the chemical symbol gives the number of protons and the right subscript the number of neutrons. The mass number is placed directly above the arrow showing the direction of the transition.

Beneath the decaying nucleus are its probable spin and parity, under the arrow the log *ft* values of the significant transitions, and beneath the daughter the probable spins and parities of the final states for the transitions and the main additional states involved in the daughter's subsequent decay to ground.

Measured spins are underlined. The other spin assignments are based on spectral shapes, angular correlations, shell model predictions, or regularities that have been observed in the region in question.

As shown in the illustrative example, Fig. 1, the daughter Ti^{46} has spin states 0^+, 2^+, and 4^+ (determined by angular correlation experiments). Spin 4 and even parity have been assigned to the ground state of Sc^{46} on the basis of the log *ft* values of 6.2 and 11.3 for the transitions to the 4^+ and 2^+ excited states of Ti^{46}, respectively.

If a metastable state of the parent enters into the determination of the Q value, its probable spin and parity are also shown. The half-lives of the metastable and ground states are placed to the left of the spin assignments. If one of the excited states of the daughter is known to be metastable, its half-life is also given.

The log *ft* values[2] are included in order to make clearer the character of the decay. In cases where the Fermi-Kurie plot exhibits a shape characteristic of a unique first forbidden transition ($\Delta I=2$, yes; spin change of two units and a parity change) or such a transition is strongly expected, log f_1t is given[3] and indicated by a superscript 1. If the unique shape has been observed, this is stated in the comment column.

Column 2 contains the adopted Q value in Mev and its assigned error. The last figure of the quoted error is to be associated with the last figure of the Q value. (For example: "2.362 *4*" means 2.362 ± 0.004.)

Method for obtaining adopted Q value and error. The absence of uniformity in the literature of nuclear spectroscopy in dealing with errors considerably complicates the choice of a "best" Q value and makes the assignment of a meaningful error an almost impossible task. The difficulties involved in arriving at "best" Q values and errors do not, however, remove the necessity for such figures. In order that all may be aware of the rather arbitrary methods used, the following procedure is recorded.

The adopted Q value is obtained by weighting the various measurements inversely as the squares of their errors. In order to include experiments that are indeed worthwhile but fail to give quantitative error information, estimates of the error involved were made. These estimates are given in the decay data column and are distinguished from the errors quoted by experimenters by means of an asterisk (*). The estimates employed in general for energy measurements are:

Method	Error (percent)
Magnetic spectrometer	~1
Scintillation spectrometer	~3
Proportional counter	~3
Absorption	~5
Cloud chamber	~5

These estimates are considered to be rough rules of thumb and are not inflexibly applied when there is ample evidence that the experiment in question is considerably more or less accurate.

In general, γ-ray energy measurements are more accurate than β measurements and thus usually contribute less to the total error (γ-absorption measure-

[2] King, Dismuke, and Way, "Table of Log *ft* Values: October 1952," ORNL 1450. In cases where new and apparently more reliable data have appeared, log ft has been recalculated.

[3] J. P. Davidson, Phys. Rev. **82**, 48 (1951).

ments are an exception to this). The estimates used for γ-ray energy measurements are:

Method	Error (percent)
Magnetic spectrometer	$\lesssim 1$
Scintillation spectrometer	~ 2
Absorption	~ 10

As in the case of β-energy measurements these rough estimates are not applied to experiments where it is obvious that the error deviates greatly from the recipe value. Measurements by methods not in the above classes have had their errors estimated individually.

To compute the error of the adopted Q value, both the external and internal error are calculated and the larger of the two quoted.

$$e^{-2}_{\text{int}}=\Sigma_i e_i^{-2}$$
$$e_{\text{ext}}=[\Sigma_i e_i^{-2}(E_i-\bar{E})^2/(n-1)\Sigma_i e_i^{-2}]^{\frac{1}{2}},$$

where e_i is the error of the i^{th} measurement, $E_i-\bar{E}$ is the difference between the i^{th} measurement and the weighted average, and n is the number of measurements.

Column 3 lists the observed half-life as selected by the author. These values are for identification purposes. While reasonable care was exercised in their selection, they are not to be considered as "best."

Column 4 gives the decay data in the following order: type of decay—energy of the transition in Mev—error in the energy measurement (as mentioned above, all estimated errors are indicated by an asterisk) —branching percentage of the indicated mode of decay—method of measuring the energy—reference. The abbreviations used are

$\%^-$, $\%^+$, $\%^T$	percent of total disintegration for a particular β^-, β^+, and $\beta^++\epsilon$ transition, respectively
†	percent of particular β^+ transition relative to all β^+
a	absorption
$a\beta\gamma$	absorption of β's in coincidence with γ's
aCpt	absorption of Compton electrons
aee	absorption of photoelectrons between counters in coincidence
$Be\gamma n$	detection of photoneutrons from Be
cc	cloud chamber
ce^- or e^-	conversion electrons
Cpt	Compton electrons
crit	critical absorption
d	deuteron
$D\gamma n$,$D\gamma p$	detection of photoneutrons or photoprotons from deuterium
ϵ	electron capture
E_β, E_γ,. . .	energy of β ray, energy of γ ray, . . .
E_γ(max)	end-point energy of continuous γ spectrum
E_{dis}	disintegration energy
EA	electrostatic analyzer
*E*1, *E*2, . . .	electric dipole, electric quadrupole, . . .
F-K	Fermi-Kurie β-energy distribution plot
$\gamma\gamma$, $\beta\gamma$	$\gamma\gamma$ or $\beta\gamma$ coincidences. $(0.123\beta)(0.165\gamma)$ means 0.123-Mev β and 0.165-Mev γ coincidences
$\gamma\gamma(\theta)$, $\beta\gamma(\theta)$	$\gamma\gamma$ or $\beta\gamma$ angular correlation
g.s.	ground state
I	nuclear spin in units of $h/2\pi$. + or − signs after spin value denote even or odd parity
IT	isomeric transition
l	orbital angular momentum
*M*1, *M*2, . . .	magnetic dipole, magnetic quadrupole, . . .
n	neutron
p	proton
pc	proportional counter
ppl	photoplates
s	magnetic spectrometer
s pr	pair spectrometer
scin	scintillation counter
Σ scin	scintillation counter used to sum energy of transitions in cascade
σ	cross section
τ	half-life in units indicated
th	thermal
Xtl	crystal spectrometer

Column 4 of Fig. 1 shows that there are four spectrographic measurements of the energies of the most intense β and the two cascading γ's in the decay of Sc^{46}. Observation of coincidences between a 0.36-Mev β^- and a γ ray and between two γ rays is also noted $[(0.36\beta)\gamma$ and $\gamma\gamma]$, as is the study of the angular correlation between the 0.89-Mev γ and the 1.12-Mev $\gamma[\gamma_1\gamma_2(\theta)]$ which establishes the spins in the γ cascade.

Column 5 contains additional comments pertinent to the interpretation of the decay. In the case of Sc^{46} (Fig. 1) mention is made of the fact that the disintegration energy of 2.362 Mev, as established by the intense 0.36-Mev β^- branch, is fairly well matched by the energy of a very weak β^- of 1.25-Mev energy which is presumably followed by the γ of 1.12-Mev energy.

Unless otherwise stated all energies are given in Mev. The notations and abbreviations are those in general use.

SHELL MODEL ORBITALS

The strong spin orbit coupling model[4] is used through out the table as a guide to spin and parity assignments. A strict single particle interpretation was not followed; rather allowance was made for the existence of multi-particle states where the total spin of the nucleus is not necessarily equal to the predicted spin of the odd particle. Even in these cases a knowledge

[4] M. G. Mayer, Phys. Rev. **75**, 1969 (1949) and Phys. Rev. **78**, 16 (1950). Haxel, Jensen, and Suess, Phys. Rev. **75**, 1766 (1949).

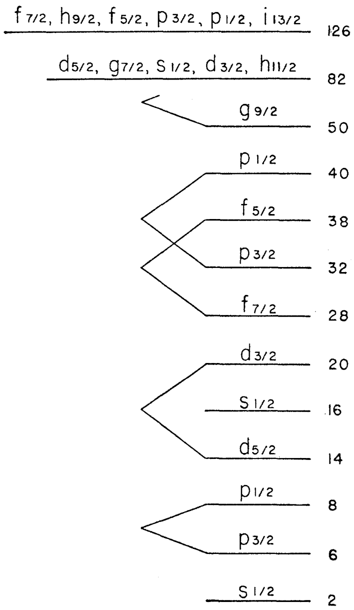

FIG. 2. *j-j* coupling level order and associated closed shell particle numbers consistent with empirical evidence.

of the individual orbitals is required for parity assignments.

Figure 2 gives the order of the individual orbitals which is consistent with the experimental data for particle numbers below fifty for either neutrons or protons. Beyond fifty the data do not indicate a well-defined level order presumably because of the combined effects of pairing, multi-particle states, configuration interaction, etc.

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Corrections in proof.—The spin of K^{39} on page 336 should read *3/2*$^+$ instead of *3/*. The spin of V^{52} on page 339 should read *2*$^+$ instead of *2,3*$^+$.

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49B60 P. R. Bell, J. Cassidy, ORNL-481, 15.

[5] K. Way and M. Wood, Phys. Rev. **94**, 119 (1954).

(Table I of King article on pages 331–401)

TABLE I.

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Mev	Error	%	Method	Ref.	Comments
$n_{0\,1} \xrightarrow{1} H_{1\,0}$ $\underline{1/2^+}$ 3.1 $\underline{1/2^+}$	0.782	13	13^m	β^-	0.782	13		s	51R25	
$H_{1\,2} \xrightarrow{3} He_{2\,1}$ $\underline{1/2^+}$ 3.0 $\underline{1/2^+}$	0.0181	2	12.4^y	β^-	0.0176	4		EA	53H55	
					0.01795	10		s	52L19	
					0.0194	4		s	51H33	
					0.0183	3		pc	49C33	
					0.0189	5		pc	49H1	
				No γ					46G14	
$He_{2\,4} \xrightarrow{6} Li_{3\,3}$ 0^+ 2.9 $\underline{1^+}$	3.50	5	0.83^s	β^-	3.50	5		s	52W22	
				No γ					53R5,48K13	
$Li_{3\,5} \xrightarrow{8} Be_{4\,4}$ $2,3^+$ ~5.6 2^+ 0^+	~15		0.9^s	β^-	~13	1*	~90%⁻	s	50H1	β^- goes to ~3 Mev α-emitting excited state (50H1,54G2). $\beta\alpha(\theta)$ not isotropic (53C7).
					12	1*		a	47O2	
					12	1*		cc	37B1	
$B_{5\,3} \xrightarrow{8} Be_{4\,4}$ $2,3^+$ 5.5 2^+ 0^+	~18		0.65^s	β^+	13.7	3		a	50A57	β^+ goes to ~3 Mev α-emitting excited state (50A57,54G2).
							~85 %^{T}		54G2	
$Be_{4\,6} \xrightarrow{10} B_{5\,5}$ 0^+ 13.6 $\underline{3^+}$	0.557	4	$2.5\text{x}10^{6y}$	β^-	0.555	5		s	50F1	Probably no γ (47L3,47M14,49H19). End points found by using D_2 correction.
					0.560	5		s	50A2	
					0.553	15		pc	49F12	
$C_{6\,4} \xrightarrow{10} B_{5\,5}$ 0^+ 3.2 1^+ $\underline{3^+}$	3.8	1	19^s	β^+	2.1	1	98%^{T}	a	53S38	For discussion of spin of 0.72 level see 53S38.
				γ	0.723	15		scin	53S38	
				$(0.72\gamma)/\beta^+$ = 1.05 ± 0.08					53S38	
$C_{6\,5} \xrightarrow{11} B_{5\,6}$ $3/2^-$ 3.6 $\underline{3/2^-}$	1.997	7	20.4^m	β^+	0.970	10*		s	44S3	
					0.981	10*		s	41T1	
				No $\beta\gamma$					46S12	
$B_{5\,7} \xrightarrow{12} C_{6\,6}$ 1^+ 4.2 $\underline{0^+}$	13.43	6	0.03^s	β^-	13.43	6		s	50H1	~9.1 β^- (4%⁻) presumably to 4.43 level in C^{12} (51V2).
					13.3	5		a	48H54	
$N_{7\,5} \xrightarrow{12} C_{6\,6}$ 1^+ >4.3 $\underline{0^+}$	17.6	2	0.013^s	β^+	16.6	2		a	49A5	Some β^+ decay to α-emitting state in C^{12} (50A57). Also expect some decay to 4.43 level in C^{12}.
$N_{7\,6} \xrightarrow{13} C_{6\,7}$ $1/2^-$ 3.7 $\underline{1/2^-}$	2.23	1	10.1^m	β^+	1.202	5		s	50H1	
					1.218	4		s	41T1	
					1.198	6		s	39L15	
					1.25	3		s	48C11	
					1.24	2		s	45S3	
				No γ with $0.135 < E_\gamma < 0.700$					47L4	
$C_{6\,8} \xrightarrow{14} N_{7\,7}$ $\underline{0^+}$ 9.0 $\underline{1^+}$	0.155	1	$\sim 5600^y$	β^-	0.155	1		s	50W62	
					0.155	1		s	49F2	
					0.155	2		s	48B21	
				No γ					41R5	
$O_{8\,6} \xrightarrow{14} N_{7\,7}$ 0^+ 3.5 0^+ $\underline{1^+}$	5.15	4	77^s	β^+	1.83	3		s	54P2	Simple β^+ decay (49S25). β^+ transition to ground state doubtful (54P2).
					1.8	1		a	49S25	
				γ	2.30	3		scin	53S38	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$C_{6\ 9} \xrightarrow{15} N_{7\ 8}$; $5/2^+$ $>6.5^1$ $\underline{1/2^-}$	8.8	4	2.4^s	β^-	8.8	4		a	50H10	2.4^s activity found from C^{14}(d,p) (50H10) not from $C^{14}(n,\gamma)$(50Y51). 5.3γ present and described as intense (52H6, 54S2). Transition must be considered favored unless 8.8 β^- branching to ground state $\lesssim 5\%^-$.
$O_{8\ 7} \xrightarrow{15} N_{7\ 8}$; $1/2^-$ 3.6 $\underline{1/2^-}$	2.705	5	2.12^m	β^+	1.683	5		s	49P12	
					1.68	9*		a	49S25	
				No γ					50P78	
$N_{7\ 9} \xrightarrow{16} O_{8\ 8}$; 2^- 8.2^1 $\underline{0^+}$	10.5	5	7.4^s	β^-	10.5	5	~18%$^-$	a	47B3	~4.3 β^- (~40%$^-$) presumably to I = 3^- 6.1 level. 4.6 β^- (~2%$^-$) and 3.8 β^- (~40%$^-$) also reported (47B3).
$N_{7\ 10} \xrightarrow{17} O_{8\ 9}$; $1/2^-$ 3.8 $1/2^-$, $\underline{5/2^+}$	8.8	2	4.2^s	β^-	3.7	2		a	49A4	β^- goes to neutron emitting excited level of O^{17}(49A4,49H43), neutron energy = 0.92 ± 0.007(49A4), neutron binding energy = 4.143 ± 0.006(51S19).
$F_{9\ 8} \xrightarrow{17} O_{8\ 9}$; $5/2^+$ 3.4 $\underline{5/2^+}$	2.771	6	70^s	β^+	1.749	6		s	53W47	
					1.72	3		s	50P64	
					1.76	5		a	54K7	
					1.75	20		a	51L4	
				No γ					53W47,51P23	
				No γ (E_γ/β < 0.1)					54K7	
$F_{9\ 9} \xrightarrow{18} O_{8\ 10}$; 1^+ 3.6 $\underline{0^+}$	1.667	8	1.87^h	β^+	0.649	9		s	51R24	
					0.635	15		s	49B26	
				No γ					51R24	
$Ne_{10\ 8} \xrightarrow{18} F_{9\ 9}$; 0^+ ≥ 2.9 1^+	4.2	2	1.6^s	β^+	3.2	2*		s	53G34	
$O_{8\ 11} \xrightarrow{19} F_{9\ 10}$; $3/2^+$ 5.6 $\underline{1/2^+}$	4.5	3	29.4^s	β^-	4.5	3	30%$^-$	a	47B4	The interpretation of an allowed transition between ground states assumes that the $(d_{5/2})^3$ configuration for O^{19} yields a total spin <5/2.
$Ne_{10\ 9} \xrightarrow{19} F_{9\ 10}$; $1/2^+$ 3.2 $\underline{1/2^+}$	3.21	3	18.5^s	β^+	2.18	3		s	52S15	
					2.3	1		a	49S25	
				No γ >0.51				scin	52S15	
				No γ					39W2	
$F_{9\ 11} \xrightarrow{20} Ne_{10\ 10}$; $2,3^+$ 5.0 2^+, 0^+	7.04	2	12^s	β^-	5.419	10		s	53W47	
					5.406	17		s	52A30	
				No >5.4β^- (<1%)					52A30	
				γ	1.627	5		s	53W47	
					1.631	6		s	52A30	
				No >1.67γ (<0.25%)					52A30	
				(~5β^-)γ					40C11,50J4	
$Na_{11\ 10} \xrightarrow{21} Ne_{10\ 11}$; $3/2^+$ 3.6 $3/2^+$	3.52	3	23^s	β^+	2.50	3		s	52S15	
					2.5	1*		scin	53B34	
				No > 0.51γ				scin	52S15	
$Na_{11\ 11} \xrightarrow{22} Ne_{10\ 12}$; $\underline{3^+}$ 7.4 2^+; ~13 0^+	2.840	5	2.6^y	β^+	0.540	5	~100†	s	53W13	1.83 β^+ (~0.06%$^+$) gives good energy match (53W13,49M34). Transition to 1.28 level has ϵ/β^+ = 0.110 in excellent agreement with theory(54S9).
					0.542	5		s	50M6	
				γ	1.277	4		s	49A7	
					1.30	3		s	46G1	
					1.3	1		s	39O1	
				$\beta\gamma$					46G1,49A7	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Mev	Error	%	Method	Ref.	Comments
$_{10}Ne_{13} \xrightarrow{23} {}_{11}Na_{12}$	4.21	2	40.2^{s}	β^-	4.21	2	93%$^-$	s	50B28	Fair energy match given by 1.18 β^-(7%$^-$) +~2.8 γ (50B28,50P9).
5/2$^+$ 5.1 3/2$^+$					4.3	3		a	40P4, 46B27	
$_{12}Mg_{11} \xrightarrow{23} {}_{11}Na_{12}$	3.97	5	11^{s}	β^+	2.95	7		scin	54H8	
3/2$^+$ 3.6 3/2$^+$					2.99	9		scin	51Z3	
					2.82	14*		cc	39W2	
				No γ					39W2	
$_{11}Na_{13} \xrightarrow{24} {}_{12}Mg_{12}$	5.511	5	14.97^{h}	β^-	1.390	5		s	46S9	4.17 β^-(0.003%$^-$) to the 1.38 level of Mg^{24} (51T12). α_{pair} suggests γ_1 and γ_2 are E2 (52B53,52S52).
4$^+$ 6.1 4$^+$					1.4	1*		s	39L6	
12.7 2$^+$				γ_1	2.7535	10		s	52H36	
0$^+$					2.753	5		s pr	53K18	
					2.755	5		s	50W2	
					2.758	28*		s	46S9	
					2.765	28*		s	49R4	
				γ_2	1.3679	10		s	52H36	
					1.380	14*		s	46S9	
					1.380	14*		s	49R4	
				γ's in cascade					46C4,47W2,47B23	
				$\gamma\gamma(\theta)$					50C77,48B18	
$_{13}Al_{11} \xrightarrow{24} {}_{12}Mg_{12}$	>7.1	1	2.0^{s}	β^+				scin	54B12	Decays to α-emitting state of Mg^{24} (54G9,52B12). Many other lower energy γ's present. (p,n) threshold ~15 Mev (52B12).
4$^+$				γ	7.0	2		scin	54B12	
0$^+$					7.1	1		scin	54G9	
$_{11}Na_{14} \xrightarrow{25} {}_{12}Mg_{13}$	3.7	3	62.5^{s}	β^-	3.7	3	~55%$^-$	a	47B4	The very probable assignments of 3/2+ or 5/2+ from a $(d_{5/2})^3$ configuration for Na^{25} argue in favor of an allowed transition between ground states. 2.7 β^-(~45%$^-$) and >0.5 γ present (47B4).
3/2,5/2$^+$ 5.3 5/2$^+$										
$_{13}Al_{12} \xrightarrow{25} {}_{12}Mg_{13}$	4.2	2	7.6^{s}	β^+	3.17	15		a	54H18	
5/2$^+$ 3.8 5/2$^+$										
$_{13}Al_{13} \xrightarrow{26} {}_{12}Mg_{14}$	3.9 (see comments)	2	6.5^{s}	β^+	2.8	2*		a	48A8	The Q-value quoted is for the 6.5^{s} state which is probably isomeric with a 5$^+$ ground state. The experimental data are not sufficient to establish the energy of the ground state.
0$^+$ 3.3 0$^+$					2.6	2*		a	38B6,46B27	
					3.4	2*		a	34F1,46B27	
					3.0	2*		cc	39W2	
$_{12}Mg_{15} \xrightarrow{27} {}_{13}Al_{14}$	2.591	7	9.5^{m}	β^-	1.754	4	58%$^-$	s	53D17	1.59 β^- in coincidence with 1.02 γ in 41% of transitions; 2.6 β^- in 0.4% (53D17). log ft ~ 8.6 for the 2.6 β^- is strikingly low for the predicted second forbidden transition. Decay scheme of 53D17 supported by E_γ/β = 0.88±0.08 (54K7).
1/2$^+$ 4.8 3/2,1/2$^+$					1.80	2*	80%$^-$	s	48B3	
8.6 5/2$^+$				γ	0.839	8		scin	53D17	
					0.835	9*		s	48B3	
				(1.75β)(0.84γ)					53D17	
				No $\gamma\gamma$					53D17	
$_{14}Si_{13} \xrightarrow{27} {}_{13}Al_{14}$	4.70	7	4.1^{s}	β^+	3.76	8		scin	54H8	
5/2$^+$ 3.6 5/2$^+$					3.54	10		cc	40B1	
					3.74	19*		cc	40M1	
$_{12}Mg_{16} \xrightarrow{28} {}_{13}Al_{15}$	1.81	2	21.4^{h}	β^-	0.459	2		s	54O3	The absence of a transition between the ground states of Al^{28} and Si^{28} argues in favor of a cascade β^- and γ in the decay of Mg^{28}. 1.35 γ (70%) apparently crossover of 0.40 γ (30%) and 0.95 γ (28%) (53S22,53I1,53L21). ~ 0.03 γ also present (53W22,53L21, 53I1) and may be in cascade with 1.35 γ.
0$^+$ 4.9 1$^+$					0.42	1		s	53M23	
2,3$^+$					0.40	6		a	53S22	
					0.39	5		a	53W22	
				γ	1.35	2		scin	53S22	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Mev	Error	%	Method	Ref.	Comments
$Al_{13\ 15} \xrightarrow{28} Si_{14\ 14}$	4.65	1	2.30^m	β^-	2.878	14		s	5403	$< 0.8\%\ \beta^-$ transitions between ground states (5403).
$2,3^+$ 4.9 2^+					2.865	10		s	52M22	
0^+					2.85	5		s	53M23	
				γ	1.782	10		s	52M22	
					1.78	2		scin	53S22	
				$\beta\gamma$					47B4	
$P_{15\ 13} \xrightarrow{28} Si_{14\ 14}$	13.4	4	0.28^s	β^+	10.6	4		scin	54G9	Many γ's present (54G9,54B12). The adopted Q value is based on the plausible assumption that the 10.6 β^+ goes to the 1.78 level of Si^{28}. (p,n) threshold ~ 15 (54B12).
$2,3^+$ >4.7 2^+										
0^+										
$Al_{13\ 16} \xrightarrow{29} Si_{14\ 15}$	3.8	1	6.56^m	β^-	2.5	1*	~75%$^-$	a$\beta\gamma$	49S40	1.4 β^-(~ 25%$^-$) + 2.43 γ provides good energy match (49S40,53R1).
$5/2^+$ 5.3 $3/2^+$				γ	1.28	3*		scin	53R1	
$1/2^+$					1.2	2		a	49S40	
				$\beta\gamma$					49S40	
$P_{15\ 14} \xrightarrow{29} Si_{14\ 15}$	4.97	1	4.5^s	β^+	3.945	10	97%^{T}	s	53R20	Weak β^+ branches to 1.28 and 2.43 levels of Si^{29} (53R1,53R20).
$1/2^+$ 3.7 $1/2^+$					3.9	2		scin	53N2	
$P_{15\ 15} \xrightarrow{30} Si_{14\ 16}$	4.29	5	2.52^m	β^+	3.24	6		scin	54G22	
1^+ 5.0 0^+					3.31	7		scin	54H8	
				No γ					54G22,53S58	
$Si_{14\ 17} \xrightarrow{31} P_{15\ 16}$	1.475	7	2.65^h	β^-	1.471	8		s	52M12	Very weak 1.26 γ present (54L3).
$3/2^+$ 5.5 $1/2^+$					1.486	12		s	52W12	
				No γ					52W12	
$S_{16\ 15} \xrightarrow{31} P_{15\ 16}$	5.5	1	2.4^s	β^+	4.50	10		scin	54H8	
$1/2^+$ 3.7 $1/2^+$					3.87			cc	41E3	
					3.85			cc	41W2	
$Si_{14\ 18} \xrightarrow{32} P_{15\ 17}$	0.10	5	~700^y	β^-	0.10	5*		a	53L21	
0^+ ~6.7 1^+				No γ					53L21	
$P_{15\ 17} \xrightarrow{32} S_{16\ 16}$	1.708	4	14.30^d	β^-	1.704	8		s	52J3	
1^+ 7.9 0^+					1.697	10		s	52M12	
					1.708	8		s	50W66	
					1.718	10		s	50A1	
					1.712	8		s	46S9	
				No γ					53G22,46S9	
$Cl_{17\ 15} \xrightarrow{32} S_{16\ 16}$	≥12.7	3	0.3^s	β^+	9.4	3		scin	54G9	2.25,3.79,4.33, and 4.82 γ's are present (54G9,54B12). (p,n) threshold ~ 14 (54B12) and log ft ~ 7.9 for P^{32} decay indicate that 9.4 β^+ may go to an excited state of S^{32}. The adopted lower limit on the Q value is given by assuming the 9.4 β^+ decay is to the known 2.25 level of S^{32}.
1^+ >4.6										
0^+										
$P_{15\ 18} \xrightarrow{33} S_{16\ 17}$	0.248	5	25^d	β^-	0.246	5		a	52W26	
$1/2^+$ 5.0 $3/2^+$					0.26	2		s	52J3	
					0.27	2		s	51S50	
				No γ					52W26,51S50	
$Cl_{17\ 16} \xrightarrow{33} S_{16\ 17}$	5.2	1	2.8^s	β^+	4.2	2		scin	53N2	Very weak 2.85 γ present (54M13).
$3/2^+$ 3.5 $3/2^+$					4.13	7		cc	41W2	

TABLE I.—*Continued.*

Disintegration	Adopted Q		Half-life	Decay Data						Comments
	Mev	Error		Type	Mev	Error	%	Method	Ref.	
${}_{15}P_{19} \xrightarrow{34} {}_{16}S_{18}$ $1^+?$ 5.1 ? 0^+	≳5.1	2	12.4^s	β^-	5.1	2	75%$^-$	a	46B1	Only other datum is 3.2 β^-(25%$^-$)(46B1). Log ft ~5.1 indicates an allowed transition, but the transition between ground states may be l-forbidden.
${}_{17}Cl_{17} \xrightarrow{34} {}_{16}S_{18}$ 0^+ 3.4 0^+	5.52	3	1.6^s	β^+	4.50 4.45	3 10		scin scin	54G22 54H8	This 1.6^s ground state is the daughter of $33^m Cl^{34}$ which was formerly considered the ground state (53A7,53S44,53A19). Complex β^- decay, with Q~5.7, (51R24) probably originates from the 33^m isomer.
${}_{16}S_{19} \xrightarrow{35} {}_{17}Cl_{18}$ $3/2^+$ 5.0 $3/2^+$	0.1670	4	87.1^d	β^-	0.1670 0.1683 0.167 0.166 0.169	5 40 2* 2* 3		s s s s s	50L4 50G9 51H24 48A3 48B21	
${}_{18}A_{17} \xrightarrow{35} {}_{17}Cl_{18}$ $3/2^+$ 3.5 $3/2^+$	5.41	6	1.84^s	β^+	4.38 4.41	7 9		cc cc	41W2 41E1	
${}_{17}Cl_{19} \xrightarrow{36} {}_{16}S_{20}$ 2^+ 0^+			$4.4x10^{5y}$	$\beta^+/\beta^- < 10^{-4}$					49W15	
${}_{17}Cl_{19} \xrightarrow{36} {}_{18}A_{18}$ 2^+ 13.5 0^+	0.714	5	$4.4x10^{5y}$	β^- No high intensity γ unless $E_\gamma < 20$ kev	0.714 0.73	5 4*		s a	52F16 49R11 49W15	$\beta^+/\beta^- < 10^{-4}$ (49W15).
${}_{16}S_{21} \xrightarrow{37} {}_{17}Cl_{20}$ $7/2^-$ 7.7^l $3/2^+$	4.2	3	5.04^m	β^-	4.3 4.0	3 4*	10%$^-$	a	46B1 46H25	~1.5 β^-(90%$^-$) and 2.7 γ in other branch (46B1,46H25). Log f_1t ~7.7 is slightly low for the $\Delta I = 2$, yes transition between ground states predicted by the shell model.
${}_{18}A_{19} \xrightarrow{37} {}_{17}Cl_{20}$ $3/2^+$ 5.1 $3/2^+$	0.82	1	34.1^d	Continuous γ spectrum E_γ (max)	0.815 0.815	15 20		scin scin	53A4 54E5	K binding energy = 0.0032
${}_{19}K_{18} \xrightarrow{37?} {}_{18}A_{19}$ $3/2^+$ 3.5 $3/2^+$	6.1 (see comments)	1	1.2^s	β^+	5.06	11		scin	54H8	1.2 ± 0.2^s activity produced by K(70-Mev γ). Identical with $0.95^s K^{38}$ below?
${}_{17}Cl_{21} \xrightarrow{38} {}_{18}A_{20}$ 2^- 8.1^l 0^+	4.81	5	37.29^m	β^-	4.81 ~5.2 4.99	5	53%$^-$ 53%$^-$	s s a$\beta\gamma$	50L2 46H2 41W3	Only 50L2 applies correction for $\Delta I = 2$, yes shape. 2.8 β^-(16%$^-$)+2.15γ and 1.1 β^-(31%$^-$)+1.60 γ+2.15 γ give reasonable energy match (50L2,46H2).
${}_{19}K_{19} \xrightarrow{38} {}_{18}A_{20}$ 3^+ 5.0 2^+ 0^+	5.86	3	7.7^m	β^+ γ No ce$^-$	2.68 2.16 ~2.1	4 4*		scin scin aee	54G22 51T24 47R3 54G22	0.95^s K^{38} decaying by 5.06 β^+ (54H8) is probably 0^+ isomeric state. 0.95 ± 0.03^s and 7.7^m activities produced with same σ for E_γ = 16.5 to 31 (53S58).
${}_{17}Cl_{22} \xrightarrow{39} {}_{18}A_{21}$ $3/2^+$ 7.9^l $7/2^-$	2.96	4	55.5^m	β^-	2.96	4	7%$^-$	a	50H61	1.65 β^-(93%$^-$) and 1.31 γ give good energy match. 0.35 γ(M4,E5?) also observed (50H61).
${}_{18}A_{21} \xrightarrow{39} {}_{19}K_{20}$ $7/2^-$ 8.8^l $3/2^+$	0.565	5	265^y	β^- No $\gamma > 0.3$ No $\beta\gamma$	0.565 > 0.35	5		s	50B66 52A15 50B66 52A15	$\Delta I = 2$, yes shape observed (50B66).

