BNL-213787-2020-JAAM

Nuclear Data Sheets for A = 90*

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To be published in "Nuclear Data Sheets"

March 2020

Nuclear Science and Technology Department

Brookhaven National Laboratory

U.S. Department of Energy

USDOE Office of Science (SC), Nuclear Physics (NP) (SC-26)

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Nuclear Data Sheets for A = 90*

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(Received 10 June 2017; Revised 1 March 2020)

Abstract: The experimental results from the various reaction and decay studies leading to nuclides in the A = 90 mass chain have been reviewed. These data are summarized and presented, together with the adopted level schemes and properties, for the nuclides from Ge(Z = 32) through Pd(Z = 46). This evaluation replaces the previous evaluation by E. Browne, which appeared in Nuclear Data Sheets 82, 379 (1998).

Cutoff Date: All data received by March 1, 2020 have been evaluated. Main bibliographic source was the NSR database (2014Pr09) at Brookhaven Laboratory webpage: www.nndc.bnl.gov/nsr.

General Policies and Organization of Material: See the January issue of the *Nuclear Data Sheets* or http://www.nndc.bnl.gov/nds/NDSPolicies.pdf.

General Comments: Theoretical conversion coefficients from BrIcc code (2008Ki07) have an implied uncertainty of 1.4%, when not stated.

Acknowledgements: The use of the XUNDL and NSR databases has been of great help during the evaluation work. S.K. Basu gratefully acknowledges J. K. Tuli for his support and encouragement and thanks the NNDC support staff for their assistance.

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* Research sponsored by Office of Nuclear Physics, Office of Science, US Department of Energy, under contract DE-AC02-98CH10946

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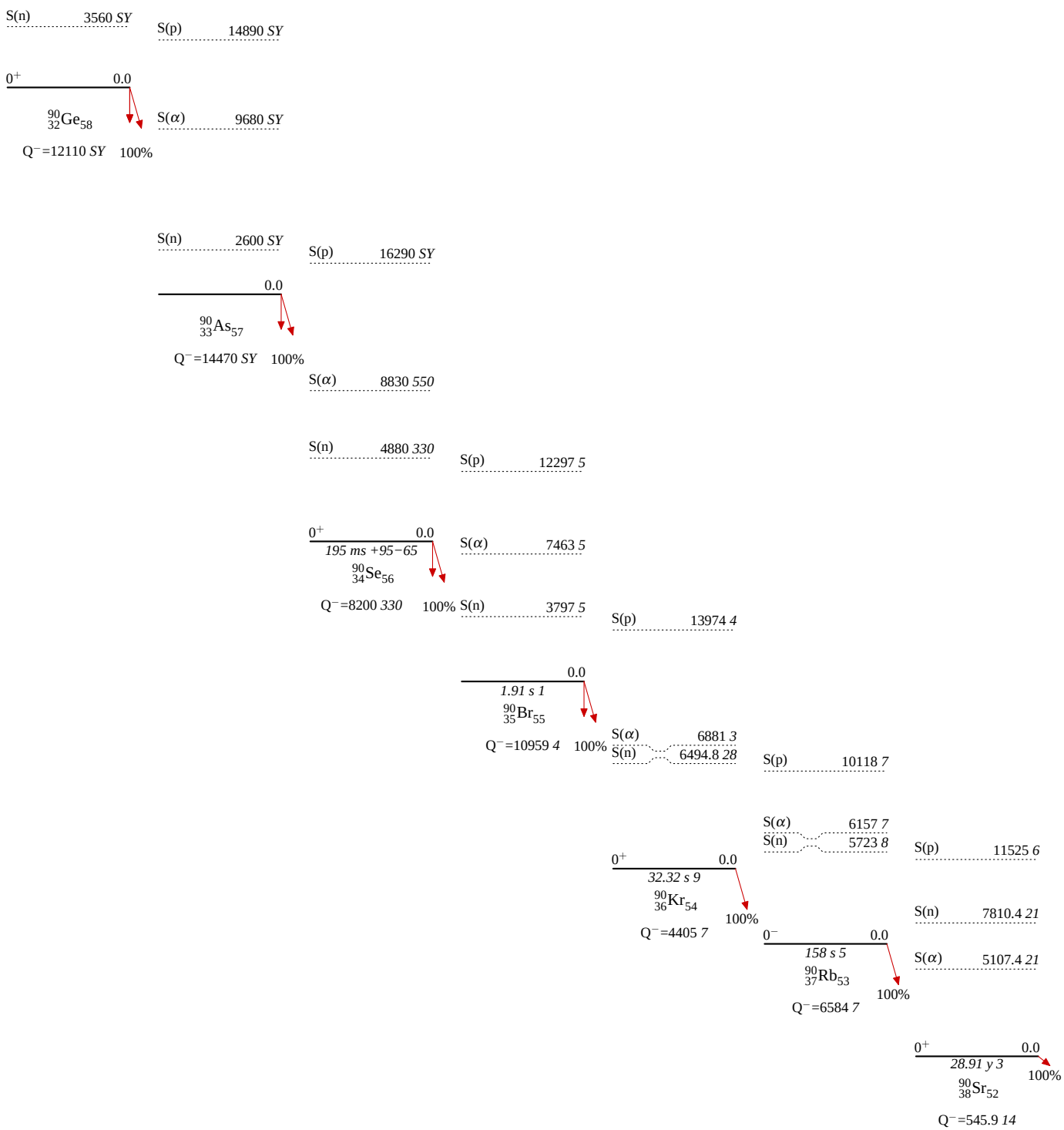
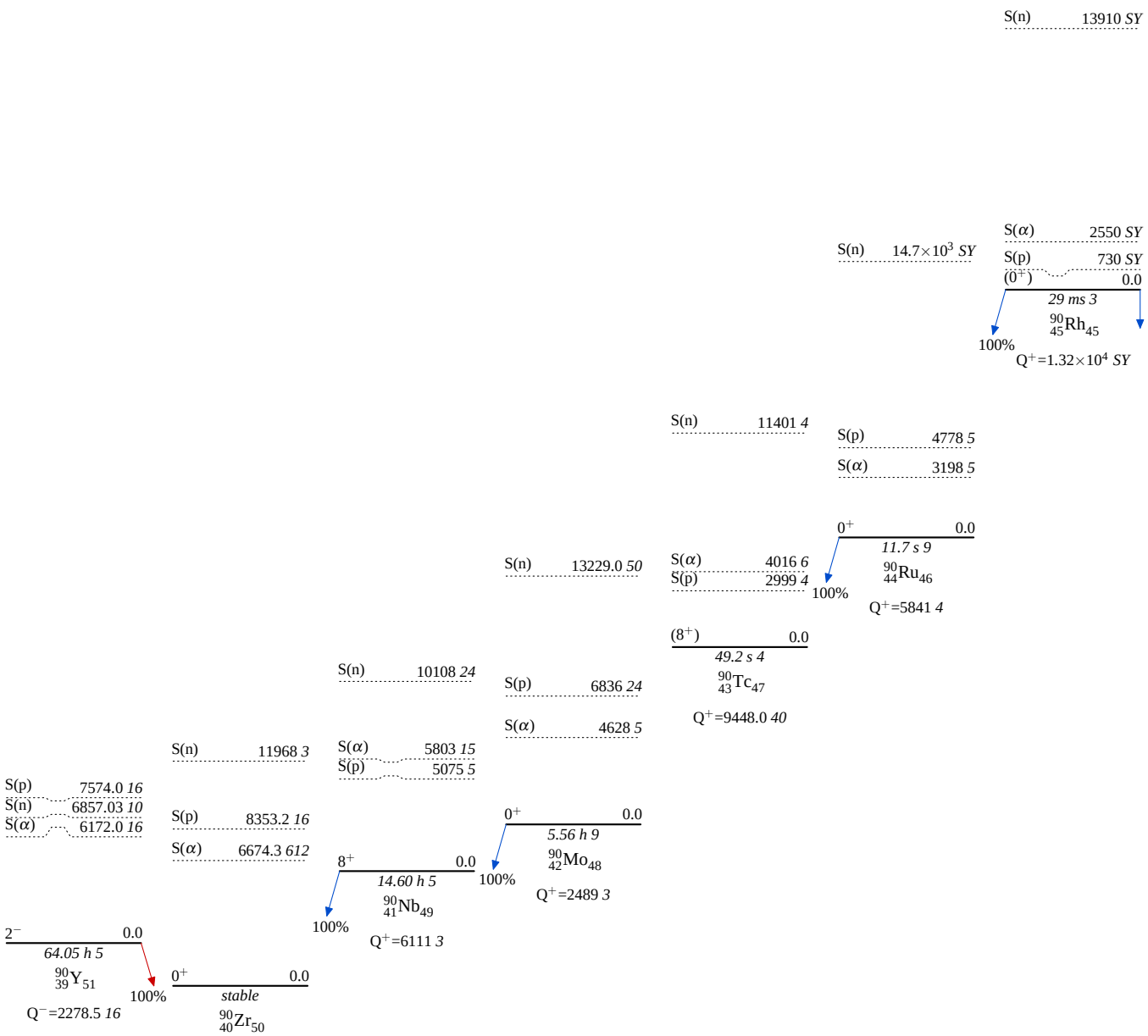
Skeleton Scheme for A=90



Skeleton Scheme for A=90 (continued)



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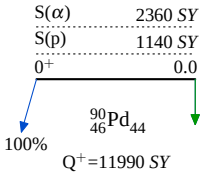


Ground-State and Isomeric-Level Properties

Nuclide	Level	Jπ	$T_{1/2}$	Decay Mode
^{90}Ge	0.0	0^+		%β^-=100; %β^-n=?; %β^-2n=?
^{90}As	0.0			%β^-=100; %β^-n=?
^{90}Se	0.0	0^+	195 ms *+95−65*	%β^-=100; %β^-n=?
^{90}Br	0.0		1.91 s *1*	%β^-=100; %β^-n=25.3 *15*
^{90}Kr	0.0	0^+	32.32 s *9*	%β^-=100
^{90}Rb	0.0	0^-	158 s *5*	%β^-=100
^{90}Sr	0.0	0^+	28.91 y *3*	%β^-=100
^{90}Y	0.0	2^-	64.05 h *5*	%β^-=100
^{90}Zr	0.0	0^+	stable	
^{90}Nb	0.0	8^+	14.60 h *5*	%ε+%β^+=100
^{90}Mo	0.0	0^+	5.56 h *9*	%ε+%β^+=100
^{90}Tc	0.0	(8^+)	49.2 s *4*	
^{90}Ru	0.0	0^+	11.7 s *9*	%ε+%β^+=100
^{90}Rh	0.0	(0^+)	29 ms *3*	%ε+%β^+=100; %εp=0.7
^{90}Pd	0.0	0^+		%ε+%β^+=100; %εp=?; %2p=?

Adopted Levels

Q(β^-)=12110 *SY*; S(n)=3560 *SY* 2017Wa10
ΔQ(β^-)=640; ΔS(n)=640 (2017Wa10).
S(2n)=5230 syst *640*; Q(β^-n)=9510 syst *580* (2017Wa10).
2010Oh02: ^{90}Ge nuclide produced in Be(^{238}U,F) and Pb(^{238}U,F) reactions with E(^{238}U)=345 at RIKEN facility. Identification of ^{90}Ge nuclei was made based on magnetic rigidity, time-of-flight and energy loss of the fragments using Big RIPS fragment separator.

^{90}Ge Levels

E(level)	J^π	Comments
0	0^+	%β^-=100; %β^-n=?; %β^-2n=? measured σ=6 pb (2010Oh02), systematic uncertainty≈50%, based on 3 counts assigned to ^{90}Ge. Probability of misidentification of ^{90}Ge isotope 0.0043% (2010Oh02). $T_{1/2}$: >635 ns from time-of-flight through spectrometer (2010Oh02). Actual half-life is expected to be much longer as suggested by the calculated value of 20.3 ms (2019Mo01). calculated %β^-n=42, %β^-2n=1 (2019Mo01).

Adopted Levels, Gammas

Q(β^-)=14470 *SY*; S(n)=2600 *SY*; S(p)=14890 *SY*; Q(α)=−9680 *SY* 2017Wa10
ΔQ(β^-)=520; ΔS(n)=500; ΔS(p)=570; ΔQ(α)=570 (2017Wa10).
S(2n)=6750 syst *450*; Q(β^-n)=9590 syst *400* (2017Wa10).
1997Be70: ^{90}As produced in ^{9}Be(^{238}U,F), E=750 MeV/nucleon, fragments separator (FRS) at GSI facility. Identification by time-of-flight. Measured production cross section.