TABLE I.—*Continued.*

Disintegration	Adopted Q		Half-life	Decay Data						Comments
	Mev	Error		Type	Mev	Error	%	Method	Ref.	
$_{20}Ca_{19} \xrightarrow{39} {}_{19}K_{20}$	7.1	2	0.9^s	β^+	6.10	15		scin	54H8	
$3/2^+$ 3.9 $3/$					6.7	5		a	53B39	
$_{19}K_{21} \xrightarrow{40} {}_{18}A_{22}$	>1.46	1	1.3×10^{9y}	γ	1.459	7		s	51G9	$\epsilon/\beta^- \sim 0.13$ (54W3).
4^- 2^+					1.46	1		scin	50B63	
0^+					1.48	2		scin	50H74	
					1.47	3		scin	50P4	
$_{19}K_{21} \xrightarrow{40} {}_{20}Ca_{20}$	1.33	1	1.3×10^{9y}	β^-	1.325	15		s	52F16	$\epsilon/\beta^- \sim 0.13$ (54W3). $\Delta I = 4$, yes shape observed.
4^- 18.1 0^+					1.36	3		s	50A7	
					1.36	5		scin	50B8	
					1.28	3		scin	51G29	
				No $\beta\gamma$					47M7	
$_{21}Sc_{19} \xrightarrow{40} {}_{20}Ca_{20}$	$\sim$13.8	4	0.22^s	β^+	9.0	4		scin	54G9	(p,n) threshold = 15.9 ± 1.0 (54G9).
4^- 4.0				γ	3.75	4		scin	54G9	
0^+				No other γ					54G9	
$_{18}A_{23} \xrightarrow{41} {}_{19}K_{22}$	2.60	6	1.78^h	β^-	1.245	5	99%$^-$	s	49B57	2.55 β^-(0.7%$^-$) gives fair energy match (46B11).
$7/2^-$ 5.1 $7/2^-$					1.18	5		a	46B11	
8.7^1 $3/2^+$				γ	1.37	6		cc	36R1	
					1.3	2		a	46B11	
				(1.18 β)γ delay $\sim 6.7\times10^{-9s}$					53E6,52E8	
$_{20}Ca_{21} \xrightarrow{41} {}_{19}K_{22}$	>0		$\sim 1.2\times10^{5y}$	K x ray					51B77	
$7/2^-$ $3/2^+$										
$_{21}Sc_{20} \xrightarrow{41} {}_{20}Ca_{21}$	5.96	7	0.87^s	β^+	4.94	7		cc	41E3	
$7/2^-$ 3.4 $7/2^-$										
$_{19}K_{23} \xrightarrow{42} {}_{20}Ca_{22}$	3.56	3	12.44^h	β^-	3.56	4*	82%$^-$	s	54K5	$\Delta I = 2$, yes shape observed (54K5,49S41, 47S8). 1.97 β^-(18%$^-$)+ 1.51 γ gives fair energy match (54K5,54L10,53K26, 51S68,50B60). Very weak 0.309 γ present (54L10).
2^- 8.5^1 0^+					3.58	7	75%$^-$	s	47S8	
					3.60			s	47P17	
					3.50		70%$^-$	a	47B4	
				No (3.5 β)γ					47B4	
$_{19}K_{24} \xrightarrow{43} {}_{20}Ca_{23}$	1.84	1	22^h	β^-	1.839	10*	1.6%$^-$	s	54L14	1.84 β^- exhibits $\Delta I = 2$, yes shape (54L14). Four lower energy β's and complex γ's give decay scheme consistent with adopted Q.
$3/2^+$ 8.7^1 $7/2^-$										
$_{21}Sc_{22} \xrightarrow{43} {}_{20}Ca_{23}$	2.20	2	3.92^h	β^+	1.18	2	72%^{T}	s	52H44	0.77 β^+ (28%^{T})+ 0.38γ gives fair energy match (52H44,53N8).
$7/2^-$ 5.1 $7/2^-$					1.12	5		s,a	45H3	
					1.4	1		a	40W1	
$_{19}K_{25} \xrightarrow{44} {}_{20}Ca_{24}$	≥4.9	2	22^m	β^-	4.9	2*	<100%	scin	54C9	Complex β^- spectrum with strong 1.5 β^-. 1.13, 2.07, 2.48, (3.67)γ's (54C9).
$?^-$ >7.0 0^+										
$_{21}Sc_{23} \xrightarrow{44} {}_{20}Ca_{24}$	3.64	1	4.0^h	β^+	1.463	5		s	50B52	$\beta\gamma$ coincidences indicate only one β^+ (50C56). 1.16 $\gamma/\beta^+ \sim 1$ (54L1).
$2,3^+$ 5.3 2^+					1.54	8*		a	50C56	
0^+					1.45	1		s	42S1	
				γ	1.16	1		s	50B52	
					1.18	12*		aee	50C56	
				β($\sim$1.0γ)					50C56	
$_{22}Ti_{22} \xrightarrow{44} {}_{21}Sc_{23}$	>0.16	6	$\sim 3^y$	γ	0.16	6		scin	54S14	
0^+ $2,3^+$										

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{20}Ca_{25} \xrightarrow{45} {}_{21}Sc_{24}$ $5/2,7/2^-$ 5.9 $7/2^-$	0.252	2	164^d	β^-	0.254	3		s	50M5	No harder β (48S2).
					0.255	4		scin	50K60	
					0.248	3*		s	47P10	
				No γ					49M32,48S2,47P10	
$_{22}Ti_{23} \xrightarrow{45} {}_{21}Sc_{24}$ $5/2,7/2^-$ 4.6 $7/2^-$	2.04	1	3.07^h	β^+	1.02	1	>96†	s	50T51	Weak γ ? (50K51, 50T51, 53N8).
					1.00	2		s	50K51	
$_{21}Sc_{25} \xrightarrow{46} {}_{22}Ti_{24}$ 4^+ 6.2 4^+ 11.3 2^+ 0^+	2.362	4	84^d	β^-	0.357	4*		s	53Y3	Energy match provided by 1.25 β^-(0.1%$^-$) + 1.12γ (54K4, 53W6).
					0.360	5	>99%$^-$	s	48P2	
					0.358	4*		s	47F2	
					0.36	1		s	47M9	
				γ_1	0.885	2		s	53L12	
					0.89	1*		s	50P71	
					0.88	1*		s	50M62	
					0.883	9*		s	47F2	
				γ_2	1.119	2		s	53L12	
					1.12	1*		s	50P71	
					1.12	1*		s	50M62	
					1.116	11*		s	47F2	
				(0.36 β^-)γ					48M9,48J7	
				$\gamma\gamma$					48M9,48J7	
				$\gamma_1\gamma_2$ (θ)					48B18,50N5,50M18	
$_{23}V_{23} \xrightarrow{46} {}_{22}Ti_{24}$ 0^+? ≥ 3.4 0^+	~7	1	0.40^s	β^+	~6	1*		scin	52M55	
$_{20}Ca_{27} \xrightarrow{47} {}_{21}Sc_{26}$ $7/2^-$ 8.5 $7/2^-$	2.06 (see comments)	2	4.8^d	β^-	2.06	2*	19%$^-$	s	53M64	0.7 β^-(81%$^-$)+ 1.3γ gives fair energy match (53M64, 53A22, 47M12, 53C44). 53C44 observes 1.4 β^- (40%$^-$) as highest energy β^- and finds complex γ spectrum.
					2.0	1*	20%$^-$	a	53A22	
$_{21}Sc_{26} \xrightarrow{47} {}_{22}Ti_{25}$ $7/2^-$ 5.4 $5/2^-$	0.490 (see comments)	5	3.44^d	β^-	0.490	5	72%$^-$	s	53M64	Reasonable energy match given by 0.28 β^- (28%$^-$) +~0.22γ. Observations of 0.62 β^- (34%$^-$), 0.44 β^- (66%$^-$), and 0.18γ (53C16) and (0.64 β^-)(0.16γ) coincidences (53C44) put adopted Q value in question.
$_{23}V_{24} \xrightarrow{47} {}_{22}Ti_{25}$ $7/2^-$ ≥ 4.6 $5/2^-$	2.88	6	33^m	β^+	1.90	4		a	54K7	γ observed (49K12).
					1.65	8*		a	49K12	
					1.8	1*		a	4201	
					2.0	1*		a	37W3,46B27	
				No γ(< 20%)					53A21	
				No γ (E_γ/β < 0.06)					54K7	
$_{20}Ca_{28} \xrightarrow{48} {}_{21}Sc_{27}$ 0^+ $6,7^+$			Stable ?							
$_{21}Sc_{27} \xrightarrow{48} {}_{22}Ti_{26}$ $6,7^+$ 5.4 6^+ 4^+ 2^+ 0^+	3.99	3	1.83^d	β^-	0.640	4		s	42S1	Total E_γ of 3.23 follows β^- (51S40).
					0.60	3*		a	51S40	
					0.57	3*		a	49K12	
				γ_1	1.04	2		scin	53C43	
					1.05	2*		scin	53S30	
					0.98			scin	52H27	
				γ_2	1.32	3*		scin	52M47	
					1.33	4		s	46P1	
					1.35	3		s	43M3	
					1.34	14*		a	45H4	
				γ_3	0.99	2*		scin	52M47	
					0.98	2*		scin	52H27	
					0.98	3		s	46P1	
				$\gamma\gamma\gamma$					53C43	
				(1.04 γ) (0.98 γ) (θ)					53W36	

TABLE I.—*Continued.*

Disintegration	Adopted Q		Half-life	Decay Data						Comments
	Mev	Error		Type	Mev	Error	%	Method	Ref.	
$V_{23\ 25} \xrightarrow{48} Ti_{22\ 26}$ $4,5^+$ ≥ 6.2 4^+ 2^+ 0^+	4.02	2	16.0^d	β^+	0.692	5		s	53M64	$\beta^+/1.32\gamma = 0.49 \pm 0.04$; $(2.2\gamma)(0.99\gamma)$ coincidences; $\gamma\gamma$ in 10 ± 5% of disintegrations (53C43).
					0.69	1		s	52R44	
					0.716	15		s	46P1	
				γ_1	1.320	13*		s	49R4	
					1.33	3*		scin	53S30	
					1.32	3*		scin	52M47	
					1.33	3		s	46P1	
				γ_2	0.990	10*		s	49R4	
					0.98	2*		scin	53S30	
					0.99	2*		scin	52M47	
					0.98	2		s	46P1	
				$\beta^+\gamma$, $\beta^+\gamma_1$, $\beta^+\gamma_2$					53E6,52R44,52M47	
				$\gamma_1\gamma_2$					52R44,52M47	
				$\gamma_1\gamma_2(\theta)$					53A33,53M30	
$Ca_{20\ 29} \xrightarrow{49} Sc_{21\ 28}$ $3/2^-$ 5.5 $3/2,5/2^-$ $7/2^-$	$\sim$5.4	3	8.5^m	β^-	2.7	1*		a	49D30	$\beta\gamma$ cascade assumed since $E_\gamma \sim E_{\beta^-}$ and shell model predicts second forbidden transition between ground states.
				γ	2.7	3*		a	49D30	
$Sc_{21\ 28} \xrightarrow{49} Ti_{22\ 27}$ $7/2^-$ 6.1 $\underline{7/2^-}$	2.1	1	57^m	β^-	2.00	5		a	54K7	
					2.4	1*		a	49D30	
					1.8	2*		a	37W6	
				No γ					40W1	
				No γ ($E_\gamma/\beta < 0.05$)					54K7	
$V_{23\ 26} \xrightarrow{49} Ti_{22\ 27}$ $7/2^-$ 6.4 $\underline{7/2^-}$	0.62	2	600^d	No β^+					54P5,39W1	Very weak 0.128γ possible (54P5). K binding energy = 0.0055
				Continuous γ spectrum						
				E_γ (max)	0.617	20		scin	54P5	
$Cr_{24\ 25} \xrightarrow{49} V_{23\ 26}$ $5/2^-$ 5.0 $7/2^-$	2.56	1	41.9^m	β^+	1.54	1	50†	s	53C18	$1.39\ \beta^+$ (35†)(53C18). Additional $1.45\ \beta^+$ suggested by low energy γ's (54N3). Absorption values therefore not used for Q.
					1.46			a	54N3	
					1.45			a,cc	4201	
$Mn_{25\ 25} \xrightarrow{50} Cr_{24\ 26}$ 0^+ 3.4 0^+	$\sim$7.3	3	0.28^s	β^+	$\sim$6.3	3*		scin	52M55	
$Ti_{22\ 29} \xrightarrow{51} V_{23\ 28}$ $3/2^-$ 5.6 $5/2,3/2^-$ $\underline{7/2^-}$	$\gtrsim$2.2	1	5.79^m	β^-	2.2	1	20%⁻	a,s	52K34	$(1.9\beta^-)(0.32\gamma)$ gives good energy match (52K34) but g.s. transition should be second forbidden. Low lying level in V^{51} seems likely, cf V^{49}.
$Cr_{24\ 27} \xrightarrow{51} V_{23\ 28}$ $7/2^-$ $\underline{7/2^-}$	$\lesssim$1 >0.32	 1	27.8^d	No β^+					45B1,48K10	
				γ	0.32	1*		scin	52L17	
$Mn_{25\ 26} \xrightarrow{51} Cr_{24\ 27}$ $5/2,7/2^-$ 5.4 $7/2^-$	3.22	8	45^m	β^+	2.16	5		a	54K7	
					2.35	10		a 38L1	46B27	
				No γ (< 20%)					53A21	
				No γ ($E_\gamma/\beta < 0.1$)					54K7	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{23}V_{29} \xrightarrow{52} {}_{24}Cr_{28}$ $2,3^+$ 4.9 2^+ 0^+	3.90	7	3.77^m	β^-	2.47	3		a	54K7	2.6^m half-life (50R67) not found (54L13, 54K7, 54W10). 16^h half-life (53W29) not found (54L13). Complex γ's (53W29) not found (54L13, 54W10).
					2.6	1*		a$\beta\gamma$	54L13	
					2.6	1*		a	50R67	
					2.0	1*		a	40G3	
					2.7	1*		cc	42Y1	
				γ	1.44	2		scin	54L13	
					1.40	4		scin	53W29	
					1.45	15*		a	47M17	
					1.5	2*		a	50R67	
					1.44	15*			42K8	
				$(2.6\beta)(1.44\gamma)$					54L13	
				$\beta\gamma/\beta$ not $f(E_\beta)$					47B20	
				$E_\gamma/\beta = 1.5$					54K7	
$_{25}Mn_{27} \xrightarrow{52} {}_{24}Cr_{28}$ 6^+ 5.6 6^+ 4^+ 2^+ 0^+	4.74	5	6.2^d	β^+	0.582	30		s	46P1	Simple β^+ spectrum indicating γ's in cascade (46P1).
				γ_1	0.734	15		s	46P1	
				γ_2	0.940	20		s	46P1	
				γ_3	1.46	3		s	46P1	
				$\beta\gamma$					46P1	
$_{26}Fe_{26} \xrightarrow{52} {}_{25}Mn_{27}$ 0^+ 4.4 21^m 2^+ 6^+	$\gtrsim 1.99$	4	7.8^h	β^+	0.640	40		a	51F20	Unobserved low energy γ probable.
					0.55	3*		a	48M12	
				No γ with $E_\gamma > 0.5$					51F20	
				From $21^m Mn^{52}$ isomer					51F20	
				γ	0.392	8		s	47O1	
$_{23}V_{30} \xrightarrow{53} {}_{24}Cr_{29}$ $5/2,7/2^-$ 5.1 $\underline{3/2^-}$	$\gtrsim 0.6$	1	23^h	β^-	0.6	1*		a	52H61	γ expected if V^{53} spin is 7/2.
$_{25}Mn_{28} \xrightarrow{53} {}_{24}Cr_{29}$ $5/2,7/2^-$ $\underline{3/2^-}$			never observed							$Q \sim 0.6$ from (p,n) threshold (52L6) suggests long-lived transition.
$_{26}Fe_{27} \xrightarrow{53} {}_{25}Mn_{28}$ $7/2^-$ 5.0 $5/2,7/2^-$	3.7	1	8.9^m	β^+	2.6	1		scin	51B47	γ weak if present (50N2). 0.370 γ present (30% of β^+) (53N8).
					2.8	1		a	50N2	
$_{25}Mn_{29} \xrightarrow{54} {}_{24}Cr_{30}$ $2,3^+$ 2^+ 0^+	>0.835 $\lesssim 1.9$	5	320^d	No β^+					49K12	
				ϵ					38A2	
				γ	0.835	5		s	44D1	
					0.83				53S66	
					0.85			a	38L1	
				Xγ					44D1	
$_{25}Mn_{29} \xrightarrow{54} {}_{26}Fe_{28}$ $2,3^+$ >11.5 0^+	$\gtrsim 1.0$	5	320^d	β^-	1.0	5*	<0.1%−	cc	49K16	
$_{27}Co_{27} \xrightarrow{54} {}_{26}Fe_{28}$ 0^+ 3.5 0^+	~8.4	3	0.18^s	β^+	~7.4	3*		scin	52M55	
$_{24}Cr_{31} \xrightarrow{55} {}_{25}Mn_{30}$ $3/2^-$ 5.2 $\underline{5/2^-}$	2.9	1	3.52^m	β^-	2.85	14*		a	52F21	
				No γ (< 10%)					52F21	

TABLE I.—*Continued.*

Disintegration	Adopted Q		Half-life	Decay Data						Comments
	Mev	Error		Type	Mev	Error	%	Method	Ref.	
$_{26}Fe_{29} \xrightarrow{55} {}_{25}Mn_{30}$	0.218	5	2.94^y	Continuous γ spectrum						K binding energy = 0.0071
$3/2^-$ 5.9 $\underline{5/2^-}$				E_γ (max)						
					0.226	10		scin	54E5	
					0.200	10		scin	53B16	
					0.215	10		scin	53M12	
					0.206	20		scin	52B45	
					0.205	10		scin	51M50	
$_{27}Co_{28} \xrightarrow{55} {}_{26}Fe_{29}$	3.46	2	18.2^h	β^+	1.50	2*	$30\%^+$	s	49D2	1.01 β^+ ($30\%^+$) + 1.41γ gives good energy match (49D2).
$7/2^-$ 6.4 $5/2, 7/2^-$					1.50	2*		s	39L6	
$3/2^-$				γ	0.935	9*		s	49D2	
					0.8	1*		cc	39C6	
				$\beta\gamma$					49D2	
$_{25}Mn_{31} \xrightarrow{56} {}_{26}Fe_{30}$	3.65	3	2.58^h	β^-	2.86	5	$60\%^-$	s	43E4	1.05 β^-($25\%^-$)+ 1.81 γ + 0.84 γ and 0.73 β^-($15\%^-$)+ 2.13 γ + 0.84 γ give good energy match (46S2, 43E4).
$2,3^+$ 7.1 2^+					2.81	3*	$50\%^-$	s	46S2	
0^+				γ	0.845	15		s	43E4	
					0.822	8*		s	46S2	
					0.866	20*			42K8	
				(2.8 β^-) (0.84 γ)					43E4	
$_{27}Co_{29} \xrightarrow{56} {}_{26}Fe_{30}$	4.63	2	80^d	β^+	1.50	1	96†	s	54S15	Disagreement on energy and % of lower energy β^+ (54S15, 52C31). Additional γ's present (54S15, 52S30, 43E2).
$4,5^+$ 8.5 4^+					1.53	2	~75†	s	52C31	
2^+					1.50	5	$25\%^+$	s	43E4	
0^+				γ_1	1.24	2		scin	54S15	
					1.26	3		s	43E4	
					1.25	3*		scin	52S30	
				γ_2	0.845	15		scin	54S15	
					0.845	15		s	43E4	
					0.87	2*		scin	52S30	
				β^+ (1.24γ)(0.845γ)					54S15	
$_{28}Ni_{28} \xrightarrow{56} {}_{27}Co_{29}$	> 1.75	4	6.2^d	ϵ					52S30, 52W15	Many γ's
0^+				γ	1.75	4*		scin	52S30	
$4,5^+$					> 1.4			scin	52W15	
$_{27}Co_{30} \xrightarrow{57} {}_{26}Fe_{31}$	1.47	2	270^d	β^+	0.320	15		s	52C31	0.138 γ E2 (54A6) is crossover of 0.119 γ and 0.014 γ. β^+ reported as 0.26 by absorption measurement (41L1).
$\underline{7/2^-}$ 7.2 $7/2^-$				γ	0.1376	5		s	54A6	
$3/2^-$					0.131	1*		s	43E4	
					0.130	1		s	42P1	
					0.133	1*		s	52C31	
$_{28}Ni_{29} \xrightarrow{57} {}_{27}Co_{30}$	3.24	2	36.4^h	β^+	0.835	10	$30\%^+$	s	51C28	Simple β^+ (51C28, 50F10, 49M38). Intensity of 1.375 γ indicates it is fed by β^+ (51C28). Additional γ's (52S30, 51C28, 50F10).
$3/2^-$ 5.7					0.845	10	$50\%^+$	s	50F10	
$\underline{7/2^-}$				γ	1.375	14*		s	51C28	
					1.39	3*		scin	52S30	
				$\beta\gamma$					50F10, 49M38	
$_{27}Co_{31} \xrightarrow{58} {}_{26}Fe_{32}$	2.299	9	72^d	β^+	0.472	6		s	52C31	
2^+ 6.7 2^+					0.470	15		s	44D1	
0^+							$14\%^+$		46G1	
				γ	0.805	8*		s	50S22	
					0.805	12		s	44D1	
				$\beta\gamma$					44D1	
				$\beta\gamma/\beta$ not f(E_β)					44D1	
$_{26}Fe_{33} \xrightarrow{59} {}_{27}Co_{32}$	1.561	6	45.1^d	β^-	0.462	3	$54\%^-$	s	52M53	0.27 β^-($46\%^-$)+ 1.29 γ gives good energy match (52M53, 42D1, 52B31). No hard $\gamma\gamma$ (51M54). (0.191 γ)(1.1γ) coincidences (52M53).
$3/2^-$ 6.7 $5/2^-$					0.460	7	$50\%^-$	s	42D1	
$\underline{7/2^-}$					0.45	1*		s	51M54	
				γ	1.098	6		s	52M53	
					1.097	11*		s	50H91	
					1.10	2		s	42D1	
					1.11	1*		s	52B31	

TABLE I.—*Continued.*

Disintegration	Adopted Q		Half-life	Decay Data						Comments
	Mev	Error		Type	Mev	Error	%	Method	Ref.	
$\mathrm{Ni}_{28\ 31} \xrightarrow{59} \mathrm{Co}_{27\ 32}$	1.07	3	7.5×10^{5y}	Continuous γ spectrum						K binding energy = 0.0083.
$3/2^-$ ~13 $\underline{7/2^-}$				E_γ (max)						
					1.065	30		scin	54E5	
$\mathrm{Co}_{27\ 33} \xrightarrow{60} \mathrm{Ni}_{28\ 32}$	2.820	3	5.2^y	β^-	0.316	3*		s	53Y3	γ_1/γ_2 = 0.98 ± 0.04 (51D27). Also numerous $\gamma\gamma$, $\gamma\gamma(\theta)$, and $\beta\gamma$ measurements. 1.48 β^-(0.15%$^-$) to 1.33 level does not have ΔI = 3, no, shape (54K4).
4^+ 7.5 4^+					0.306	5		s	52F14	
12.6 2^+					0.319	4		s	50W9	
0^+					0.308	8		s	45D1	
				γ_1	1.1728	5		s	53L11	
					1.1726	10		s	49L8	
				γ_2	1.3325	3		s	53L11	
					1.3329	10		s	49L8	
$\mathrm{Cu}_{29\ 31} \xrightarrow{60} \mathrm{Ni}_{28\ 32}$	6.19	6	24.6^m	β^+	3.84	5	7†	s	54L6	2.96 β^+ (19†) + 0.81 γ + 1.33 γ and 2.01 β^+ (73†) + 1.8 γ + 1.33 γ give good energy match (54L6). No 1.17γ (< 10%)(54L6) implies I = 2 for Cu^{60}.
2^+ 7.3 2^+					3.3			a	47L7	
0^+				γ	1.33	3*		scin	54L6	
$\mathrm{Co}_{27\ 34} \xrightarrow{61} \mathrm{Ni}_{28\ 33}$	1.42 (see comments)	2	99.0^m	β^-	1.42	2	55%$^-$	a	51S64	1.0 β^-(45%$^-$) and ~0.5γ present (51S64). The possibility of spin 3/2 for Ni^{61} makes the interpretation of an allowed transition between ground states tentative.
$7/2^-$ 5.7 $5/2^-$?										
$\mathrm{Cu}_{29\ 32} \xrightarrow{61} \mathrm{Ni}_{28\ 33}$	2.229	6	3.33^h	β^+	1.205	5	63%$^+$	s	48C8, 50O3	γ intensities indicate 1.2 β^+ is to ground state. (50O3, 50B4). 0.55 β^+ (2.5%$^+$) + 0.655 γ gives good energy match. Additional β^+ branching (50O3).
$3/2^-$ 5.0 $3/2,5/2^-$					1.225	15		s	45B2	
$\mathrm{Co}_{27\ 35} \xrightarrow{62} \mathrm{Ni}_{28\ 34}$	3.6	1	13.9^m	β^-	2.3	1		a	49P1	β/γ~1. β^- and γ emission with 1.6^m half-life is also observed for Co^{62} (49P1).
5.5 ?				γ	1.3	1*		a	49P1	
0^+				$\beta\gamma$					49P1	
$\mathrm{Cu}_{29\ 33} \xrightarrow{62} \mathrm{Ni}_{28\ 34}$	3.93	2	9.8^m	β^+	2.92	2		s	50H65	0.56 γ (47T8) is extremely weak if present at all (53N9).
1^+ 5.1 0^+					2.83	5		s	49B17	
					2.92	6		a	50K1	
$\mathrm{Zn}_{30\ 32} \xrightarrow{62} \mathrm{Cu}_{29\ 33}$	1.68	1	9.33^h	β^+	0.66	1		s	50H65	0.0418 γ (50H65) probably due to complex β^+ decay.
0^+ ≥4.7 1^+										
$\mathrm{Ni}_{28\ 35} \xrightarrow{63} \mathrm{Cu}_{29\ 34}$	0.063	2	85^y	β^-	0.0615	10		EA	53K37	ΔI = 2, yes shape reported (53K37), however, a ΔI = 2, yes transition is not in accord with the ft value or the shell model spin and parity assignments. Non-linear F-K plot also reported by 53M11.
$3/2,5/2^-$ 6.4 $\underline{3/2^-}$					0.067	2		pc, a	51B5	
					0.063	2		pc	49W10	
				No γ (< 1%)					49F6, 49W10	
$\mathrm{Zn}_{30\ 33} \xrightarrow{63} \mathrm{Cu}_{29\ 34}$	3.342	5	38.3^m	β^+	2.36	4	85%$^+$	s	47H20	1.40 β^+ (7%$^+$) + 0.96 γ gives good energy match. ~0.47β^+ (1%$^+$) and other γ's (47H20).
$3/2,5/2^-$ 5.4 $\underline{3/2^-}$					2.320	5		s	41T1	
$\mathrm{Cu}_{29\ 35} \xrightarrow{64} \mathrm{Ni}_{28\ 36}$	1.678	2	12.80^h	β^+	0.657	4		s	48C2	1.34 γ (~0.3%)(53D30, 52V3, 52B31, 50K51, 49B16, 48K10, 47D7). 0.656 β^+ branching ~60%^{T} (50R12, 47P10, 48C2, 49B16, 46B3, 49H21, 48C14). See β^- branching below.
1^+ 4.9 0^+					0.644	6*		s	47P10	
					0.659	3		s	46B3	
$\mathrm{Cu}_{29\ 35} \xrightarrow{64} \mathrm{Zn}_{30\ 34}$	0.573	2	12.80^h	β^-	0.571	2		s	48C2	0.573 β^- branching ~40%$^-$ (50R12, 47P10, 48C2, 49B16, 46B3, 49H21, 48C14). See $\beta^+ + \epsilon$ branching above.
1^+ 5.3 0^+					0.570	6*)		s	47P10	
					0.578	3		s	46B3	
$\mathrm{Ga}_{31\ 33} \xrightarrow{64} \mathrm{Zn}_{30\ 34}$	≳6	1	2.6^m	β^+	~5	1*		scin	53C14	0.97γ, 2.2γ?, 3.8γ present. Q = 7.2 ± 0.5 from (p,n) threshold (53C14).
1^+ ≳5.6 0^+										