^{90}As Levels

Cross Reference (XREF) Flags

A ^{9}Be(^{238}U,Fγ)

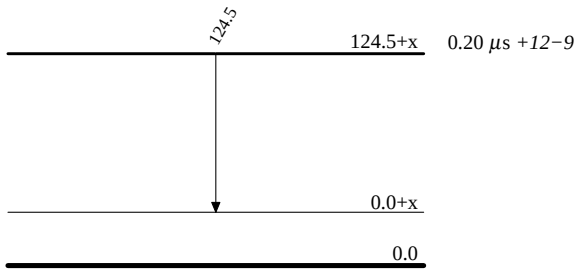
E(level)	$T_{1/2}$	XREF	Comments
0.0			%β^-=100; %β^-n=? E(level): the observed fragments assigned to ^{90}As are assumed to correspond to the ground state. $T_{1/2}$: >300 ns from time-of-flight in 1997Be70. Actual half-life is expected to be much longer as suggested by the calculated value of 20.5 ms (2019Mo01). J^π: 1/2$^-$ proton and 3/2$^+$ neutron orbital predicted by 2019Mo01. production cross section=21 nb (1997Be70) corresponding to 228 counts assigned to ^{90}As. Calculated %β^-n=40, %β^-2n=1 (2019Mo01).
0.0+x		A	E(level): it is not established to which level the 0.20 μs isomer decays. It is possible this is the ground state of ^{90}As.
124.5+x *5*	0.20 μs *+12−9*	A	$T_{1/2}$: from 124.5γ(t) in ^{9}Be(^{238}U,Fγ) (2012Ka36).

γ(^{90}As)

E_i(level)	E_γ	E_f
124.5+x	124.5 *5*	0.0+x

Adopted Levels, Gammas

Level Scheme



$^{90}_{33}As_{57}$

^{9}Be(^{238}U,Fγ) 2012Ka36

2012Ka36: ^{238}U beam at E=345 MeV/nucleon provided by the RIBF accelerator complex at RIKEN facility. Fission fragments separated and analyzed by BigRIPS separator, transported to focal plane of Zero Degree spectrometer and implanted in an aluminum stopper. Particle identification based on ΔE-TOF-Bρ method. Measured Eγ, Iγ, $\gamma\gamma$-coin, γ(t) using three Clover HPGe detectors.

^{90}As Levels

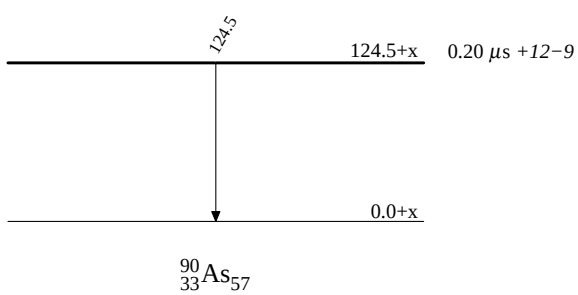
E(level)	$T_{1/2}$	Comments
0.0+x		
124.5+x *5*	0.20 μs *+12−9*	Number of implanted fragments=1.1×10^{4}. $T_{1/2}$: from 124.5γ(t) using maximum likelihood method assuming exponential decay component(s) plus a constant background (2012Ka36).

γ(^{90}As)

E_γ	E_i(level)	E_f
124.5 *5*	124.5+x	0.0+x

^{9}Be(^{238}U,Fγ) 2012Ka36

Level Scheme



Adopted Levels, Gammas

Q(β^-)=8.20×10^3 *33*; S(n)=4.88×10^3 *33*; S(p)=16290 *SY*; Q(α)=−8.83×10^3 *55* 2017Wa10
ΔS(p)=330 (2017Wa10).
S(2n)=8060 *330*; S(2p)=30240 syst *520*; Q(β^-n)=4400 *330* (2017Wa10).

1994Be24: ^{208}Pb(^{238}U,X), E=750 MeV/nucleon. Fragment recoil separator (FRS) at GSI facility. Measured σ=240 μb with 409 counts assigned to ^{90}Se.

1998Do08: ^{208}Pb(^{238}U,X), E=750 MeV/nucleon. Fragment recoil separator (FRS) at GSI facility. Fragments separated by magnetic rigidity, mass and total kinetic energy distribution. Measured (fragment)(β and/or γ) coincidence. Tentative evidence for the formation of ^{90}Se.

2012Qu01: ^{9}Be(^{136}Xe,X), E=120 MeV/nucleon. A1900 fragment separator at the NSCL Coupled Cyclotron Facility. Fragments were separated using the Bρ-ΔE-Bρ technique. Beta decays measured in the NSCL Beta Counting System (BCS) consisting of four silicon PIN detectors, a double sided silicon strip detector (DSSD), and a single sided silicon strip detector (SSSD). Measured energy loss, total kinetic energy (TKE), time of flight, and β(t).

^{90}Se Levels

Cross Reference (XREF) Flags

A ^{1}H(^{91}Br,2pγ)

E(level)[†]	J$^\pi$	T$_{1/2}$	XREF	Comments
0	0$^+$	195 ms *+95−65*	A	%β^-=100; %β^-n=? T$_{1/2}$: from β-decays correlated with implants (2012Qu01). Value given in 2012Qu01 is 195 ms *7* (syst) *+95−65* (stat) using maximum likelihood method for analysis of T$_{1/2}$ data from 70 implants and 30 correlated decay sequences. Calculated %β^-n=1 (2019Mo01), 2.6 (2012Mc04).
547 *8*	(2$^+$)		A	J$^\pi$: 548γ to 0$^+$ and systematics of 2$^+$ states in even-even Se nuclei.
964 *9*	(2$^+$)		A	J$^\pi$: 419γ to 2$^+$, 960γ to 0$^+$, systematics of even-even Se nuclei.
1238 *11*	(4$^+$)		A	J$^\pi$: 691γ to 2$^+$, systematics of even-even Se nuclei.
1627 *9*			A	J$^\pi$: (3,4$^+$) is proposed in 2017Ch18.

[†] From a least-squares fit to Eγ, by evaluators.

γ(^{90}Se)

E$_i$(level)	J$^\pi_i$	E$_\gamma$	I$_\gamma$	E$_f$	J$^\pi_f$
547	(2$^+$)	548 *9*	100	0	0$^+$
964	(2$^+$)	419 *8*	30	547	(2$^+$)
		960 *15*	100	0	0$^+$
1238	(4$^+$)	691 *7*	100	547	(2$^+$)
1627		663[†]		964	(2$^+$)
		1075 *24*		547	(2$^+$)

[†] Placement of transition in the level scheme is uncertain.

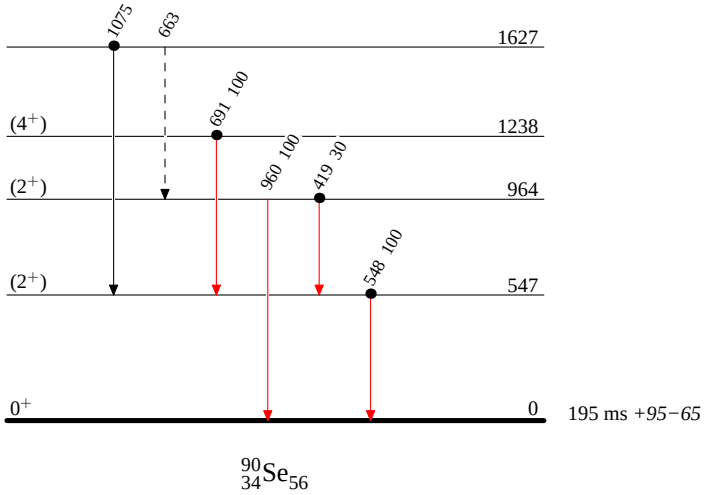
Adopted Levels, Gammas

Level Scheme

Intensities: Type not specified

Legend

- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)
- Coincidence



^{1}H(^{91}Br,2pγ) 2017Ch18

2017Ch18: E(^{91}Br) ≈ 270 MeV beam from ^{9}Be(^{238}U,F), E=345 MeV/nucleon reaction. Beam extracted using BigRIPS spectrometer at RIBF-RIKEN facility and ^{90}Se recoils identified by the ZeroDegree spectrometer. Measured particle spectra using time projection chamber (TPC) of the MINOS ensemble and Eγ, Iγ, $\gamma\gamma$ using DALI2 array of 186 NaI(Tl) detectors.

^{90}Se Levels

E(level)†	J$^{\pi}$‡
0.0	0$^+$
547 *8*	(2$^+$)
964 *9*	(2$^+$)
1238 *11*	(4$^+$)
1627 *9*	(3,4$^+$)

† From a least-squares fit to Eγ, by evaluators.
‡ As proposed in 2017Ch18 based on systematics of even-even nuclei.

γ(^{90}Se)

E$_i$(level)	J$^{\pi}_i$	E$_\gamma$	I$_\gamma$†	E$_f$	J$^{\pi}_f$	Comments
547	(2$^+$)	548 *9*		0.0	0$^+$	
964	(2$^+$)	419 *8*	23	547	(2$^+$)	
		960 *15*	77	0.0	0$^+$	
1238	(4$^+$)	691 *7*		547	(2$^+$)	
1627	(3,4$^+$)	663‡		964	(2$^+$)	This transition was not observed, probably not resolved from 691γ.
		1075 *24*		547	(2$^+$)	

† Relative photon branching.
‡ Placement of transition in the level scheme is uncertain.

Adopted Levels

Q(β^-)=10959 *4*; S(n)=3797 *5*; S(p)=12297 *5*; Q(α)=−7463 *5* 2017Wa10
S(2n)=9427 *5*; S(2p)=27860 syst *200*; Q(β^-n)= 4464 *4* (2017Wa10).

^{90}Br Levels

E(level)	$T_{1/2}$	Comments
0	1.91 s *1*	%β^-=100; %β^-n=25.3 *15* $T_{1/2}$: weighted average of 1.910 s *10* (1993Ru01), 1.93 s *3* (1987PfZX), 1.92 s *6* (1984Ew01), 1.92 s *2* (1980Al15), and 1.80 s *15* (1975As04). Others: 2.09 s *23* (2012Qu01 from maximum-likelihood fit), 1.85 s *18* (2012Qu01 from least-squares fit), 1.96 s *5* (1976Ru01), 1.71 s *14* (1975Kr17), 1.3 s *2* (1972Sc48) and 1.4 s *8* (1971Ch38). %β^-n: weighted average of 29.0% *21* (1993Ru01), 24.3% *30* (1987PfZX), 24.8% *15* (1984Ew01), 24.6% *17* (1980Al15), 22.6% *31* (1975As04). Others: 18.9% *39* (1978Kr15), 20% *5* (1974Kr21) and 30% *7* (1972Sc48).

Adopted Levels, Gammas

Q(β^-)=4405 *7*; S(n)=6494.8 *28*; S(p)=13974 *4*; Q(α)=−6881 *3* 2017Wa10
S(2n)=11411 *3*; S(2p)=25653 *4* (2017Wa10).

There are a number of γ-ray transitions initially proposed to belong to ^{90}Kr in ^{252}Cf and ^{248}Cm SF decay datasets, that have subsequently been assigned to ^{91}Kr in ^{235}U(n,Fγ). These transitions and their respective levels are not included in the Adopted Levels and Gammas. See the ^{252}Cf and ^{248}Cm SF decay datasets for their placements.

^{90}Kr Levels

Cross Reference (XREF) Flags

A	^{90}Br β^- decay	D	^{235}U(n,Fγ)
B	^{248}Cm SF decay	E	Coulomb excitation
C	^{252}Cf SF decay		

E(level)[†]	J$^\pi$	T$_{1/2}$	XREF	Comments
0.0[‡]	0$^+$	32.32 s *9*	ABCDE	%β^-=100 T$_{1/2}$: From γ(t) with mass separation and Ge(Li) (1969Ca03). Δ<r^2> (^{89}Kr, ^{90}Kr)=0.116 fm^2 *11* (1996Li25); Δ<r^2> (^{86}Kr, ^{90}Kr)=0.5 fm^2 *1* (1995Ke04). Others: 1992Li24, 1992Ne09.
707.12[‡] *5*	2$^+$	10.7 ps *16*	ABCDE	B(E2)↑=0.1500 *230* (2017El04) J$^\pi$: E2 707γ to 0$^+$. T$_{1/2}$: deduced from B(E2) in Coulomb Excitation. Other: 10.4 ps *69* from centroid difference between 707γ and 1123γ in LaBr$_3$ coincidence spectra in ^{235}U(n,Fγ).
1362.25 *6*	2$^+$	1.1 ps *+4−2*	ABCDE	B(E2)↑=0.0330 *90* (2017El04) T$_{1/2}$: deduced from B(E2) in Coulomb Excitation. J$^\pi$: E2 1362.32γ to 0$^+$.
1763.89 *15*	(3,4,2)$^+$		BCD	J$^\pi$: $\gamma\gamma(\theta)$ data limit J to 2,3,4 in ^{235}U(n,Fγ). Jπ=2$^+$ is less likely due to absence of a ground state transition. Q (assumed E2) transitions to 2$^+$ levels give positive parity.
1830.49[‡] *15*	4$^+$		ABCD	J$^\pi$: E2 1123.37γ to 2$^+$; band assignment.
1940.33 *8*			A	
2103.13 *8*			A	
2147.81 *10*			A	
2193.1 *4*			A	
2249.34 *14*	(2$^+$)	<0.23 ps	A E	B(E2)↑=0.0150 *110* (2017El04) J$^\pi$: direct population in Coulomb excitation. T$_{1/2}$: deduced from B(E2) in Coloumb excitation.
2318.09 *7*			A	
2536.04 *21*			A	
2543.70 *10*			A	
2595.93 *14*			A	
2596.49 *25*			BCD	
2685.83 *13*			A	
2687.31 *13*			A	
2730.76 *17*			A	
2747.94 *15*			A	
2780.60 *9*			A	
2828.26 *22*			A	
2853.16 *22*	5		BCD	J$^\pi$: D+Q 1022.7γ to 4$^+$.
2864.15 *20*			A	
2987.32 *10*			A	
3084.86 *21*			BCD	
3140.25 *16*			A	
3223.5 *3*	(5$^+$,6$^+$)		BCD	J$^\pi$: $\gamma\gamma(\theta)$ data in ^{235}U(n,Fγ) are consistent with J=4,5,6; 4$^+$ is less likely

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{90}Kr Levels (continued)

E(level)[†]	XREF	Comments
		due to the absence of transitions to any of the 2^+ states.
3231.44 *17*	A	
3285.10 *17*	A	
3318.4 *3*	A	
3372.6 *3*	A	
3508.2 *3*	A	
3695.5 *4*	CD	
3896.53 *24*	BCD	
4036.5 *5*	BCD	
4099.0 *10*	D	
4284.9 *4*	CD	
4291.0 *3*	A	
4546.6 *5*	A	
4785.78 *22*	A	
5004.4 *3*	A	
5053.0 *3*	BCD	
5080.0 *5*	A	
5385.4 *6*	A	
5683.3 *5*	A	
5730.1 *3*	A	
6298.3? *4*	C	E(level): observed only in ^{252}Cf SF decay.

[†] From least-squares fit to Eγ, by evaluators.
[‡] Band(A): Ground state band.

$\gamma(^{90}Kr)$

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[§]	δ[§]	α[&]	Comments
707.12	2^+	707.05 *6*	100	0.0	0^+	E2		1.18×10^{-3}	B(E2)(W.u.)=12.8 *19* Mult.: Q from $\gamma\gamma(\theta)$ in ^{252}Cf and ^{248}Cm SF decay, M2 excluded by comparison to RUL.
1362.25	2^+	655.17 *6*	63.5 *15*	707.12	2^+	(M1+E2)	+0.507		B(E2)(W.u.)=14 *6*; B(M1)(W.u.)=0.022 *6* I_γ: from ^{235}U(n,Fγ). Mult.: D from $\gamma\gamma(\theta)$ in ^{248}Cm SF decay, $\Delta\pi$=no from level scheme.
		1362.32 *10*	100 *8*	0.0	0^+	E2		2.93×10^{-4}	B(E2)(W.u.)=2.8 *+6−8* Mult.: Q from $\gamma\gamma(\theta)$ in ^{252}Cf and ^{248}Cm SF decay, M2 excluded by comparison to RUL.
1763.89	$(3,4,2)^+$	401.4[‡]	100 *4*	1362.25	2^+	E2		0.00638	I_γ: from ^{235}U(n,Fγ).
		1056.2[‡]	24.1	707.12	2^+	E2		4.36×10^{-4}	I_γ: from ^{235}U(n,Fγ).
1830.49	4^+	1123.37 *15*	100	707.12	2^+	E2		3.81×10^{-4}	
1940.33		578.06 *18*	14.5 *16*	1362.25	2^+				
		1233.21 *8*	100 *4*	707.12	2^+				
2103.13		740.82 *8*	100 *5*	1362.25	2^+				
		1396.16 *13*	33 *3*	707.12	2^+				
2147.81		786.02 *12*	100 *7*	1362.25	2^+				
		1440.21 *12*	20.2 *19*	707.12	2^+				
2193.1		1486.0 *4*	100	707.12	2^+				
2249.34	(2^+)	1542.20 *13*	100	707.12	2^+				
		2249[@]	<23.0	0.0	0^+	[E2]			E_γ,I_γ: limit on unobserved transition in Coulomb excitation.
2318.09		955.84 *8*	98 *5*	1362.25	2^+				
		1610.80 *11*	100 *5*	707.12	2^+				
		2318.6 *2*	47 *4*	0.0	0^+				
2536.04		1828.90 *20*	100	707.12	2^+				
2543.70		1836.49 *10*	100 *6*	707.12	2^+				
		2543.93 *20*	20 *3*	0.0	0^+				
2595.93		1888.79 *13*	100	707.12	2^+				
2596.49		832.8[‡]	100	1763.89	$(3,4,2)^+$				
2685.83		1323.57 *12*	100	1362.25	2^+				
2687.31		539.50 *8*	100	2147.81					
2730.76		2024.1 *3*	26 *4*	707.12	2^+				
		2730.5 *2*	100 *7*	0.0	0^+				
2747.94		2040.79 *14*	100	707.12	2^+				
2780.60		840.29 *10*	100 *8*	1940.33					
		1418.34 *11*	84 *8*	1362.25	2^+				
		2073.0 *5*	16 *4*	707.12	2^+				
2828.26		1465.9 *3*	98 *12*	1362.25	2^+				
		2121.2 *3*	100 *11*	707.12	2^+				

$^{90}_{36}Kr_{54}$-3

Adopted Levels, Gammas (continued)

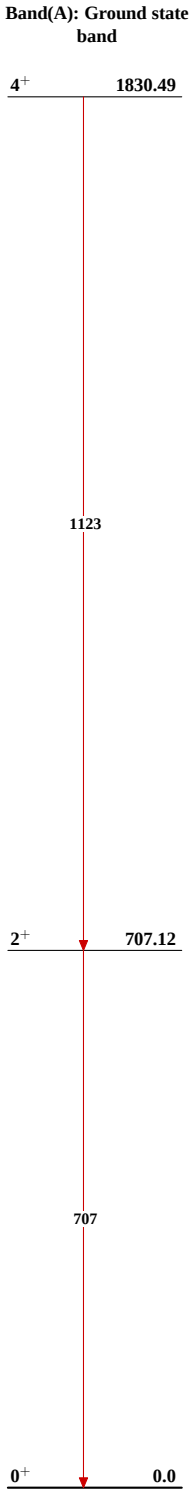
$\gamma(^{90}Kr)$ (continued)

E_i(level)	J^π_i	E_γ †	I_γ †	E_f	J^π_f	Mult. §	δ §	Comments
2853.16	5	1022.7‡	100	1830.49	4^+	D+Q	+0.072 *19*	Mult.,δ: from $\gamma\gamma(\theta)$ in ^{235}U(n,Fγ).
2864.15		2864.1 *2*	100	0.0	0^+			
2987.32		1625.11 *13*	100 *7*	1362.25	2^+			
		2987.1 *2*	66 *5*	0.0	0^+			
3084.86		1254.4‡		1830.49	4^+			
		1321.5‡		1763.89	$(3,4,2)^+$			
3140.25		2433.09 *15*	100	707.12	2^+			
3223.5	$(5^+,6^+)$	1393.2‡		1830.49	4^+			
		1460.3‡		1763.89	$(3,4,2)^+$			
3231.44		913.38 *20*	7.6 *10*	2318.09				
		3231.3 *3*	100 *10*	0.0	0^+			
3285.10		1344.76 *15*	100	1940.33				
3318.4		3318.5 *3*	100	0.0	0^+			
3372.6		2665.4 *3*	100	707.12	2^+			
3508.2		2801.0 *3*	100	707.12	2^+			
3695.5		1099.0‡	100	2596.49				
3896.53		672.9‡		3223.5	$(5^+,6^+)$			E_γ: observed only in ^{252}Cf SF decay.
		811.7‡		3084.86				E_γ: observed only in ^{252}Cf SF decay.
		1043.4‡		2853.16	5			
4036.5		813.4‡	100	3223.5	$(5^+,6^+)$			
4099.0		1245.8	100	2853.16	5			E_γ: from ^{235}U(n,fγ).
4284.9		1200.0‡	100	3084.86				
4291.0		4290.9 *3*	100	0.0	0^+			
4546.6		2002.9 *5*	100	2543.70				
4785.78		2682.6 *2*	100	2103.13				
5004.4		4297.2 *3*	100	707.12	2^+			
5053.0		1156.6‡	100	3896.53				
5080.0		4372.8 *5*	100	707.12	2^+			
5385.4		4023.1 *6*	100	1362.25	2^+			
5683.3		4320.9 *5*	100	1362.25	2^+			
5730.1		2411.8 *3*	71 *12*	3318.4				
		4367.3 *5*	100 *13*	1362.25	2^+			
6298.3?		1245.3‡@	100	5053.0				E_γ: observed only in ^{252}Cf SF decay.

† From ^{90}Br β^- decay, except where noted.
‡ From ^{252}Cf SF decay.
§ From $\gamma\gamma(\theta)$ in ^{235}U(n,Fγ), except where noted. Q transitions are assumed to be E2 in character.
& Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
@ Placement of transition in the level scheme is uncertain.

$^{90}_{36}Kr_{54}$-4

Adopted Levels, Gammas



$^{90}_{36}Kr_{54}$

^{90}Br β^- decay 1981Ho17

Parent: ^{90}Br: E=0; $T_{1/2}$=1.91 s *1*; Q(β^-)=10959 *4*; %β^- decay=100.0

1981Ho17: Activity from ^{235}U(n,F). Measured Eγ, Iγ, $\gamma\gamma$, and $\beta\gamma$ coin. Mass and chemical separation. Ge(Li), x-ray and Si(Li) detectors.

1980Al15: Measured Iβ(t), delayed neutrons. Plastic scintillator, ^{3}He tubes.

Others: 1971Ch38, 1974Kr21, 1974Cr06, 1975As04, 1975Ba36, 1976Ru01, 1978Be51, 1984Ew01, 1987PfZX.

For spectra of delayed neutrons, see 1977Sh01.

The decay scheme of ^{89}Kr via delayed neutrons following the ^{90}Br decay is given by 1981Ho17.

All data are from 1981Ho17, except as noted.

^{90}Kr Levels

E(level)	J^{π} †	$T_{1/2}$ †	Comments
0.0	0^+	32.32 s *9*	
707.13 *5*	2^+		
1362.25 *6*	2^+		
1830.50 *16*	(4^+)		
1940.33 *8*			
2103.13 *9*			
2147.81 *10*			
2193.1 *4*			
2249.34 *14*			
2318.09 *8*			
2536.05 *21*			
2543.70 *10*			
2595.94 *14*			
2685.83 *14*			
2687.31 *13*			
2730.76 *17*			
2747.94 *15*			
2780.60 *10*			
2828.26 *22*			
2864.15 *20*			
2987.31 *12*			
3140.25 *16*			
3231.44 *18*			
3285.10 *17*			
3318.4 *3*			
3372.6 *3*			
3508.2 *3*			
4291.0 *3*			
4546.6 *5*			
4785.78 *22*			
5004.4 *3*			
5080.0 *5*			
5385.4 *6*			
5683.3 *5*			
5730.1 *4*			
6494.8+x			E(level): x<4464 keV from Q(β^-)(^{90}Br)-S(n)(^{90}Kr), where Q(β^-)= 10959 *4* and S(n)=6495 *3* (2017Wa10).

† From the Adopted Levels.

^{90}Br β^- decay 1981Ho17 (continued)

β^- radiations

1981Ho17 measured Q(β^-)value=9800 keV *400* for ^{90}Br. This value deviates significantly from the evaluated value of 10959 *4* (2017Wa10).

1986Ke10 measured Q(β^-)=10300 *120* from $\beta\gamma$ coin with mass separation, compared to the evaluated value of 10959 *4* (2017Wa10).