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Mev	Error	%	Method	Ref.	Comments
$_{28}Ni_{37} \xrightarrow{65} {}_{29}Cu_{36}$ $5/2^-$ 6.6 $\underline{3/2^-}$	2.10	2	2.564^h	β^-	2.10	2*	57%⁻	s	49S21	1.01 β^- (14%⁻) + 1.12 γ and 0.60 β^- (29%⁻) + 1.49 γ give good energy match (49S21).
					1.97	13		a	49M38	
$_{30}Zn_{35} \xrightarrow{65} {}_{29}Cu_{36}$ $3/2, 5/2^-$ 7.3 $\underline{3/2^-}$	1.347	1	245^d	β^+	0.325	3	$56\%^T$	s	53P14	1.1 γ from ϵ branch.
					0.327	3	$56\%^T$	s	53B74	
					0.320	4		s	53Y4	
					0.325	2		s	53B82	
					0.325	2		s	49M57	
				No $\beta\gamma$					52M8	
$_{31}Ga_{34} \xrightarrow{65} {}_{30}Zn_{35}$ $3/2^-$ 4.5 $3/2, 5/2^-$	3.1 (see comments)	1	8^m	β^+	2.1	1		a	54K7	All 2.1 β^+'s listed were observed with 15^m half-life. 2 β^+ groups (2.1, 90%⁻, and 2.5, 10%⁻) reported by 53C15. 8^m β^+ decay, and 15^m γ's of 0.052, 0.092 and 0.114 found (54C7). Since no 8^m γ is observed (54C7), 8^m state is assumed to be ground. $E_\gamma/\beta^+ < 0.3$ (54K7).
					2.1	1*		s	53C15	
					2.1	1*		a	52P27	
					2.2	1		a	52A31	
				No γ					54C7	
$_{29}Cu_{37} \xrightarrow{66} {}_{30}Zn_{36}$ 1^+ 5.3 0^+	2.63	2	5.10^m	β^-	2.63	2	91%⁻	s	51F19	1.59 β^-(9%⁻)+ 1.04 γ gives good energy match (51F19, 51R22). $E_\gamma/\beta = 0.10$ (54K7).
					2.60	5	90%⁻	a	54K7	
					2.7	1	95%⁻	scin	51R22	
$_{31}Ga_{35} \xrightarrow{66} {}_{30}Zn_{36}$ 1^+ 7.8 0^+	5.17	3	9.45^h	β^+	4.144	41*	67%⁺	s	50L55	Several lower energy β^+'s and complex γ spectrum give consistent decay scheme (53M69, 52M35, 52M32).
					4.15	5	56%⁺	s	52M35	
				No (4.15 β^+)γ					52M35	
				No (4.14 β^+)(1.03γ)					50M24	
$_{29}Cu_{38} \xrightarrow{67} {}_{30}Zn_{37}$ $3/2^-$ 6.3 $\underline{5/2^-}$	0.572	8	61^h	β^-	0.577	6*	20%⁻	s	53E11	0.484 β^-(35%⁻)+ 0.092 γ and 0.395 β^- (45%⁻)+ 0.182 γ give good energy match (53N5, 53E11).
					0.550	20		a	53N5	
					0.54	2		a	50K5	
$_{31}Ga_{36} \xrightarrow{67} {}_{30}Zn_{37}$ $3/2^-$ $\underline{5/2^-}$	>0.88 ≲1	2	77.9^h	No β^+ (< 0.01%)					53M52, 52M35	β^+ expected if Q > 1.
				γ	0.880	18*		scin	53K17	
$_{32}Ge_{35} \xrightarrow{67} {}_{31}Ga_{36}$ $3/2, 5/2^-$ ≥5.7 $3/2^-$	~4.4	3	19^m	β^+	3.4	3		a	53A23	0.17 γ present (53A23).
$_{29}Cu_{39} \xrightarrow{68} {}_{30}Zn_{38}$ 1^+ ≥4.6 0^+	≥3.0	2	32^s	β^-	3.0	2		a	53F10	Weak γ (53F10).
$_{31}Ga_{37} \xrightarrow{68} {}_{30}Zn_{38}$ 1^+ 5.2 0^+	2.90	2	68^m	β^+	1.88	2	82%⁺	s	52M35	0.77 β^+ (3%⁺) + 1.10 γ gives good energy match (52M35). $E_\gamma/\beta < 0.1$ (54K7)
					1.90	4		a	54K7	
					2.0	1*		a	37M2	
					1.9	1*		a	37R1	
$_{30}Zn_{39} \xrightarrow{69} {}_{31}Ga_{38}$ $1/2^-$ 4.4 $\underline{3/2^-}$	0.897	5	52^m	β^-	0.897	5		s	53D3	Simple β^- decay (53D3).
					0.92	2		s	53D31	
					0.86	4		a 39L2	46B27	
				No Ga^{69} γ's					53D3	
$_{32}Ge_{37} \xrightarrow{69} {}_{31}Ga_{38}$ $3/2, 5/2^-$ 6.7 $\underline{3/2^-}$	2.23 or 3.35 (see comments)	2 2	39.6^h	β^+	1.215	12*	88†	s	51H38	Although the transition between ground states can be considered l-forbidden and (1.2 β^+)γ coincidences are reported, β decay energy systematics (54W1) and the fact that l is not a perfect quantum number suggest that the 1.2 β^+ may be between ground states. Complex β^+ and γ spectra are observed (51H38).
					1.0	1*	33%⁺	a	48M32	
					1.22	4		a 38M1	46B27	
				γ	1.120	11*		s	51H38	
					1.22	12*		a	48M32	
				(1.215 β^+)γ					51H38	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{31}Ga_{39} \xrightarrow{70} {}_{32}Ge_{38}$ 1^+ ≥ 5.1 $\underline{0^+}$	1.65	2	20.3^m	β^-	1.65 1.62 1.68	2* 8* 8*		s a cc	48H23 47B13 39S9	1.04γ (<1%), 0.174γ (<1%), and $\gamma\gamma$ coincidences suggest complex β^- decay (54B16). Decay to Zn^{70} also possible.
$_{33}As_{37} \xrightarrow{70} {}_{32}Ge_{38}$ $4,5^+$ 5.8 $4^+?$ $2^+?$ $\underline{0^+}$	$\geq$3.7 6.7?	1	52^m	β^+	2.7	1*		a	52V9	γ's of 1.04, 2.0, and possibly 1.7 are reported with $\epsilon/\beta^+ < 0.2$ and $\gamma/\beta^+ \sim 2$ (52V9).
$_{34}Se_{36} \xrightarrow{70?} {}_{33}As_{37}$ 0^+	> 1		$\sim 44^m$	β^+					48H4	
$_{30}Zn_{41} \xrightarrow{71} {}_{31}Ga_{40}$ $1/2^-$ ≥ 4.7 $\underline{3/2^-}$	2.3 (see comments)	2	2.2^m	β^-	2.4 2.1	2 2*		a a	54L18 46H25	A $3^h Zn^{71}$ state is observed to decay by 1.5 β^-+ 0.38γ+ 0.49γ+ 0.61γ (54L18). Since either the 2.2^m or 3^h state should be $1/2^-$, the 2.2^m β^- is assumed to go to the measured $3/2^-$ ground state of Ga^{71}. However, 0.51γ reported "following" 2.4 β^- (54L18).
$_{32}Ge_{39} \xrightarrow{71} {}_{31}Ga_{40}$ $1/2^-$ 4.3 $\underline{3/2^-}$	0.24	1	11.4^d	No β^+ Continuous γ spectrum E_γ (max)	 0.225	 12		 scin	47S33, 48M32 53S47	K binding energy = 0.0111
$_{33}As_{38} \xrightarrow{71} {}_{32}Ge_{39}$ $3/2,5/2^-$ ≥ 5.8 $1/2^-$	$\geq$1.83 $\leq$2.00	2 2	60^h	β^+ γ	0.815 $\sim$0.80 0.175 0.175 0.162	20 2* 2* 2* 2*		s s s s s	53A5 53S31 53A5 53S31 50M25	Another γ of 0.0233 possible (53A5). $3/2^-$ assignment for As^{71} suggests β^+ to ground while $5/2^-$ assignment implies β-γ cascade.
$_{30}Zn_{42} \xrightarrow{72} {}_{31}Ga_{41}$ 0^+ 8.5 $3,4^-$	$\geq$1.6	1	49^h	β^- γ	1.6	1*	5%$^-$	a	50S1 50S1	0.3 β^- (95%$^-$) (50S1). Since Ga^{72} and Ge^{72} are <u>not</u> connected by a β^- transition between ground states, it is highly probable that this is also the case with the Zn^{72}-Ga^{72} pair.
$_{31}Ga_{41} \xrightarrow{72} {}_{32}Ge_{40}$ $3,4^-$ 8.9 2^+ $\underline{0^+}$	4.00	2	14.1^h	β^- γ	3.15 3.17 0.84 0.83	3* 3* 1* 1*	9.5%$^-$ 8 %$^-$	s s s s	48H23 48M17 48H23 48M17	Very complex β and γ spectrum but intensities and energy match support the adopted Q. Also $\beta\gamma$ coincidences as f(E_β) and E_γ/β indicate no transition between ground states. (48H23, 47M29, 47B22).
$_{33}As_{39} \xrightarrow{72} {}_{32}Ge_{40}$ 2^- 9.3^1 $\underline{0^+}$	4.36	3	26^h	β^+	3.34	3*		s	50M25	Very complex decay, but energy match is good with levels of Ge^{72} (as given by Ga^{72} decay) if 3.34 β^+ from As^{72} goes to ground state of Ge^{72}. 3.34 β^+ shows $\Delta I = 2$, yes shape.
$_{34}Se_{38} \xrightarrow{72} {}_{33}As_{39}$ 0^+ 2^-	> 0		9.7^d	ϵ					48H4	
$_{31}Ga_{42} \xrightarrow{73} {}_{32}Ge_{41}$ $3/2^-$ 6.0 $1/2^-$? $\underline{9/2^+}$	1.5	1	5.0^h	β^- γ_1 γ_2	1.4 0.0539 0.053 0.0135 0.0130	1* 5 1* 3 1*		a s s s s	50S1 52J21 53S31 52J21 53S31	γ_1 and γ_2 are observed in the decay of As^{73} and are <u>assumed</u> in the decay of Ga^{73}. γ_2 is shown to follow γ_1 (53W25)

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{33}As_{40} \xrightarrow{73} {}_{32}Ge_{41}$ 3/2⁻ 1/2⁻ ? 9/2⁺	$\lesssim 1$ > 0.07		76^d	No β^+, ϵ only					48M31	γ_2 is shown to follow γ_1 (53W25).
				γ_1	0.0539	5		s	52J21	
					0.053	1*		s	53S31	
				γ_2	0.0135	3		s	52J21	
					0.0130	1*		s	53S31	
$_{34}Se_{39} \xrightarrow{73} {}_{33}As_{40}$	$\gtrsim 2.70$	2	7.08^h	β^+	1.68	2*	1.2†	s	51S70	7.08^h state is possibly not ground state. Complex β^+ and γ spectra (51S70).
$_{33}As_{41} \xrightarrow{74} {}_{32}Ge_{42}$ 2⁻ 6.9 2⁺ 8.6[1] 0⁺	2.56	1	17.5^d	β^+	0.92	1*	62 %^{T}	s	51J6	1.53 β^+ (4 %^{T}) gives good energy match. (51J6). Its $\Delta I = 2$, yes shape is in accord with the $\Delta I = 2$, yes shape exhibited by the β^- decay of As^{74} to the ground state of Se^{74} (see below).
					0.96	1*		s	50M55	
					0.95	1*		s	42E4	
				γ	0.5963	10		s	51J6	
					0.593	3		s	50M55	
					0.588	6*		s	42E4	
					0.582	6*		s	41D1	
				(0.92 β^+) γ					51J6	
				0.588 γ follows ϵ and β^+					42E4	
$_{33}As_{41} \xrightarrow{74} {}_{34}Se_{40}$ 2⁻ 8.6[1] 0⁺	1.36	1	17.5^d	β^-	1.36	1*	17 %⁻	s	51J6	Only (51J6) uses $\Delta I = 2$, yes shape correction. 0.69 β^- (17 %⁻) + 0.635 γ give fair energy match (51J6).
					1.45			s	50M55	
					1.40			s	42E4	
$_{32}Ge_{43} \xrightarrow{75} {}_{33}As_{42}$ 1/2⁻ 5/2 3/2⁻	1.14	1	82^m	β^-	1.137	11*	85 %⁻	s	52S51	0.614 β^- ($\sim$15 %⁻) present (52S51). Complex γ spectrum (54S3, 52S51).
					1.3	1*		a	50R66	
					1.2	1		a	41S3	
				No (1.137 β^-) γ					52S51	
$_{34}Se_{41} \xrightarrow{75} {}_{33}As_{42}$ 5/2 3/2⁻	$\lesssim 1$ > 0.4		127^d	No β^+, ϵ only					53J8, 50C57, 47F8	Complex γ spectrum (54S3, 53J8, 50C57, 49T2).
				γ	0.405			s	53J8	
$_{35}Br_{40} \xrightarrow{75} {}_{34}Se_{41}$ 3/2,5/2⁻ 6.6 5/2	$\gtrsim 2.72$	2	1.6^h	β^+	1.70	2*	46†	s	52F4	No γ (48W8). Complex β^+ (52F4).
					$\sim$1.8	1*		a	51H42	
					1.6	1*		a	48W8	
$_{33}As_{43} \xrightarrow{76} {}_{32}Ge_{44}$ 2⁻ >6.9[1] 0⁺	1.69	3	26.8^h	β^+	0.67	3	<0.1 %⁺	s	54M22	β^- branching (see below).
$_{33}As_{43} \xrightarrow{76} {}_{34}Se_{42}$ 2⁻ 8.8[1] 0⁺	2.97	1	26.8^h	β^-	2.96	1*	53 %⁻	s	53H47	Only 53H47 and 52T18 correct for $\Delta I = 2$, yes shape. 2.40 β^- (32 %⁻) + 0.56 γ gives good energy match (53H47, 52T18, 49M3, 47S9). Three other branches present.
					2.98	1	52 %⁻	s	52T18	
					3.04		60 %⁻	s	47S9	
					3.12		54 %⁻	s	49M3	
$_{35}Br_{41} \xrightarrow{76} {}_{34}Se_{42}$? 8.1 0⁺	4.59	7	17.2^h	β^+	3.57	7	46†	s	52F4	F-K plot seems straight. Four other β's, eight γ's (52F4).
					3.5			s	51H42	
				No (3.57 β^+) γ					52F4	
$_{36}Kr_{40} \xrightarrow{76} {}_{35}Br_{41}$ 0⁺ ?	< 1.6	1	9.7^h	No β^+ with $E_{\beta+} > 0.6$				a	54C3	
$_{32}Ge_{45} \xrightarrow{77} {}_{33}As_{44}$ 7/2⁺ 7.6 3/2⁻	2.46	2	12^h	β^-	2.196	22*	42 %⁻	s	52S13	β^- and γ spectra are complex. 0.264 γ is believed in coincidence with 2.196 β from intensity considerations (52S13).
				γ	0.264	3*		s	52S13	
				(2.196 β^-) γ					52S13	
$_{33}As_{44} \xrightarrow{77} {}_{34}Se_{43}$ 3/2⁻ 5.8 1/2⁻	0.684	9	39^h	β^-	0.700	7		s	51C4	($\sim$0.44 β^-)(0.25 γ) coincidences (1.5 %) give energy match. Other γ's. (53S47, 53B57, 53R12, 53R18).
					0.679	4		s	51J1	
				No (0.7 β) γ					53S47	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Mev	Error	%	Method	Ref.	Comments
$_{35}Br_{42} \xrightarrow{77} {}_{34}Se_{43}$	1.36	1	57.2^h	β^+	0.336	4*		s	51C28	Complex γ spectrum and $x\gamma$ coincidences. (51C28, 52F4, 53B57). No other β^+ (51C28).
$3/2^-$ >5.4 $\underline{1/2^-}$					0.36	1*		s	48H27	
					0.36	1*	$5\%^+$	a,s	48W8	
				No $\beta^+\gamma$					52F4	
$_{36}Kr_{41} \xrightarrow{77} {}_{35}Br_{42}$	≥2.7	2	1.1^h	β^+	1.7	2*	$30\%^+$	a	48W7	If β^+ transition is allowed then $\epsilon/\beta+ \sim 2.6$ indicates too much ϵ for single transition. Thus, γ may well be due to complex decay.
$1/2^-$ ≥5.4 $3/2^-$				γ					48W7	
$_{32}Ge_{46} \xrightarrow{78} {}_{33}As_{45}$	>0.9	1	86^m	β^-	0.9	1*		a	50S2	
0^+ ≥4.7				γ					50S2	
$_{33}As_{45} \xrightarrow{78} {}_{34}Se_{44}$	4.1	1	90^m	β^-	4.1	2*			53C33	1.4 β^- ($30\%^-$) present (50S2).
7.6 $\underline{0^+}$					4.1	2*	$70\%^-$	a	50S2	
				No $(4.1\beta)\gamma$					51S40	
$_{35}Br_{43} \xrightarrow{78} {}_{34}Se_{44}$	≥3.42	8	6.4^m	β^+	2.40	8		a	37S2 46B27	0.046 and 0.108 γ's (39V2) may be in isomeric state of Br^{78} (53M47).
1^+? ≥4.5 $\underline{0^+}$										
$_{33}As_{46} \xrightarrow{79} {}_{34}Se_{45}$	2.3	1	9^m	β^-	2.3	1		a	53C33	
$3/2^-$ 5.3 $1/2^-$					2.1	1*		a	52V1	
$\underline{7/2^+}$				From $3.9^m Se^{79}$ isomer					53C33	
				γ	0.0959	3		s	52R10	
$_{34}Se_{45} \xrightarrow{79} {}_{35}Br_{44}$	0.16	1	6.5×10^{4y}	β^-	0.16	1*		a	50P76	ΔI = 2, yes shape not as yet observed.
$\underline{7/2^+}$ 9.1^1 $\underline{3/2^-}$					~0.15	1*		a	50K43	
				No γ					50P76	
$_{36}Kr_{43} \xrightarrow{79} {}_{35}Br_{44}$	1.924	7	34.5^h	β^+	0.595	6*	$10\%^+$	s	51B16	$\epsilon/\beta+ \sim 10$ indicates decay is predominantly to one level, hence γ's are probably in cascade with β^+.
$7/2^+$ 5.3					~0.6			a	50h2	
$\underline{3/2^-}$				γ_1	0.263	3*		s	51B16	
					0.2			a	50h2	
				γ_2	0.044	1*		s	51B16	
$_{35}Br_{45} \xrightarrow{80} {}_{34}Se_{46}$	1.888	6	18.5^m	β^+	0.862	10	$3.6\%^+$	s	54L19	β^- branching ($\sim 89\%^-$)
1^+ ~4.5 $\underline{0^+}$					0.868	7	$2.6\%^+$	s	51L8	
					1.0			s	49D19	
					~0.8			s	48W8	
					0.73			a	47B8	
							$3.3\%^+$		51M16	
$_{35}Br_{45} \xrightarrow{80} {}_{36}Kr_{44}$	2.00	1	18.5^m	β^-	2.04	2	$79\%^-$	s	54L19	0.62γ, presumably in cascade with $\sim 1.4\beta^-$ ($\sim 10\%^-$)(53S71, 54L19, 54L17).
1^+ 5.5 0^+					1.97	3	$72\%^-$	s	52F4	
					1.99	1	$76\%^-$	s	52L11	
				No $(1.97\beta^-)\gamma$					52F4	
$_{34}Se_{47} \xrightarrow{81} {}_{35}Br_{46}$	1.40	5	17^m	β^-	1.38	5		s	49B59	
$1/2^-$ 4.7 $\underline{3/2^-}$					1.5	1*		s	52R10	
				No γ					50g1, 52R10	
$_{36}Kr_{45} \xrightarrow{81} {}_{35}Br_{46}$	>0		2.1×10^{5y}	ϵ				a	50R54	
$7/2^+$ $\underline{3/2^-}$										
$_{37}Rb_{44} \xrightarrow{81} {}_{36}Kr_{45}$	2.20	5	4.7^h	β^+	0.99	5	$6\%^+$	s	50K62	0.95γ present but β^+ : K : γ = 0.1 : 1 : 0.6 (50K62) implies γ not in cascade with β^+
$3/2^-$ 5.7 10^s $1/2^-$				From 10^s Kr^{81} isomer					50K62	
$7/2^+$				γ	0.187	3		s	40C6	
					0.193	10		a	50K62	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{38}Sr_{43} \xrightarrow{81} {}_{37}Rb_{44}$ 3/2$^-$	> 1		29^m	β^+					50C79	
$_{35}Br_{47} \xrightarrow{82} {}_{34}Se_{48}$ 0$^+$			35.9^h	$\beta^+/\beta^- < 2 \times 10^{-4}$ $(\epsilon + \beta^+)/\beta^- < 3 \times 10^{-4}$					51M16 50R12	β^- decay (see below)
$_{35}Br_{47} \xrightarrow{82} {}_{36}Kr_{46}$ 0$^+$			35.9^h	Complex β^- and γ spectra Various Q's proposed Q = 3.15 = 3.57 = 2.38					 41R1 50S78 52H52	Insufficient data available to choose a Q from the proposed schemes.
$_{37}Rb_{45} \xrightarrow{82} {}_{36}Kr_{46}$ 0$^+$			6.3^h	Complex β^+ and γ spectra Various Q's proposed Q = 2.57 = 2.87					 52H52 53E16	The data do not permit a choice of Q from the schemes proposed. β decay energy systematics (54W1) suggests Q~4. 1.25^m Rb^{82} isomer has 3.15 β^+ (50C79) and no γ with $E_\gamma > 0.6$ (53L27) also suggesting Q~4 for 6.3^h Rb^{82}.
$_{38}Sr_{44} \xrightarrow{82} {}_{37}Rb_{45}$ 0$^+$ $1.25^m 1^+$?			26^d	ϵ					53K10, 50C79	Parent of $1.25^m Rb^{82}$ but not $6.3^h Rb^{82}$ (53L27, 53K10, 50C79) suggesting, as does the Rb^{82} decay, that $1.25^m Rb^{82}$ has low spin and $6.3^h Rb^{82}$ has high spin.
$_{34}Se_{49} \xrightarrow{83} {}_{35}Br_{48}$ 69^s 1/2$^-$ 26^m 9/2$^+$ ≥5.0 ?$^+$ 3/2$^-$	> 1.5 < 3.4	1	26^m	β^- Several γ's 0.04 ⟶ 1.1	1.5 1.5	1* 1*		a a	52R10 46PP 46PP, 52R10	Upper limit on Q from 3.4 β^- of $69^s Se^{83}$ isomer which presumably decays to the ground state of Br^{83}.
$_{35}Br_{48} \xrightarrow{83} {}_{36}Kr_{47}$ 3/2$^-$ ≥5.0 1.9^h 1/2$^-$ 7/2$^+$ 9/2$^+$	0.98	1	2.4^h	β^- From 1.9^h Kr^{83} isomer γ_1 γ_2	0.94 0.940 0.0322 0.032 0.0093 0.009	2 10 3* 1* 1* 1*		s s s pc s pc	52F4 51D3 50e1, 40L3 51B11 52B28 51B11 52B28	0.05γ (53S63) may be due to unresolved complex β^- decay.
$_{37}Rb_{46} \xrightarrow{83} {}_{36}Kr_{47}$ 3/2, 5/2$^-$ 9/2$^+$	>0.8	1	83^d	ϵ γ	 0.8	 1*		 a	50K62 50C79	Parent of 1.9^h Kr^{83}. ~0.15γ and ~0.45γ also present (50C79).
$_{38}Sr_{45} \xrightarrow{83} {}_{37}Rb_{46}$ ≥6.0 3/2, 5/2$^-$	≥2.17	5	38^h	β^+ Several γ's 0.04 ⟶ 0.165	1.15	5		s	50C79 50C79	
$_{34}Se_{50} \xrightarrow{84} {}_{35}Br_{49}$ 0$^+$	> 0		~2^m	Parent of 32^m Br^{84}					50e1, 50k2	
$_{35}Br_{49} \xrightarrow{84} {}_{36}Kr_{48}$ 7.6 0$^+$	5.57 or 4.68	1 1	32^m	β^- No $\beta\gamma$ for $E_\beta > 3.5$ γ	4.679 0.890	10 9*	40%$^-$	s scin	51D3 51D3 52L25	3.56 β^- (9%$^-$), 2.53 β^- (16%$^-$), and 1.72 β^- (35%$^-$) present. β^- transitions may come from short-lived daughter of 32^m state (51D3). 0.89γ (Cf. Rb^{84}) may follow 4.68 β^- (52L25).
$_{37}Rb_{47} \xrightarrow{84} {}_{36}Kr_{48}$ 2$^-$ 9.1[1] 0$^+$	2.64	2	34^d	β^+ No (1.63 β^+) γ	1.629 1.53	5 2*	39†	s s	52H52 50K62 52H52	1.6 β^+ shows ΔI = 2, yes shape. 0.82β^+ (58†) + 0.89γ gives good energy match (52H52).

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{37}Rb_{47} \xrightarrow{84} {_{38}Sr_{46}}$ 2^- 0^+			34^d	β^-	very weak if present				52H52	
$_{39}Y_{45} \xrightarrow{84} {_{38}Sr_{46}}$ ≥ 5.8 0^+	≳3.0	1	3.7^h	β^+	2.0	1		a	49S9	γ present (49S9).
$_{35}Br_{50} \xrightarrow{85} {_{36}Kr_{49}}$ $3/2^-$ 5.1 $4.4^h 1/2^-$ $9/2^+$	2.8	1	3.00^m	β^-	2.5	1*		a	49S14	
				No γ					48S16	
				From 4.4^h Kr^{85} isomer					40S3,43B1	
				γ	0.3050	2		s	52B55	
$_{36}Kr_{49} \xrightarrow{85} {_{37}Rb_{48}}$ $4.4^h 1/2^-$ $10^y 9/2^+$ 8.3^1 $5/2^-$	0.68	1	10.3^y	β^-	0.666	7*		s	52B55	0.69 β^- shows $\Delta I = 2$, yes shape (50Z51, 52B55). 0.83 β^- + 0.1495γ - 0.3050γ from 4.4^h isomeric state gives energy match (52B55).
					0.695	5	~100%⁻	s	50Z51	
$_{38}Sr_{47} \xrightarrow{85} {_{37}Rb_{48}}$ $70^m 1/2^-$ $65^d 9/2^+$ $9/2^+$? $5/2^-$	≲1.5		65^d	No β^+					51T11	If 70^m Sr^{85} has no β^+, Q≲1 is implied for 65^d Sr because 70^m Sr^{85} decays by ϵ to 0.15 level ($3/2^-$) of Rb^{85} and by 0.23γ to 65^d Sr^{85}.
				γ	0.513	5*		s	52S29	
					0.514	3		s	52E2	
					0.513	3		s	51T11	
				$x/\gamma \sim 1$					52E2	
$_{37}Rb_{49} \xrightarrow{86} {_{36}Kr_{50}}$ 2^- 0^+			19.5^d	$\epsilon_K/\beta^- < 0.001$					53S39	β^- decay (see below).
				$\beta^+/\beta^- < 1.6 \times 10^{-5}$					51M16	
$_{37}Rb_{49} \xrightarrow{86} {_{38}Sr_{48}}$ 2^- 8.4^1 0^+	1.783	4	19.5^d	β^-	1.785	5		s	52M29	$\Delta I = 2$, yes shaped observed (52M29, 51M2, 50M67). (0.7β^-)(1.08γ) coincidences give good energy match (50M67, 53H40, 51M2, 51P8).
					1.760	10		s	51M2	
					1.80	1		s	50M67	
							~80%⁻		48Z2	
$_{39}Y_{47} \xrightarrow{86} {_{38}Sr_{48}}$ 6.7 0^+	4.2 ?	1	14.6^h	β^+	1.80	2	50†	s	51H24	1.2 β^+ (50†) also present (51H24). γ tentatively considered in cascade with 1.8 β^+.
				γ	1.4	1*		a	51H24	
$_{40}Zr_{46} \xrightarrow{86} {_{39}Y_{47}}$ 0^+			17^h	No β^+					51H24	
$_{35}Br_{52} \xrightarrow{87} {_{36}Kr_{51}}$ $3/2, 5/2^-$ 7.3 $5/2^+$	8.0	5	55.6^s	β^-	8.0	5	30%⁻	a	53S2	2.6 β^- (70%⁻) + 5.4γ gives energy match. Other γ's also present (53S2).
$_{36}Kr_{51} \xrightarrow{87} {_{37}Rb_{50}}$ $5/2^+$ 7.3 $3/2^-$	3.63	7	78^m	β^-	3.63	7	75%⁻	s	52T16	1.27 β^- (25%⁻) + 0.405γ + 1.89γ gives good energy match (52T16).
					3.2	3		a	49K13	
$_{37}Rb_{50} \xrightarrow{87} {_{38}Sr_{49}}$ $3/2^-$ 17.6 $9/2^+$	0.274	4	6.2×10^{10y}	β^-	0.275	8*		s	54M27	Third forbidden non-unique β^- transition.
					0.275	8*		scin	52L24	
					0.275	8*		pc	51C30	
					0.270	8*		scin	50B38	
				No βe^-					52M20,52B54	
				No ce^- or γ					52L24	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Type	Mev	Error	%	Method	Ref.	Comments
$Y_{39\ 48} \xrightarrow{87} Sr_{38\ 49}$	> 0.389	1	80^h	β^+	~0.7	1*	$0.3\%^+$	s	51M46	
$1/2^-$ 7.6 $2.8^h 1/2^-$	or ~2.1	1			~0.7	1*		s	50R3	
$\underline{9/2^+}$				No 0.7 β^+					51H24	
				From 2.8^h Sr^{87} isomer					51H24, 51M46	
				γ	0.3882	39*		s	52G14	
					0.388	4*		s	52B33	
					0.390	2		s	51M46	
					0.388	4*		s	51T11	
					0.394	4		s	51H24	
$Zr_{40\ 47} \xrightarrow{87} Y_{39\ 48}$	3.51	2	1.6^h	β^+	2.10	2		s	51H24	0.35γ and 0.65γ present (49S9).
$7/2,9/2^+$ 5.5 $14^h 9/2^+$					2.0	1*		a	49S9	
$\underline{1/2^-}$				No ce^- or γ					51H24	
				From 14^h Y^{87} isomer					51H24	
				γ	0.3813	38*		s	52G14	
					0.384	3		s	51M46	
					0.389	4*		s	51H24	
$Kr_{36\ 52} \xrightarrow{88} Rb_{37\ 51}$	2.7	1	2.77^h	β^-	2.7	1*	$20\%^-$	s	51T19	(52T19) corrects for probable $\Delta I = 2$, yes shape. 0.52 β^- ($68\%^-$), 0.9 β^- ($12\%^-$)?, and 0.028γ (52T19).
0^+ 8.6^1 2^-					2.4			a	49K13	
					2.4			a	48J20	
$Rb_{37\ 51} \xrightarrow{88} Sr_{38\ 50}$	5.17	7	17.7^m	β^-	5.13	3	$66\%^-$	s	51B2	$\Delta I = 2$, yes shape (51B2, 52T19). 3.29 β^- ($19\%^-$) + 1.86γ and 2.04 β^- ($15\%^-$) + 0.90γ + 1.86γ give good energy match (51B2). Disagreement about lower energy β's (52T19, 51G35).
2^- 8.2^1 $\underline{0^+}$					5.30	5	$78\%^-$	s	52T19	
					5.2	1	$65\%^-$	a	51G35	
				No $(5.2\beta)\gamma$					51G35	
$Y_{39\ 49} \xrightarrow{88} Sr_{38\ 50}$	3.74	3	105^d	β^+	0.83	2	$0.2\%^+$	s	48P13	99% of disintegrations go by $\epsilon + 0.91\gamma + 1.85\gamma$. Crossover 2.76γ present (48P13, 43G4).
9.6 2^+				γ	1.853	37		s	48P13	
$\underline{0^+}$					1.89	5		s	41D4	
					1.92	3		cc	41R3	
$Zr_{40\ 48} \xrightarrow{88} Y_{39\ 49}$	> 0.406	4	85^d	ϵ					51H24	
0^+				γ	0.406	4		s	51H24	
$Kr_{36\ 53} \xrightarrow{89} Rb_{37\ 52}$	4.0	1	3.18^m	β^-	4.0	2*	$65\%^-$	a	51K10	2.0 β^- ($35\%^-$) + γ (51K10).
$5/2,7/2^+$ 6.2 $3/2,5/2^-$					3.9	2*		recoil	51K13	
$Rb_{37\ 52} \xrightarrow{89} Sr_{38\ 51}$	4.5	3	15.4^m	β^-	4.5	3		a	40G5, 46B27	
$3/2,5/2^- \geq 6.9$ $5/2^+$										
$Sr_{38\ 51} \xrightarrow{89} Y_{39\ 50}$	1.464	9	53^d	β^-	1.463	5		s	49L6	1.5 β^- shows $\Delta I = 2$, yes shape (49L6, 49S10).
$5/2^+$ 8.3^1 $\underline{1/2^-}$					1.50	2*		s	49S10	
				No γ					39S8, 49S10, 50O3	
$Zr_{40\ 49} \xrightarrow{89} Y_{39\ 50}$	2.841	7	79.3^h	β^+	0.901	10		s	53S48	Experimental $\epsilon/\beta^+ \sim 3$ (51G42) is in agreement with theoretical $\epsilon/\beta^+ = 3$ indicating decay to one level; however, other γ's reported (51H24).
$9/2^+$ 6.1 $13^s 9/2^+$					0.905	10*		s	51S24	
$\underline{1/2^-}$					0.910	10		s	51H24	
				From 13^s Y^{89} isomer					51G42, 51S74	
				γ	0.913	5			51S74	
					0.917	5		s	51H24	
					0.910	9*		s	51S24	
				No other γ's					51G42	
				No γ with E_γ = 0.95-2.0					53S48	
				No $\beta\gamma$, $x\gamma$, or $\gamma\gamma$					51S24	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Type	Mev	Error	%	Method	Ref.	Comments
$_{36}Kr_{54} \xrightarrow{90} {}_{37}Rb_{53}$ 0^+ >4.8	≳3.2	2	33^s	β^-	3.2	2*		a	51K10	γ, complex β^- (51K10).
$_{37}Rb_{53} \xrightarrow{90} {}_{38}Sr_{52}$ >6.6 0^+	≳5.7	3	2.74^m	β^-	5.7	3*		a	51K10	γ, complex β^- (51K10).
$_{38}Sr_{52} \xrightarrow{90} {}_{39}Y_{51}$ 0^+ 8.1^1 2^-	0.533	4	19.9^y	β^-	0.531	5*		s	49B11	0.53 β^- shows ΔI = 2, yes shape (49B11, 50L52).
					0.54	1*		s	50L52	
				No γ					50G3,46PP	
$_{39}Y_{51} \xrightarrow{90} {}_{40}Zr_{50}$ 2^- 8.0^1 0^+	2.20	3	65^h	β^-	2.27	2		s	52M29	2.2 β^- shows ΔI = 2, yes shape (52M29, 49L6, 49B11, 50L52).
					2.180	7		s	49L6	
					2.24	2*		s	50L52	
					2.25	2*		s	49B11	
				No γ					50G3,49B11	
$_{41}Nb_{49} \xrightarrow{90} {}_{40}Zr_{50}$ ≥5.6 0^+	4.44	8	14.7^h	β^+	1.19	6*		a	49K19	β^+ probably simple followed by 2.2 Mev of γ's (51B54). 1.14γ and 0.14γ present (51B54).
					1.2	1*		a	53D8	
				γ	2.23	5*		scin	51B54	
$_{42}Mo_{48} \xrightarrow{90} {}_{41}Nb_{49}$ 0^+ ≥5.4	≥2.5 ?	1	5.7^h	β^+	~1.4 ?	1*		a	53D8	Since the ground states of Nb^{90} and Zr^{90} are not connected by β^+, there should be at least one γ in cascade with 1.4 β^+ of Mo^{90}.
				γ's ~0.12, ~0.25, 1.1				a	53D8	
$_{36}Kr_{55} \xrightarrow{91} {}_{37}Rb_{54}$ 5/2,7/2$^+$ >4.5 3/2,5/2$^-$	≳3.6	2	10^s	β^-	~3.6	2*		a	51K10	γ, complex β^- (51K10).
$_{37}Rb_{54} \xrightarrow{91} {}_{38}Sr_{53}$ 3/2,5/2$^-$ >6.0 5/2$^+$ >6.1	≳4.6	2	100^s	β^-	4.6	2*		a	51K10	γ, complex β^- (51K10).
	≳3.0	2	14^m	β^-	3.0	2*		a	51K10	γ, complex β^- (51K10).
$_{38}Sr_{53} \xrightarrow{91} {}_{39}Y_{52}$ 5/2$^+$ 8.2^1 1/2$^-$	2.67	1	9.67^h	β^-	2.665	10	26%$^-$	s	53A8	2.67 β^- shows ΔI = 2, yes shape. Very complex decay with good energy matches. γγ coincidences studied (53A8).
$_{39}Y_{52} \xrightarrow{91} {}_{40}Zr_{51}$ 1/2$^-$ 8.5^1 5/2$^+$	1.549	4	61^d	β^-	1.564	10		s	52M29	All authors listed find ΔI = 2, yes shape for 1.55 β^-. Very weak 1.2 γ (49L6, 54H14). Very weak 0.2γ in cascade with 1.2γ (49L6). 1.2γ observed with 160^d half-life (53B21).
					1.537	7		s	49L6	
					1.54	5		scin	53B21	
					1.56	1		s	50A1	
					1.54	2*		s	49O3	
					1.55	1		s	49W17	
$_{41}Nb_{50} \xrightarrow{91} {}_{40}Zr_{51}$ 62^d1/2$^-$ ~8^y9/2$^+$ 5/2$^+$	>1.1		~8^y	Zr x-ray					51O1	Limit on Q from 62^d Nb^{91} decay by ε + 1.2γ to Zr^{91} and by 0.104γ to ~8^y Nb^{91} (54H14, 51P20, 51O1). Presence of 1.2γ in both 62^d Nb^{91} and 61^d Y^{91} suggests 9/2$^+$ for ~ 8^y Nb^{91} (54H14).
$_{42}Mo_{49} \xrightarrow{91} {}_{41}Nb_{50}$ 15^m1/2$^-$ 66^s9/2$^+$ 4.0 9/2$^+$	3.6	2	66^s	β^+	2.6	2		a	49D10	Mo^{92}(γ,n) 15^m Mo^{91} threshold ~13.1 (53K11) is not expected to be the threshold for a 9/2$^+$ level. Mo^{92}(n,2n) threshold ~12.34 (53B22) suggests that 66^s Mo^{91} is the lower and the expected 9/2$^+$ state.
				No γ					52H62	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{38}Sr_{54} \xrightarrow{92} {}_{39}Y_{53}$ 0^+ ≥ 4.3 1^+? 2^-	1.93	4	2.7^h	β^- γ	0.55 1.38	3* 3*		 scin	54B32 54B32	0.44 γ (54B32).
$_{39}Y_{53} \xrightarrow{92} {}_{40}Zr_{52}$ 2^- $\gtrsim 8.0^1$ 0^+	3.5	1	3.5^h	β^-	3.5 3.6 3.4	2* 2* 2*		a a a	50h3 43B2 41G4	γ present (46PP, 41G4). $\Delta I = 2$, yes shape not yet observed.
$_{41}Nb_{51} \xrightarrow{92} {}_{40}Zr_{52}$ 2,3 2^+ 0^+	> 0.930	6	10.1^d	ϵ γ 0.9 γ follows ϵ	 0.930 0.933 0.91	 9* 9 2*		 s scin scin	53S42,51B54,47K1 53S42 52T6 51B54 53S42,52T6,51B54	1.84γ probably from isomeric state of Nb^{92} (54H14). β^- branching < 0.05% (see below).
$_{41}Nb_{51} \xrightarrow{92} {}_{42}Mo_{50}$ 2,3 0^+			10.1^d	No β^- (< 0.05 %$^-$)					53S42	β decay energy systematics (54W1) predicts Q ~ 1.
$_{43}Tc_{49} \xrightarrow{92} {}_{42}Mo_{50}$ ≥ 5.4 0^+	6.4 (see comments)	6	4.3^m	β^+ γ	4.1 1.3	5* 3		a a	52B82 48M18	β decay energy systematics (54W1) suggests (4.1 β^+) (1.3γ) in cascade.
$_{39}Y_{54} \xrightarrow{93} {}_{40}Zr_{53}$ $1/2^-$ $\geq 8.2^1$ $5/2^+$	3.1	2	10.0^h	β^-	3.1	2*		a	50b6	0.7γ (50b6) is assumed due to complex β^- decay. Probable $\Delta I = 2$, yes shape not yet observed.
$_{40}Zr_{53} \xrightarrow{93} {}_{41}Nb_{52}$ $5/2^+$ 11.1 $\underline{9/2^+}$	0.063	2	9.5×10^{5y}	β^-	0.063	2*	75%$^-$	scin	53G31	0.034 β^- (25%$^-$) + 0.029γ (IT from 3.65^y Nb^{93}) gives energy match (53G31).
$_{42}Mo_{51} \xrightarrow{93} {}_{41}Nb_{52}$ $5/2,7/2^+$ $\underline{9/2^+}$	> 0		$> 2^y$	ϵ					49B44	6.95^h Mo^{93} appears to be a metastable high spin state at ~2.4 Mev above ground (53K52, 53F12, 53A2, 53B24, 52B62, 51R24).
$_{43}Tc_{50} \xrightarrow{93} {}_{42}Mo_{51}$ $9/2^+$? 4.6 $5/2,7/2^+$	3.14	3	2.7^h	β^+ γ β^+ (1.32γ)	0.800 0.83 1.32	5 4* 3*		s a scin	51B48 48K26 51B48 51B48	No 6.95^h Mo^{93} activity from 2.7^h Tc^{93} (51B48). β^+ (1.32γ) coincidences suggest $5/2^+$ for Mo^{93} ground state.
$_{39}Y_{55} \xrightarrow{94} {}_{40}Zr_{54}$ 2^- $\geq 8.1^1$ 0^+	5.4	3	16.5^m	β^-	5.4	3*		a	49B10	1.4γ (49B10) is assumed due to complex β^- decay. $\Delta I = 2$, yes shape not yet observed.
$_{41}Nb_{53} \xrightarrow{94} {}_{40}Zr_{54}$ 6^+ 0^+			2.2×10^{4y}							β decay energy systematics (54W1) suggests Q > 0.
$_{41}Nb_{53} \xrightarrow{94} {}_{42}Mo_{52}$ $6.6^m 3^-$ $10^{4y} 6^+$ 12.1 4^+ 2^+ 0^+	2.07	5	2.2×10^{4y}	β^- γ_1 γ_2	0.50 0.70 0.87	5 1 1		a scin scin	53D18 53D18 53D18	1.57 γ crossover (53D18). 6.6^m Nb^{94} decay gives Q = 1.3(β^-) + 0.87(γ) − 0.04 (IT) = 2.1