E(decay)	E(level)	Iβ^- †‡	Log *ft*	Comments
(2.2×10^3 # *22*)	6494.8+x	25.3 *15*		Iβ^-: from %β^-n = 25.3 *15* for ^{90}Br decay.
(5229 *4*)	5730.1	1.04 *13*	6.45 *6*	
(5276 *4*)	5683.3	0.35 *6*	6.94 *8*	
(5574 *4*)	5385.4	0.25 *7*	7.20 *13*	
(5879 *4*)	5080.0	0.54 *9*	6.97 *8*	
(5955 *4*)	5004.4	0.63 *9*	6.93 *7*	
(6173 *4*)	4785.78	0.46 *7*	7.13 *7*	
(6412 *4*)	4546.6	0.25 *6*	7.47 *11*	
(6668 *4*)	4291.0	0.65 *9*	7.14 *6*	
(7451 *4*)	3508.2	0.35 *8*	7.62 *10*	
(7586 *4*)	3372.6	0.34 *6*	7.67 *8*	
(7641 *4*)	3318.4	0.74 *19*	7.35 *12*	
(7674 *4*)	3285.10	0.51 *7*	7.52 *6*	
(7728 *4*)	3231.44	3.6 *5*	6.69 *6*	
(7819 *4*)	3140.25	0.99 *11*	7.27 *5*	
(7972 *4*)	2987.31	2.8 *3*	6.86 *5*	
(8095 *4*)	2864.15	1.18 *17*	7.26 *7*	
(8131 *4*)	2828.26	0.74 *8*	7.47 *5*	
(8178 *4*)	2780.60	1.90 *17*	7.08 *4*	
(8211 *4*)	2747.94	0.80 *11*	7.46 *6*	
(8228 *4*)	2730.76	2.11 *22*	7.04 *5*	
(8272 *4*)	2687.31	0.66 *10*	7.56 *7*	
(8273 *4*)	2685.83	0.80 *11*	7.47 *6*	
(8363 *4*)	2595.94	0.56 *7*	7.65 *6*	
(8415 *4*)	2543.70	1.48 *19*	7.24 *6*	
(8423 *4*)	2536.05	0.41 *6*	7.80 *7*	
(8641 *4*)	2318.09	5.3 *6*	6.74 *5*	
(8710 *4*)	2249.34	1.33 *18*	7.36 *6*	
(8766 *4*)	2193.1	0.56 *10*	7.75 *8*	
(8811 *4*)	2147.81	1.26 *23*	7.40 *8*	
(8856 *4*)	2103.13	3.3 *4*	7.00 *6*	
(9019 *4*)	1940.33	3.3 *5*	7.03 *7*	
(9129 *4*)	1830.50	0.50 *7*	7.88 *6*	
(9597 *4*)	1362.25	6.8 *18*	6.84 *12*	
(10252 *4*)	707.13	13 *4*	6.69 *14*	
(10959 *4*)	0.0	15 *7*	6.77 *21*	

† β^- branches are obtained by I(γ+ce) imbalance at each level.
‡ Absolute intensity per 100 decays.
# Estimated for a range of levels.

^{90}Br β^- decay 1981Ho17 (continued)

$\gamma(^{90}Kr)$

Iγ normalization: From known absolute intensity Iγ(1119γ)=39% *3* in ^{90}Kr β^- decay (1981Ho17).

E_γ †	I_γ §	E_i(level)	J^π_i	E_f	J^π_f	Mult. ‡
539.50 *8*	17.3 *20*	2687.31		2147.81		
578.06 *18*	15.9 *18*	1940.33		1362.25	2^+	
655.17 *6*	202 *12*	1362.25	2^+	707.13	2^+	D
707.05 *6*	1000 *40*	707.13	2^+	0.0	0^+	E2
740.82 *8*	75 *4*	2103.13		1362.25	2^+	
786.02 *12*	42 *3*	2147.81		1362.25	2^+	
840.29 *10*	25 *2*	2780.60		1940.33		
913.38 *20*	6.8 *9*	3231.44		2318.09		
^{x}939.9 *2*	11.2 *13*					
955.84 *8*	58 *3*	2318.09		1362.25	2^+	
1123.37 *15*	13.1 *11*	1830.50	(4^+)	707.13	2^+	E2
^{x}1133.5 *4*	4.9 *10*					
1233.21 *8*	110 *4*	1940.33		707.13	2^+	
1323.57 *12*	21 *2*	2685.83		1362.25	2^+	
1344.76 *15*	13.5 *12*	3285.10		1940.33		
1362.32 *10*	295 *23*	1362.25	2^+	0.0	0^+	E2
1396.16 *13*	25 *2*	2103.13		707.13	2^+	
1418.34 *11*	21 *2*	2780.60		1362.25	2^+	
1440.21 *12*	8.5 *8*	2147.81		707.13	2^+	
1465.9 *3*	9.6 *11*	2828.26		1362.25	2^+	
1486.0 *4*	14.7 *21*	2193.1		707.13	2^+	
1542.20 *13*	35 *3*	2249.34		707.13	2^+	
1610.80 *11*	59 *3*	2318.09		707.13	2^+	
1625.11 *13*	44 *3*	2987.31		1362.25	2^+	
1828.90 *20*	10.7 *11*	2536.05		707.13	2^+	
1836.49 *10*	38 *2*	2543.70		707.13	2^+	
1888.79 *13*	14.7 *12*	2595.94		707.13	2^+	
2002.9 *5*	6.7 *13*	4546.6		2543.70		
2024.1 *3*	11.6 *16*	2730.76		707.13	2^+	
2040.79 *14*	21 *2*	2747.94		707.13	2^+	
2073.0 *5*	4.0 *10*	2780.60		707.13	2^+	
^{x}2105.7 *2*	15.0 *12*					
2121.2 *3*	9.8 *10*	2828.26		707.13	2^+	
^{x}2172.9 *4*	3.4 *12*					
^{x}2297.1 *3*	7.4 *13*					
2318.6 *2*	28 *2*	2318.09		0.0	0^+	
2411.8 *3*	11.4 *19*	5730.1		3318.4		
2433.09 *15*	26 *1*	3140.25		707.13	2^+	
2543.93 *20*	7.7 *10*	2543.70		0.0	0^+	
^{x}2612.2 *2*	14.6 *14*					
2665.4 *3*	8.9 *13*	3372.6		707.13	2^+	
2682.6 *2*	12.2 *14*	4785.78		2103.13		
2730.5 *2*	44 *3*	2730.76		0.0	0^+	
^{x}2763.9 *4*	5.0 *4*					
2801.0 *3*	9.1 *18*	3508.2		707.13	2^+	
2864.1 *2*	31 *3*	2864.15		0.0	0^+	
2987.1 *2*	29 *2*	2987.31		0.0	0^+	
^{x}3022.3 *4*	6.2 *15*					
^{x}3116.7 *4*	9.9 *13*					
3231.3 *3*	89 *9*	3231.44		0.0	0^+	
3318.5 *3*	31 *3*	3318.4		0.0	0^+	
^{x}3505.8 *4*	6.5 *12*					

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^{90}Br β^- decay 1981Ho17 (continued)

$\gamma(^{90}Kr)$ (continued)

E_γ †	I_γ §	E_i(level)	E_f	J^π_f	E_γ †	I_γ §	E_i(level)	J^π_i	E_f	J^π_f
x3669.1 *4*	7.3 *11*				4367.3 *5*	16.1 *20*	5730.1		1362.25	2^+
x3949.0 *3*	9.4 *11*				4372.8 *5*	14.1 *20*	5080.0		707.13	2^+
x3955.0 *3*	8.4 *9*				x4495.1 *4*	8.8 *14*				
4023.1 *6*	6.7 *18*	5385.4	1362.25	2^+	x4762.3 *5*	6.8 *11*				
4290.9 *3*	17.0 *15*	4291.0	0.0	0^+	x4787.4 *4*	5.7 *11*				
4297.2 *3*	16.7 *15*	5004.4	707.13	2^+	x5154.0 *5*	2.8 *10*				
4320.9 *5*	9.1 *14*	5683.3	1362.25	2^+	x5221.6 *5*	7.9 *13*				

† For several γ's not seen by 1981Ho17, see 1975Kr17.

‡ From the Adopted Gammas.

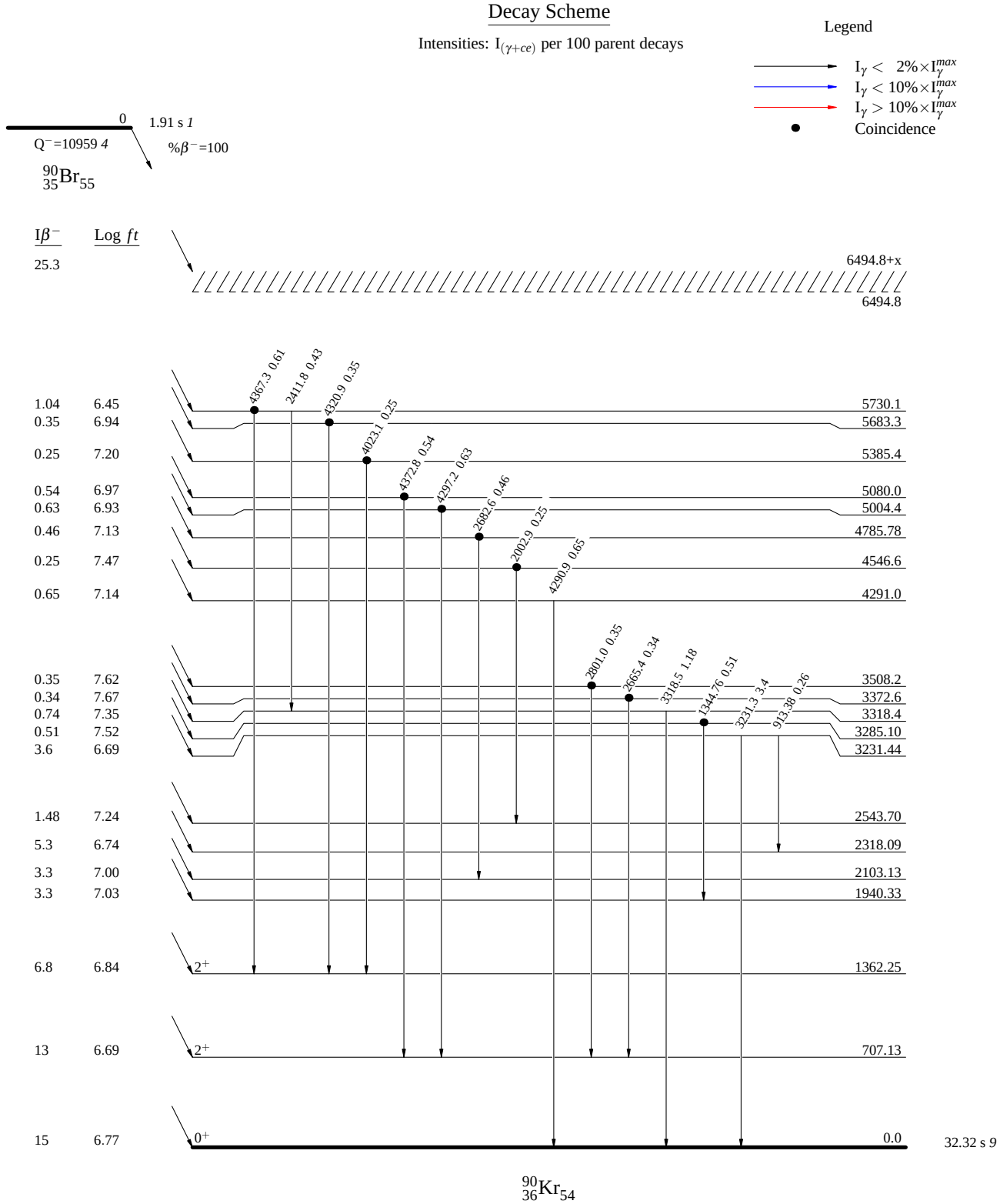
§ For absolute intensity per 100 decays, multiply by 0.038 *4*.

x γ ray not placed in level scheme.

^{90}Br β^- decay 1981Ho17

Decay Scheme

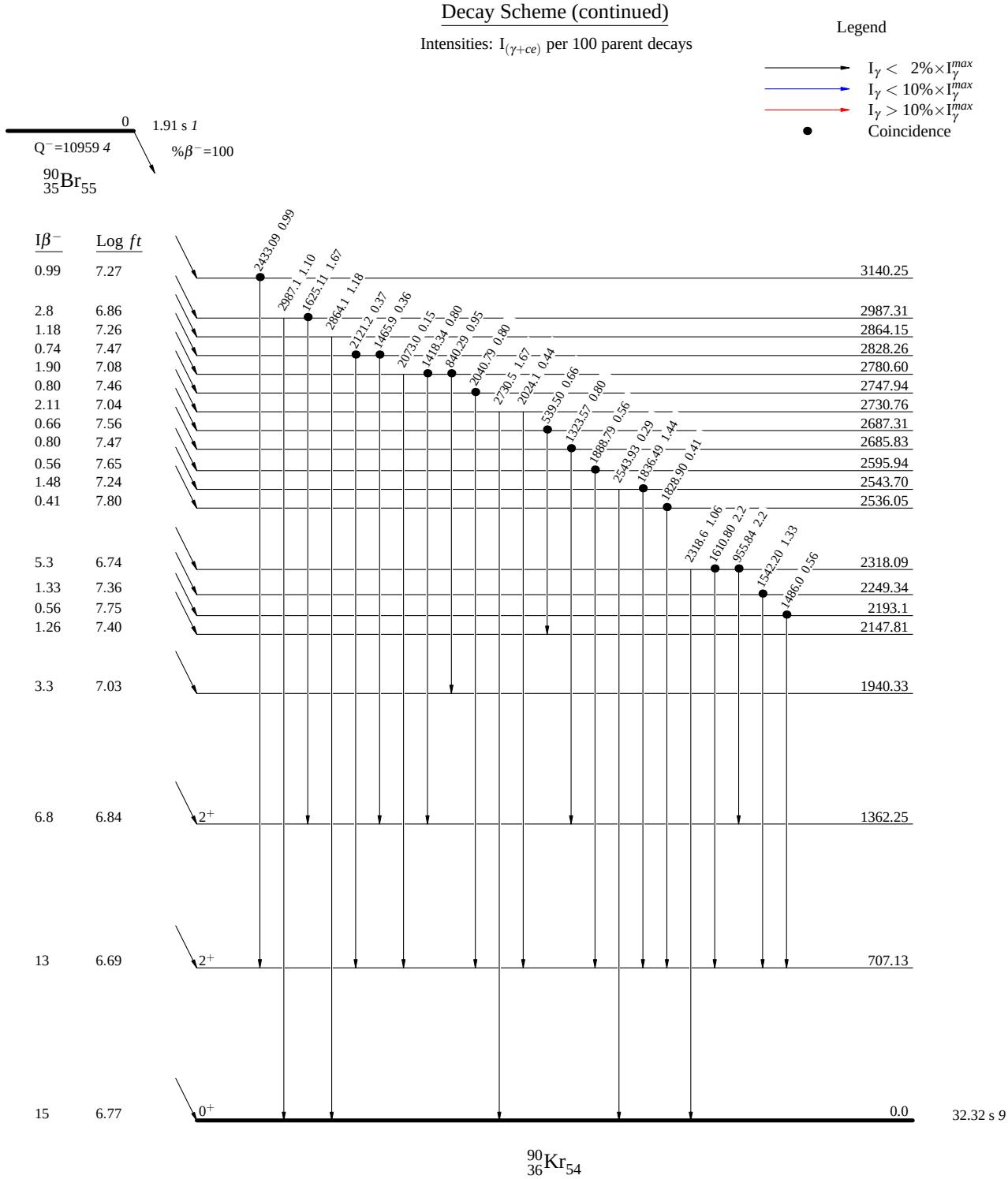
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Br β^- decay 1981Ho17

Decay Scheme (continued)

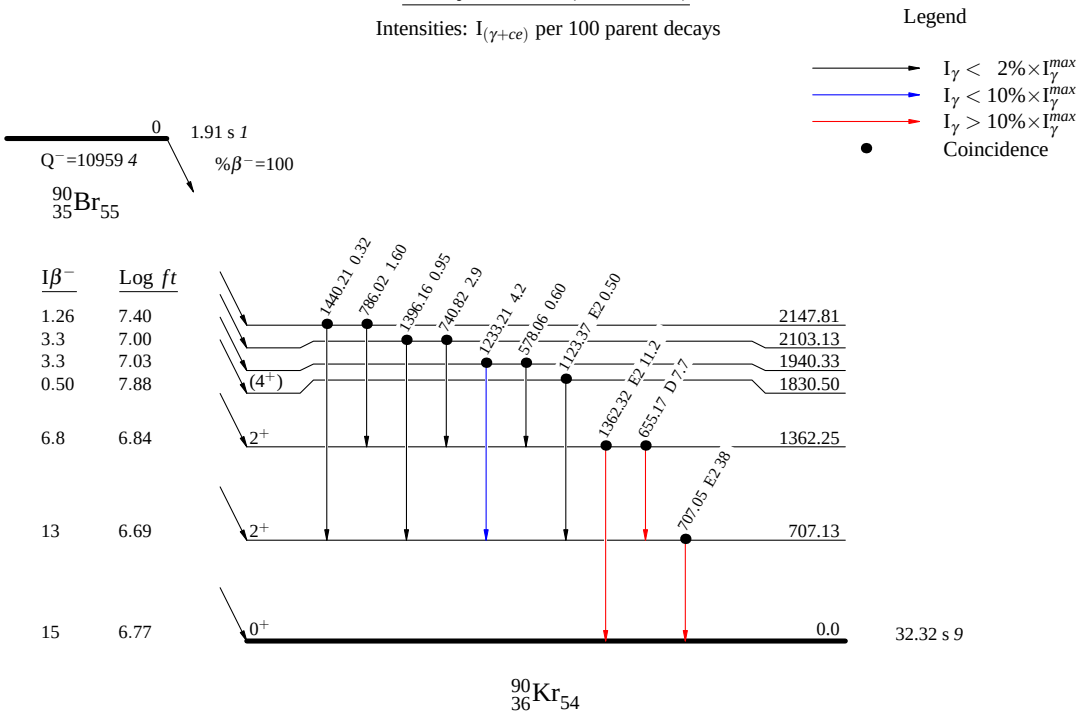
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Br β^- decay 1981Ho17

Decay Scheme (continued)

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{248}Cm SF decay 2000Rz02

Parent: ^{248}Cm: E=0; $J^{\pi}=0^{+}$; $T_{1/2}=3.48\times10^{5}$ y *6*; %SF decay=?

2000Rz02: Spontaneous fission decay of ^{248}Cm; EUROGAM2 array; measured γ, $\gamma\gamma\gamma$, $\gamma\gamma(\theta)$, linear polarization.

^{90}Kr Levels

E(level)†	J^{π}‡	Comments
0.0	0^{+}	
707.10	2^{+}	
1362.61	2^{+}	
1506.4	3^{-}	E(level): the 799.3γ from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from Adopted Levels.
1764.1	(4^{+})	
1830.1	4	
1974.2		E(level): the 467.9γ from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from Adopted Levels.
2596.6		E(level): either E(level)=2599.7, as quoted by 2000Rz02 seems to be in error or Eγ=832.5 needs adjustment. Evaluator opts for the adjustment of E(level) to be consistent with ^{252}Cf SF decay (2011Li34).
2678.1		E(level): the 1171.5γ from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from Adopted Levels.
2745.5		E(level): the 771.4γ ray from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from Adopted Levels.
2761.8		E(level): the 1255.5γ ray from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from Adopted Levels.
2852.6		
3084.3		
3222.6		
3407.9		E(level): The γ rays from this level have been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from Adopted Levels. levels.
3896.0		
4003.6		E(level): the 1258.1γ ray from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from Adopted Levels.
4035.2		
4324.5		E(level): the 916.6γ ray from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from Adopted Levels.
5052.3		

† From least-squares fit to Eγ, by evaluators.

‡ As proposed by 2000Rz02 based on multipolarity deduced from $\gamma\gamma$ angular correlation measurements and systematics.

$\gamma(^{90}$Kr)

E_{γ}	E_i(level)	J^{π}_i	E_f	J^{π}_f	Mult.†	Comments
401.6	1764.1	(4^{+})	1362.61	2^{+}	Q	(401γ)(655γ)(θ): A_2=−0.03 *2*, A_4=−0.03 *1*. (401γ)(1362γ)(θ): A_2=+0.13 *2*, A_4=+0.03 *1*.
467.9	1974.2		1506.4	3^{-}	D	(468γ)(799γ)(θ): A_2=+0.12 *2*, A_4=+0.07 *1*. E_{γ}: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
646.2	3407.9		2761.8			E_{γ}: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
655.6	1362.61	2^{+}	707.10	2^{+}	D	(655γ)(707γ)(θ): A_2=−0.23 *4*, A_4=+0.13 *2*.
662.4	3407.9		2745.5			E_{γ}: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
707.1	707.10	2^{+}	0.0	0^{+}	Q	

Continued on next page (footnotes at end of table)

^{248}Cm SF decay 2000Rz02 (continued)

$\gamma(^{90}Kr)$ (continued)

E_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.†	Comments
729.5	3407.9		2678.1			E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
771.4	2745.5		1974.2			E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
799.3	1506.4	3^-	707.10	2^+	D	(799γ)(707γ)(θ): A_2=−0.20 *2*, A_4=−0.02 *1*. E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
812.6	4035.2		3222.6			
832.5	2596.6		1764.1	(4^+)		
916.6	4324.5		3407.9			E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
1022.5	2852.6		1830.1	4		
1043.4	3896.0		2852.6			
1056.9	1764.1	(4^+)	707.10	2^+	Q	(1056γ)(707γ)(θ): A_2=+0.08 *3*, A_4=+0.02 *1*.
1123.0	1830.1	4	707.10	2^+	Q	(1123γ)(707γ)(θ): A_2=+0.10 *2*, A_4=+0.04 *1*.
1156.3	5052.3		3896.0			
1171.5	2678.1		1506.4	3^-		E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
1254.2	3084.3		1830.1	4		
1255.5	2761.8		1506.4	3^-	D	(1255γ)(799γ)(θ): A_2=+0.13 *4*, A_4=+0.07 *2*. E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
1258.1	4003.6		2745.5			E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
1320.2	3084.3		1764.1	(4^+)		
1362.6	1362.61	2^+	0.0	0^+	Q	
1392.6	3222.6		1830.1	4		
1458.4	3222.6		1764.1	(4^+)		

† Deduced from $\gamma\gamma$ angular correlation measurements (2000Rz02).

^{252}Cf SF decay 2011Li34

Parent: ^{252}Cf: E=0; $J^{\pi}=0^{+}$; $T_{1/2}$=2.645 y *8*; %SF decay=?

2011Li34: Spontaneous fission decay of ^{252}Cf; GAMMASPHERE Array at LBL; measured γ, $\gamma\gamma\gamma$, $\gamma\gamma(\theta)$.

^{90}Kr Levels

E(level)[†]	J^{π}[‡]	Comments
0.0[#]	0^{+}	
707.60[#]	2^{+}	
1362.41[a]	2^{+}	
1506.7[@]	3^{-}	J^{π}: confirmed from angular correlation of 707.6-799.1 keV cascade; consistent with 2000Rz02. E(level): the 799.1γ from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from Adopted Levels.
1763.8[a]	(4^{+})	
1830.9[#]	(4^{+})	
1975.0[&]		E(level): the 468.3γ from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from Adopted Levels.
2596.6[a]	(6^{+})	
2678.8		E(level): the 1172.1γ from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from Adopted Levels.
2746.5[&]		E(level): the 771.5γ ray from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from the Adopted Levels.
2762.3[@]		E(level): the 1255.6γ ray from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from the Adopted Levels.
2853.6[#]	(6^{+})	
3085.3	(6^{+})	
3224.1	(6^{+})	
3408.6[@]		E(level): the γ rays from this level have been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from the Adopted Levels.
3695.6[a]	(8^{+})	
3897.0[#]	(8^{+})	
4005.5[&]		E(level): the 1259.0γ ray from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from the Adopted Levels.
4037.5	(8^{+})	
4285.3	(8^{+})	
4325.4[@]		E(level): the 916.8γ ray from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from the Adopted Levels.
5053.6[#]	(10^{+})	
5081.3[&]		E(level): The 1075.8 γ ray from this level has been assigned to ^{91}Kr by 2017Rz01 in ^{235}U(n,Fγ). Hence, this level is excluded from the Adopted Levels.
6298.9[#]	(12^{+})	

[†] From least-squares fit to Eγ by evaluators.
[‡] Based on deduced multipolarity in ^{248}Cm decay (2000Rz02) and from systematics of N=52 isotones, unless otherwise stated.
[#] Band(A): Band-1.
[@] Band(B): Band-2.
[&] Band(C): Band-3.
[a] Band(D): Band-4.

^{252}Cf SF decay 2011Li34 (continued)

$\gamma(^{90}Kr)$

E_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.†	Comments
319.9	4325.4		4005.5			E_γ: not seen in ^{248}Cm SF decay; consequent to exclusion of 4005.5 keV level, this γ ray is not included in the Adopted Levels.
401.4	1763.8	(4+)	1362.41	2+		
468.3	1975.0		1506.7	3−		E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
646.3	3408.6		2762.3			E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
654.8	1362.41	2+	707.60	2+		
662.1	3408.6		2746.5			E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
672.9	3897.0	(8+)	3224.1	(6+)		
707.6	707.60	2+	0.0	0+	Q	
729.8	3408.6		2678.8			E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
771.5	2746.5		1975.0			E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
799.1	1506.7	3−	707.60	2+	D	(707.6γ)(799.1γ)(θ): A_2=−0.214 *36*, A_4=−0.01 *5*. E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
811.7	3897.0	(8+)	3085.3	(6+)		
813.4	4037.5	(8+)	3224.1	(6+)		
832.8	2596.6	(6+)	1763.8	(4+)		
916.8	4325.4		3408.6			E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
1022.7	2853.6	(6+)	1830.9	(4+)		
1043.4	3897.0	(8+)	2853.6	(6+)		
1056.2	1763.8	(4+)	707.60	2+		
1075.8	5081.3		4005.5			
1099.0	3695.6	(8+)	2596.6	(6+)		
1123.3	1830.9	(4+)	707.60	2+		
1156.6	5053.6	(10+)	3897.0	(8+)		
1172.1	2678.8		1506.7	3−		E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
1200.0	4285.3	(8+)	3085.3	(6+)		
1245.3	6298.9	(12+)	5053.6	(10+)		
1254.4	3085.3	(6+)	1830.9	(4+)		
1255.6	2762.3		1506.7	3−		E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
1259.0	4005.5		2746.5			E_γ: in ^{235}U(n,Fγ), this transition is assigned to ^{91}Kr; thus it is not included in the Adopted Levels.
1321.5	3085.3	(6+)	1763.8	(4+)		
1362.4	1362.41	2+	0.0	0+		
1393.2	3224.1	(6+)	1830.9	(4+)		
1460.3	3224.1	(6+)	1763.8	(4+)		

† Deduced from angular correlation data (2011Li34).