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Mev	Error	%	Method	Ref.	Comments
$_{43}Tc_{51} \xrightarrow{94} {}_{42}Mo_{52}$ 2^+ 5.6 2^+ 0^+	4.32	3	52.5^m	β^+	2.41	3*	73%+	s	50M21	0.9 β^+ (~1%+) ? and complex γ spectrum (50M21, 48H5).
					2.47	5		s	47G3	
					2.5	3		a	48M19	
				γ	0.874	9*		s	50M21	
					0.873	4		s	48H5	
					0.9	1		a	48M19	
				$\beta^+\gamma$ for all β^+					50M21	
$_{40}Zr_{55} \xrightarrow{95} {}_{41}Nb_{54}$ $5/2^+$ 6.9 $5/2,7/2^+$ $9/2^+$	1.123	7	65^d	β^-	0.397	10*	43%-	s	54M28	0.364 β^- (54%-) + 0.754γ gives good energy match (54M28). 0.887 β^- (2%-, log f_1t~8.9) goes to 90^h 0.235 level of Nb^{95}.
					0.405	10	~49%-	s	53C23	
				γ	0.722	1		s	54M28	
					0.725	4*		s	53C23	
				$\beta\gamma$					54M28	
				$\gamma/\beta \sim 1$					53M6	
$_{41}Nb_{54} \xrightarrow{95} {}_{42}Mo_{53}$ $9/2^+$ 5.1 $7/2,9/2^+$ $\underline{5/2^+}$	0.931	4	35^d	β^-	0.165	10		s	53C23	
					0.160	3		s	52F14	
					0.159	10		s	53S14	
					0.171	2*		s	53S18	
					0.146	10		s	49H31	
				γ	0.764	1		s	54M28	
					0.768	8*		s	53C23	
					0.771	8*		s	53S18	
					0.774	8*		s	53M14	
					0.745	10		s	53S14	
					0.77	1*		s	52F14	
					0.758	20		s	49H31	
				$\beta\gamma$					50S27, 48M1	
				$\gamma/\beta \sim 1$					53M6	
$_{43}Tc_{52} \xrightarrow{95} {}_{42}Mo_{53}$ $60^d 1/2^-$ 7.8^1 $\underline{5/2^+}$ $20^h 9/2^+$	1.63	1	20^h	From 60^d Tc^{95} isomer						20^h Tc^{95} decays by ϵ only (50M21).
				β^+	0.65	1*	0.4%+	s	51B84	
				IT	0.0390	7		s	50M73	
$_{44}Ru_{51} \xrightarrow{95} {}_{43}Tc_{52}$ $5/2,7/2^+ \geq 4.7$ $9/2^+$	2.1 or 3.1	1 1	1.65^h	β^+	1.1	1*	50%+	a	48E3	ϵ/β^+ should be 2.6 for simple β^+. 0.95γ may be in daughter.
				γ	0.95	10*		a	48E3	
$_{40}Zr_{56} \overset{96}{\text{—}} {}_{41}Nb_{55}$ 0^+ $6,7^+$			Stable ?							Q = 0.3 ± 0.3 from mass spectroscopy (53G35). Q = 0.5 ± 0.5 from double β decay (53M25).
$_{41}Nb_{55} \xrightarrow{96} {}_{42}Mo_{54}$ $6,7^+$ 5.8 $5,6^+$? 2^+ 0^+	3.13	2	23^h	β^-	0.686	5	92%-	s	52J15	Good energy match with other γ chains (0.804 + 0.840 + 0.770), (0.451 + 1.187 + 0.770). 0.37 β^- (8%-) also present (51P20, 52J15).
					0.750	5	92%-	s	51P20	
					0.75	1*		s	50B43	
				γ_1	0.560	2		s	51P20	
				γ_2	1.078	4		s	51P20	
				γ_3	0.770	2		s	51P20	
				Total $E_\gamma \sim 2.39$ follows β^-					51S40	
$_{43}Tc_{53} \xrightarrow{96} {}_{42}Mo_{54}$ $6,7^+$? ? 2^+ 0^+	> 2.73 ≲ 3.4	2	4.35^d	No β^+, ϵ only					47E1, 48M2	Decay scheme fits well with that of Nb^{96}. 80%ϵ to ~2.4 (5,6+) level in Mo^{96} (50M21). β^- branching ? (see below).
				γ_1	1.119	11*		s	50M21	
				γ_2	0.842	9*		s	50M21	
				γ_3	0.771	8*		s	50M21	
				$\gamma\gamma$					48M2	
$_{43}Tc_{53} \xrightarrow{96} {}_{44}Ru_{52}$ $6,7^+$ 0^+			4.35^d	β^- ?					47E1, 48M2	β decay energy systematics (54W1) suggests Q~1, thus if Tc^{96} has spin of 6^+ or 7^+, observable β^- transition is unlikely.

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$Zr_{40\ 57} \xrightarrow{97} Nb_{41\ 56}$; $1/2,3/2^+?$ 7.2 $60^s 1/2^-$; $74^m 9/2^+$	2.67 (see comments)	8	17^h	β^-	1.91	2		s	50B54	The shell model favors $5/2^+$ or $7/2^+$ for Zr^{97} but neither assignment is in accord with the ft value for the $1.9\beta^-$ to 60^s Nb^{97}.
					2.5	1*		a	52M24	
					1.9	1*		a	49S50	
				No $\beta\gamma$					50B54	
				From 60^s Nb^{97} isomer					50B54	
				γ	0.747	5		s	50B54	
					0.74	8*		a	52M24	
$Nb_{41\ 56} \xrightarrow{97} Mo_{42\ 55}$; $9/2^+$ 5.4 $7/2^+$; $\underline{5/2^+}$	1.94	2	74^m	β^-	1.267	20		s	50B54	
					1.35	7*		a	49S50	
					1.4	1*		a	52M24	
				γ	0.665	5		s	50B54	
				$\beta\gamma$					52M24,50B54	
$Tc_{43\ 54} \xrightarrow{97} Mo_{42\ 55}$; $9/2^+$ $\underline{5/2^+}$	> 0		10^4–10^{5y}	Mo K x-rays					54B24	
$Ru_{44\ 53} \xrightarrow{97} Tc_{43\ 54}$; $5/2,7/2^+$; $9/2^+$	> 0.217	2	2.8^d	ϵ					46S11	
				γ	0.217	2		s	50M26	
					0.23	2*		a	46S11	
$Tc_{43\ 55} \xrightarrow{98} Mo_{42\ 56}$; 0^+			?							$5x10^{6y} < \tau < 2.5x10^{8y}$ (54B33).
$Tc_{43\ 55} \xrightarrow{98} Ru_{44\ 54}$; 0^+			?							(see above).
$Rh_{45\ 53} \xrightarrow{98?} Ru_{44\ 54}$; $1^+?$ ≥ 5.4 0^+	≥ 5.0	5	9^m	β^+	4.0	5		a	53A27	
$Nb_{41\ 58} \xrightarrow{99} Mo_{42\ 57}$; $9/2^+?$ 5.5; $1/2^+$	> 3.2	2	2.5^m	β^-	3.2	2*		a	50D54	
$Mo_{42\ 57} \xrightarrow{99} Tc_{43\ 56}$; $1/2^+$ 7.1 $1/2^-$; $\underline{9/2^+}$	1.38	1	68.3^h	β^-	1.225	15	87%⁻	s	51M6	The shell model favors $5/2^+$ or $7/2^+$ for Mo^{99} but an analysis of the complex β and γ spectra suggests $1/2^+$ (54V3). $0.445\ \beta^-$ (~20%⁻) + (0.741γ)(0.041γ)(0.140γ) coincidences gives good energy match (50B91, 54V3).
					1.25	1*		s	51M40	
					1.23	1	80%⁻	s	50B91	
				From 6^h Tc^{99} isomer					50B91,51M6	
				γ_1	0.0018	3		pc	49M45, 51M6	
				γ_2	0.140	3*		scin	54V3	
					0.1412	5		s	49M45, 51M6	
					0.1403	2		s	51M21	
					0.139	1*		s	51M40	
					0.140	1*		s	50B91	
					0.1396	14*		s	49C7	
$Tc_{43\ 56} \xrightarrow{99} Ru_{44\ 55}$; $\underline{9/2^+}$ 12.3 $\underline{5/2^+}$	0.293	2	$2.1x10^{5y}$	β^-	0.290	4		s	52F16	0.29 β^- shows shape consistent with tensor interaction for $\Delta I = 2$, no transition (52F16, 52W1).
					0.296	3*		s	52W1	
					0.292	3		s	51T5	
				No γ					49K34,47M15	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{45}Rh_{54} \xrightarrow{99} {}_{44}Ru_{55}$	2.05	1	4.5^{h}	β^+	0.74	1		s	52S11	
$7/2, 9/2^+$ 4.9	or 1.76	1		γ	0.286	5		s	52F19	
$\underline{5/2^+}$				No γ					52S11	
$_{43}Tc_{57} \xrightarrow{100} {}_{42}Mo_{58}$			15.8^{s}							Direction of decay unknown.
0^+										
$_{43}Tc_{57} \xrightarrow{100} {}_{44}Ru_{56}$	$\gtrsim$2.7	2	15.8^{s}	β^-	2.8	2		a	52B30	γ's present (52H17, 52B30).
≥ 4.3 0^+					2.4	3		a	52H17	
$_{45}Rh_{55} \xrightarrow{100} {}_{44}Ru_{56}$	3.65	7	20.8^{h}	β^+	2.615	20	45†	s	53M64	Complex β^+ and γ spectra permit consistent decay scheme (53M64).
2^- ? $>7.2^1$ 0^+					3.0	1*		s	48L3	$\Delta I = 2$, yes shape not yet observed.
$_{46}Pd_{54} \xrightarrow{100} {}_{45}Rh_{55}$	> 0.0807	4	4.0^{d}	ϵ					48L3	1.8γ (48L3) may be in Rh^{100} decay.
0^+				γ	0.0807	4		s	53M64	
2^- ?					0.09	1*		a	48L3	
$_{42}Mo_{59} \xrightarrow{101} {}_{43}Tc_{58}$	2.3	1	14.6^{m}	β^-	2.2	1*	30%$^-$	a	54W4	1.2 β^- (70%$^-$) + 0.96γ + 0.2γ gives good energy match (52R10, 54W4).
$5/2^+$ 6.0 $7/2^+$					2.1	1*		s	52R10	
$9/2^+$					2.2	1*		a	42M4	
					1.9	1*		a	40S8	
				γ	0.200	20		scin	54W4	
					0.1912	19*		s	52R10	
$_{43}Tc_{58} \xrightarrow{101} {}_{44}Ru_{57}$	1.56	5	14.3^{m}	β^-	1.4	1*		a	54W4	
$9/2^+$ 4.6 $7/2^+$					1.20	5	>95%$^-$	s	51B48	
$\underline{5/2^+}$					1.3	1*		s	52R10	
				γ	0.300	20		scin	54W4	
					0.307	3*		s	52R10	
					0.300	6*		scin	51B48	
				(1.2β^-)(0.3γ)					52R10,51B48	
$_{45}Rh_{56} \xrightarrow{101} {}_{44}Ru_{57}$	> 0.29	1	4.5^{d}	No β^+, ϵ only					52F19,49E4,48L3	~0.14γ also observed (52F19, 52S11, 49E4).
$7/2, 9/2^+$ $7/2^+$				γ	0.286	3*		s	52F19	
$\underline{5/2^+}$					0.300	5		s	52S11	
					0.35	4*		s,a	48L3	
$_{46}Pd_{55} \xrightarrow{101} {}_{45}Rh_{55}$	3.3 ?	2	9^{h}	β^+	2.3	2	~10%$^+$	s	48L3	
$5/2, 7/2^+$ 7.3 or 4.5 $7/2, 9/2^+$	or 1.55 ?	3			0.53	3*	~10%$^+$	a	49E4	
				No γ, no e$^-$					48L3	
$_{42}Mo_{60} \xrightarrow{102} {}_{43}Tc_{59}$	$\geq$1.0	5	11^{m}	β^-	1.0	5		a	52C38	
0^+ 4.2 1^+?										
$_{43}Tc_{59} \xrightarrow{102} {}_{44}Ru_{58}$	$\geq$4.0	3	<25^{s}	β^-	4.1	4		a	52C38	γ present (41H7).
1^+? ~5.2 0^+					3.7	4*		a	49B44	
					~5	1*		a	41H7	
$_{45}Rh_{57} \xrightarrow{102} {}_{44}Ru_{58}$	2.18	5	215^{d}	β^+	1.3	1*		a	50S31	**Mixed β^- and β^+. ~0.46γ probably annihilation radiation (50S31).
2^-? 8.1^1 0^+					1.13	6*		cc	45H1	β^-/β^+ ~ 1.2 (41M2).
					~1.1**	1		a	41M2	
$_{45}Rh_{57} \xrightarrow{102} {}_{46}Pd_{56}$	1.05	5	215^{d}	β^-	1.04	5*		cc	45H1	
2^- ? 8.8^1 0^+					~1.1**	1		a	41M2	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Type	Mev	Error	%	Method	Ref.	Comments
$_{44}Ru_{59} \xrightarrow{103} {}_{45}Rh_{58}$	**0.749**	*6*	39.5^d	β^-	0.217	*4*	~99 %⁻	s	52K27	0.69 β^- (~6 %⁻)(52C16, 52K27, 50M26) shows non-linear F-K plot (52K27). γ's of 0.053, 0.295, and 0.611 also reported (52C16).
? 5.7 ?					0.222	*2**	94 %⁻	s	50M26	
56^m 7/2$^+$					0.205	*2**		s	50S26	
<u>1/2$^-$</u>				γ	0.498	*10**		scin	54B25	
					0.4979	*8*		s	52K12	
					0.498	*2*		s	52K27	
					0.498	*5**		s	52C16	
					0.494	*2*		s	50M26	
				From 56^m Rh^{103} isomer					50M53, 52K27	
				γ	0.0396	*4**		s	52C16	
					0.0400	*5*		s	52K27	
					0.0404	*4**		s	50M26	
				(0.22 β^-)(0.498γ)					52K27	
				No $\gamma\gamma$					52K27	
$_{46}Pd_{57} \xrightarrow{103} {}_{45}Rh_{58}$	**0.56**	*2*	17^d	Continuous γ spectrum						K binding energy = 0.023. 0.503γ, 0.367γ, 0.305γ, and possible 0.262γ present (54R9).
5/2, 7/2$^+$ 5.7 56^m 7/2$^+$				E_γ (max)	0.50	*2*		scin	54R9	
<u>1/2$^-$</u>				From 56^m Rh^{103} isomer					54R9, 47M12	
				γ (see Ru^{103} decay above)						
$_{45}Rh_{59} \xrightarrow{104} {}_{44}Ru_{60}$			44^s							β decay energy systematics (54W1) suggests Q~1.
1$^+$ 0$^+$										
$_{45}Rh_{59} \xrightarrow{104} {}_{46}Pd_{58}$	**2.5**	*1*	44^s	β^-	2.6	*1**		s	47H5	$\beta\gamma$ coincidence rate indicates 2.6 β^- goes to ground state (53J9). 0.55γ (51M70, 53J9, 53G30).
1$^+$ 4.7 0$^+$					2.46	*10*		a	40M9	
					2.3	*1**		cc	39C3	
$_{47}Ag_{57} \xrightarrow{104} {}_{46}Pd_{58}$	**≥3.72**	*3*	27^m	β^+	2.70	*3**		s	52J25	0.55γ and possibly other γ's (52J25).
≥5.3 0$^+$										
$_{48}Cd_{56} \xrightarrow{104} {}_{47}Ag_{57}$	**≥1.95**	*1*	59^m	β^+	0.93	*1**		s	52J25	0.0666γ, 0.0835γ, and weak 0.1498γ (52J25).
0$^+$ >3.5										
$_{44}Ru_{61} \xrightarrow{105} {}_{45}Rh_{60}$	**2.005**	*9*	4.5^h	β^-	1.15	*2*		s	52S11	
? 5.8 ?					1.150	*6*		s	51D3	
45^s 1/2$^-$				γ	0.726	*7*		s	51D3	
7/2$^+$					0.75	*8**		a	50S7	
				From 45^s Rh^{105} isomer					52S11, 51D3	
				γ	0.130	*2*		s	51D3	
					0.127	*5*		s	52S11	
				$\beta\gamma$					51D3	
				No $\gamma\gamma$					51D3	
$_{45}Rh_{60} \xrightarrow{105} {}_{46}Pd_{59}$	**0.570**	*4*	36.2^h	β^-	0.570	*5*		s	51D3	[0.24 β^- (4-10 %⁻)][0.32γ] coincidences give energy match (52B27, 54L16).
7/2$^+$ 5.6 <u>5/2$^+$</u>					0.57	*1*		s	52S11	
							90-96 %⁻		54L16, 52B27	
$_{47}Ag_{58} \xrightarrow{105} {}_{46}Pd_{59}$	**>0.783**	*3*	45^d	ϵ, no β^+					50G54	$\gamma_1\gamma_2$ cascade assumed because of energy matches in complex γ spectrum (53J20, 52H7, 50M61).
?				γ_1	0.4432	*40**		s	53J20	
?					0.440	*4**		s	52H7	
<u>5/2$^+$</u>					0.437	*4**		s	50M61	
				γ_2	0.3449	*30**		s	53J20	
					0.343	*3**		s	52H7	
					0.340	*3**		s	50M61	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
${}_{48}Cd_{57} \xrightarrow{105} {}_{47}Ag_{58}$ ≥ 5.0	≥ 2.71 < 3.21	1 1	54.7^m	β^+	1.691 1.5	5 1*		s a	53J20 50G54	Very complex γ spectrum (53J20).
				No $\beta^+\gamma$ for $E_\gamma > 0.5$					53J20	
${}_{44}Ru_{62} \xrightarrow{106} {}_{45}Rh_{61}$ 0^+ 4.3 1^+	0.0393	5	1.0^y	β^-	0.0392 0.041	3 1*		s s	50A1 49M46	
				No γ					50A1	
${}_{45}Rh_{61} \xrightarrow{106} {}_{46}Pd_{60}$ 1^+ 5.2 0^+	3.53	1	30^s	β^-	3.53 3.55	1 10	68 %$^-$ 82 %$^-$	s s	52A6 47P7	Complex β^- and γ spectra (52A6, 53K51, 53K47, 53K7, 52A8). 3.1 β^- (11 %$^-$) + 0.51 γ gives fair energy match (52A6).
${}_{47}Ag_{59} \xrightarrow{106} {}_{46}Pd_{60}$ 1^+ ~5.0 0^+	2.98	2	24^m	β^+	1.96 2.04	2 10*	83 †	s a	53B42 38F1	1.45 β^+ (17 †) + 0.51 γ gives energy match (53B42). β^- branching? (see below). 8.6^d Ag^{106} decaying by ϵ and γ known. • Isomers have ~ equal p,n thresholds (39E2).
${}_{47}Ag_{59} \xrightarrow{106} {}_{48}Cd_{58}$ 1^+ ~5.0? 0^+	$\lesssim 0.36$	1	24^m	β^-?	≤ 0.36	1*	<1 %$^-$	s	53B42	
${}_{44}Ru_{63} \xrightarrow{107} {}_{45}Rh_{62}$ ~6.2	$\gtrsim 4$	1	4^m	β^-	~4	1*		a	43B3	
${}_{45}Rh_{62} \xrightarrow{107} {}_{46}Pd_{61}$ ≥ 4.9 $5/2^+$	≥ 1.2	1	25^m	β^-	1.2	1*		a	43B3	γ ? (50g6).
${}_{46}Pd_{61} \xrightarrow{107} {}_{47}Ag_{60}$ $5/2^+$ 8.5^1 $\underline{1/2^-}$	0.035	1	7×10^{6y}	β^-	0.035	2*		a	49P17	Probable $\Delta I = 2$, yes shape not yet observed.
${}_{48}Cd_{59} \xrightarrow{107} {}_{47}Ag_{60}$ $5/2, 7/2^+$ 4.9 44^s $7/2^+$ $\underline{1/2^-}$	1.44	1	6.7^h	β^+	0.320	10	0.31 %$^+$	s	45B4	Theoretical $\beta^+/\epsilon \sim 0.0023$. 0.85 γ (~0.5 %)(45B4, 54M19).
				From 44^s Ag^{107} isomer						
				γ	0.0930 0.0939 0.0925	9* 2 10		s s s	53J20 47B5 39V2,41H1	
${}_{49}In_{58} \xrightarrow{107?} {}_{48}Cd_{59}$ $9/2^+$ ≥ 5.0 $5/2, 7/2^+$	$\gtrsim 3.0$	5	33^m	β^+	~2.0	5*		s	49M20	γ present (49M20). See $In^{108?}$ below.
${}_{47}Ag_{61} \xrightarrow{108} {}_{46}Pd_{62}$ 1^+ 4.8 0^+	1.80 (see comments)	5	2.3^m	β^+	(0.78	5)**	0.14 %$^+$		53P16	** β^+ energy calculated from ϵ_K/β^+ for ground state transition. $\epsilon_K/\beta^- = 0.016$, $\beta^+/\beta^- = 0.0014$, 15 %ϵ to excited levels. (K x-ray) (0.43 γ, 0.60 γ) coincidences. (0.60 γ)(0.43 γ) coincidences (53P16).
				No $\beta^+\gamma$					53P16	
${}_{47}Ag_{61} \xrightarrow{108} {}_{48}Cd_{60}$ 1^+ 4.6 0^+	1.77	6	2.3^m	β^-	1.77	6	97.3 %$^-$	scin	53P16	0.62 γ present implying 1.15 β^- (0.8 %$^-$) (53P16).
				No $\beta\gamma$					52G2	
${}_{49}In_{59} \xrightarrow{108?} {}_{48}Cd_{60}$ ≥ 5.4 0^+	(see comments)		50^m	β^+	2.31	2*		s	51M11	0.285 γ present (51M11). Assignment to In^{107} in better accord with β decay energy systematics (54W1).

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{46}Pd_{63} \xrightarrow{109} {}_{47}Ag_{62}$	1.09	3	13.6^h	β^-	1.020	5		s	54M38	
$5/2^+?$ 6.0 $39^s 7/2^+$					0.95	1		s	49S23	
$\underline{1/2^-}$				No γ					50S12	
				No delayed $\beta\gamma$ ($3\times10^{-8s} \rightarrow 10^{-3s}$)					49M26	
				From 39^s Ag^{109} isomer 53A25, 53N4, 49S23						
				γ	0.0877	2		s	54M38	
					0.087	1*		pc	53A25	
					0.087	1*		s	49S23	
$_{48}Cd_{61} \xrightarrow{109} {}_{47}Ag_{62}$	~0.16		$\sim350^d$	ϵ, no β, no γ					50G54	
$5/2, 7/2^+$ ~4.8 $39^s 7/2^+$				$E_\epsilon \sim 0.07$ from $\epsilon_L/\epsilon_K = 0.28$					53D26	
$\underline{1/2^-}$				From 39^s Ag^{109} isomer 53B73, 53J20, 46H4						
				γ	0.0879	9*		s	53J20	
					0.087	1*		s	52H1	
					0.0875	9*		s	50C22	
					0.087	1*		s	46H4	
$_{49}In_{60} \xrightarrow{109} {}_{48}Cd_{61}$	≥1.77	4	4.2^h	β^+	0.75	4*		a	49M20	0.058γ, 0.205γ, 0.347γ, 0.427γ (51M11). $\epsilon_K/\beta^+ = 8$ (49M20).
$9/2^+$ ≥5.0 $5/2, 7/2^+$										
$_{47}Ag_{63} \xrightarrow{110} {}_{46}Pd_{64}$			24.5^s							β decay energy systematics (54W1) suggests Q~0.9.
1^+ 0^+										
$_{47}Ag_{63} \xrightarrow{110} {}_{48}Cd_{62}$	2.88	2	24.5^s	β^-	2.86	3*		s	50S1	2.24 β^- (~65%$^-$) + 0.66γ gives good energy match (51G20).
1^+ 5.0 0^+					2.82	10	~35%$^-$	scin	51G20	
					2.89	3*		s	51A5	
					2.91	3*		s	51S84	
				No (2.86 β^-)γ					49M38	
$_{49}In_{61} \xrightarrow{110} {}_{48}Cd_{62}$	3.93	4	66^m	β^+	2.25	2		s	53B44	0.66γ is only γ with 66^m activity (53B44).
$2, 3^+$ 5.5 2^+					2.2	1*		a	48L4	
0^+				γ	0.656	3		s	53B44	
					0.661	5		s	51M11	
				(2.25 β^+)γ					53B44	
$_{46}Pd_{65} \xrightarrow{111} {}_{47}Ag_{64}$	≥2.15	3	22^m	β^-	2.15	3	~60%$^-$	s	52M34	γ's (0.060 → 0.73) present (52M34).
$1/2^+?$ 6.0 $1/2^-$										
$_{47}Ag_{64} \xrightarrow{111} {}_{48}Cd_{63}$	1.05	1	7.5^d	β^-	1.04	1*	91%$^-$	s	50J53	Complex β^- spectrum gives rise to few $\beta\gamma$ coincidences indicating 1.04 β^- goes to ground (50J53). 0.73 β^- (6.5%$^-$) + 0.34γ gives energy match (50S60).
$1/2^-$ 7.3 $\underline{1/2^+}$					1.06	1*		s	50M61	
					1.06	3		s	49H6	
$_{49}In_{62} \xrightarrow{111} {}_{48}Cd_{63}$	> 0.4187 ≲1.4	7	2.84^d	No β^+					48G7	
$9/2^+$ $7/2^+$				$\beta^+/\epsilon < 0.06\%$					51M11	
$5/2^+$				γ_1	0.1708	17*		s	52G14	
$\underline{1/2^+}$					0.1721	5		s	51M11	
					0.1728	10		s	40L7	
				γ_2	0.2456	25*		s	52G14	
					0.2466	7		s	51M11	
					0.2467	10		s	40L7	
				(0.172γ)(0.247γ) ~ $0.1^{\mu s}$ delay					51M53	
				$\gamma_1\gamma_2(\theta)$ 53S6, 52K14, 51A22, 51R2						
$_{50}Sn_{61} \xrightarrow{111} {}_{49}In_{62}$	2.52	3	35^m	β^+	1.51	3	29%$^+$	s	51M11	
$7/2^+$ 4.7 $9/2^+$					1.45	7*		a	49H10	
				No ce$^-$					51M11	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{46}Pd_{66} \xrightarrow{112} {}_{47}Ag_{65}$ 0^+ ≥3.9 1^+ $2,1,0^-$	0.2	1	21^h	β^- γ	0.2 0.018	1*		a scin	50S12 53N4	
$_{47}Ag_{65} \xrightarrow{112} {}_{48}Cd_{64}$ $2,1,0^-$ 8.6 0^+	4.0	2	3.2^h	β^- No (4.1 β^-)γ No γ follows 3.5 β^-	4.1 4.2 3.5	4* 4 4*	25 $\%^-$	a scin a	53N4 51P8 51S40 53N4 51S40	Three lower energy β's. 3.5 β^- (40 $\%^-$) + 0.62γ gives reasonable energy match (53N4).
$_{49}In_{63} \xrightarrow{112} {}_{48}Cd_{64}$ 1^+ 4.6 0^+	2.54	5	14.5^m	β^+ No $\beta\gamma$	1.52 1.7	5	24 $\%^+$	s a	53B44 47T4 53B44	β^- branching (see below).
$_{49}In_{63} \xrightarrow{112} {}_{50}Sn_{62}$ 1^+ 4.1 0^+	0.656	6	14.5^m	β^- No $\beta\gamma$	0.656 1.0	6	44 $\%^-$	s a	53B44 47T4 53B44	
$_{47}Ag_{66} \xrightarrow{113} {}_{48}Cd_{65}$ $1/2^-$ 7.0 <u>$1/2^+$</u>	2.1	1	5.3^h	β^- No γ	2.1 2.2 2.0	2 2* 2		a a scin	49D6 47T13 51P8 49D6,47T13	
$_{48}Cd_{65} \xrightarrow{113} {}_{49}In_{64}$ $5^y 11/2^-$ <u>$1/2^+$</u> <u>$9/2^+$</u>	<0.6		Stable ?	From 5^y Cd^{113} isomer β^- IT ?	 0.55 0.5	 2*		 scin a	 50C64 50C63	IT to ground state has not been observed.
$_{50}Sn_{63} \xrightarrow{113} {}_{49}In_{64}$ $1.7^h 1/2^-$ <u>$9/2^+$</u>	>0.39		112^d	ϵ No β^+ with $E_\beta > 0.05$ From 1.7^h In^{113} isomer γ	 0.3917 0.3933			 s s	51T17,39B3 50N52 51T17,51C34 39B3 52G14 51C34	γ's reported by (51C34, 49N9, 39B3) not found (53B17, 53D7, 50N52, 47C4).
$_{49}In_{65} \xrightarrow{114} {}_{48}Cd_{66}$ 1^+ 6.6 0^+	2.2	2	72^s	β^+	1.2	2	0.004 $\%^+$	a	54J1	(1.30γ)(0.56γ) coincidences show Q> 1.86 (54J1). 0.65 β^+ (0.015 $\%^+$) reported (49B52). Strikingly different ft values for β^+ and β^- transitions suggest that ground state configurations of Sn^{114} and Cd^{114} are quite dissimilar.
$_{49}In_{65} \xrightarrow{114} {}_{50}Sn_{64}$ 1^+ 4.5 0^+	1.985	4	72^s	β^- No β^-e^- No $\beta^-\gamma$	1.984 2.01 1.98	4 2* 2*	96 $\%^-$	s s s	52J22 51S84 40L7 49M38 49M13,49M38	
$_{47}Ag_{68} \xrightarrow{115} {}_{48}Cd_{67}$ $1/2^-$ 6.4 $1/2^+$	3.0	2	21^m	β^- No γ	3.0	2		a	47T13 49D6 49D6	Parent (91 %) 2.3^d Cd^{115}, (9 %) 43^d Cd^{115} (52W6) which is ~0.17 Mev above ground (52H24).
$_{48}Cd_{67} \xrightarrow{115} {}_{49}In_{66}$ $1/2^+$ 7.1 $4.5^h 1/2^-$ <u>$9/2^+$</u>	1.45	1	2.33^d	β^- From 4.5^h In^{115} isomer γ	1.11 1.11 1.13 0.3346 0.335 0.336 0.338	1* 1 3 10* 1 1 1*	58 $\%^-$ 60 $\%^-$	s s s s s s s	52L2 52H24 40L7 39C4,49H7 52G14 52H24 50D60 40L7,49B53	0.59 β^- (40 $\%^-$) + 0.525γ provides energy match (52H24).