^{235}U(n,Fγ) 2012Mu08,2014Re15,2017Rz01

2012Mu08: E=thermal neutrons from the Canada India Research Utility Services (CIRUS) reactor facility, Bhabha Atomic Research Center (BARC), Mumbai. Measured Eγ, Iγ, $\gamma\gamma$-coin using two Clover HPGe detectors equipped with anti-Compton shields, in coincidence mode.

2014Re15: E=cold neutron beam from Institut Laue-Langevin (ILL) reactor at Grenoble, France. Measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma$(t) using the EXILL spectrometer consisting of eight BGO shielded EXOGAM Clover detectors and the FATIMA array consisting of sixteen 5% Ce-doped $LaBr_3$ detectors (FWHM=500-270 ps for the FATIMA prompt response function). Deduced $T_{1/2}$ of 707-keV level using the generalized centroid difference (GCD) method.

2017Rz01: E(n)=cold neutrons from PF1B facility of ILL-Grenoble. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma\gamma(\theta)$ using EXILL array of 28 pairs of the eight clover detectors mounted in a planar, octagonal geometry. Identification of γ rays from ^{90}Kr in correlation with the γ rays from its complementary fission partners ^{144}Ba, ^{143}Ba and ^{142}Ba.

Several γ rays previously assigned to ^{90}Kr have been identified as belonging to ^{91}Kr by 2017Rz01. Some include a 468γ from a proposed 1974.3 level, a 771γ from a 2745 level and a 799γ from a 1506 level. For a full list of transitions and their original placements, see the ^{248}Cm and ^{252}Cf decay datasets. These transitions and their corresponding levels are not included in the Adopted Levels and Gammas, nor are they placed in this dataset.

^{90}Kr Levels

E(level)†	J^π‡	$T_{1/2}$	Comments
0	0^+		
707.3	2^+	10.4 ps *69*	$T_{1/2}$: from centroid difference between 707γ and 1123γ in $LaBr_3$ coincidence spectra (2014Re15). Spectra obtained by summing gates on the 199 keV and 331 keV transitions (from the complementary partner ^{144}Ba) in the EXILL array (2014Re15). $\Delta T_{1/2}$ includes uncertainty from large Compton background and prompt response difference uncertainty of 10 ps (2014Re15).
1362.7	2^+		
1764.4	$3^+,4^+$		J^π: $\gamma\gamma(\theta)$ data are consistent with J=2,3,4; 2^+ is rejected by 2017Rz01 due to the absence of transition to the g.s.
1830.7	4^+		
2596.8			
2853.5	5		
3085.5	5^+		
3224.1	$5^+,6^+$		J^π: $\gamma\gamma(\theta)$ data are consistent with J=4,5,6; 4^+ is rejected by 2017Rz01 due to the absence of transition to any of the 2^+ states.
3695.2			
3897.2			
4038.2			
4099.3			
4285.1			
5053.9			

† From least-squares fit to Eγ values by the evaluators.
‡ As proposed by 2017Rz01, based on $\gamma\gamma(\theta)$ measurements.

γ(^{90}Kr)

E_i(level)	J^π_i	E_γ	I_γ†	E_f	J^π_f	Mult.	δ	Comments
707.3	2^+	707.3		0	0^+	Q‡		I_γ: other: >226 (2012Mu08).
1362.7	2^+	655.5	63.5 *15*	707.3	2^+	(M1+E2)	+0.507	δ: from (655.5γ)(707.3γ)(θ): A_2=−0.129 *14*, A_4=+0.090 *27*. I_γ: other: 53 *3* (2012Mu08).
		1362.7	100	0	0^+	Q‡		I_γ: other: 63 *3* (2012Mu08).
1764.4	$3^+,4^+$	401.7	415 *16*	1362.7	2^+			Mult=Q for J(1764)=4. δ(Q/D)=+0.242 *+17−16* for J(1764)=3, +0.194 *+15−13* for J(1764)=2 from

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^{235}U(n,Fγ) 2012Mu08,2014Re15,2017Rz01 (continued)

γ(^{90}Kr) (continued)

E_i(level)	J^π_i	E_γ	I_γ[†]	E_f	J^π_f	Mult.	δ	Comments
								(401.7γ)(1362.7γ)(θ): A_2=+0.100 *1*, A_4=−0.004 *20* (2017Rz01). I_γ: other: 47 *7* (2012Mu08).
1764.4	$3^+,4^+$	1057.1	100	707.3	2^+			Mult=Q for J(1764)=4. δ(Q/D)=+0.182 *+53−48* or +2.75 *+38−48* for J(1764)=3, +0.244 *45* for J(1764)=2 (2017Rz01). Mult.: from (1057.1γ)(707.3γ)(θ): A_2=+0.062 *33*, A_4=−0.16 *74* (2017Rz01).
1830.7	4^+	1123.4		707.3	2^+	Q[‡]		Mult.: (1123.4γ)(707.3γ)(θ): A_2=+0.095 *15*, A_4=−0.012 *33* (2017Rz01). I_γ: other: 100 *5* (2012Mu08).
2596.8		832.4		1764.4	$3^+,4^+$			
2853.5	5	1022.8		1830.7	4^+	D+Q[‡]	+0.072 *19*	Mult.,δ: (1022.8γ)(1123.4γ)(θ): A_2=−0.023 *12*, A_4=+0.004 *22* (2017Rz01). I_γ: other: 53 *3* (2012Mu08).
3085.5	5^+	1254.7		1830.7	4^+			δ(Q/D)=+0.47 *+15−11* or +1.72 *+47−48* for J(3085)=5; +0.05 *+12−15* for J(3085)=4 from (1254.7γ)(1123.4γ)(θ): A_2=+0.180 *43*, A_4=−0.001 *94* (2017Rz01).
		1321.1		1764.4	$3^+,4^+$			
3224.1	$5^+,6^+$	1393.4		1830.7	4^+			Mult.: Q for J(3224)=6. δ(Q/D)=+0.33 *+15−11* or +2.38 *+95−66* for J(3224)=5; −1.39 *+40−52* or +0.21 *+15−16* for J(3224)=4. Mult.: (1393.4γ)(1123.4γ)(θ): A_2=+0.122 *58*, A_4=−0.012 *123* (2017Rz01).
		1459.7		1764.4	$3^+,4^+$			
3695.2		1098.4		2596.8				
3897.2		1043.7		2853.5	5			I_γ: other: 47 *7* (2012Mu08).
4038.2		814.1		3224.1	$5^+,6^+$			
4099.3		1245.8		2853.5	5			
4285.1		1199.6		3085.5	5^+			
5053.9		1156.7		3897.2				

[†] Relative photon intensity (2017Rz01). 2012Mu08 provide intensities relative to Iγ(1123γ)=100. These are given in the comments.

[‡] From $\gamma\gamma(\theta)$ results in 2017Rz01, mult=Q indicates stretched quadrupole.

Coulomb excitation 2017El04

2017El04: Intermediate energy Coulomb excitation using 68 MeV/nucleon ^{90}Kr beam, produced in ^{9}Be(^{96}Zr,X) primary reaction with E=120 MeV/nucleon beam from K500 and K1200 coupled cyclotrons at NSCL-MSU facility. Fragments were separated using A1900 fragment separator. Target was 246 mg/cm^2 thick ^{209}Bi. Measured scattered particles using S800 spectrograph, Eγ, Iγ, (particle)γ-coin using CAESAR array of 192 closely packed CsI(Na) crystals.

^{90}Kr Levels

E(level)	J^{π}‡	$T_{1/2}$†	Comments
0	0^+		
707	2^+	10.7 ps *16*	B(E2)↑=0.1500 *230* (2017El04) Measured σ=180 mb *30* (2017El04).
1362	2^+	1.1 ps *+4−2*	B(E2)↑=0.0330 *90* (2017El04) Measured σ=40 mb *10* (2017El04).
2249	(2^+)	<0.23 ps	B(E2)↑=0.0150 *110* (2017El04) J^{π}: tentative assignment by 2017El04. Measured σ=17 mb *13* (2017El04).

† Deduced by evaluators from B(E2)↑ values in 2017El04, and adopted gamma-ray properties.
‡ From the Adopted Levels.

γ(^{90}Kr)

E_i(level)	J^{π}_i	E_{γ}	I_{γ}	E_f	J^{π}_f	Mult.	Comments
707	2^+	707		0	0^+	E2	
1362	2^+	655		707	2^+		
		1362		0	0^+	[E2]	
2249	(2^+)	1542	100	707	2^+		
		2249†	<23	0	0^+	[E2]	E_{γ},I_{γ}: estimated by 2017El04, the 2249γ was not seen by the authors.

† Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Q(β^-)=6584 *7*; S(n)=5723 *8*; S(p)=10118 *7*; Q(α)=−6157 *7* 2017Wa10
S(2n)=12898 *8*; S(2p)=23226 *7* (2017Wa10).

^{90}Rb Levels

Cross Reference (XREF) Flags

A	^{90}Kr β^- decay
B	^{90}Rb IT decay (258 s)
C	^{235}U(n,Fγ)

E(level)†	J$^\pi$	T$_{1/2}$‡	XREF	Comments
0	0$^-$	158 s *5*	ABC	%β^-=100 J$^\pi$: J=0 from atomic-beam measurement (1979Ek02). π from ^{90}Rb(g.s.) β^- decay with log $f^{1u}t$=8.42 *6* to ^{90}Sr(832) 2$^+$ state. T$_{1/2}$: weighted average of 153 s *3* (1969Ca03) and 162 s *3* (1977Hu03), both from γ(t) with mass separated sources and Ge(Li).
106.90 *3*	3$^-$	258 s *4*	ABC	%β^-=97.5 *4*; %IT=2.5 *4* μ=1.6160 *6* (1981Th04) Q=+0.25 *7* (1981Th04,2016St14) %IT: from measured Iγ, α and normalization (1981Ta05), see ^{90}Rb β^- decay (258 s). J$^\pi$: J=3 from atomic-beam measurement (1979Ek02); M3 106.9γ to 0$^-$. T$_{1/2}$: weighted average of 258 s *5* (1967Am01) and 258 s *4* (1977Hu03), both from γ(t) with mass separated sources and Ge(Li). μ: from atomic-beam laser spectroscopy (1981Th04). Other: 1.612 *5* (atomic-beam magnetic resonance, 1979Ek02). Q: from atomic-beam laser spectroscopy (1981Th04,2016St14). Measured value given in 1981Th04 is 0.20 *5*, evaluated to +0.25 *7* by 2016St14.
121.79 *3*	(1$^-$)		A	J$^\pi$: (M1) 121.8γ to 0$^-$.
162.72 *18*	4$^-$	<7 ns	C	J$^\pi$: M1+E2 55.8γ to 3$^-$. Configuration=$\pi p^{-1}_{3/2}\otimes\nu(d^3_{5/2})$ or less likely $\pi f^{-1}_{5/2}\otimes\nu(d^3_{5/2})$.
227.83 *3*	(2$^-$)		A	J$^\pi$: (M1+E2) 106.05γ to (1$^-$) and (M1+E2) 120.92γ to 3$^-$.
242.19 *3*			A	
356.23 *3*			A	
536.91 *6*			A	
614.42 *4*			A	
661.28 *3*			A	
676.10 *5*			A	
712.46 *8*			A	
740.87 *5*			A	
838.20 *4*			A	
933.08 *6*			A	
1102.19 *6*			A	
1127.90 *20*	(5$^+$)	<7 ns	C	J$^\pi$: $\gamma\gamma(\theta)$ for 965-56 cascade in ^{235}U(n,Fγ) gives 5 or 6; (M1+E2) 365.1γ from 6$^{(+)}$ favors (5$^+$).
1153.41 *7*			A	
1204.75 *20*	5	<7 ns	C	J$^\pi$: from $\gamma\gamma(\theta)$ for the 1042-55.8 cascade in ^{235}U(n,Fγ); J=4 and 6 are excluded by the $\gamma\gamma(\theta)$ analysis. Proposed configuration=$\pi f^{-1}_{5/2}\otimes\nu(d^3_{5/2})$ (2016Cz01) which would result in Jπ=5$^-$.
1400.6 *4*			A	
1462.97 *16*			A	
1492.98 *21*	6$^{(+)}$	<7 ns	C	J$^\pi$: $\gamma\gamma(\theta)$ data for 365-965 cascade in ^{235}U(n,Fγ) are consistent with 6−>5−>4 or 6−>6−>4 sequences and large δ(Q/D) value for the 365γ in both spin sequences. This implies mult=M1+E2, and thus the same parity for 1493 and 1128 levels. The $\gamma\gamma(\theta)$ data for the 288-1042 cascade is consistent with J=5 or 6 for 1493 level. Absence of transition to 163, 4$^-$ level suggests positive parity for J=6 for the 1493 level.

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Adopted Levels, Gammas (continued)

^{90}Rb Levels (continued)

E(level)†	J^π	$T_{1/2}$‡	XREF	Comments
1688.17 *18*			A	
1703.67 *23*	(7,6)	<7 ns	C	J^π: $\gamma\gamma(\theta)$ in ^{235}U(n,Fγ) is consistent with J=6 or 7, but absence of transitions to 1128, (5^+) and 1204, 5 makes J=6 less likely.
1780.01 *3*	1^+		A	J^π: β^- decay from ^{90}Kr(g.s.) with log *ft*=4.6.
1901.63 *12*			A	
2127.58 *5*	1^+		A	J^π: β^- decay from ^{90}Kr(g.s.) with log *ft*=5.78.
2271.34 *9*			A	
2433.59 *19*			A	
2500.4 *4*	(8^+,7)		C	J^π: 1007.1γ to $6^{(+)}$.
2686.96 *25*	(8,9)		C	J^π: 186.5γ to (8^+,7), 983.3γ to (7,6).
3083.07 *7*	1^+		A	J^π: β^- decay from ^{90}Kr(g.s.) with log *ft*=4.9.
3093.74 *12*	1^+		A	J^π: β^- decay from ^{90}Kr(g.s.) with log *ft*=5.3.
3238.68 *14*	1^+		A	J^π: β^- decay from ^{90}Kr(g.s.) with log *ft*=5.7.
3401.3 *3*			C	
3475.6 *4*			A	
3518.2 *4*			C	
3625.2 *4*	1^+		A	J^π: β^- decay from ^{90}Kr(g.s.) with log *ft*=5.3.
3633.8 *6*			C	
3703.98 *20*	1^+		A	J^π: β^- decay from ^{90}Kr(g.s.) with log *ft*=4.9.
3878.6 *3*	1^+		A	J^π: β^- decay from ^{90}Kr(g.s.) with log *ft*=4.9.
3881.3 *3*	1^+		A	J^π: β^- decay from ^{90}Kr(g.s.) with log *ft*=4.5.

† From least-squares fit to adopted γ-ray data.
‡ From $\gamma\gamma$(t) in ^{235}U(n,Fγ), except where noted.

$\gamma(^{90}Rb)$

E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f	Mult.	δ	α§	Comments
106.90	3^-	106.92 *15*	100	0	0^-	M3		10.76	B(M3)(W.u.)=0.0085 *15* Mult.: from α(K)exp/α(L)exp=6.2 *12* in ^{90}Kr β^- decay and level scheme requirement of ΔJ=3.
121.79	(1^-)	121.82 *3*	100	0	0^-	(M1)		0.0844	Mult.,δ: from α(K)exp in ^{90}Kr β^- decay.
162.72	4^-	55.8 *1*	100	106.90	3^-	M1+E2	0.298 *25*	1.35 *10*	Mult.,δ: from α(exp) in ^{235}U(n,Fγ).
227.83	(2^-)	106.05 *3*	12.8 *8*	121.79	(1^-)	(M1+E2)	0.5 *2*	0.255 *85*	Mult.,δ: from α(K)exp in ^{90}Kr β^- decay.
		120.92 *3*	100 *7*	106.90	3^-	(M1+E2)	0.5 *2*	0.165 *52*	Mult.,δ: from α(K)exp in ^{90}Kr β^- decay.
		227.76 *8*	3.6 *4*	0	0^-	[E2]		0.0478	
242.19		242.19 *3*	100	0	0^-				
356.23		234.44 *3*	100 *5*	121.79	(1^-)				
		249.32 *3*	52 *5*	106.90	3^-				
		356.00 *20*	4.0 *15*	0	0^-				
536.91		180.66 *15*	26 *14*	356.23					
		309.07 *9*	92 *8*	227.83	(2^-)				
		429.93 *14*	100 *21*	106.90	3^-				
614.42		386.48 *9*	10.7 *10*	227.83	(2^-)				
		492.63 *5*	100 *3*	121.79	(1^-)				
		508.0 *3*	5.2 *16*	106.90	3^-				
		614.38 *9*	17.4 *13*	0	0^-				
661.28		305.10 *18*	0.18 *4*	356.23					
		419.12 *5*	1.04 *4*	242.19					
		433.47 *5*	4.24 *13*	227.83	(2^-)				
		539.49 *4*	100.0 *23*	121.79	(1^-)				
		554.37 *5*	16.5 *4*	106.90	3^-				
		661.23 *5*	1.08 *4*	0	0^-				
676.10		433.9 *3*	17 *6*	242.19					
		569.20 *5*	100 *4*	106.90	3^-				
712.46		470.34 *8*	100	242.19					
740.87		498.59 *12*	14.0 *11*	242.19					
		619.08 *5*	100 *3*	121.79	(1^-)				
838.20		731.33 *4*	100	106.90	3^-				
933.08		220.82 *14*	10 *5*	712.46					
		396.54 *21*	13 *3*	536.91					
		577.1 *3*	14 *4*	356.23					
		690.72 *7*	100 *4*	242.19					
		705.47 *12*	31 *3*	227.83	(2^-)				
1102.19		565.19 *8*	100 *8*	536.91					
		745.8 *4*	30 *10*	356.23					
		980.29 *11*	91 *8*	121.79	(1^-)				
1127.90	(5^+)	965.2‡ *1*	100‡	162.72	4^-				δ: δ(Q/D)=+0.24 *+21−28* or +3 *+16−3* for J(1127.9 level)=5 from $\gamma\gamma(\theta)$ in ^{235}U(n,Fγ).

$^{90}_{37}Rb_{53}$-3

$\gamma(^{90}Rb)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.	δ	α[§]	Comments
1153.41		925.49 *9*	100 *7*	227.83	(2⁻)				
		1031.2 *3*	28 *7*	121.79	(1⁻)				
1204.75	5	1042.0[‡] *1*	100[‡] *4*	162.72	4⁻	D(+Q)	−0.08 *+26−29*		Mult.,δ: from $\gamma\gamma(\theta)$ in ^{235}U(n,Fγ).
1400.6		739.0 *10*	40 *14*	661.28					
		1293.7 *4*	100 *27*	106.90	3⁻				
1462.97		1341.31 *22*	100	121.79	(1⁻)				
1492.98	6(+)	288.2[‡] *1*	100[‡] *16*	1204.75	5	D,D+Q			Mult.,δ: δ(Q/D)=+0.05 *4* or +8.5 *+48−22* for J(1492.98 level)=6 from $\gamma\gamma(\theta)$ in ^{235}U(n,Fγ). Mult.,δ: δ(Q/D)=+0.76 *+13−11* or −3.5 *+8−14* for J(1492.98 level)=5 from $\gamma\gamma(\theta)$ in ^{235}U(n,Fγ).
		365.1[‡] *1*	67[‡] *16*	1127.90	(5⁺)	(M1+E2)		0.0072 *22*	Mult.: all $\gamma\gamma(\theta)$ solutions in ^{235}U(n,Fγ) lead to significant quadrupole admixture suggestive of mult=(M1+E2) rather than (E1+M2). δ: δ(Q/D)=+0.47 *+42−31* or +1.8 *+26−17* for J(1127.9 level)=5 from $\gamma\gamma(\theta)$ in ^{235}U(n,Fγ).
1688.17		585.86 *20*	76 *12*	1102.19					
		947.6 *4*	88 *30*	740.87					
		1460.6 *5*	100 *30*	227.83	(2⁻)				
1703.67	(7,6)	210.7[‡] *1*	100[‡]	1492.98	6(+)				
1780.01	1⁺	626.49 *8*	0.73 *5*	1153.41					
		677.69 *7*	0.98 *5*	1102.19					
		941.86 *5*	3.43 *9*	838.20					
		1039.11 *8*	1.07 *5*	740.87					
		1103.92 *7*	0.88 *5*	676.10					
		1118.69 *5*	100.0 *22*	661.28					
		1165.56 *6*	2.12 *8*	614.42					
		1423.77 *6*	7.53 *17*	356.23					
		1537.85 *5*	24.8 *5*	242.19					
		1552.18 *6*	5.63 *14*	227.83	(2⁻)				
		1658.18 *6*	3.40 *9*	121.79	(1⁻)				
		1780.04 *6*	17.2 *4*	0	0⁻				
1901.63		1240.34 *11*	100	661.28					
2127.58	1⁺	1386.62 *15*	14.2 *14*	740.87					
		1466.26 *15*	17.9 *14*	661.28					
		1885.42 *15*	16.4 *12*	242.19					
		1899.61 *16*	13.9 *12*	227.83	(2⁻)				
		2006.00 *14*	8.5 *15*	121.79	(1⁻)				
		2127.52 *7*	100 *4*	0	0⁻				
2271.34		1530.50 *20*	14 *7*	740.87					
		2149.51 *10*	100 *5*	121.79	(1⁻)				
2433.59		1692.6 *5*	69 *18*	740.87					

$^{90}_{37}Rb_{53}$-4

$\gamma(^{90}Rb)$ (continued)

E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f
2433.59		1819.1 *3*	66 *11*	614.42	
		2191.5 *3*	100 *11*	242.19	
		2205.6 *6*	34 *11*	227.83	(2^-)
2500.4	$(8^+,7)$	1007.1‡ *5*	100‡	1492.98	$6^{(+)}$
2686.96	(8,9)	186.5‡ *3*	33‡ *13*	2500.4	$(8^+,7)$
		983.3‡ *1*	100‡ *20*	1703.67	(7,6)
3083.07	1^+	1303.4 *3*	10.7 *18*	1780.01	1^+
		1620.22 *22*	17.4 *18*	1462.97	
		1980.99 *15*	19.6 *14*	1102.19	
		2421.5 *8*	5.8 *18*	661.28	
		2468.56 *11*	54 *5*	614.42	
		2726.68 *11*	100 *4*	356.23	
		2855.4 *3*	37 *8*	227.83	(2^-)
3093.74	1^+	2160.9 *6*	17 *5*	933.08	
		2352.7 *4*	47 *9*	740.87	
		2417.33 *23*	100 *9*	676.10	
		2432.78 *21*	80 *9*	661.28	
		2479.4 *7*	20 *11*	614.42	
		2865.73 *21*	98 *9*	227.83	(2^-)
3238.68	1^+	967.33 *11*	100 *9*	2271.34	
		2497.6 *15*	7 *4*	740.87	
		3010.3 *8*	15 *6*	227.83	(2^-)
3401.3		714.6‡ *2*	100‡	2686.96	(8,9)
3475.6		392.6 *4*	100 *50*	3083.07	1^+
		1695.2 *19*	55 *32*	1780.01	1^+
3518.2		117.2 *2*	1.0×10^2 *3*	3401.3	
		830.7 *3*	$6.\times10^1$ *3*	2686.96	(8,9)
3625.2	1^+	2948.8 *5*	59 *30*	676.10	
		3269.0 *4*	100 *18*	356.23	
3633.8		1133.4‡ *4*	100‡ *3*	2500.4	$(8^+,7)$
3703.98	1^+	465.28 *19*	100 *17*	3238.68	1^+
		621.3 *9*	$6.\times10^1$ *4*	3083.07	1^+
		2770.9 *4*	83 *17*	933.08	
3878.6	1^+	1751.0 *3*	100 *20*	2127.58	1^+
		3217.1 *21*	19 *15*	661.28	
3881.3	1^+	3205.1 *6*	31 *8*	676.10	
		3344.3 *3*	100 *14*	536.91	

† From ^{90}Kr β^- decay.

‡ From $^{235}U(n,F\gamma)$.

§ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

$^{90}_{37}Rb_{53}$-5

^{90}Kr β^- decay 1979Du04

Parent: ^{90}Kr: E=0; $J^\pi=0^+$; $T_{1/2}$=32.32 s *9*; Q(β^-)=4405 *7*; %β^- decay=100.0

1979Du04: Activity from ^{235}U(n,F) followed by mass separation. Measured Eγ, Iγ, ce, $\gamma\gamma$ coincidences. Magnetic spectrometer, Ge(Li).

1979Bo26: High precision measurements of Eγ, Iγ(t) following n-induced fission. Anti-Compton and curved crystal spectrometers.

1976Wo05: Activity from ^{235}U(n,F). Measured Iγ, Iβ using Ge(Li) detectors and plastic scintillators.

Others: 1962Wa34, 1970Ma11, 1974Gr29, 2017FI06.

All data are from 1979Du04, except as noted.

For a discussion of the differences between decay schemes of 1979Du04 and 1970Ma11, see 1979Du04.