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{49}In_{66} \xrightarrow{115} {}_{50}Sn_{65}$ $4.5^h 1/2^-$ $\underline{9/2^+}$ 23.0 $\underline{1/2^+}$	0.50	2	$6 \times 10^{14} y$	β^-	0.63	3		a	50M76	Adopted Q = 0.84 (β^-) − 0.34 (IT) differs significantly from directly measured β energy.
				Decay of 4.5^h isomer of In^{115}						
				β^-	0.84	2*	5.5%	s	52L2	
					0.83	2	6%	s	49B53	
				IT to In^{115} g.s.						
					0.336	1		See Cd^{115}		
$_{49}In_{67} \xrightarrow{116} {}_{48}Cd_{68}$ 1^+ 0^+			13^s							β decay energy systematics (54W1) suggests Q~1.
$_{49}In_{67} \xrightarrow{116} {}_{50}Sn_{66}$ 1^+ 4.5 0^+	3.29	6	13^s	β^-	3.29	6		scin	54B27	Q < 3.36 from E_{dis} of 54^m In^{116} isomer (50S12).
					2.95			a	40L7,46B27	
				No γ					54B24,38M2	
$_{51}Sb_{65} \xrightarrow{116} {}_{50}Sn_{66}$ $2,3^+$ 4.8 2^+ 0^+	4.72	9	15.5^m	β^+	2.40	8*		scin	53S42	Weak 0.9γ, 2.2γ (53S42, 50B92). $\beta\gamma$ cascade implied by intensity of 1.30γ and p,n threshold > 5.
				γ	1.30	3		s	53S42	
$_{48}Cd_{69} \xrightarrow{117} {}_{49}In_{68}$? 6.2 ? ? $1.9^h 1/2^-$ $1.1^h 9/2^+$	~2.8		3.0^h?	β^- ~1.8					54B28	
				γ_1	0.43	1*		scin	54L9	
				γ_2	0.281	3*		s	54L9	
				From 1.9^h In^{117} isomer						
					0.312	3*		s	54M21	
					0.312	3*		s	54L9	
$_{49}In_{68} \xrightarrow{117} {}_{50}Sn_{67}$ $9/2^+$ 4.6 $7/2^+$ $3/2^+$ $\underline{1/2^+}$	1.48	1	1.1^h	β^-	0.76	1		s	54M21	Good energy match from 1.9^h In^{117} which has 1.77 β^- to ground state of Sn^{117} and 0.31 IT to 1.1^h In^{117} (54M21). Other measurements of γ_2 (50N52, 49M51, 50H66, 50M52).
				γ_1	0.56	1*		scin	54L9	
					0.56	1		scin	54M21	
				γ_2	0.161	1		s	54M21	
					0.160	1*		s	54L9	
				β^- (0.16γ), β^- (0.56γ), (0.16γ)(0.56γ),					54M21	
$_{51}Sb_{66} \xrightarrow{117} {}_{50}Sn_{67}$ $5/2^+$? $3/2^+$ $\underline{1/2^+}$	>0.156 ≲1.2	2	2.8^h	ϵ					47C4	
				No β^+					49T11	
				γ	0.156	2*		s	49T11	
$_{52}Te_{65} \xrightarrow{117} {}_{51}Sb_{66}$? 6.0 $5/2^+$?	≥3.5	1	2.5^h	β^+	2.5	1		s	53F27	0.80 e^- tentatively assigned to Te^{117} (53F27). 2.5^h Te^{117} may be isomeric to short lived ground state.
$_{49}In_{69} \xrightarrow{118} {}_{50}Sn_{68}$ <5.7 0^+	≥4.0	4	$<1^m$	β^-	4.0	4*		a	53C4	
$_{51}Sb_{67} \xrightarrow{118} {}_{50}Sn_{68}$ ≥4.7 0^+	≥4.1	2	3.3^m	β^+	3.1	2		a	48L2	
				γ					48L2	
$_{49}In_{70} \xrightarrow{119} {}_{50}Sn_{69}$ $1/2^-$ 6.2 $\underline{1/2^+}$	≤2.7 (see comments)	2	17.5^m	β^-	2.7	2		a	49D4	17.5^m In^{119} may be isomeric with $9/2^+$ ground state.
				No γ					49D4	
$_{51}Sb_{68} \xrightarrow{119} {}_{50}Sn_{69}$ $5/2^+$ $3/2^+$ $\underline{1/2^+}$	≲1		39^h	ϵ, no β^+					47C4	0.024γ from first excited $3/2^+$ level in Sn^{119} expected.
				No γ					47C4	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{52}Te_{67} \xrightarrow{119} {}_{51}Sb_{68}$	> 1.6	2	4.5^d	ϵ					50L11	
$5/2^+$				γ	1.6	2*		a	50L11	
$_{51}Sb_{69} \xrightarrow{120} {}_{50}Sn_{70}$	2.72	2	16.4^m	β^+	1.70	2		s	50B92	
1^+ 4.6 0^+					1.5	2*		cc	38A3	
				No γ					53S42	
$_{51}Sb_{69} \xrightarrow{120} {}_{52}Te_{68}$			16.4^m							β decay energy systematics (54W1) suggests $Q \sim 1$.
$_{50}Sn_{71} \xrightarrow{121} {}_{51}Sb_{70}$	0.383	5	27.5^h	β^-	0.383	5		s	49D15	
$3/2^+$? 5.0 $\underline{5/2^+}$					0.35	4*		a	49L5	
				No γ					49N6,48L2,49D15,50N52	
				No e^-					49M51,50N52	
$_{52}Te_{69} \xrightarrow{121} {}_{51}Sb_{70}$	> 0.575	1	17^d	ϵ					46E3	
$1/2^+$ $1/2,3/2^+$				γ	0.575	1		s	51C34	
$\underline{5/2^+}$					0.610			s	50K4	
					0.615			s	42K2	
				$x\gamma$, $e^-\gamma$					46B6	
$_{53}I_{68} \xrightarrow{121} {}_{52}Te_{69}$	2.38	5	1.6^h	β^+	1.13	5		s	53F27	$\sim 0.185\,e^-$ (53F27, 49M53) is assumed to be from second cascade 0.21γ in 143^d Te^{121} decay.
$143^d\ 11/2^-$					1.2	1*		a,s	49M53	
$5/2^+$ 5.0 $3/2^+$				γ	0.2136	5		s	51C34	
$1/2^+$					0.213	1*		s	49H25, 50K4	
$_{51}Sb_{71} \xrightarrow{122} {}_{50}Sn_{72}$			2.8^d							β decay energy systematics (54W1) suggests $Q \sim 1.6$.
2^- 0^+										
$_{51}Sb_{71} \xrightarrow{122} {}_{52}Te_{70}$	1.98	3	2.8^d	β^-	2.015	20*		s	51M2	$(1.40\beta\ 56\%^-)(0.57\gamma)$ coincidences (54C8). 1.98 β^- shows $\Delta I = 2$, yes shape (51M2, 52G9, 54C8).
2^- 8.6^1 0^+					1.94	2*	$26\%^-$	s	52G9	
					2.00	3	$36\%^-$	s	54C8	
$_{53}I_{69} \xrightarrow{122} {}_{52}Te_{70}$	≥4.0	1	3.6^m	β^+	3.1	1		a	51Y6	γ ? (49M53).
1^+ ≥ 4.8 0^+					2.9	1		a	49M53	
$_{50}Sn_{73} \xrightarrow{123} {}_{51}Sb_{72}$	1.42	1	130^d	β^-	1.42	1		s	50K11	1.42 β^- has $\Delta I = 2$, yes shape (50K11). Either state of Sn^{123} could be the ground state within the present limits of error.
$130^d\ 11/2^-$? 8.8^1 $\underline{7/2^+}$					1.42	2*		s	49B58	
				No γ					51C34,49N6,49L5	
$40^m\ 3/2^+$? 5.3 $5/2^+$?	1.41	2	40^m	β^-	1.26	1		s	49D15	
$\underline{7/2^+}$					1.12	6*		a	49N9	
					1.32	7*		a	49L5	
				γ	0.153	5		scin	50B47	
					0.153	5		s	49D15	
$_{52}Te_{71} \xrightarrow{123} {}_{51}Sb_{72}$			Stable ?							$\tau_\epsilon > 2 \times 10^{14y}$ (45R3). β decay energy systematics (54W1) suggests $Q \sim 0.3$.
$\underline{1/2^+}$ $\underline{7/2^+}$										
$_{53}I_{70} \xrightarrow{123} {}_{52}Te_{71}$	> 0.159	2	13^h	ϵ					49M35	
$5/2^+$ $3/2^+$				γ	0.159	2*		s	49M35	
$\underline{1/2^+}$				e^-	0.150	15		s	49M53	
$_{51}Sb_{73} \xrightarrow{124} {}_{50}Sn_{74}$			60^d	For β^- decay see below						β decay energy systematics (54W1) suggests $Q \sim 0.5$.
$4^+,3^-$ 0^+										

TABLE I.—*Continued.*

Disintegration	Adopted Q		Half-life	Decay Data						Comments
	Mev	Error		Type	Mev	Error	%	Method	Ref.	
${}_{51}Sb_{73} \xrightarrow{124} {}_{52}Te_{72}$	2.91	1	60^d	β^-	2.317	23*	$21\%^-$	s	53M16	$2.31\beta^-$ has non-linear F-K plot that is not characteristic of $\Delta I = 2$, yes (53M16, 53T5). Very complex decay scheme (five lower energy β's) consistent with adopted Q.
$4^+,3^-$ 10.3 2^+					2.306	23*	$21\%^-$	s	53T5	
0^+					2.295	23*		s	53M71	
				γ	0.607	6*		s	53M71	
					0.607	6*		s	53M14	
					0.604	6*		s	53T5	
					0.603	6*		s	53M16	
					0.603	6*		s	48K4	
				$(2.3\,\beta^-)(0.6\gamma)$					52J26, 53H40 52K39, 51S59	
${}_{53}I_{71} \xrightarrow{124} {}_{52}Te_{72}$	3.22	1	4^d	β^+	2.20	1	51†	s	49M35	$2.2\,\beta^+$ has $\Delta I = 2$, yes shape (49M35) $1.50\,\beta^+$ (44†) and $0.67\,\beta^+$ (5†) (49M35). $(1.50\,\beta^+)\gamma$ coincidences (51S4).
2^- 8.0^1 0^+					2.1	1		a,s	49M53	
				No $(2.2\,\beta^+)\gamma$					51S40, 51S59	
${}_{53}I_{71} \xrightarrow{124} {}_{54}Xe_{70}$			4^d	For β^+ decay see above.						β decay energy systematics (54W1) suggests $Q \sim 0.5$.
2^- 0^+										
${}_{50}Sn_{75} \xrightarrow{125} {}_{51}Sb_{74}$	2.35	2	9.4^d	β^-	2.37	2	$95\%^-$	s	50H58	$2.37\,\beta^-$ has $\Delta I = 2$, yes shape (50H58, 50K11). $0.40\,\beta^-$ ($\sim 5\%^-$) + $\sim 1.9\gamma$ gives approximate energy match (50H58, 50B45, 52M33).
9.4^d $11/2^-$ 9.0^1 $7/2^+$					2.33	1		s	50K11	
9.5^m $3/2^+$? >5.4 $5/2^+$?	2.37	2	9.5^m	β^-	2.04	2*	$<100\%^-$	s	49D27	Either state of Sn^{125} could be the ground state within the present limits of error.
$7/2^+$					2.06	10*	$<100\%^-$	a	50N52	
				γ	0.326	3*		s	49D27	
					0.38	4*		a	50N52	
				$(2.06\,\beta^-)(0.38\gamma)$					50N52	
${}_{51}Sb_{74} \xrightarrow{125} {}_{52}Te_{73}$	0.764	5	$\sim 2.7^y$	β^-	0.616	6*	$18\%^-$	s	50S19	$0.299\,\beta^-$ ($47\%^-$) + 0.465γ and $0.128\,\beta^-$ ($35\%^-$) + 0.637γ give good energy match (50S19, 53J24). $\beta\gamma$ and $\gamma\gamma$ coincidences give self-consistent decay scheme (53J24). $\Delta I = 2$, yes shape probable for $0.62\,\beta^-$ but not yet observed.
$7/2^+$ 8.6^1 58^d $11/2^-$					0.621	6*		s	49K14	
$3/2^+$				No $(0.62\,\beta^-)\gamma$					53J24	
$\underline{1/2^+}$				From 58^d Te^{125} isomer					48F2, 50S19	
				γ_1	0.1096	2		s	51C34	
					0.110	1*		s	52B16	
					0.110	1*		s	50S19	
					0.110	1		s	49K14	
					0.109	1*		s	49H27	
				γ_2	0.0353	1		s	51C34	
					0.0354	3*		s	49H25	
					0.035	1*		s	50S19	
${}_{53}I_{72} \xrightarrow{125} {}_{52}Te_{73}$	~ 0.15		60^d	ϵ, no β^+					53D26, 51F21	
$5/2^+$ $3/2^+$				$E_\epsilon \sim 0.11$ from $\epsilon_L/\epsilon_K = 0.23$					53D26	
$\underline{1/2^+}$				~ 0.12 from $\epsilon_L/\epsilon_K = 0.30$					51F21	
				γ	0.0354	4		s	52B55	
					0.0354	4*		pc	51F21	
${}_{54}Xe_{71} \xrightarrow{125} {}_{53}I_{72}$	>0.46	2	18^h	ϵ, no β^+					50A5, 52B55	Five other γ's (0.054 → 0.243) present (52B55).
$5/2^+$				γ	0.460	23		scin	52B55	
${}_{53}I_{73} \xrightarrow{126} {}_{52}Te_{74}$	2.23	5	13^d	β^+	1.21	5	$1.4\%^+$	s	53M13	β^- branching (see below). 0.68γ, 0.74γ and crossover 1.42γ present (54P10, 53M13).
2^- 8.1^1 0^+							$2\%^+$		51P9	
${}_{53}I_{73} \xrightarrow{126} {}_{54}Xe_{72}$	1.259	7	13^d	β^-	1.255	10	$14\%^-$	s	53M13	$[0.87\,\beta^-$ ($\sim 35\%^-$)$][0.39\gamma]$ coincidences (53M13). 0.48γ and crossover 0.86γ also present (54P10). $1.26\,\beta^-$ referred to as having $\Delta I = 2$, yes shape (51S68).
2^- 8.4^1 0^+					1.268	10		s	49M35	
					1.24	2	$10\%^-$	s	51P9	
				No $(1.2\,\beta^-)\gamma$					51P9	

TABLE I.—*Continued.*

Disintegration	Adopted Q		Half-life	Decay Data						Comments
	Mev	Error		Type	Mev	Error	%	Method	Ref.	
${}_{51}\mathrm{Sb}_{76} \xrightarrow{127} {}_{52}\mathrm{Te}_{75}$ $7/2^+$? ≥ 7.3 ? $3/2^+$	≥1.2	1	93^h	β^-	1.2	1*		a	50S17	0.72γ present (50S17).
${}_{52}\mathrm{Te}_{75} \xrightarrow{127} {}_{53}\mathrm{I}_{74}$ $3/2^+$ 5.7 $5/2^+$	0.8	1	9.3^h	β^- No γ	0.8	1*		a	40S1 46PP	
${}_{54}\mathrm{Xe}_{73} \xrightarrow{127} {}_{53}\mathrm{I}_{74}$ $1/2^+$? ? $5/2^+$	>0.36	2	25^d	ε γ	 0.365	 18		 scin	52B55 52B55	Four other γ's (0.057→0.203) present (52B55).
${}_{55}\mathrm{Cs}_{72} \xrightarrow{127} {}_{54}\mathrm{Xe}_{73}$ $5/2, 7/2^+$ 5.6 $5/2^+$? $1/2^+$?	≥2.2	1	5.5^h	β^+	1.2	1*		a	49F9	0.41γ, 0.125γ (53W20).
${}_{53}\mathrm{I}_{75} \xrightarrow{128} {}_{52}\mathrm{Te}_{76}$ 1^+ 0^+	>0		24.99^m	ϵ/β^- = 0.063 = 0.053					51M51 50R12	β decay energy systematics (54W1) suggests Q ~ 1.3.
${}_{53}\mathrm{I}_{75} \xrightarrow{128} {}_{54}\mathrm{Xe}_{74}$ 1^+ 5.9 0^+	2.02	2	24.99^m	β^-	2.02 2.2	2* 2*	87%$^-$	s a	46S10 38L5	1.6 β^- (7%$^-$) + 0.44γ gives energy match (46S10, 53G30, 53W20). 0.98γ (53W20).
${}_{55}\mathrm{Cs}_{73} \xrightarrow{128} {}_{54}\mathrm{Xe}_{74}$ 1^+ >4.8 0^+	4.1	2	3.9^m	β^+ No (3.1 β^+)γ	3.1	2	<100%$^+$	s	53F11 53F11	(1.1 ± 0.7 β^+) γ coincidences (53F11). Several γ's and γγ coincidences (53F11, 53W20).
${}_{56}\mathrm{Ba}_{72} \xrightarrow{128} {}_{55}\mathrm{Cs}_{73}$ 0^+ 1^+	>0		2.4^d	ε ~ 100%					52L23, 53F11	
${}_{52}\mathrm{Te}_{77} \xrightarrow{129} {}_{53}\mathrm{I}_{76}$ $3/2^+$ ≥ 6.0 ? $7/2^+$	≥1.7	1	72^m	β^-	1.8 1.75 1.6	1 1* 1*		s a a	47R1 46PP 50N5	0.3γ, ~ 0.8γ (46PP).
${}_{53}\mathrm{I}_{76} \xrightarrow{129} {}_{54}\mathrm{Xe}_{75}$ $7/2^+$ 13.4 $3/2^+$? $1/2^+$	0.188	5	$1.72\mathrm{x}10^{7y}$	β^- γ βγ	0.150 ~0.13 ~0.12 ~0.12 0.038 0.039	5 1 1*		s a pc s pc	53D10 51K16 50B31 49P19 53D10 50B31 50B31	No 0.188 β^-(< 1 %$^-$)(53D10).
${}_{55}\mathrm{Cs}_{74} \xrightarrow{129} {}_{54}\mathrm{Xe}_{75}$ $7/2^+$? ? $1/2^+$	>0.56	1	31^h	ε, no β^+ γ	 0.560	 11*		 scin	49F9 53W20	0.385γ present, 0.039γ not observed (53W20).
${}_{56}\mathrm{Ba}_{73} \xrightarrow{129} {}_{55}\mathrm{Cs}_{74}$ ≥ 5.4 $7/2^+$?	≥2.6	2	1.9^h	β^+	1.6	2		s	53F11	
${}_{53}\mathrm{I}_{77} \xrightarrow{130} {}_{52}\mathrm{Te}_{78}$ 6^- 0^+			12.5^h	For β^- decay see below						β decay energy systematics (54W1) suggests Q~ 0.5.

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Type	Mev	Error	%	Method	Ref.	Comments
$_{53}I_{77} \xrightarrow{130} {}_{54}Xe_{76}$ 6^- 6.5 6^+, 4^+, 2^+, 0^+	2.97	1	12.5^h	β^-	1.02	1*	46%$^-$	s	54C18	0.60 β^- (54 %$^-$) + 0.41γ+ $\gamma_1+\gamma_2+\gamma_3$ gives good energy match (43R2, 54C18). 1.15γ present (54C18). $\beta\gamma$ and $\gamma\gamma$ coincidences support decay scheme (43R2, 54C18).
					1.03	2	60%$^-$	s	43R2	
				γ_1	0.744	7*		s	54C18	
					0.744	10		s	43R2	
				γ_2	0.660	7*		s	54C18	
					0.677	8		s	43R2	
				γ_3	0.528	5*		s	54C18	
					0.537	5		s	43R2	
$_{55}Cs_{75} \xrightarrow{130} {}_{54}Xe_{76}$ 1^+ 5.3 0^+	2.99	2	30^m	β^+	1.97	2*	98.3%^{T}	s	52S41	β^+/β^-= 27.6 (52S41).
				No γ				scin	52S41	
$_{55}Cs_{75} \xrightarrow{130} {}_{56}Ba_{74}$ 1^+ 5.3 0^+	0.442	4	30^m	β^-	0.442	4*	1.7%$^-$	s	52S41	
				No γ				scin	52S41	
$_{52}Te_{79} \xrightarrow{131} {}_{53}I_{78}$ $3/2^+$ 6.1 $5/2^+$, $\underline{7/2^+}$	2.2	1	24.8^m	β^-	2.0	1	55%$^-$	a$\beta\gamma$	52G17	1.35 β^- (45 %$^-$) + 0.7γ+ 0.16γ gives good energy match (52G17).
				γ	0.16	2*		a	52G17	
				$\beta\gamma, \gamma\gamma$					52G17	
$_{53}I_{78} \xrightarrow{131} {}_{54}Xe_{77}$ $\underline{7/2^+}$ 6.6 $5/2^+$?, $\underline{3/2^+}$	0.968	2	8.07^d	β^-	0.604**	2	85%$^-$	s		**Weighted average of six measurements where authors quoted errors (52R16, 52B28, 51C5, 51Z1, 49K14, 48M28). See also (51K29, 51T27, 51V5, 49F1).
				γ	0.364467	50		Xtl	53H28	
				(0.6 β^-)(0.364γ)					51W13, 51K29, 52B26	
$_{55}Cs_{76} \xrightarrow{131} {}_{54}Xe_{77}$ $5/2^+$ 5.5 $\underline{3/2^+}$	0.35	1	9.6^d	Continuous γ spectrum						K binding energy = 0.033
				E_γ (max)	0.320	10		scin	54S22	
				No γ					51K11, 50k12, 47K5, 54S22, 52S33, 51C41	
$_{56}Ba_{75} \xrightarrow{131} {}_{55}Cs_{76}$ $5/2^+$.	> 0.620	5	12^d	ϵ, no β^+					47K5, 47F9, 51K11, 53C24	(0.12γ)(0.50γ) coincidences (53P4). Many other γ's present.
				γ	0.620	6*		s	53C24	
					0.620	13*		scin	53P4	
$_{57}La_{74} \xrightarrow{131} {}_{56}Ba_{75}$ ≥ 5.1	≥ 2.6	1	58^m	β^+	1.6	1*		a	51G14	
$_{52}Te_{80} \xrightarrow{132} {}_{53}I_{79}$ 0^+ 5.3 1^+, 2,3	0.41	2	77.7^h	β^-	0.28	1*	60%$^-$	a	50n6	~0.1β^- (40 %$^-$) and 0.22γ present (50n6).
				γ	~0.13	2*		a	50n6	
$_{53}I_{79} \xrightarrow{132} {}_{54}Xe_{78}$ 2,3 7.1 2^+, 0^+	2.9	1	2.4^h	β^-	2.2	1*	50%$^-$	a	50n6	0.9 β^-, 1.4γ, and 2.0γ present (50n6, 51M63). (1.4γ)(0.6γ) coincidences (51M63). No (2.0γ)(0.6γ) coincidences (51M63). Adopted decay scheme (50n6) is similar to that for I^{134}, but Q is ~1 Mev too low on β systematics (54W1). Considerably different β^- energies reported, 1.35β^- (43B2), 1.5 β^- (49S50)
				γ	0.68	1*		scin	51M63	
					0.6	1*		a	50n6	
$_{55}Cs_{77} \xrightarrow{132} {}_{54}Xe_{78}$ 0^+	> 0.68	1	7.1^d	ϵ					44C11	
				γ	0.685	10		scin	53W20	
					0.62	6*		a	44C11	
$_{55}Cs_{77} \xrightarrow{132} {}_{56}Ba_{76}$ 0^+			7.1^d	For ϵ branching see above						β decay energy systematics (54W1) suggests Q~1.

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{57}La_{75} \xrightarrow{132} {}_{56}Ba_{76}$; ≥6.9; 0^+	≥4.5	2	4.5^h	β^+	3.5	2*		a	51G14	1.0γ (51G14).
$_{52}Te_{81} \xrightarrow{133} {}_{53}I_{80}$; $3/2^+$? 5.6 $5/2^+$?; $7/2^+$	3.0	1	2^m	β^-	2.4	1*	30%⁻	a	52P13	1.3 β^- (70%⁻) + 1.0γ + 0.6γ gives approximate energy match (52P13).
				γ	0.6	1*		a	52P13	
$_{53}I_{80} \xrightarrow{133} {}_{54}Xe_{79}$; $7/2^+$ 6.8 ?; $3/2^+$	1.83	7	20.8^h	β^-	1.25	10*	93%⁻	a	51B85	~1.5β^- (~1%⁻) decays to 2.3^d, 0.232-Mev Xe^{133} level. 0.4 β^- (~6%⁻) + 0.87γ + 0.53γ gives self-consistent decay scheme.
					1.35	10		a	50S19	
				γ	0.53	1*		s	49B47	
					0.53	1*		s	47P13	
$_{54}Xe_{79} \xrightarrow{133} {}_{55}Cs_{78}$; $3/2^+$ 5.6 $5/2^+$; $\underline{7/2^+}$	0.428	4	5.27^d	β^-	0.347	4		s	52B55	
					0.34	2		a	50e5	
				γ	0.081	1*		s	52B55	
					0.08	1*		cc	51B28	
					0.085	9*		a	50e6	
				β[e⁻(0.08γ)]					52B55	
$_{56}Ba_{77} \xrightarrow{133} {}_{55}Cs_{78}$; $1/2^+$ $1/2^+$?; $5/2^+$; $\underline{7/2^+}$	> 0.444	3	10^y	ε					50K13,47K5	0.057γ, 0.300γ (54H5, 54L15). (0.082γ)(0.057γ, 0.300γ) coincidences, (0.057γ)(0.300γ) coincidences, and no (0.357γ)(0.300γ, 0.057γ) coincidences (54H5).
				No β^+ (< 0.1%)					54L15	
				γ_1	0.357	4*		scin	54H5	
					0.363	2		scin	54L15	
					0.36	4*		a	47K5	
				γ_2	0.082	1*		scin	54H5	
					0.082	1		scin	54L15	
					0.085	5		a,cc	48Y1	
				(0.082γ)(0.357γ)					54H5	
$_{57}La_{76} \xrightarrow{133} {}_{56}Ba_{77}$; ≥5.5; $1/2^+$	≥2.2	1	4.0^h	β^+	1.2	1*		a,s	49N8	0.8γ and 0.26 e⁻ present (49N8).
$_{58}Ce_{75} \xrightarrow{133} {}_{57}La_{76}$; ≥5.8	≥2.3	1	6.3^h	β^+	1.3	1*		a	50J5	1.8γ present (50J5).
$_{53}I_{81} \xrightarrow{134} {}_{54}Xe_{80}$; 2,3 > 6.5 2^+; 0^+	3.4	2	53^m	β^-	2.5	2		scin	54M33	1.5 β^-, and 1.1γ, 1.78γ (much less intense than 0.86γ). (1.5 β^-)(> 0.9γ) coincidences (54M33) Cf I^{132}.
				γ	0.86	1		scin	54M33	
				(2.5 β^-)(0.86γ)					54M33	
$_{55}Cs_{79} \xrightarrow{134} {}_{54}Xe_{80}$; $\underline{4^\pm}$ 0^+			2.3^y	For β^- decay see below						β decay energy systematics (54W1) suggests Q~1.1.
$_{55}Cs_{79} \xrightarrow{134} {}_{56}Ba_{78}$; $\underline{4^\pm}$ 8.9 4^+; 2^+; 0^+	2.051	5	2.3^y	β^-	0.657	5	81%⁻	s	53C13	Complex β^- and γ spectra. **Weighted average of six spectrometer measurements (53C13, 53M14, 52S4, 51P3, 50W59, 47E2). ††Weighted average of seven spectrometer measurements (53C13, 53M14, 52G20, 52S4, 51P3, 50W59, 47E2).
					0.648	6*	75%⁻	s	51P3	
					0.651	15		s	50W59	
					0.650	20	65%⁻	s	52G20	
					0.658	30	75%⁻	s	47E2	
				γ_1	0.602**	2		s		
				γ_2	0.797††	2		s		
				(0.66 β^-)$\gamma_1\gamma_2$ cascade					51R20	
				$\gamma_1\gamma_2(\theta)$					53A33,52K39,52R45	

TABLE I.—*Continued.*

Disintegration	Adopted Q		Half-life	Decay Data						Comments
	Mev	Error		Type	Mev	Error	%	Method	Ref.	
$La_{57\ 77} \xrightarrow{134} Ba_{56\ 78}$ 1^+ 4.8 0^+	3.7	2	6.5^m	β^+ No γ; no e^-	2.7	2*		a	51S3 51S3	
$I_{53\ 82} \xrightarrow{135} Xe_{54\ 81}$ $5/2, 7/2^+$? $3/2^+$	>2.4 ? (see comments)		6.68^h	γ	2.4		2%	γn	51E12, 49L19	1.4 β^- (25%$^-$), 1.0 β^- (40%$^-$), 0.47 β^- (35%$^-$) and 1.8γ, 1.3γ reported (47P13, 50K6, 50S32). No (1.4 β^-)γ coincidences (47P13). Incomplete and contradictory data do not permit the construction of a self-consistent decay scheme.
$Xe_{54\ 81} \xrightarrow{135} Cs_{55\ 80}$ $3/2^+$ 5.9 $5/2^+$ $\underline{7/2^+}$	1.17	1	9.2^h	β^- γ $\beta\gamma$	0.91 0.93 0.25 0.25 0.25	1 1* 1* 1* 1*	 95%$^-$	s s scin s s	52B55 47P13 54T10 54T10 52B55 47P13 52B55	[0.548 β^- ($\sim$5%$^-$)] [0.60γ] coincidences support Q-value. (ce_K^- 0.25γ)($\sim$0.37γ) coincidences. No (ce_K 0.25γ)(> 0.55γ) coincidences (54T10).
$Cs_{55\ 80} \xrightarrow{135} Ba_{56\ 79}$ $\underline{7/2^+}$ 13.2 $\underline{3/2^+}$	0.207	4	2.9×10^{6y}	β^- No γ	0.210 0.19 0.21	5* 1* 1		s a a	53L1 50Z55 49S3 49S3, 50Z55	$\Delta I = 2$, no shape (53L1).
$La_{57\ 78} \xrightarrow{135} Ba_{56\ 79}$ $5/2^+$? $\underline{3/2^+}$	> 0.66	2	19.5^h	ϵ γ	 0.66	 2*		 scin	48C3, 53W30 53W30	0.49 γ present. K x-ray/0.66γ $\sim$ 300 and K x-ray/0.49γ $\sim$ 50 suggest ϵ between ground states (53W30).
$Ce_{58\ 77} \xrightarrow{135} La_{57\ 78}$ $3/2^+$? > 6.6 $5/2^+$	$\geq$ 1.8	1	22^h	β^+	0.8	1*	<1%$^+$	a	51S3	
$I_{53\ 83} \xrightarrow{136} Xe_{54\ 82}$ $0, 1^-$ > 6.7 0^+	6.4	2	86^s	β^- No (6.3 β) γ	6.3 6.5	3 3*	<100%$^-$	scin a	54M33 49S27 54M33	(5.0 β^-)(1.38γ) and (3.7 β^-)(2.9γ) coincidences support adopted Q (54M33).
$Cs_{55\ 81} \xrightarrow{136} Xe_{54\ 82}$ 4,5$^+$? 0^+			13.7^d	For β^- decay see below.						
$Cs_{55\ 81} \xrightarrow{136} Ba_{56\ 80}$ 4,5$^+$? 5.9 ? ? 0^+	2.21	5	13.7^d	β^- γ_1 γ_2 $\gamma/\beta = 2$ $\beta\gamma$	$\sim$0.35 $\sim$0.28 0.830 1.06	5* 5* 25 8		a a scin scin	48G11 50f6 53B77 53B77 48G11 50f6	
$La_{57\ 79} \xrightarrow{136} Ba_{56\ 80}$ 1^+? 4.5 +	$\geq$ 3.0	1	9.5^m	β^+ γ No γ	2.1 2.1 1.8	1* 1* 1*		s a a	49N8 47M2 49R7 49R7 47M2	K/β^+ $\sim$ 2 (49N8).
$La_{57\ 79} \xrightarrow{136} Ce_{58\ 78}$ 1^+? 0^+			9.5^m	For β^+ decay see above.						
$Xe_{54\ 83} \xrightarrow{137} Cs_{55\ 82}$ 7/2, 9/2$^-$ $\gtrsim$ 6.3 $\underline{7/2^+}$	$\sim$4	1	3.9^m	β^-	$\sim$4	1*		a	43B2	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$Cs_{55\,82} \xrightarrow{137} Ba_{56\,81}$ 7/2+ 8.9^j 2.6^m 11/2− 12.0 3/2+	1.182	2	33^y	β^-	0.521**	3	92%−	s		**Weighted average of seven spectrometer measurements (54A1, 54O3, 53B17, 51L12, 51W19, 50A1, 49P2). 0.519 β^- shows $\Delta I = 2$, yes shape.
				From 2.6^m Ba^{137} isomer						
				γ	0.66165	15		s	53L4	
					0.66160	14		Xtl	52M45	
					0.6614	7		s	52G14	
$La_{57\,80} \xrightarrow{137} Ba_{56\,81}$ 7/2+ 3/2+			> 400^y							
$Ce_{58\,79} \xrightarrow{137} La_{57\,80}$ 3/2+? 5/2+? 7/2+?	> 0.255	2	36^h	ϵ, no β^+					48C3	
				γ	0.257	1		s	51H14	
					0.253	1		s	51K26	
$Cs_{55\,83} \xrightarrow{138} Ba_{56\,82}$?− > 7.0 ? 0+	4.84	5	32^m	β^-	3.40	4*	<100%−	s	53L7	0.46 γ and 0.98 γ present. Both probably in coincidence with 1.44 γ (53L7).
				γ	1.44	3*		scin	53L7	
				(~3 β^-)(1.44 γ ?)					53L7	
$La_{57\,81} \xrightarrow{138} Ba_{56\,82}$ 4+, 5± ? 0+	> 1.39	3	~10^{11}y	ϵ					51P22, 52M39	0.535 γ, 0.807 γ (51P22). $\tau_{\epsilon K} \sim 7 \times 10^{10}$y and $\tau_{\beta^-} \sim 1.2 \times 10^{12}$y (52M39). For β^- decay see below.
				γ	1.39	3		scin	51P22	
$La_{57\,81} \xrightarrow{138} Ce_{58\,80}$ 4+, 5± 21.2 0+	1.0 ?	2	~10^{11}y	β^-	1.0**	2		a	52M39	**Possibly e− (52M39).
$Pr_{59\,79} \xrightarrow{138} Ce_{58\,80}$? ≥ 5.4 ? 0+	3.7	2	2.0^h	β^+	1.4	1*	11%+	a	51S3	0.16 γ, 0.50 γ. 1.4 β^+ : 1.3 γ : K x-ray ~12 : 75 : 100 (51S3) suggests (1.4 β^+)(1.3 γ) cascade.
				γ	1.3	1*		a	51S3	
$Ba_{56\,83} \xrightarrow{139} La_{57\,82}$ 7/2− ≥ 6.7 7/2+	2.27	3	85^m	β^-	2.27	3*		s	48S27	0.165 γ (26%), 1.05 γ (0.6%) (49L14, 48S27). Intensity of γ's indicates ~74%− branching for the 2.27 β^-.
					2.2			a	50K8	
$Ce_{58\,81} \xrightarrow{139} La_{57\,82}$ 3/2+ 5/2+ 7/2+	> 0.166	1	140^d	ϵ, no β^+					54P11, 48P1, 47M12	0.275 γ reported (51K26).
				γ	0.166	2*		s	54P11	
					0.166	2*		s	51K26	
					0.166	2*		s	51H14	
				No other γ					54P11	
$Pr_{59\,80} \xrightarrow{139?} Ce_{58\,81}$ 5/2+ 5.5 3/2+	2.0	1	4.5^h	β^+	1.0	1*	~96%^T	a	51S3	1.0 γ (~4%) and $\beta^+/\epsilon \sim 0.06$ (51S3) imply 1.0 γ not in cascade with 1.0 β^+.
$Nd_{60\,79} \xrightarrow{139?} Pr_{59\,80}$ 3/2+ 7.6 5/2+	4.1	2	5.5^h	β^+	3.1	2*	~10%+	a	51S3	Weak 1.3 γ and weak 0.28 e− present (51S3)
$Ba_{56\,84} \xrightarrow{140} La_{57\,83}$ 0+ 7.9 ≥ 3−	> 1.02	2	12.8^d	β^-	1.022	10*	60%−	s	49B36	0.48 β^- (40%−) and γ's of 0.03, 0.13, 0.16, 0.30, 0.54 (51C43, 49B36, 49L14). 1.02 β^- to excited state is implied from direct evidence that La^{140} decay is not to ground state of Ce^{140} (see below).
					0.990	10*		s	49L14	
					1.05	1*		s	50W5	
$La_{57\,83} \xrightarrow{140} Ce_{58\,82}$ ≥ 3− 9.1 2+ 0+	3.78	4	40.2^h	β^-	2.15	2*	7%−	s	54P8	Very complex β^- and γ spectra permit construction of self-consistent decay scheme (54P8, 52H36, 51B76, 51C43, 49B36).
					2.26	3*	10%−	s	49B36	
					2.12	8	10%−	s	46O1	
				γ	1.596	2		s	52H36	
					1.597	5*		s	51C43	
				(2.26 β^-)(1.60 γ)					51R21	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
${}_{59}Pr_{81} \xrightarrow{140} {}_{58}Ce_{82}$ 1^+ 4.3 0^+	3.25	2	3.5^m	β^+ No γ (< 4%)	2.23 2.4	2 1*		s scin	52B3 53B34 52B3	$\beta^+/\epsilon_K \sim 1.6$ (52B3) in fair agreement with theoretical value of 1.0.
${}_{60}Nd_{80} \xrightarrow{140} {}_{59}Pr_{81}$ 0^+ 3.7 1^+	~0.1		3.3^d	ϵ $E_\epsilon \sim 0.1$ from $\epsilon_K/\epsilon_L = 2.8$					49W2 52B3	log $(2I_f+1)ft \sim 4.2$ is in good accord with value for Pr^{140}.
${}_{56}Ba_{85} \xrightarrow{141} {}_{57}La_{84}$ $7/2,9/2^-$ ≳6.4 $7/2,5/2^+$	≳2.8		18^m	β^-	~2.8			a	48L10	γ present (50g12).
${}_{57}La_{84} \xrightarrow{141} {}_{58}Ce_{83}$ $7/2,5/2^+$ 7.3 $7/2^-$	2.43	3	3.7^h	β^-	2.43	3	~95%$^-$	s	51D19	(< 1.5 β^-)(weak γ) coincidences (51D19).
${}_{58}Ce_{83} \xrightarrow{141} {}_{59}Pr_{82}$ $7/2^-$ 7.7 $\underline{5/2^+}$	0.581	3	32.5^d	β^-	0.582 0.581	6* 3	30%$^-$ 33%$^-$	s s	52K27 50F58	Good energy match given by 0.44 β^- (~70%$^-$) + 0.14γ. $\beta\gamma$ coincidences (52K27, 50F58, 51D19).
${}_{60}Nd_{81} \xrightarrow{141} {}_{59}Pr_{82}$ $3/2^+$ 5.0 $\underline{5/2^+}$	1.7	1	2.42^h	β^+	0.7 0.78	1*	2%$^+$	a	49W2 42K3	1.05γ (2%) present (49W2), presumably not in cascade with 0.7 β^+.
${}_{61}Pm_{80} \xrightarrow{141} {}_{60}Nd_{81}$ $5/2^+$ ≥5.3 $3/2^+$	≥3.6	2	20^m	β^+	2.6	2		s	52K25	γ present (52K25).
${}_{57}La_{85} \xrightarrow{142} {}_{58}Ce_{84}$ $?^-$ 0^+	>2.5	2	74^m	β^-	>2.5	2*		a	53B47	0.63γ and 0.87γ present. (0.63γ)/(0.87γ) ~ 9. (< 2.5 β^-)γ coincidences (53B47).
${}_{59}Pr_{83} \overset{142}{—} {}_{58}Ce_{84}$ 2^- 0^+			19.1^h	$(\epsilon+\beta^+)/\beta^- < 0.006$					50R64	No conclusive evidence concerning direction of decay. β^-decay(see below)
${}_{59}Pr_{83} \xrightarrow{142} {}_{60}Nd_{82}$ 2^- 7.8^1 0^+	2.14	1	19.1^h	β^- No (2.2 β^-)γ	2.14 2.15	1 2*	 96%$^-$	s s	52M29 50J56 49M12	Approximate energy match given by 0.64 β^- (4%$^-$) + 1.58γ (52J13). 2.15 β^- exhibits $\Delta I = 2$(yes) shape. (50J56, 52M29).
${}_{58}Ce_{85} \xrightarrow{143} {}_{59}Pr_{84}$ $7/2^-$ 7.8 $5/2^+$	1.386	4	33^h	β^-	1.390 1.37	5 1	30%$^-$ 30%$^-$	s s	52B70 52K27	Good energy match given by 1.09 β^- (40%$^-$) + 0.29γ (52B70, 52K27, 51K26).
${}_{59}Pr_{84} \xrightarrow{143} {}_{60}Nd_{83}$ $5/2^+$ 7.6 $\underline{7/2^-}$	0.929	5	13.8^d	β^- No γ	0.915 0.932 0.922 0.920 0.930	15 2 3 10 20		s s s s s	52K27 49F18 49B56 49T12 48S28 50S20,50b12,48P1	
${}_{58}Ce_{86} \xrightarrow{144} {}_{59}Pr_{85}$ 0^+ 7.4 0^-	0.303	2	290^d	β^-	0.304 0.304 0.300	4 2 3*	70%$^-$ 70%$^-$ 70%$^-$	s s s	54E9 52P18 52P28	Good energy match given by 0.170 β^- (22%$^-$) + 0.134γ (52P18, 54E9).
${}_{59}Pr_{85} \xrightarrow{144} {}_{60}Nd_{84}$ 0^- 6.5 0^+	2.97	1	17.5^m	β^-	2.98 2.965 2.97	2 15 1	97%$^-$ 90% ≥ 98%	s s s	54E9 52A19 52P18	γ's in < 3% of disintegrations (54E9, 52P18). If $I \neq 0$ is assigned to Pr^{144}, difference in value of log $(2I_f+1)ft$ for Ce^{144} and Pr^{144} would be increased.
${}_{58}Ce_{87} \xrightarrow{145?} {}_{59}Pr_{86}$ $7/2,9/2^-$ ≥5.0 $5/2,7/2^+$	≥2.0	1	3.0^m	β^-	2.0	1*		a	54M7	γ's present (54M7).

TABLE I.—*Continued.*

Disintegration	Adopted Q		Half-life	Decay Data						Comments
	Mev	Error		Type	Mev	Error	%	Method	Ref.	
$_{59}Pr_{86} \xrightarrow{145?} {}_{60}Nd_{85}$ 5/2,7/2+ ≥6.3 7/2−	≥1.7	1	6.0^{h}	β^-	1.7	1*		a	54M7	
$_{61}Pm_{84} \xrightarrow{145?} {}_{60}Nd_{85}$ 5/2,7/2+ 7/2−			~30^{y}							16^{d} 0.45 β^+ assigned to Pm^{145} (52L20).
$_{62}Sm_{83} \xrightarrow{145?} {}_{61}Pm_{84}$ 7/2,9/2− 5/2,7/2+ 5/2,7/2+	>0.061		410^{d}	ϵ					52R10	Parent ~ 30^{y} Pm (51B18).
				γ	0.061	1		s	52R10	
$_{58}Ce_{88} \xrightarrow{146} {}_{59}Pr_{87}$ 0+ ≥4.0 1+ 3−	1.0 ?	1	13.9^{m}	β^-	0.7	1		scin	54B10	Complex γ spectrum. No (0.32γ)γ coincidences. Spectrum of β's coincident with γ's is similar to β spectrum (54B10), therefore 0.7 β^- is assumed in cascade with intense 0.32γ.
					0.9			a	53C10	
				γ	0.32	1		scin	54B10	
$_{59}Pr_{87} \xrightarrow{146} {}_{60}Nd_{86}$ 3− 7.4 2+ 0+	4.2	1	24.4^{m}	β^-	3.7	2	56%−	scin	54B10	2.3 β^- (44%−) + 1.49γ+ 0.455γ gives good energy match. (0.46γ)(0.75γ, 1.49γ), (2.3 β^-)(0.75γ, 1.49γ), and (0.75γ)(0.75γ) coincidences. No (0.75γ)(1.49γ) coincidences (54B10).
					3.8	2*		a	53C10	
				γ	0.455	13		scin	54B10	
				(3.7 β^-)(0.46γ)					54B10	
$_{61}Pm_{85} \xrightarrow{146} {}_{60}Nd_{86}$ 0+			~1^{y}	For β^- decay see below.						
$_{61}Pm_{85} \xrightarrow{146} {}_{62}Sm_{84}$ ≳8.6 0+	≥0.7	1	~1^{y}	β^-	0.75	10			52L20	
					0.7	1*		a	52K25	
$_{60}Nd_{87} \xrightarrow{147} {}_{61}Pm_{86}$ 9/2− 7.6 7/2+ 5/2+	0.91	1	11.1^{d}	β^-	0.825	15*		s	52R10	[0.60 β^- (~15%−)] [0.32γ] coincidences and [0.38 β^- (~25%−)] [0.53γ] coincidences support adopted Q (52R10, 51E23).
					0.825	15	~60%−	s	51E23	
				γ	0.0918	9*		s	52M18	
					0.091	1		s	52R10	
					0.0915	10		s	51E23	
				(0.825 β^-) (0.091γ)					51E23, 52R10	
$_{61}Pm_{86} \xrightarrow{147} {}_{62}Sm_{85}$ 5/2+ 7.4 7/2−	0.225	3	2.6^{y}	β^-	0.2232	5		s	49P20	
					0.229	1		s	50A1	
					0.227	1		s	49L23	
				No γ					50S26, 50M3, 47M28	
$_{63}Eu_{84} \xrightarrow{147} {}_{62}Sm_{85}$ 5/2,7/2+ ? 7/2−	>0.208	3	24^{d}	ϵ, no β^+					53M17	0.12 γ (53M17).
				γ	0.208	3*		s	53M17	
$_{61}Pm_{87} \xrightarrow{148?} {}_{60}Nd_{88}$ 0+			42^{d}	For β^- decay see below.						
$_{61}Pm_{87} \xrightarrow{148?} {}_{62}Sm_{86}$ 10.9 0+	2.7 ?	3	42^{d}	β^-	2.7	3*	7%−	a	52K25	0.7 β^- (93%−), ~ 1.0γ (52K25). 0.6 β^-, 1.7 β^- and 0.54γ reported (52L1).
$_{63}Eu_{85} \xrightarrow{148} {}_{62}Sm_{86}$ 0+	>0.58	1	54^{d}	γ	0.58	1*		s	53M17	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
^{149} ${}_{60}Nd_{89} \rightarrow {}_{61}Pm_{88}$ 9/2,7/2⁻ >6.1 7/2⁺? 5/2⁺?	1.6	1	1.8^{h}	β^-	1.5	1*	<100%⁻	s	52R10	(1.1 β^-)(0.210 → 0.266γ) and (0.95 β^-)(0.650γ) coincidences give plausible decay scheme with good energy match. Complex γ spectrum (52R10).
					1.4	1*		a	50K71	
					1.5	1*		a	50m5	
					1.6	1*		a	46B25	
				γ	0.114	1*		s	52R10	
				(1.5 β^-)(0.114γ)					52R10	
^{149} ${}_{61}Pm_{88} \rightarrow {}_{62}Sm_{87}$ 5/2⁺? 7.0 ? 7/2⁻	1.34 ?	1	50^{h}	β^-	1.05	1*		s	52K27	The shell model argues for a transition between ground states but the adopted Q is based on the reported $\beta\gamma$ cascade.
					1.05	1*		s	52R10	
				γ	0.285	3*		s	52R10	
				(1.05 β^-)(0.285γ)					52R10	
^{149} ${}_{63}Eu_{86} \rightarrow {}_{62}Sm_{87}$ 5/2,7/2⁺ ? 7/2⁻	>0.57	1	120^{d}	γ	0.57	1*		s	53M17	0.30 γ (53M17).
^{150} ${}_{60}Nd_{90}$ — ${}_{61}Pm_{89}$ 0⁺			Stable ?	No β^- (τ_β > 2 x 10^{15y})					52M4	
^{150} ${}_{61}Pm_{89} \rightarrow {}_{62}Sm_{88}$? 7.0 ? 0⁺	≥4.4	1	2.7^{h}	β^-	2.01	3	70%⁻	s	52K25	2.01 β^- (70%⁻) or 3.00 β^- (30%⁻) in coincidence with ten γ's (0.14 to 2.4) (54F12).
				γ	2.4	1*		scin	54F12	
				(2.01 or 3.00 β)(2.4 γ)					54F12	
^{150} ${}_{63}Eu_{87} \rightarrow {}_{62}Sm_{88}$ 0,1⁻ 0⁺			13.7^{h}	No β^+					53M34	1.8 β^+ reported (50W64). For β^- decay see below.
				No γ, no ce⁻					53M34	
^{150} ${}_{63}Eu_{87} \rightarrow {}_{64}Gd_{86}$ 0,1⁻ ≥6.5 0⁺	1.07 ?	1	13.7^{h}	β^-	1.07	1*		s	53M34	F-K plot is not linear suggesting complex β^- decay but no evidence for required γ's or ce⁻ is found (53M34).
				No γ, no ce⁻					53M34	
^{151} ${}_{60}Nd_{91} \rightarrow {}_{61}Pm_{90}$ 9/2⁻? 5.6 11/2⁻? 5/2⁺?	≥3.07	2	12^{m}	β^-	1.93	2*		s	52R10	Complex γ spectrum. β^- (~0.1γ) coincidences (52R10).
				γ	1.14	1*		s	52R10	
				β^-(1.14γ)					52R10	
^{151} ${}_{61}Pm_{90} \rightarrow {}_{62}Sm_{89}$ 5/2⁺? 6.9 ? 9/2⁻?	≥1.8	1	27.5^{h}	β^-	1.1	1		a	52R10	Very complex γ spectrum. β^- (0.100γ, 0.165γ, 0.275γ, 0.340γ) coincidences (52R10).
				γ	0.715	7*		s	52R10	
				β^- (0.715γ)					52R10	
^{151} ${}_{62}Sm_{89} \rightarrow {}_{63}Eu_{88}$ 9/2⁻? 7.3 7/2⁺? 5/2⁺	0.096	2	~70^{y}	β^-	0.0755	11		s	50A1	
					0.079	3		s	49K5	
					0.075	5		pc	52W25	
					0.074	3*		s	49M5	
				γ	0.019	1*		pc	52W25	
					0.021	1*		pc	49S35	
				β^-(0.019γ)					52W25	
^{151} ${}_{64}Gd_{87} \rightarrow {}_{63}Eu_{88}$ 7/2,9/2⁻ ? 5/2⁺	>0.27	3	~150^{d}	ϵ, no β^+					50H18	
				γ	0.27	3*		a	50H18	
^{152} ${}_{63}Eu_{89} \rightarrow {}_{62}Sm_{90}$ 4⁺ 2⁺ 0⁺	>0.3654	6	~13^{y}	ϵ					49M5,49H4	0.720γ, 0.964γ, and 1.086γ converted in Sm (50C4) may belong to Eu^{152} ϵ decay. For β^- decay see below.
				γ_1	0.2443	6		s	54C24	
					0.2436	7		s	54L7	
				γ_2	0.1218	5		s	54C24	
					0.1212	3		s	54L7	
				(0.244γ)(0.121γ)					50F80	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{63}Eu_{89} \xrightarrow{152} {}_{64}Gd_{88}$; 0^+	(see comments)		$\sim 13^y$							Radiations not easily separated from those of Eu^{154}. Main decay may be by $0.9\ \beta^- + 0.123\gamma + 0.344\ \gamma$.
$_{62}Sm_{91} \xrightarrow{153} {}_{63}Eu_{90}$; $7/2^-$ 7.3 $\underline{5/2^+}$	0.798	4	47^h	β^-	0.795	5	$21\%^-$	s	54L8	($0.69\ \beta^-$)(0.103γ) coincidences support adopted Q value (52B49, 52R10, 54L8, 54G19) other β^- branches + γ's (54L8, 54M10, 54G19, 52B49, 52R10, 52S47, 50H17).
					0.810	10	$\leq 19\%^-$	s	54G19	
					0.80	1	$33\%^-$	s	50H17	
					0.80	2		scin	52B49	
				Q	0.800	20		Σscin	52B49	
$_{64}Gd_{89} \xrightarrow{153} {}_{63}Eu_{90}$; $7/2^-$ $7/2^+$ $\underline{5/2^+}$	>0.104	1	236^d	ϵ, no β^+					50H18	
				γ	0.104	1*		s	52C33	
				No other γ					52C33	
$_{65}Tb_{88} \xrightarrow{153?} {}_{64}Gd_{89}$; $3/2^+?$? $7/2^-$	>1.2	1	5.1^d	ϵ, no β^+					50W13	0.23 γ and ce^- present (50W13).
				γ	1.2	1*		a	50W13	
$_{63}Eu_{91} \xrightarrow{154} {}_{62}Sm_{92}$; 0^+			16^y	$K/\beta^- < 0.05$					49H4	Direction of decay unknown.
$_{63}Eu_{91} \xrightarrow{154} {}_{64}Gd_{90}$; 12.1 0^+	≥1.88	2	16^y	β^-	1.88	2*	$22\%^-$	s	50K12	Complex β^- and γ spectra (50K12, 54L7, 54C24). High energy β found in Eu^{154} separated from Eu^{152} (49M5, 50K12).
					1.9	1*	$10\%^-$	a	49H4, 49M5	
$_{65}Tb_{89} \xrightarrow{154} {}_{64}Gd_{90}$; >7.2 0^+	≥3.76	4	17.2^h	β^+	2.75	3*	50†	s	53R26	1.66 β^+ (50†) and complex ce^- (53R26).
					2.6	1*		s	50W13	
$_{62}Sm_{93} \xrightarrow{155} {}_{63}Eu_{92}$; $9/2^-?$ 5.8 $?^+$ $?^+$ $5/2^+$	2.2	1	23.5^m	β^-	1.8	1*		s	52R10	
					1.9	1*		a	50W7	
					1.8				42K3	
				γ_1	0.246	2*		s	52R10	
				γ_2	0.105	1*		s	52R10	
				($1.8\ \beta^-$)(0.246γ)(0.105γ)					52R10	
$_{63}Eu_{92} \xrightarrow{155} {}_{64}Gd_{91}$; $5/2^+$ 8.2 $7/2^-$	0.248	4	1.7^y	β^-	0.252	5	$16\%^-$	s	54L8	Energy match provided by $0.152\ \beta^-$ ($84\%^-$) + 0.105γ (54L8, 54C24, 52W25, 49M5). Several other γ's (54L8, 54C24, 52R10, 52W25).
					0.243	5*	$20\%^-$	s	49M5	
					~0.25	1*		pc	52W25	
				No ($0.25\ \beta^-$)γ					52W25	
$_{65}Tb_{90} \xrightarrow{155} {}_{64}Gd_{91}$; $3/2^+?$? $7/2^-$	(see comments)		190^d	ϵ					50W13	1.4 γ (50W13).
$_{62}Sm_{94} \xrightarrow{156} {}_{63}Eu_{93}$; 0^+ ≳6.1 ? 2^-	>0.9	1	$\sim 10^h$	β^-	~0.9	1		a	50W9	
$_{63}Eu_{93} \xrightarrow{156} {}_{64}Gd_{92}$; $2^-?$ 9.8^1 0^+	2.4	1	15.4^d	β^-	2.4	1*	$40\%^-$	a	50W9	Approximate energy match provided by $0.5\ \beta^-$ ($60\%^-$) + 2.0γ (50W9).
$_{65}Tb_{91} \xrightarrow{156} {}_{64}Gd_{92}$; 5.5 0^+	≥2.3	1	5.0^h	β^+	1.3	1*	$\sim 20\%^+$	a	50W13	0.3γ, 1.1γ (49B1).

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{65}Tb_{91} \xrightarrow{156} {}_{66}Dy_{90}$ 0^+			5.0^h	For β^+ decay see above.						
$_{63}Eu_{94} \xrightarrow{157} {}_{64}Gd_{93}$ $5/2,7/2^+$ 8.0 $7/2,9/2^-$	~1.7	1	15.4^h	β^-	~1.7	1*	25%$^-$	a	50W8	~1.0β^- (75%$^-$) + 0.6γ+ 0.2γ gives approximate energy match. 0.6γ/0.2γ ~1 (50W8).
$_{65}Tb_{92} \xrightarrow{157} {}_{64}Gd_{93}$ $3/2^+$? $7/2,9/2^-$			> 100^y or < 30^m							Not observed from Tb(24-Mev P) or as daughter of 8.2^h Dy^{157} (53H23).
$_{66}Dy_{91} \xrightarrow{157} {}_{65}Tb_{92}$ $7/2,9/2^-$? $3/2^+$?	> 0.325	7	8.2^h	No β^+ or e^-					53H23	
				γ	0.325	7*		scin	53H23	
$_{64}Gd_{95} \xrightarrow{159} {}_{65}Tb_{94}$ $7/2^-$ > 6.4 $5/2^+$ <u>$3/2^+$</u>	1.26	5	18.0^h	β^-	0.9	1*		a$\beta\gamma$	53J21	(~1.1β^-)(0.058γ) coincidences give fair support to adopted Q. No $\gamma\gamma$, no γ (x ray) coincidences (53J21).
					0.95	10*		a	49B1	
					0.85	10*		a	48K3	
					0.9	1*		a	48K21	
				γ	0.364	2			53J21	
					0.38	4*		a	49B1	
					0.35	4*		a	48K21	
				(0.9 β^-)(0.364 γ)					53J21	
$_{65}Tb_{95} \xrightarrow{160} {}_{64}Gd_{96}$? 0^+			71^d	No β^+					50B19	β^- decay (see below).
$_{65}Tb_{95} \xrightarrow{160} {}_{66}Dy_{94}$? 8.7 ? 2^+ 0^+	1.82	1	71^d	β^-	0.850	10*	40%$^-$	s	53S70	Complex β^- and γ spectra. $\beta\gamma$ and $\gamma\gamma$ coincidence measurements permit self-consistent decay scheme (54B26, 53S70, 52M3, 52M5. 50B19, 48C9).
					0.860	10	43%$^-$	s	50B19	
					0.882	10*		s	48C9	
				γ	0.960	4		s	54B26	
					0.962	4*		s	50C17	
				(0.86 β^-)(0.96γ)					54B26	
$_{67}Ho_{93} \xrightarrow{160} {}_{66}Dy_{94}$ 6.0 0^+	≥2.3	1	22.5^m	β^+	1.3	1*	0.5%$^+$	a	50W13	1.2 γ present (50W13). Low percentage of β^+ suggests decay is to more than one level.
$_{64}Gd_{97} \xrightarrow{161} {}_{65}Tb_{96}$ $7/2,9/2^-$ ≥4.9 $?^-$? $3/2^+$?	1.9	1	3.7^m	β^-	1.6	1*		a	53J21	0.360γ, and Tb K x-ray. No (0.36γ)(0.316γ) coincidences. (0.36γ)(K x-ray) coincidences (53J21).
					1.5	1*		a	48K21	
				γ_1	0.102	3		scin	53J21	
				γ_2	0.316	3*		s	53J21	
				(0.102 γ) (0.316 γ)					53J21	
				β^-(all γ's and K x-ray)					53J21	
$_{65}Tb_{96} \xrightarrow{161} {}_{66}Dy_{95}$ $3/2^+$? 6.5 ? <u>$7/2^-$</u>	0.56	2	6.8^d	β^-	0.50	3*		a	50H18	No other γ (52C33).
					0.52	3*		a	49B1	
				γ	0.049	1*		s	52C33	
					~0.045			a	49K1	
$_{67}Ho_{94} \xrightarrow{161} {}_{66}Dy_{95}$ $7/2^+$? ? <u>$7/2^-$</u>	>0.17	1	2.5^h	ϵ, no β^+					54H1	0.090 γ (54H1).
				γ	0.17	1*		scin	54H1	
$_{68}Er_{93} \xrightarrow{161} {}_{67}Ho_{94}$ $7/2,9/2^-$? $7/2^+$?	>1.12	2	3.6^h	ϵ, no β^+					54H1	0.065γ, 0.1958γ ?, 0.824γ (54H1).
				γ	1.12	2*		scin	54H1	

TABLE I.—*Continued.*

Disintegration	Adopted Q. Mev	Adopted Q. Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
${}_{67}Ho_{95} \xrightarrow{162} {}_{66}Dy_{96}$	> 0.95	*2*	5.0^h	ε, no β^+					54H19	0.19γ, 0.71γ (54H19). No neutron deficient Ho with $5.0^h < \tau < 20^y$ (54H19).
0^+				γ	0.95	*2**		scin	54H19	
${}_{67}Ho_{95} \xrightarrow{162} {}_{68}Er_{94}$	≥ 0.8 ?	*1*	65^d	β^- ?	0.8	*1**	~15 %$^-$	a	50W13	
9.0 0^+										
${}_{67}Ho_{96} \xrightarrow{163} {}_{66}Dy_{97}$			< 30^m or > 1^y							No 5^d activity (53H43).
7/2$^-$										
${}_{68}Er_{95} \xrightarrow{163} {}_{67}Ho_{96}$	> 1.10	*2*	75^m	ε, no β^+ (< 1 %)					53H43	0.43γ (53H43).
				γ	1.10	*2**		scin	53H43	
${}_{67}Ho_{97} \xrightarrow{164} {}_{66}Dy_{98}$	> 0.119	*1*	36.7^m	ε ?					54B29	$(0.046\gamma)(0.037\gamma, 0.046\gamma)$ coincidences (54B29). β^- branching (see below).
?				γ_1	0.073	*1**		s	54B29	
?				γ_2	0.046	*1**		s	54B29	
0^+				$(0.046\gamma)(0.073\gamma)$					54B29	
${}_{67}Ho_{97} \xrightarrow{164} {}_{68}Er_{96}$	0.98	*3*	36.7^m	β^-	0.99	*3*		s	54B29	$\beta^-(0.090\gamma)$ coincidences. β^- spectrum is consistent with two β^- groups separated by 0.090 (54B29).
> 5.1 0^+					0.95	*5**		a	50W13	
${}_{66}Dy_{99} \xrightarrow{165} {}_{67}Ho_{98}$	1.25	*2*	2.31^h	β^-	1.25	*2**	75 %$^-$	s	47S14	Complex γ spectrum (53J15, 54W10). $(\sim 1.2\,\beta^-)(0.094\gamma)$ coincidences (53J15) are interpreted as due to an unresolved β^- with energy 0.094 less than ground state β^-. 0.3 β^- is in coincidence with all other γ's (53J15).
7/2$^-$ *6.2* *7/2*$^+$										
${}_{68}Er_{97} \xrightarrow{165} {}_{67}Ho_{98}$	> 0		10^h	ε					50B85	
7/2$^-$ *7/2*$^+$				No e^-, no γ					52K15	
${}_{69}Tm_{96} \xrightarrow{165} {}_{68}Er_{97}$	> 1.38	*3*	24.5^h	No β^+ (< 1 %)					53H43	0.205γ, 0.808γ, 1.16γ (53H43).
1/2$^+$?				γ	1.38	*3**		scin	53H43	
7/2$^-$										
${}_{66}Dy_{100} \xrightarrow{166} {}_{67}Ho_{99}$	≲ 0.27	*2*	82^h	β^-	0.22	*2**		a	50B30	
0^+ *≥ 5.1* 1^+	> 0.22	*2*		γ	< 0.05	*1**		a	50B30	
2^-?										
${}_{67}Ho_{99} \xrightarrow{166} {}_{68}Er_{98}$	1.85	*2*	27.3^h	β^-	1.84	*2**	~ 55 %$^-$	s	50S20	74 %$^-\beta$ branch to 0.080 level (54S12).
2^-? *8.4*^{1} 0^+	or				1.84	*2**		s	50A75	
or	1.29	*3*			1.88	*2**		s	49G1	
> 9.3 (0.28 β^-*)*	(see comments)						25 %$^-$		54S12	
			> 30^y	β^-	0.28	*2**	46 %$^-$	a$\beta\gamma$	52B18	$0.18\,\beta^-$ (46 %$^-$) + 0.83γ + 0.28γ and $1.1\,\beta^-$ (8 %$^-$) + 0.212γ give good energy match. $(0.18\,\beta^-$ or $0.28\,\beta^-)(0.73\gamma$ or $0.83\gamma)$ and $(1.1\,\beta^-)(0.212\gamma)$ coincidences (52B18). Q value of 27^h state fits β decay energy systematics better (54W1).
				γ_1	0.725	*15**		scin	52B18	
				γ_2	0.280	*6**		scin	52B18	
				$(0.73\gamma)(0.28\gamma)$					52B18	
				$\beta\gamma$					52B18	
${}_{69}Tm_{97} \xrightarrow{166} {}_{68}Er_{98}$	≥ 3.1	*1*	7.7^h	β^+	2.1	*1**	0.4 %$^+$	a	49W3	1.7γ and 0.24 e^- present (49W3).
8.4 0^+										

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{69}Tm_{98} \xrightarrow{167} {}_{68}Er_{99}$ $1/2^+$? $7/2^-$	>0.9	1	9.6^d	ε, no β^+					49W3	0.22γ and 0.21 e^- present (49W3).
				γ	0.95	10*		a	49W3	
$_{70}Yb_{97} \xrightarrow{167} {}_{69}Tm_{98}$ $7/2^-$? ? $1/2^+$	>0.118	2	18.5^m	ε, no β^+					54H16	0.18γ, 0.33γ possible (54H16).
				γ	0.118	2*		scin	54H16	
$_{69}Tm_{99} \xrightarrow{168} {}_{68}Er_{100}$ 0^+	>0.85	9	85^d	ε					49W3	0.21γ. L x-ray/K x-ray ~0.2. Total ε branching ~98%. (49W3). β^- branching (see below).
				γ	0.85	9*		a	49W3	
$_{69}Tm_{99} \xrightarrow{168} {}_{70}Yb_{98}$ ~9.4 0^+	0.5 ?	1	85^d	β^- ?	0.5	1*	~2%$^-$	a	49W3	
$_{68}Er_{101} \xrightarrow{169} {}_{69}Tm_{100}$ $1/2^-$ 6.1 $1/2^+$	0.33	1	9.4^d	β^-	0.33	1*		s	48K11	
					0.33	1*		scin	49B60	
				No γ					48K11	
$_{70}Yb_{99} \xrightarrow{169} {}_{69}Tm_{100}$ $7/2^-$? $1/2^+$	>0.308	2	33^d	ε					46B9	Many γ's present (51M25, 49C23, 50S49).
				γ	0.308	3*		s	51M25	
					0.308	3*		s	49C23	
					0.307	3*		s	50S49	
$_{69}Tm_{101} \xrightarrow{170} {}_{68}Er_{102}$ 1^- 0^+			127^d	For β^- decay see below.						
$_{69}Tm_{101} \xrightarrow{170} {}_{70}Yb_{100}$ 1^- 9.0 0^+	0.969	3	127^d	β^-	0.968	4	76%$^-$	s	52G18	0.886 β^- (24%$^-$) + 0.084γ gives good energy match. β^-(0.084γ) coincidences. No other γ (52G18).
					0.970	10*		s	52R7	
					0.970	5		s	49F13	
					0.970	10		s	49S5	
$_{71}Lu_{99} \xrightarrow{170?} {}_{70}Yb_{100}$ 0^-? ? 0^+	>2.5	3	1.7^d	ε					51W8	
				γ	~2.5	3*		a	51W8	
$_{72}Hf_{98} \xrightarrow{170?} {}_{71}Lu_{99}$ 0^+ 6.2 0^-?	3.4 ?	2	1.87^h	β^+	2.4	2*		s	51W8	
				No γ ?					51W8	
$_{68}Er_{103} \xrightarrow{171} {}_{69}Tm_{102}$ $5/2^-$? 6.5 ? ? 7.8^1 $1/2^+$	1.47	3	7.5^h	β^-	1.05	3	72%$^-$	s	48K11	1.49 β^- (6%$^-$) directly to ground gives good energy match (48K11). 0.67 β^- (22%$^-$) + 0.805γ (48K11) in doubt because 0.805γ not found (51K26).
				γ_1	0.307	3*		s	51K26	
					0.305	10		s	48K11	
				γ_2	0.113	2*		s	51K26	
					0.113	5		s	48K11	
$_{69}Tm_{102} \xrightarrow{171} {}_{70}Yb_{101}$ $1/2^+$ 6.4 $1/2^-$	0.10	1	680^d	β^-	0.10	1*		s	48K21	
				No γ					48K21	
$_{71}Lu_{100} \xrightarrow{171} {}_{70}Yb_{101}$ $7/2^+$? ? $1/2^-$	>1.2	1	8.5^d	ε					51W8	
				γ	1.2	1*		a	51W8	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	%	Method	Ref.	Comments
$_{71}Lu_{101} \xrightarrow{172} {}_{70}Yb_{102}$? 0^+	>1.2	1	6.7^d	ε					51W8	
				γ	1.2	1*		a	51W8	
$_{72}Hf_{100} \xrightarrow{172} {}_{71}Lu_{101}$ 0^+	>0.8	1	$\sim 5^y$	ε					51W8	
				γ	0.8	1*		a	51W8	
$_{71}Lu_{102} \xrightarrow{173} {}_{70}Yb_{103}$ $7/2^+$? ? 5/2	>0.88	9	500^d	γ	0.88	9*		a	51W8	0.22 γ (51W8).
$_{72}Hf_{101} \xrightarrow{173} {}_{71}Lu_{102}$ $1/2^-$? ? $7/2^+$?	>0.299	5	23.6^h	ε					51W8, 54W2	0.121 γ (54W2). 0.63 γ and 1.02 γ could belong to Hf^{171} or Hf^{173}.
				γ	0.299	5		scin	54W2	
$_{71}Lu_{103} \xrightarrow{174} {}_{70}Yb_{104}$ 0^+	>0		165^d	ε					51W8	γ and e^- reported (51W8). β^- branching (see below).
$_{71}Lu_{103} \xrightarrow{174} {}_{72}Hf_{102}$ 8.9 0^+	≥0.6 ?	1	165^d	β^- ?	0.6	1*	20%	a	51W8	γ, and e^- reported (51W8).
$_{70}Yb_{105} \xrightarrow{175} {}_{71}Lu_{104}$?⁻ >6.4 $7/2^+$	0.48	4	4.2^d	β^-	0.50	5*		a	46B9	0.13 β^- + 0.35 γ gives fair energy match (46B9). 0.138 γ, 0.259 γ, 0.283 γ and 0.396 γ reported (50C16).
					0.45	5*		cc	46A2	
				No (0.50 β^-) γ					46B9	
$_{72}Hf_{103} \xrightarrow{175} {}_{71}Lu_{104}$? $7/2^+$	>0.431	4	70^d	ε					49W11	0.089 γ, 0.113 γ, 0.228 γ, 0.318 γ and 0.342 γ fit into consistent scheme with good energy match (52B25, 51H10, 53B81). 1.5 γ reported (49W11) would make Q > 1.5.
				γ	0.431	4*		s	52B25	
$_{71}Lu_{105} \xrightarrow{176} {}_{70}Yb_{106}$ ≥9 0^+			2.2×10^{10y}	$\epsilon/\beta^- < 0.1$					54A3	For β^- decay see below.
$_{71}Lu_{105} \xrightarrow{176} {}_{72}Hf_{104}$ ≥9 18.4 6^+ 4^+ 2^+ 0^+	1.00	2	2.2×10^{10y}	β^-	0.40	2*		a	53A3	
					0.40	2*		a	47F7	
				γ_1	0.306	6*		scin	54A3	
					0.27				52S64	
				γ_2	0.203	4*		scin	54A3	
					0.18				52S64	
				γ_3	0.089	2*		scin	54A3	
					0.090				52S64	
				(0.32 γ)(0.20 γ)					53A3	
				(0.4 β^-) γ					53A3	
$_{73}Ta_{103} \xrightarrow{176} {}_{72}Hf_{104}$? 0^+	>1.2	1	8^h	ε, no β^+					50W67	
				γ	1.2	1*		a	50W67	
$_{74}W_{102} \xrightarrow{176} {}_{73}Ta_{103}$ 0^+ ~7.4	(see comments)		80^m							~2.0 β^+ (~0.5% β^+), 1.3 γ (50W67).

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Type	Mev	Error	%	Method	Ref.	Comments
$_{70}Yb_{107} \xrightarrow{177} {}_{71}Lu_{106}$	1.4	1	1.8^h	β^-	1.3	1*		a	46B9	
					1.2	1*		cc	46A2	
$1/2,3/2^-$ 6.1 $1/2,3/2^+$				γ	0.150	10		scin	49M41	
$5/2^+$				$\beta\gamma$ delay $0.13^{\mu s}$					49M41	
$_{71}Lu_{106} \xrightarrow{177} {}_{72}Hf_{105}$	0.49	1	6.8^d	β^-	0.495	5	$65\%^-$	s	49D5	Approximate energy match from 0.366 β^- ($17\%^-$) + 0.112γ and 0.169 β^- ($18\%^-$) +0.206γ+ 0.112γ. Crossover 0.318γ observed (49D5, 52M6).
$5/2^+$ 6.8 $3/2^-$					0.475	5		s	50A13	
$_{73}Ta_{104} \xrightarrow{177} {}_{72}Hf_{105}$	>1.4	2	2.2^d	ϵ					50W67	0.1 e^- (50W67).
?				γ	~1.4	2*		a	50W67	
$3/2^-$										
$_{74}W_{103} \xrightarrow{177} {}_{73}Ta_{104}$	>1.2	2	2.2^h	ϵ					50W67	0.45γ, 0.13e^-, 0.4e^- (50W67).
				γ	1.2	2*			50W67	
$_{73}Ta_{105} \xrightarrow{178} {}_{72}Hf_{106}$	≥2.08	5	9.35^m	β^+	1.06	5*	~6$\%^+$	s	50W67	~1.5γ present (50W67).
	or		2.1^h	β^+	~1.0	5*	~3$\%^+$	a	50W67	1.3-1.5γ present (50W67).
4.5 or ~5.6	≥2.0	5								
$_{73}Ta_{106} \xrightarrow{179} {}_{72}Hf_{107}$			~600^d							0.1e^-, weak 0.7γ (50W67).
$1/2,3/2^-$										
$_{73}Ta_{107} \xrightarrow{180} {}_{72}Hf_{108}$	>0.093	1	8.1^h	ϵ, no β^+ ($<10^{-3}\%$)					3801,50W67,51B87	Total ϵ ~79%, Total β^-~21%. ϵ(g.s.)/ϵ (0.093 level) ~0.7 (51B87).
1^-? 2^+				γ	0.093	1*		s	51B87	
0^+										
$_{73}Ta_{107} \xrightarrow{180} {}_{74}W_{106}$	0.70	2	8.1^h	β^-	0.705	15	~10$\%^-$	s	51B87	0.605 β^- (~11$\%^-$)+ 0.102γ gives good energy match. β(~0.1γ) coincidences (51B87).
					0.7			a	50W67	
1^-? 6.8 0^+					0.7			a	51M47	
$_{72}Hf_{109} \xrightarrow{181} {}_{73}Ta_{108}$	1.020	3	45^d	β^-	0.406**	3		s		**β^- energy is weighted average of five spectrometer measurements (53B81, 52F14 49C11, 51B50, 49J5). γ_1 is weighted average of six spectrometer measurements (53B81, 51B50, 50C9, 49H34 49C11, 49J5). γ_2 is weighted average of seven spectrometer measurements (53B81, 52F14, 51B50, 50C9, 49J5, 49C11 49H34).
$3/2^-$ 7.2 $5/2^+$				γ_1	0.133**	1		s		
$9/2^+$				γ_2	0.481**	1		s		
$7/2^+$				$\gamma_1\gamma_2$					49B9,50P62,50C9,50F80	
				$\gamma_1\gamma_2(\theta)$					54M3	
				$\beta(\gamma_1,\gamma_2)$ delay ~$22^{\mu s}$					50P62	
$_{74}W_{107} \xrightarrow{181} {}_{73}Ta_{108}$	>0.289	2	140^d	ϵ					47W3	0.03, 0.6, 0.8, 1.8γ's not found (53C41).
?				γ_1	0.1525	15*		s	53C41	
$9/2^+$				γ_2	0.1365	14*		s	53C41	
$7/2^+$				$\gamma_1\gamma_2$?					53C41	
$_{73}Ta_{109} \xrightarrow{182} {}_{74}W_{108}$	1.732	5	111^d	β^-	0.510	5	<100$\%^-$	s	54B30	Very complex γ spectrum (54B30, 52M45, 50C16, 50E2, 49G14, 49B21). Probable final state of 0.510 β^- is the 1.222 level of W^{182} (54B30, 54M35, 54S10, 54F13).
					0.53		<100$\%^-$	s	50J62	
>8.0 2^+?					0.53			s	49B21	
0^+				γ	1.222	1		Xtl	54B30	
				(0.5 β^-)(hardγ)					50E2	
$_{75}Re_{107} \xrightarrow{182} {}_{74}W_{108}$	(see comments)		13^h	ϵ					50W14,50D61	Several γ's (0.11 to 1.6) listed (50W14,50D61).
?										
0^+										

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{76}Os_{106} \xrightarrow{182} {}_{75}Re_{107}$; 0^+ ?	> 0		24^h	ϵ, no β^+					50J5	
$_{73}Ta_{110} \xrightarrow{183} {}_{74}W_{109}$; ≥ 6.7 $1/2^-$	≥ 0.56	1	5.2^d	β^-	0.558	10		s	53D20	27 γ's (0.041 to 0.407) observed (54M36, 53M38).
					0.6	1*		a	51M47	
$_{75}Re_{108} \xrightarrow{183} {}_{74}W_{109}$; $1/2^-$	(see comments)		~ 120^d							γ's of 0.081, 0.252, 1.0 (50W14). γ's of 0.1, 0.3, 0.8, 1.0 (51T9) Cf Re^{184}.
$_{76}Os_{107} \xrightarrow{183} {}_{75}Re_{108}$	> 1.6	2	12^h	γ	1.6	2*		a	50J5	0.3 γ (50J5).
$_{75}Re_{109} \xrightarrow{184} {}_{74}W_{110}$; ? 0^+	> 1.0	1	50^d	γ	1.0	1*		a	50W14	Several γ's reported with energies from 0.043 to 1.0 (50W14). ~ 1.0γ assigned to long-lived Re^{183}, Re^{184}, Re^{189}(51T9). Seems definitely to belong to Re^{184} and possibly to other isotopes.
					1.0	1*		a	51T9	
					0.9	1*		a	40F1	
$_{75}Re_{109} \xrightarrow{184} {}_{76}Os_{108}$; 0^+			50^d	No β^-					50W14	
$_{73}Ta_{112} \xrightarrow{185} {}_{74}W_{111}$; 6.3	1.7	1	48^m	β^-	1.7	1*		a	50D54	0.075 ce^- are probably L ce^- indicating γ ~ 0.087
					1.6	1*		a	51M47	
				From 1.85^m W^{185} isomer					50D54	
				ce^-	0.075			scin	50D54	
$_{74}W_{111} \xrightarrow{185} {}_{75}Re_{110}$; 7.5 $5/2^+$	0.429	4	74^d	β^-	0.428	5*		s	48S24	
					0.43	1		s	48S18	
					0.43	1*		s	48P2	
				No γ					53L20, 48P2, 47C2	
$_{76}Os_{109} \xrightarrow{185} {}_{75}Re_{110}$; ? $5/2^+$	> 0.879	5	97^d	ϵ					51M22, 50B51, 48K8, 47G1	0.645γ (53C13, 52S57, 51M22, 50B51). 0.234γ, 0.163γ (53C13).
				γ	0.879	9*		s	53C13	
					0.878	9*		s	50B51	
					0.88	1*		s	52S57	
					0.88	1		scin	51M22	
$_{75}Re_{111} \xrightarrow{186} {}_{74}W_{112}$; $0,1^-$ 2^+ 0^+	> 0.1230	6	91^h	ϵ					51S39, 51M23	ϵ ~ 3% to ground state and ~ 2% to 0.12 level (51M23).
				γ	0.1234	6		s	53A32	
					0.123	1*		s	51M23	
					0.122	1*		s	51S39	
				β^+ per disintegration < 10^{-7}					50M87	
				No β^- [ce^-(0.122γ)]					51S39	
$_{75}Re_{111} \xrightarrow{186} {}_{76}Os_{110}$; $0,1^-$ 7.7 0^+	1.068	3	91^h	β^-	1.064	4	76%⁻	s	54G20	0.93 β^- (19%⁻) + 0.137γ gives good energy match (54G20, 53A32, 51S39, 51M23). (0.93 β^-)(0.14γ) coincidences (53W26).
					1.060	10	73%⁻	s	53A32	
					1.070	10*	76%⁻	s	51M23	
					1.070	5	67%⁻	s	51S39	
					1.09	1*	~ 67%⁻	s	49G3	
				No (1.07 β^-)γ					51M23	
$_{74}W_{113} \xrightarrow{187} {}_{75}Re_{112}$; $3/2^-$? 8.0 $5/2^+$	1.311	4	24^h	β^-	1.304	5	20%⁻	s	53C11	Good energy match provided by 0.62 β^- (~ 80%⁻) + 0.69γ. Other γ's fit decay scheme (53C11, 53S1, 52M45, 49L10, 48P2, 53G30).
					1.318	13*		s	49L10	
					1.33	1	30%⁻	s	48P2	
					1.34	2*		s	48H52	
$_{75}Re_{112} \xrightarrow{187} {}_{76}Os_{111}$; $5/2^+$ 17.6 $11/2, 13/2^+$	0.039	5	4×10^{12y}	β^-	0.043	6		a	48N1	0.4 β^- reported (52D26).
					~ 0.034	6*		ppl	53G6	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{77}Ir_{110} \xrightarrow{187} {}_{76}Os_{111}$ $3/2^+$? 8.9 ? $11/2, 13/2^+$	≥3.2	1	11.8^h	β^+	2.2	1	$0.2\%^+$	s	50C11	1.3γ, $0.28ce^-$, $1.2ce^-$ present (50C11).
$_{75}Re_{113} \xrightarrow{188} {}_{76}Os_{112}$ $2,1,0^-$ >7.9 0^+	2.08 (see comments)	2	17^h	β^-	2.07 2.10	2 2*	$<100\%^-$	s s	52R39 49B21	Complex γ's. From γ intensities get ~25% of β^- to ground, ~62% to 0.1553 level. (52R39, 53M39, 49B21, 48C23).
$_{77}Ir_{111} \xrightarrow{188} {}_{76}Os_{112}$ 9.1 0^+	≥3.0	1	41.5^h	β^+	2.0	1*	$0.3\%^+$	s,a	50C11	1.8γ, $0.16ce^-$, $0.85ce^-$ (50C11). 0.156γ (54N4).
$_{75}Re_{114} \xrightarrow{189?} {}_{76}Os_{113}$ $\underline{3/2^-}$	(see comments)		150^d or $\geq 5^y$							150^d 0.2 β^- and $\geq 5^y$ 0.75 β^- found from Re(th n) (51L19) ~250^d 0.2 e^- and 1.0γ assigned here from W (α,p) (51T9).
$_{75}Re_{116} \xrightarrow{191?} {}_{76}Os_{115}$ ≥5.7 $7/2^+$?	≥1.8 (see comments)	2	9.8^m	β^-	1.8	2		a	53A24	This activity from Os(20-Mev n) assigned to Re^{189} (53A24). 17^m period from Os(23-Mev γ) (50B7) is possibly mixture of 9.8^m and 22^m (Re^{188}).
$_{76}Os_{115} \xrightarrow{191} {}_{77}Ir_{114}$? 5.6 ? $\underline{3/2^+}$	>0.143 <0.313	2 2	15^d	β^-	0.143 0.142	2 3		s s	52K27 48S18	0.042γ and 0.128γ (52S57, 52K27, 50B51, 52J23). β(e^- 0.042γ) coincidences (52K27); (e^- 0.042γ)(e^- 0.129γ) coincidences (52S57); no β(e^- 0.129γ) coincidences (54M10).
$_{78}Pt_{113} \xrightarrow{191} {}_{77}Ir_{114}$? $\underline{3/2^+}$	>0.62	1	3.2^d	ϵ γ	 0.62	 1		 s	49W8 54T13	Total of 16 γ's permit self consistent scheme (54T13, 53S20, 54G4).
$_{79}Au_{112} \xrightarrow{191} {}_{78}Pt_{113}$ $3/2^+$?	>0.159	2	~4^h	γ	0.1587	16*		s	54G4	0.048γ, 0.091γ, 0.130γ (54G4).
$_{80}Hg_{111} \xrightarrow{191} {}_{79}Au_{112}$? $3/2^+$?	>0.274	3	57^m	γ	0.2741	27*		s	54G4	0.2526γ, $0.0111e^-$ (54G4).
$_{77}Ir_{115} \xrightarrow{192} {}_{78}Pt_{114}$ >8.2 ? 2^+? 2^+ 0^+	1.58	1	74.4^d	β^- γ_1 γ_2 γ_3 Q	0.67 0.66 0.67 0.62 0.308454 0.295942 0.316462 1.58	1 2* 2* 2* 33 31 34 3	<100%	s s s s Xtl Xtl Xtl Σscin	52B77 51S84 47L6 47J1 52M45 52M45 52M45 52R40	Energies and intensities of other γ's support decay scheme (52M45, 52B77, 51S84, 50W80).
$_{79}Au_{113} \xrightarrow{192} {}_{78}Pt_{114}$ 0^+	(see comments)		4.1^h							Many γ's present including 0.316γ and 0.296γ (53E14, 54G4). 1.9 β^+ (~1 $\%^+$) (49W8).
$_{80}Hg_{112} \xrightarrow{192} {}_{79}Au_{113}$ 0^+	(see comments)		5.7^h							1.4γ and several lower energy γ's present (54G4, 52F6). 1.2 β^+ (52F6).
$_{76}Os_{117} \xrightarrow{193} {}_{77}Ir_{116}$ $1/2^-$ ≥7.2 $\underline{3/2^+}$	1.09	2	31^h	β^-	1.10 1.10 1.05	3* 2* 3		scin s s	54D4 50B51 50M60	Complex γ's in coincidence with weak lower energy β's (54D4, 53C13, 53S46, 52S57, 50M60).

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Mev	Error	%	Method	Ref.	Comments
$_{78}Pt_{115} \xrightarrow{193} {}_{77}Ir_{116}$			$> 74^d$							
$1/2^-$ $\underline{3/2^+}$			or $< 1^h$							
$_{79}Au_{114} \xrightarrow{193} {}_{78}Pt_{115}$	> 0.440	4	17.4^h	ϵ					53E14,54G4,49W8	Complex γ's (53E14, 54G4).
$3/2^+$?				γ	0.4396	44*		s	53E14	
$1/2^-$										
$_{80}Hg_{113} \xrightarrow{193} {}_{79}Au_{114}$	> 0.224	2	4^h	ϵ					54G4	
$3/2^-$ $3/2^+$				γ_1	0.1865	19*		s	54G4	
$1/2^+$				γ_2	0.0379	4*		s	54G4	
$3/2^+$										
$_{77}Ir_{117} \xrightarrow{194} {}_{78}Pt_{116}$	2.16	4	19^h	β^-	2.18	4		s	41W7	0.48 β^-(0.5%$^-$)+1.48γ+ 0.33γ gives approximate energy match (48M14, 51C33, 52W16, 53K7, 54B2).
1^- ≥ 8.2 0^+					2.1	1*		a	47G1	
$_{79}Au_{115} \xrightarrow{194} {}_{78}Pt_{116}$	$\geq$ 2.8	1	39.5^h	β^+	1.8	1*	3%$^+$	a	49W8	0.291γ, 1.48γ and 0.328γ in cascade. 2.1γ crossover, plus weak 0.466γ indicate Q > 2.6 (49S17).
≥ 7.4 0^+										
$_{77}Ir_{118} \xrightarrow{195} {}_{78}Pt_{117}$	2.1	1	2.3^h	β^-	2.1	1		a	54B2	1.2 β^-+ 0.88γ gives energy match. 0.42γ, 0.66γ, and > 1.0γ present. a$\beta\gamma$ indicates another lower energy β^- (54B2).
$3/2^+$ > 7.2 $\underline{1/2^-}$				No (2.1 β^-)γ					54B2	
$_{79}Au_{116} \xrightarrow{195} {}_{78}Pt_{117}$	> 0.127	2	180^d	ϵ					52S26,49S17	0.030γ and 0.098γ present (52S26, 54G4).
$3/2^+$ $5/2^-$				γ	0.126	2*		s	52S26	
$\underline{1/2^-}$					0.129	2		s	49S17	
$_{80}Hg_{115} \xrightarrow{195} {}_{79}Au_{116}$	> 1.15	1	9.5^h	ϵ					54G4,53H44	Other γ's of lower energy and higher intensity present (54G4, 53H44, 52H54).
$3/2^-$?				γ	1.15	1*		s	53H44	
$3/2^+$										
$_{77}Ir_{119} \xrightarrow{196?} {}_{78}Pt_{118}$	> 1.0	2	9.7^d	β^-	0.08	2	< 100%$^-$	a	54B2	0.58γ, 0.76γ (54B2).
> 4.4 ?				γ	~1.0	2*		scin	54B2	
0^+										
$_{79}Au_{117} \xrightarrow{196} {}_{78}Pt_{118}$	> 0.687	4	5.55^d	ϵ					52S40,49S17	Total ϵ branching 95%, β^- branching 5% (49S17).
$2,3^-$ 2^+				γ_1	0.332	3*		s	52S40	
2^+					0.330	3*		s	49S17	
0^+				γ_2	0.354	4*		s	52S40	
					0.358	4*		s	49S17	
				$\gamma\gamma(\theta)$					53S5,51S61	
$_{79}Au_{117} \xrightarrow{196} {}_{80}Hg_{116}$	0.70	2	5.55^d	β^-	0.27	2		s	52S40	Total ϵ branching 95% (49S17).
$2,3^-$ 7.2 2^+					0.30	5	5%$^-$	s	49S17	
0^+				γ	0.426	2		s	52S40	
				β^- (0.426γ)					52S40	
$_{77}Ir_{120} \xrightarrow{197} {}_{78}Pt_{119}$	> 1.8	2	7^m	β^-	1.6	2	<100%$^-$	a	54B2	1.8 γ and other γ's present (54B2).
> 5.4 ?				(1.6 β^-)γ					54B2	
$1/2^-$										

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$_{78}Pt_{119} \xrightarrow{197} {}_{79}Au_{118}$	0.75	1	19^h	β^-	0.67	1*	98.5%⁻	sl	52S27	Intensity of 0.077γ supports $\beta\gamma$ cascade $[e^-(0.191\gamma)][e^-(0.077\gamma)]$ coincidences found as in Hg^{197} (52S27).
$1/2^-$ 6.2 $1/2^+$					0.62	4*		a	52H16	
$\underline{3/2^+}$				γ	0.077	1*		s	52S27	
					0.077	1*		s	52C12	
$_{80}Hg_{117} \xrightarrow{197} {}_{79}Au_{118}$	> 0.268	1	65^h	ϵ					43F1	$\gamma_1\gamma_2$ coincidences also found in decay of Pt^{197}.
$1/2^-$ $1/2,3/2^+$				γ_1	0.192	2*		s	53H44	
$1/2^+$					0.191	2*		s	53M22	
$\underline{3/2^+}$					0.191	2*		s	51H17	
					0.191	2*		s	52C1	
				γ_2	0.0776	8*			53H44	
					0.0774	8*		s	53M22	
					0.077	1*		s	51H17	
					0.078	1*		s	52C1	
					0.077	1*		s	50F55	
				$[e^-(0.191\gamma)][e^-(0.077\gamma)]$					51H17	
$_{77}Ir_{121} \xrightarrow{198} {}_{78}Pt_{120}$	4.4	3	50^s	β^-	3.6	3		a	54B2	
≥ 5.9 ?				γ	0.78	2*		scin	54B2	
0^+				$(3.6\beta^-)(0.78\gamma)$					54B2	
$_{79}Au_{119} \xrightarrow{198} {}_{78}Pt_{120}$			2.697^d	No ϵ_K (< 0.5%)					49R6, 53B17	
$2^+,3^\pm$ 0^+										
$_{79}Au_{119} \xrightarrow{198} {}_{80}Hg_{118}$	1.377	5	2.697^d	β^-	0.965**	5	98%⁻	s		**β^- energy is weighted average of six spectrometer measurements (52W29, 52S62, 52F14, 49L7, 49L6, 49S17). Energy match is provided by 1.371 β^- (0.0025%⁻)(54E4) and 0.29 β^- (~1.8%⁻) + 0.676γ + 0.412γ (51E2, 51B52, 51C24, 53S19, 51C6, 54E4, 54M19).
$2^+,3^\pm$ 7.4 2^+				γ	0.411770	36		Xtl	52M45	
11.5 0^+					0.41173	7		s	52H36	
$_{81}Tl_{117} \xrightarrow{198} {}_{80}Hg_{118}$	> 1.086	8	5^h	γ_1	0.675	7*		s	53B79	Levels of Hg^{198} from Au^{198} decay indicate γ_1 and γ_2 in cascade. Other γ's (53B79).
2,3 2^+				γ_2	0.411	4*		s	53B79	
2^+										
0^+										
$_{78}Pt_{121} \xrightarrow{199} {}_{79}Au_{120}$	≥ 1.8	1	29^m	β^-	1.8	1*		a	41S8	Complex γ spectrum. $(\sim 1.2\beta^-)(0.197\gamma, 0.246\gamma, 0.316\gamma, 0.54\gamma)$ coincidences (54L24).
$3/2^-$ >6.2 $3/2^+$										
$_{79}Au_{120} \xrightarrow{199} {}_{80}Hg_{119}$	0.451	5	3.15^d	β^-	0.291	5	73%⁻	s	52S26	Energy match provided by $\sim 0.45\beta^-$ (7%⁻)(52S26, 52B26, 51S58) and 0.25 β^- (20%⁻) + 0.21γ (52S47, 51S58, 52B26, 52C12). βe^-, $\gamma\gamma$, and e^-e^- coincidences support decay scheme (52S47, 51S58).
$3/2^+$ 5.8 $3/2^-$?					0.30	1*		s $\beta\gamma$	52B26	
7.7 $\underline{1/2^-}$					0.300	25	73.5%⁻	s	51S58	
				γ	0.157	2*		s	52S26	
					0.158	2*		s	52S47	
					0.158	2*		s	52C12	
					0.159	2*		s	51S58	
$_{81}Tl_{118} \xrightarrow{199} {}_{80}Hg_{119}$	> 0.491	4	7^h	ϵ, no β^+					51I2, 49O1	Complex γ's (51I2, 53B79). Not parent of 44^m Hg (53B79).
$1/2^+$? $1/2^-$?				γ	0.490	5*		s	51I2	
$\underline{1/2^-}$					0.491	5*		s	53B79	
$_{79}Au_{121} \xrightarrow{200} {}_{80}Hg_{120}$	2.3	2	48^m	β^-	2.2	1*		a	52B63	0.39γ and 1.13γ present (52B63).
$0,1^-$ ≥ 6.9 0^+					2.5	1*		a	41S8	
				$\beta/\gamma = 5$					52B63	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Mev	Error	%	Method	Ref.	Comments
$_{81}Tl_{119} \xrightarrow{200} {}_{80}Hg_{120}$	> 1.36	1	27^h	ε, no β^+					51I2,4901	Complex γ's (51I2, 53B79).
?				γ	1.36	1*		sπ;ce^-	51I2	
0^+										
$_{82}Pb_{118} \xrightarrow{200} {}_{81}Tl_{119}$	> 0.320	3	18^h	ε					49N5	0.139 γ also present (5106).
0^+				γ	0.320	3*			5106	
$_{79}Au_{122} \xrightarrow{201} {}_{80}Hg_{121}$	1.5	1	26^m	β^-	1.5	1*	$95\%^-$	a	52B63	0.55 γ present (52B63).
$3/2^+$ 5.9 $3/2^-$				β^-/γ = 20					52B63	
$_{81}Tl_{120} \xrightarrow{201} {}_{80}Hg_{121}$	> 0.168	2	72^h	ε, no β^+					49N5	
$1/2^+$?				γ	0.1676	17*		s	53B79	
$3/2^-$										
$_{82}Pb_{119} \xrightarrow{201} {}_{81}Tl_{120}$	> 0.583	3	8.4^h	γ	0.583	3		s	54W12	0.325 γ (54W12).
$1/2^-$ $1/2^+$										
$_{81}Tl_{121} \xrightarrow{202} {}_{80}Hg_{122}$	> 0.437	3	12.5^d	ε					50W17,42M3,40K8	
				β^+ < 0.5%					50W17	
				γ	0.4391	44*		s	53B79	
					0.431	10		scin	52M28	
					0.435	5		s,a	50W17	
				No other γ					53B79	
$_{79}Au_{124} \xrightarrow{203} {}_{80}Hg_{123}$	1.9 ?	1	55^s	β^-	1.9	1*		a	52B63	0.69γ present (52B63). The adopted Q is put in doubt by the anomalously low ft value for the parity change transition predicted by the shell model.
$3/2^+$? 4.9 $3/2^-$?	(see comments)			β/γ = 10						
$_{80}Hg_{123} \xrightarrow{203} {}_{81}Tl_{122}$	0.487	2	47^d	β^-	0.210	5*		pc	51W22	
$3/2^-$? 6.4 $3/2^+$					0.208	2*		sβγ	49S16	
$1/2^+$					0.205	10		s	48S30	
				γ	0.279	3*		s	52C1	
					0.286	6*		scin	52J23	
					0.278	3*		s	51W22	
					0.279	2		s	49S16	
					0.286	5		s	48S30	
				βγ					49S16	
				βγ delay < 0.4×10^{-9s}					52M3	
$_{82}Pb_{121} \xrightarrow{203} {}_{81}Tl_{122}$	> 0.678	2	52^h	ε					42M3	(0.40γ)(0.28γ)(θ) consistent with I = 5/2, 3/2, 1/2 (54V4, 54P4). Q = 1.8 ± 0.5 from ϵ_K/ϵ (54W12). Q = 1.4 from ϵ_K/ϵ_L (54P4).
$3/2,5/2^-$ $5/2^+$	(see comments)			γ	0.685	10		scin	54P4	
$1/2^+$					0.683	10*		scin	54V4	
					0.678	2		s	54W12	
$_{81}Tl_{123} \xrightarrow{204} {}_{80}Hg_{124}$	0.33	1	~4^y	Continuous γ spectrum						K binding energy = 0.0833. β^- branching (see below).
2^- 0^+				E_γ (max)						
					0.25	1*			52D22	
				ε			1.5%		52D22	
$_{81}Tl_{123} \xrightarrow{204} {}_{82}Pb_{122}$	0.762	5	~4^y	β^-	0.760	10	$98.5\%^-$	scin	52D22	ΔI = 2, yes shape observed (52D22, 52L13 50E52).
2^- 8.9^1 0^+					0.765	10		s	52L13	
					0.762	8*		s	50E52	
				No γ					41F4	
				No 0.37γ (< 10^{-2}%)					52D22	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Mev	Error	%	Method	Ref.	Comments
${}_{83}Bi_{121} \xrightarrow{204} {}_{82}Pb_{122}$	> 1.28	1	12^h	From 68^m Pb^{204} isomer					47T3,49S34	0.217 γ reported (49S34). 4 % of decay to 68^m Pb (47T3).
$6^+,7^-$				γ_1	0.905	9*		s	49S34	
2^+					0.9	1*		a	42M3	
0^+					1.1	1*		a	41F4	
				γ_2	0.374	4*		s	49S34	
				$\gamma_1\gamma_2(\theta)$					53F24,50S59,50G13	
${}_{80}Hg_{125} \xrightarrow{205} {}_{81}Tl_{124}$	1.75	9	5.66^m	β^-	1.75	9*		a	51L23	
$1/2^-$ 5.5 $\underline{1/2^+}$										
${}_{82}Pb_{123} \xrightarrow{205} {}_{81}Tl_{124}$			$>10^{6y}$							No long-lived Pb activity observed from Tl(20-Mev d) or decay of 14.5^d Bi (54S13).
$3/2^-?$ $\underline{1/2^+}$										
${}_{83}Bi_{122} \xrightarrow{205} {}_{82}Pb_{123}$	> 1.84	2	14.5^d	ϵ					51K3	Other lower energy γ's (51K3).
$9/2^-?$?				γ	1.84	2*		s	51K3	
$3/2^-?$										
${}_{81}Tl_{125} \xrightarrow{206} {}_{82}Pb_{124}$	1.51	1	4.2^m	β^-	1.51	1		s	51A14	
0^- 5.2 0^+				No γ					51A14,41F4	
${}_{83}Bi_{123} \xrightarrow{206} {}_{82}Pb_{124}$	> 2.200 (see comments)	1	6.4^d	ϵ, no β^+					51A5,47T3	Very complex γ spectrum (51A5). Bi^{206} feeds $I=7^-$, 2.200 Mev metastable state of Pb^{206} (53A30).
$?^+$ $1.45^{\mu s}$ 7^-										
0^+										
${}_{84}Po_{122} \xrightarrow{206} {}_{83}Bi_{123}$	> 0.8	1	9^d	ϵ					47T1	α branching ~ 5 % (53M21).
0^+				γ	0.8	1*		a	47T1	
${}_{81}Tl_{126} \xrightarrow{207} {}_{82}Pb_{125}$	1.45	4	4.79^m	β^-	1.44	5*		a	50E3	Weak 0.870 γ (41S16).
$1/2^+$ 5.2 $\underline{1/2^-}$					1.47	7*		a	39S12	
${}_{83}Bi_{124} \xrightarrow{207} {}_{82}Pb_{125}$	> 2.49	5	$\sim 50^y$	ϵ					51N2	Very complex γ spectrum (51N2, 53M67, 53A18).
$9/2^-?$?				γ	2.49	5		s	51N2	
$\underline{1/2^-}$										
${}_{84}Po_{123} \xrightarrow{207} {}_{83}Bi_{124}$	> 1.3	1	5.7^h	ϵ					47T1	α branching ~ 0.01 % (47T1).
$3/2^-?$				γ	1.3	1*		a	47T1	
$9/2^-?$										
${}_{81}Tl_{127} \xrightarrow{208} {}_{82}Pb_{126}$	4.97	3	3.1^m	β^-	1.79	2*		s	48M29	1.79 β^- (49 %$^-$), 1.51 β^- (18 %$^-$), 1.28 β^- (33 %$^-$) (54E7). Complex β and γ spectra and coincidences give consistent decay scheme (54E7, 48R12).
5^+ 5.6 5^-					1.80	2*		s$\beta\gamma$	48F9	
3^-					1.72	2*		s$\beta\gamma$	47S37	
0^+							49 %$^-$		54E7	
				γ_1	0.582978	27		Xtl	52M45	
				γ_2	2.61425	50		s	52L15	
					2.6147	6		s	51B70	
					2.6158	15		s	51H12	
				(0.58 γ)(2.62 γ)					54E7,53K7,50P59	
				(1.79 β) (0.58 γ)					54E7	
${}_{81}Tl_{128} \xrightarrow{209} {}_{82}Pb_{127}$	> 1.99	2	2.2^m	β^-	1.99	2*		s	52W24	
$1/2^+?$ ≥ 5.3 ?					1.8	1*		a	50H64	
$9/2^+?$										

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$Pb_{82\ 127} \xrightarrow{209} Bi_{83\ 126}$	0.63	1	3.32^h	β^-	0.62	1*		s	52W24	
$9/2^+?$ 5.5 $\underline{9/2^-}$					0.64	2*		scin	52W24	
					0.64	3		a	52W13	
				No γ					52W13	
				No e^- with $E_{e^-} > 0.030$					52W13	
$Tl_{81\ 129} \xrightarrow{210} Pb_{82\ 128}$	>1.8	1	1.32^m	β^-	1.8	1*		cc	38L7	γ's with $E_\gamma > 2.8$ reported by 37D3 and 37N4 not detected by Dγp (50B20).
$3,4,5^+? \geq 5.0$					1.9	1*		a	37D3	
0^+										
$Pb_{82\ 128} \xrightarrow{210} Bi_{83\ 127}$	0.064	1	22^y	β^-	0.023	3		pc	53H46	Other γ's weak if present at all (53W4, 52E17, 51C15).
0^+ 5.4 0^-					0.0152	10*		pc	53J2	
1^-					0.018	2		scin	52B2	
					0.018	2		pc	52I1	
				γ	0.0464	5*		s	53W4	
					0.0465	5*		Xtl	52E17	
					0.0467	5*		s	51B37	
					0.0467	5*		Xtl	51F3	
				β^- (0.0467γ)					52B2	
				Q	0.0645	25*		pc	52I1	
$Bi_{83\ 127} \xrightarrow{210} Po_{84\ 126}$	1.17	1	4.99^d	β^-	1.17	1		s	53B80	Non-allowed shape does not permit good determination of β^- end point energy (49L6, 53W4). $\sim 2.6 \times 10^{6y}$ Bi^{210} is possibly 25 kev below 5^d Bi^{210}.
1^- 8.0 0^+					1.17	2*		s	49L6	
					1.17	2*		s	49Z3	
					1.17	2*		s	40N4	
					1.17	2*		s	39F2	
				No γ, no ce^-					53W4, 47L22	
				No 0.08 γ					53M20	
$At_{85\ 125} \xrightarrow{210} Po_{84\ 126}$	>1.50	3	8.3^h	ϵ					49K10	$\alpha/\epsilon < 10^{-4}$ (49K10). 0.045, 0.024, 1.19, and 1.46 γ's present (53H49).
? ?				γ	1.50	3*		scin	53H49	
0^+										
$Pb_{82\ 129} \xrightarrow{211} Bi_{83\ 128}$	1.39	7	36.1^m	β^-	1.39	7*	$\sim 80\%^-$	a	39S12	Approximate energy match given by $\sim 0.5\beta^-$ ($\sim 20\%^-$) and complex γ spectrum (39S12, 44M7, 42S9, 40F2, 38C4).
$7/2, 9/2^+$ 6.1 $9/2^-$										
$Bi_{83\ 128} \xrightarrow{211} Po_{84\ 127}$	(see comments)		2.16^m	β^-			$0.32\%^-$		31IR	α branching = 98.68%. Q$\sim$0.6 estimated assuming log ft$\sim$6 as in Pb^{211} decay.
$9/2^-$ $9/2^+$										
$At_{85\ 126} \xrightarrow{211} Po_{84\ 127}$	>0		7.5^h	ϵ			59%		51N2, 40C10	α branching = 41%
$7/2, 9/2^-$ $9/2^+$				No γ (< 0.5%)					53H49	
$Pb_{82\ 130} \xrightarrow{212} Bi_{83\ 129}$	0.582	7	10.64^h	β^-	0.590	6*		s	50Z54	(0.34 β^-)(0.24γ) coincidences support Q-value (53M9, 52S47, 52M45, 52B26, 52L20, 49G26, 48M30, 48F9).
0^+ 6.8 1^-					0.589	6*		s	48F9	
					0.569	6*	$12\%^-$	s	48M30	
$Bi_{83\ 129} \xrightarrow{212} Po_{84\ 128}$	2.25	2	60.5^m	β^-	2.250	23*		s	48M30	α branching = 35.4% (53M26). Complex γ's indicate complex β^- decay. Intensities of γ's imply 2.25 β^- to ground (52M45, 47J5, 47L24, 46S23).
1^- ≥ 7.2 0^+					2.256	23*		s	48F9	
$Bi_{83\ 130} \xrightarrow{213} Po_{94\ 129}$	1.39	1	47^m	β^-	1.39	1*	$68\%^-$	s	53W44	Energy match given by 0.96 β^- ($32\%^-$) + 0.43γ. α branching = 2%. (50H52, 49H35, 47E3). 53W44 supersedes 52W24.
$9/2^-$ 6.3 $7/2, 9/2^+$					$\sim$1.2			s	50H52	
					$\sim$1.3			a	47E3	

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Decay Data Mev	Decay Data Error	Decay Data %	Decay Data Method	Decay Data Ref.	Comments
$Pb_{82\ 132} \xrightarrow{214} Bi_{83\ 131}$ 0^+ 5.2 0^- 1^-	0.99	4	26.8^m	β^- γ $(0.65\ \beta^-)(e^-\ 0.298\gamma)$ $(0.73\ \beta^-)(e_K^-\ 0.29\gamma)$	0.65 0.73 0.295217 39	1 1*	44 $\%^-$ 25 $\%^-$	s s Xtl	53K40 52B78 52M45 53K40 52B78	$[0.59\ \beta^-\ (56\%^-)]\ [e^-\ 0.35\gamma]$ coincidences (53K40). $[0.67\ \beta^-(75\%^-)]\ [e_K^-\ 0.35\gamma]$ coincidences (52B78). See also (51C15, 53P7, 51K32, 41C4, 33Sar).
$Bi_{83\ 131} \xrightarrow{214} Po_{84\ 130}$ 1^- 7.8 0^+	3.17	2	19.7^m	β^- No $(3.17\ \beta^-)(> 0.15\gamma)$	3.2 3.17 3.15	1* 2* 16*	23 $\%^-$ 23 $\%^-$	s s a	53K40 41C4 33Sar 52W33	Complex γ's. All observed have $E_\gamma > 0.15\gamma$ (52M58, 53L11, 49M75, 52K11, 51C15, 52M45, 53P7, 49L28, 50W2, 50B42, 48G23, 47L24, 34E1). 1.65 β^- and probably other β's (41C4, 53K40, 52W33) α branching = 0.04 % (31IR).
$Fr_{87\ 136} \xrightarrow{223} Ra_{88\ 135}$ ≥ 5.6	$\geq$ 1.15	1	21^m	β^-	1.15 1.2	5		scin cc	53H59 46P5	Complex γ spectrum (53H59, 50L13). 0.049 γ in cascade with most β's (50L13).
$Ra_{88\ 137} \xrightarrow{225} Ac_{89\ 136}$ ≥ 6.6	$\geq$ 0.30 $\leq$ 0.34	1 1	14.8^d	β^-	0.31 0.28	1* 2*		s scin	52F27 52E21	$(0.0105\gamma)(0.0303\gamma)$ coincidences 0.0395 γ present (52E21).
$Ac_{89\ 137} \xrightarrow{226} Th_{90\ 136}$ $0,1^-$ 7.6 0^+	1.2	1	29^h	β^- No γ	1.17	10		a	50H92 50H92	
$Ra_{88\ 139} \xrightarrow{227} Ac_{89\ 138}$ ≥ 6.1 $\underline{3/2^-}$	1.31	2	41.2^m	β^-	1.31	2		a	53B63	0.29 γ and 0.49 γ present in low intensity (53B63).
$Ac_{89\ 138} \xrightarrow{227} Th_{90\ 137}$ $\underline{3/2^-}$ ≥ 6.7	0.04 to 0.08		22^y	β^- γ	0.041 ~0.02 0.037 0.037	1* 4* 4*	 99 $\%^-$	s cc a a	50F81 46P5 50L13 46P5	< 2 % β^- with 3 kev < E_β < 40 kev (50L13).
$Ra_{88\ 140} \xrightarrow{228} Ac_{89\ 139}$ 0^+ ≥ 5.0 ? ?	> 0.018	3	6.7^y	β^-	?~0.018	3*		cc	49L2	L x-ray ~ 4 % (49L27, 53R23). 0.053 β^- (39L14).
$Ac_{89\ 139} \xrightarrow{228} Th_{90\ 138}$ 8.9 0^+	2.18 or 2.24 (see comments)	2 2	6.13^h	β^- No $(2.18\beta)\gamma$	2.18	2	10 $\%^-$	s	53K19 53K19	2.18 β^- could be in cascade with delayed 0.0567 γ. Very complex β^- and γ decay scheme (53K19, 54B11).
$Ra_{88\ 142} \xrightarrow{230?} Ac_{89\ 141}$ 0^+ ~6.1	$\geq$ 1.2	1	1^h	β^-	1.2	1*		s	52J6	
$Ac_{89\ 141} \xrightarrow{230} Th_{90\ 140}$ ~5.4 0^+	$\geq$ 2.2	1	$<1^m$	β^-	2.2	1*		s	52J6	
$Pa_{91\ 139} \xrightarrow{230} Th_{90\ 140}$ > 7.3 0^+	$\geq$ 1.4	1	17.7^d	β^+	0.4	1*		s	5404	0.2 β^+, complex γ's. Total β^+ ~ 0.07 $\%^+$ (5404). Total ϵ branching ~ 90 %, total β^- branching ~ 10 %, α branching ~ 3.4×10^{-3} % (48S10, 50M8, 4602).
$Pa_{91\ 139} \xrightarrow{230} U_{92\ 138}$ ~9.0 0^+	$\geq$ 0.43	4	17.7^d	β^-	0.43	4*	~2 $\%^-$	a	4602	β^+, ϵ, and α branching (see above). 0.22 β^- (~ 8 $\%^-$) present (4602).

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Mev	Error	%	Method	Ref.	Comments
$^{231}_{90}\mathrm{Th}_{141} \rightarrow {}^{231}_{91}\mathrm{Pa}_{140}$ 5.9 $3/2^-$	0.324	2	25.6^h	β^- γ	0.302 0.390 0.022	2 1*	44%⁻ ~20%⁻	s s s	52F8 51S41 52F8	0.216 β^- (11%⁻), 0.093 β^- (45%⁻), and complex γ spectrum give energy match. 0.022 γ is most intense (52F8).
$^{231}_{92}\mathrm{U}_{139} \rightarrow {}^{231}_{91}\mathrm{Pa}_{140}$? $3/2^-$	>0.076	1	4.2^d	ϵ γ	 0.076	 1*		 s	4602 50054	α branching = 0.05%, K,L x-rays observed (49C6). 0.051 γ and 0.084 γ present (50054).
$^{232}_{91}\mathrm{Pa}_{141} \rightarrow {}^{232}_{92}\mathrm{U}_{140}$ 9.0 0^+	1.24	1	1.32^d	β^-	1.24	1*	6%⁻	s	5404	Four lower energy β^- components and complex γ spectrum give good energy match (5404, 52P29, 48J16, 4907). ϵ < 2% (52B81).
$^{233}_{90}\mathrm{Th}_{143} \rightarrow {}^{233}_{91}\mathrm{Pa}_{142}$ 5.9	1.23	1	23.6^m	β^- No γ, no e^-	1.23 1.23 1.2	1 6* 1*		s a a	50B68 52R10 42S6 42S6,50B68,52R10	γ's of low intensity present (53F28).
$^{233}_{91}\mathrm{Pa}_{142} \rightarrow {}^{233}_{92}\mathrm{U}_{141}$ 8.9 $5/2^+$	0.56	2	27.4^d	β^-	0.57 0.53 0.58	3* 3* 3*	6%⁻	s s	5404 50F58 50E1	Complex β and γ spectra (50F58, 50E1, 50K54, 52B81, 5404).
$^{234}_{90}\mathrm{Th}_{144} \rightarrow {}^{234}_{91}\mathrm{Pa}_{143}$ 0^+ 6.6 1.2^m? ?	>0.196	5	24.10^d	β^- From 1.2^m Pa^{234} isomer IT ?	0.193 0.205 0.190	2* 2* 2*	67%⁻ 80%⁻	s s	53S36 46B12 46J1 53D25 53S36 5301	0.10 β^- (33%⁻) + 0.092 γ gives energy match (53S36, 53D25, 46B12, 46J1). Conflicting data on energy of isomeric transition (45B5, 53S36, 5301).
$^{234}_{91}\mathrm{Pa}_{143} \rightarrow {}^{234}_{92}\mathrm{U}_{142}$ 1.2^m? 5.6 0^+ 6.7^h?	<2.31	1	6.7^h	From 1.2^m Pa^{234} isomer β^- IT ?	 2.305 2.32	 20* 2*	 90%⁻ 98%⁻	 s s	 53S36 45B5	Complex β^- and γ spectra from 1.2^m and 6.7^h Pa^{234}. (53S36, 53D25, 5301, 47B17, 45B5, 43B4, 38F2).
$^{234}_{93}\mathrm{Np}_{141} \rightarrow {}^{234}_{92}\mathrm{U}_{142}$ 0^+	>1.42	1	4.40^d	ϵ γ	 1.42	 1*		 s	46H9,48J8,5106 5106	0.177, 0.442 and 0.803 γ's present (5106).
$^{234}_{94}\mathrm{Pu}_{140} \rightarrow {}^{234}_{93}\mathrm{Np}_{141}$ 0^+	(see comments)		9^h	ϵ No γ					53H49,48P10 53H49	If log ft > 5, then Q > 0.33.
$^{235}_{91}\mathrm{Pa}_{144} \rightarrow {}^{235}_{92}\mathrm{U}_{143}$ 6.0 $5/2^+$	1.4	1	23.7^m	β^- No γ	1.4	1*		a	50M8 50M8	
$^{235}_{93}\mathrm{Np}_{142} \rightarrow {}^{235}_{92}\mathrm{U}_{143}$? $5/2^+$	>0.066		410^d	ϵ γ	 0.066	 1*		 scin	52J1 53H49	α branching ~ 5x10⁻³%, ϵ_K/ϵ_L = 0.1 (52J1).
$^{236}_{93}\mathrm{Np}_{143} \rightarrow {}^{236}_{92}\mathrm{U}_{144}$ $0,1^-$ 0^+	(see comments)		22^h	ϵ					5102	Total ϵ branching ~ 67% (5102). For log ft ~ 7 as in β^- branch below, Q > 1. 0.050 γ observed in Pu^{240} α decay (52F25).
$^{236}_{93}\mathrm{Np}_{143} \rightarrow {}^{236}_{94}\mathrm{Pu}_{142}$ $0,1^-$ 7.0 0^+	0.51	1	22^h	β^-	0.51	1*	~20%⁻	s	5102	0.36 β^- (~13%⁻) + 0.15 γ gives good energy match (5102).

TABLE I.—*Continued.*

Disintegration	Adopted Q Mev	Adopted Q Error	Half-life	Decay Data Type	Mev	Error	%	Method	Ref.	Comments
$_{92}U_{145} \xrightarrow{237} {}_{93}Np_{144}$ 6.1 ? ? $\underline{5/2^-}$	0.51	1	6.75^d	β^-	0.245	5*	>80%⁻	s	53W5	Complex γ's give reasonable decay scheme (53W5). α decay of Am^{241} shows 0.060 level in Np^{237} implying that γ_2 follows γ_1 (53H49).
					0.23	2*	<100%⁻	s	49M43	
					0.25	2*	<100%⁻	a	50e10	
				γ_1	0.207	2*		s	53W5	
					0.204	2*		s	49M43	
				γ_2	0.059	1*		s	53W5	
					0.057	1*		s	49M43	
				(0.25 β^-)(0.21γ)					53W5	
				(0.21γ)(0.06γ)					53W5	
$_{94}Pu_{143} \xrightarrow{237} {}_{93}Np_{144}$ $5/2^+$? ? $\underline{5/2^-}$	>0.064	5	$\sim 40^d$	ε					48J9	
				γ	0.064	5*		scin	53H49	
$_{93}Np_{145} \xrightarrow{238} {}_{92}U_{146}$? 0^+			2.10^d	No U x-ray**					50F53	**Intensity limit not stated (50F53).
$_{93}Np_{145} \xrightarrow{238} {}_{94}Pu_{144}$? 8.4 4^+ 2^+ 0^+	≤1.412 ≥1.29 (see comments)	9 1	2.10^d	β^-	1.260	13*	55%⁻	s	54S1	0.26 β^- (~50%⁻) and complex γ's give fair energy match (50F53, 54S1, 52A33). $\gamma_1\gamma_2$ cascade implied from Cm^{242} α decay (53A14). 1.26 β^- component may be composite of 1.246 β^- and 1.290 β^- implying 1.29 β^- to ground (54S1, 53A14)
					1.272	13*	47%⁻	s	50F53	
					1.4		40%⁻	a	47J3	
				γ_1	0.102	1*		s	54S1	
					0.103	1*		s	50F53	
				γ_2	0.044	1*		s	54S1	
					0.043	1*		s	50F53	
				(1.3 β^-)(0.103γ)					50F53	
$_{92}U_{147} \xrightarrow{239} {}_{93}Np_{146}$ 5.8	1.24	5	23.5^m	β^-	1.22	1*		s	51H56	
					1.12	1*		s	48S14	
				γ	0.075	1*		scin	51H56	
					0.074	1*		pc	51K46	
					0.073	1*		s	48S14	
$_{93}Np_{146} \xrightarrow{239} {}_{94}Pu_{145}$ > 7.2 $\underline{1/2^+}$	0.717	6	2.32^d	β^-	0.719	7*		s	51T22	Complex β and γ spectra form consistent scheme (51T22, 51G34).
					0.705	15			51G34	
				No E_β > 0.72				s	51H56	
				No (0.72 β)γ					51G34	
$_{95}Am_{144} \xrightarrow{239} {}_{94}Pu_{145}$? $\underline{1/2^+}$	>0.29	3	12^h	ε					48S5, 52H63	α branching ~0.003% (52H63).
				γ	0.285	29*		a	48S5	
					0.3	1*		scin	52H63	
$_{92}U_{148} \xrightarrow{240} {}_{93}Np_{147}$ 0^+ 5.6 0,1	0.36	2	14.1^h	β^-	0.36	2		s	53K23	If Np^{240} has I = 1, then $\log(2I_f+1)ft$ ~6.1 for U^{240} decay is in fair accord with ~6.5 for Np^{240} decay.
				No γ with E_γ > 0.02					53K23	
$_{93}Np_{147} \xrightarrow{240} {}_{94}Pu_{146}$ 0,1 6.5 0^+	2.16	1	7.3^m	β^-	2.156	10	52%⁻	s	53K23	1.59 β^- (31%⁻) + 0.56γ, 1.26 β^- (11%⁻) + 0.90γ, and 0.76 β^- (6%⁻) + 1.40γ give good energy match.
$_{95}Am_{145} \xrightarrow{240} {}_{94}Pu_{146}$ 0^+	>0		50^h	ε					48S5	
				No γ > 0.7					52H63	
$_{93}Np_{148} \xrightarrow{241} {}_{94}Pu_{147}$ ≥ 5.8	≥0.89	1	60^m	β^-	0.89	1*		s	51O7	0.15, 0.20, 0.26, 0.58 and 0.7 γ's (51O7).

TABLE I.—*Continued.*

Disintegration	Adopted Q		Half-life	Decay Data						Comments
	Mev	Error		Type	Mev	Error	%	Method	Ref.	
${}_{94}Pu_{147} \xrightarrow{241} {}_{95}Am_{146}$ ≥ 5.6 $5/2^-$	0.021	1	13^y	β^-	0.021 0.01-0.02	1		s a	52F25 48S5	0.100 γ and 0.145 γ probably in α branch (52F25). α branching $\sim 3x10^{-3}$% (50T54).
${}_{95}Am_{147} \xrightarrow{242} {}_{96}Cm_{146}$ $4,5^+?$ 11.3 2^+ 0^+	0.634	5	$\sim 100^y$	β^-	0.593	5*		s	5106	α branching $\sim$1% (50S61). ϵ branching?
				γ	0.041	2		s	53H49	
${}_{94}Pu_{149} \xrightarrow{243} {}_{95}Am_{148}$ 6.1 $5/2^-$	0.57	3	4.98^h	β^-	0.57 0.39 $\sim$0.5	3	53%$^-$	scin s,a a	53E8 51T20 51S55	(0.47 β^-)(0.085γ), (0.085γ)(L x-rays), (0.085γ)(0.1γ) coincidences (53E8). 0.09γ, 0.1γ also found by 51T20.
				No (0.57 β^-)(0.085γ)					53E8	
				No (0.57 β^-)(L x-rays)					53E8	

TABLE I.—*Continued.*

REFERENCES

The code numbers for the references are those already used in National Bureau of Standards Circular 499 and those in present use by the Nuclear Data Group of the National Research Council. For this reason they do not follow in consecutive order without breaks. They are arranged, however, in sequence according to year, first letter of the senior author's name, and running number. Tables have special designations such as 31IR just below.

Abbreviations for books and reports can be found at the end of the references.

1931

31IR International Radium Standard Commission Report, M.Curie, A.Debierne, A.S.Eve, H.Geiger, O.Hahn, S.C.Lind, S.Meyer, E.Rutherford, E.Schweidler, Rev. Mod. Phys. 3, 427 (1931); Physik. Zeits. 32,569(1931).

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Reference Abbreviations for Books and Reports:

AECD Atomic Energy Commission Declassified.

AECU Atomic Energy Commission Unclassified.

ANL Argonne National Laboratory.

BNL Brookhaven National Laboratory.

CNL Clinton National Laboratory.

CUD Columbia University.

ISC Iowa State College.

ORNL Oak Ridge National Laboratory.

UCRL University of California Radiation Laboratory.

NNES National Nuclear Energy Series, Plutonium Project Record, McGraw-Hill Book Company, Inc., New York.