^{90}Rb Levels

E(level)	J^π †	$T_{1/2}$ †	E(level)	J^π †	E(level)	J^π †
0	0^-	158 s *5*	740.87 *5*		2271.34 *9*	
106.90 *3*	3^-	258 s *4*	838.20 *4*		2433.59 *19*	
121.79 *3*	(1^-)		933.08 *6*		3083.07 *7*	1^+
227.83 *3*	(2^-)		1102.19 *6*		3093.74 *12*	1^+
242.19 *3*			1153.41 *7*		3238.68 *14*	1^+
356.23 *3*			1400.6 *4*		3475.6 *4*	
536.91 *6*			1462.97 *16*		3625.2 *4*	1^+
614.42 *4*			1688.17 *18*		3703.98 *20*	1^+
661.28 *3*			1780.01 *3*	1^+	3878.6 *3*	1^+
676.10 *5*			1901.63 *12*		3881.3 *3*	1^+
712.46 *8*			2127.58 *5*	1^+		

† From the Adopted Levels.

β^- radiations

E(decay)	E(level)	Iβ^- †‡	Log *ft*	E(decay)	E(level)	Iβ^- †‡	Log *ft*
(524 *7*)	3881.3	0.148 *22*	4.54 *7*	(2717 *7*)	1688.17	0.18 *4*	7.21 *10*
(526 *7*)	3878.6	0.069 *16*	4.88 *11*	(2942# *7*)	1462.97	<0.029	>8.2
(701 *7*)	3703.98	0.17 *4*	4.93 *11*	(3004 *7*)	1400.6	0.082 *19*	7.74 *10*
(780 *7*)	3625.2	0.105 *25*	5.31 *11*	(3472 *7*)	933.08	0.58 *6*	7.16 *5*
(929 *7*)	3475.6	0.036 *15*	6.05 *19*	(3567 *7*)	838.20	0.15 *6*	7.80 *18*
(1166 *7*)	3238.68	0.19 *3*	5.70 *7*	(3664 *7*)	740.87	0.34 *7*	7.50 *9*
(1311 *7*)	3093.74	0.69 *7*	5.34 *5*	(3693 *7*)	712.46	0.20 *3*	7.74 *7*
(1322 *7*)	3083.07	2.07 *19*	4.87 *4*	(3729 *7*)	676.10	0.10 *5*	8.06 *22*
(1971 *7*)	2433.59	0.30 *4*	6.41 *6*	(3791 *7*)	614.42	0.20 *7*	7.79 *16*
(2134 *7*)	2271.34	0.10 *3*	7.03 *13*	(4049# *7*)	356.23	<0.29	>7.8
(2277 *7*)	2127.58	2.29 *19*	5.78 *4*	(4177# *7*)	227.83	<0.2	>8.0
(2503 *7*)	1901.63	0.35 *4*	6.77 *5*	(4283 *7*)	121.79	<1.5	>7.1
(2625 *7*)	1780.01	65 *6*	4.59 *4*	(4405 *7*)	0	29 *4*	5.92 *6*

† Ground state feeding from 1976Wo05 from absolute β counting. Iβ for excited states obtained by intensity imbalance at each level, assuming no β^- feeding to the 106.9 level with ΔJ=3, $\Delta\pi$=no.

‡ Absolute intensity per 100 decays.

Existence of this branch is questionable.

^{90}Kr β^- decay 1979Du04 (continued)

$\gamma(^{90}Rb)$

Iγ normalization: from Σ(I(γ+ce)(to g.s) + I(γ+ce)(to 106.9-keV isomer)) = 100 − 29 % *4*, where Iβ(to g.s.)=29 % *4* was measured by 1976Wo05. Normalization factor of 0.047 *3* given by 1976Wo05 is incorrect. It was possibly deduced without including the sum of γ-ray transition intensities to the 106.9-keV isomer. Current normalization of 0.039 *3* deduced by evaluator agrees with normalization factor of 0.0389 *27* from 1975Ko16.

E_γ[†&]	I_γ[†@]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[#]	Comments
106.05[§] *3*	11.5 *7*	227.83	(2$^-$)	121.79	(1$^-$)	(M1+E2)	0.5 *2*	0.255 *85*	Mult.,δ: α(K)exp=0.22 *6* (1979Du04).
106.92[§] *15*	1.1 *3*	106.90	3$^-$	0	0$^-$	M3		10.76	I_γ: main depopulating intensity via ^{90}Rb β^- decay (258 s). α(K)exp/α(L)exp=6.2 *12* (1979Du04). Mult.: α(K)exp/α(L)exp yields E2, M2 or M3. From atomic beam measurements, J of ground state is 0 and J of 106.9-keV isomer is 3, resulting in M3 as only possible multipolarity.
120.92[§] *3*	90 *6*	227.83	(2$^-$)	106.90	3$^-$	(M1+E2)	0.5 *2*	0.165 *52*	Mult.,δ: α(K)exp=0.15 *4* (1979Du04).
121.82[§] *3*	910 *30*	121.79	(1$^-$)	0	0$^-$	(M1)		0.0844	Mult.: α(K)exp=0.14 *4* (1979Du04). E_γ: other: 121.837 *4* (1979Bo26).
180.66 *15*	1.0 *5*	536.91		356.23					
220.82 *14*	1.0 *5*	933.08		712.46					
227.76 *8*	3.2 *3*	227.83	(2$^-$)	0	0$^-$	[E2]		0.0478	
234.44 *3*	68 *3*	356.23		121.79	(1$^-$)				E_γ: other: 234.477 *42* (1979Bo26).
242.19 *3*	255 *8*	242.19		0	0$^-$				E_γ: other: 242.248 *20* (1979Bo26).
249.32 *3*	35 *3*	356.23		106.90	3$^-$				
305.10 *18*	1.4 *3*	661.28		356.23					
309.07 *9*	3.5 *3*	536.91		227.83	(2$^-$)				
356.00 *20*	2.7 *10*	356.23		0	0$^-$				
386.48 *9*	3.3 *3*	614.42		227.83	(2$^-$)				
392.6 *4*	0.6 *3*	3475.6		3083.07	1$^+$				
396.54 *21*	1.3 *3*	933.08		536.91					
419.12 *5*	8.2 *3*	661.28		242.19					
429.93 *14*	3.8 *8*	536.91		106.90	3$^-$				
433.47 *5*	33.5 *10*	661.28		227.83	(2$^-$)				
433.9 *3*	2.6 *8*	676.10		242.19					
465.28 *19*	1.8 *3*	3703.98	1$^+$	3238.68	1$^+$				
470.34 *8*	6.1 *4*	712.46		242.19					
[x]476.10 *11*	3.4 *3*								
492.63 *5*	31.0 *8*	614.42		121.79	(1$^-$)				
498.59 *12*	3.9 *3*	740.87		242.19					
508.0 *3*	1.6 *5*	614.42		106.90	3$^-$				
539.49 *4*	790 *18*	661.28		121.79	(1$^-$)				E_γ: other: 539.631 *20* (1979Bo26).
554.37 *5*	130 *3*	661.28		106.90	3$^-$				E_γ: other: 554.339 *18* (1979Bo26).
565.19 *8*	5.3 *4*	1102.19		536.91					
569.20 *5*	15.5 *5*	676.10		106.90	3$^-$				
577.1 *3*	1.4 *4*	933.08		356.23					
585.86 *20*	1.3 *2*	1688.17		1102.19					
614.38 *9*	5.4 *4*	614.42		0	0$^-$				
619.08 *5*	27.8 *8*	740.87		121.79	(1$^-$)				
621.3 *9*	1.0 *7*	3703.98	1$^+$	3083.07	1$^+$				
626.49 *8*	7.3 *5*	1780.01	1$^+$	1153.41					

Continued on next page (footnotes at end of table)

^{90}Kr β^- decay 1979Du04 (continued)

$\gamma(^{90}Rb)$ (continued)

E_γ †&	I_γ †@	E_i(level)	J^π_i	E_f	J^π_f
x658.1 *5*	0.8 *3*				
661.23 *5*	8.5 *3*	661.28		0	0^-
677.69 *7*	9.8 *5*	1780.01	1^+	1102.19	
690.72 *7*	10.2 *4*	933.08		242.19	
705.47 *12*	3.2 *3*	933.08		227.83	(2^-)
731.33 *4*	38.1 *10*	838.20		106.90	3^-
739.0 *10*	0.6 *2*	1400.6		661.28	
745.8 *4*	1.6 *5*	1102.19		356.23	
925.49 *9*	5.7 *4*	1153.41		227.83	(2^-)
941.86 *5*	34.3 *9*	1780.01	1^+	838.20	
947.6 *4*	1.5 *5*	1688.17		740.87	
967.33 *11*	5.5 *5*	3238.68	1^+	2271.34	
980.29 *11*	4.8 *4*	1102.19		121.79	(1^-)
1031.2 *3*	1.6 *4*	1153.41		121.79	(1^-)
1039.11 *8*	10.7 *5*	1780.01	1^+	740.87	
1103.92 *7*	8.8 *5*	1780.01	1^+	676.10	
1118.69 *5*	1000 *22*	1780.01	1^+	661.28	
1165.56 *6*	21.2 *8*	1780.01	1^+	614.42	
1240.34 *11*	9.0 *6*	1901.63		661.28	
1293.7 *4*	1.5 *4*	1400.6		106.90	3^-
1303.36 *24*	2.4 *4*	3083.07	1^+	1780.01	1^+
x1309.68 *10*	7.1 *4*				
1341.31 *22*	4.0 *5*	1462.97		121.79	(1^-)
1386.62 *15*	5.0 *5*	2127.58	1^+	740.87	
1423.77 *6*	75.3 *17*	1780.01	1^+	356.23	
1460.6 *5*	1.7 *5*	1688.17		227.83	(2^-)
1466.26 *15*	6.3 *5*	2127.58	1^+	661.28	
1530.50 *20*	1.0 *5*	2271.34		740.87	
1537.85 *5*	248 *5*	1780.01	1^+	242.19	
1552.18 *6*	56.3 *14*	1780.01	1^+	227.83	(2^-)
1620.22 *22*	3.9 *4*	3083.07	1^+	1462.97	
1658.18 *6*	34.0 *9*	1780.01	1^+	121.79	(1^-)
1692.6 *5*	2.0 *5*	2433.59		740.87	
1695.2 *19*	0.33 *19*	3475.6		1780.01	1^+
1751.0 *3*	1.5 *3*	3878.6	1^+	2127.58	1^+
1780.04 *6*	172 *4*	1780.01	1^+	0	0^-
1819.1 *3*	1.9 *3*	2433.59		614.42	
1885.42 *15*	5.8 *4*	2127.58	1^+	242.19	
1899.61 *16*	4.9 *4*	2127.58	1^+	227.83	(2^-)
1980.99 *15*	4.4 *3*	3083.07	1^+	1102.19	
2006.00 *14*	3.0 *5*	2127.58	1^+	121.79	(1^-)
2127.52 *7*	35.3 *12*	2127.58	1^+	0	0^-
2149.51 *10*	7.1 *3*	2271.34		121.79	(1^-)
2160.9 *6*	0.81 *24*	3093.74	1^+	933.08	
2191.46 *25*	2.9 *3*	2433.59		242.19	
2205.6 *6*	1.0 *3*	2433.59		227.83	(2^-)
2352.7 *4*	2.3 *4*	3093.74	1^+	740.87	
2417.33 *23*	4.9 *4*	3093.74	1^+	676.10	
2421.5 *8*	1.3 *4*	3083.07	1^+	661.28	
2432.78 *21*	3.9 *4*	3093.74	1^+	661.28	
2468.56 *11*	12.0 *10*	3083.07	1^+	614.42	
2479.4 *7*	1.0 *5*	3093.74	1^+	614.42	
2497.6 *15*	0.4 *2*	3238.68	1^+	740.87	
2726.68 *11*	22.4 *9*	3083.07	1^+	356.23	
2770.9 *4*	1.5 *3*	3703.98	1^+	933.08	
2855.4 *3*	8.3 *16*	3083.07	1^+	227.83	(2^-)
2865.73 *21*	4.8 *4*	3093.74	1^+	227.83	(2^-)
2948.8 *5*	1.0 *5*	3625.2	1^+	676.10	
3010.3 *8*	0.79 *25*	3238.68	1^+	227.83	(2^-)
3205.1 *6*	0.89 *22*	3881.3	1^+	676.10	
3217.1 *21*	0.28 *22*	3878.6	1^+	661.28	
x3256.2 *12*	0.53 *22*				
3269.0 *4*	1.7 *3*	3625.2	1^+	356.23	
3344.3 *3*	2.9 *4*	3881.3	1^+	536.91	
x3465.1 *9*	0.9 *3*				
x3855.3 *4*	3.1 *3*				
x4166.5 *10*	0.8 *3*				

† From 1979Du04.

‡ From the Adopted Levels. In cases were Adopted values originate from this dataset, supporting evidence is given in the comments.

§ The 106-keV and 121-keV doublets were resolved by γ and conversion electron measurements (1979Du04).

& From a least-squares fit to Eγ, by evaluators.

@ For absolute intensity per 100 decays, multiply by 0.039 *3*.

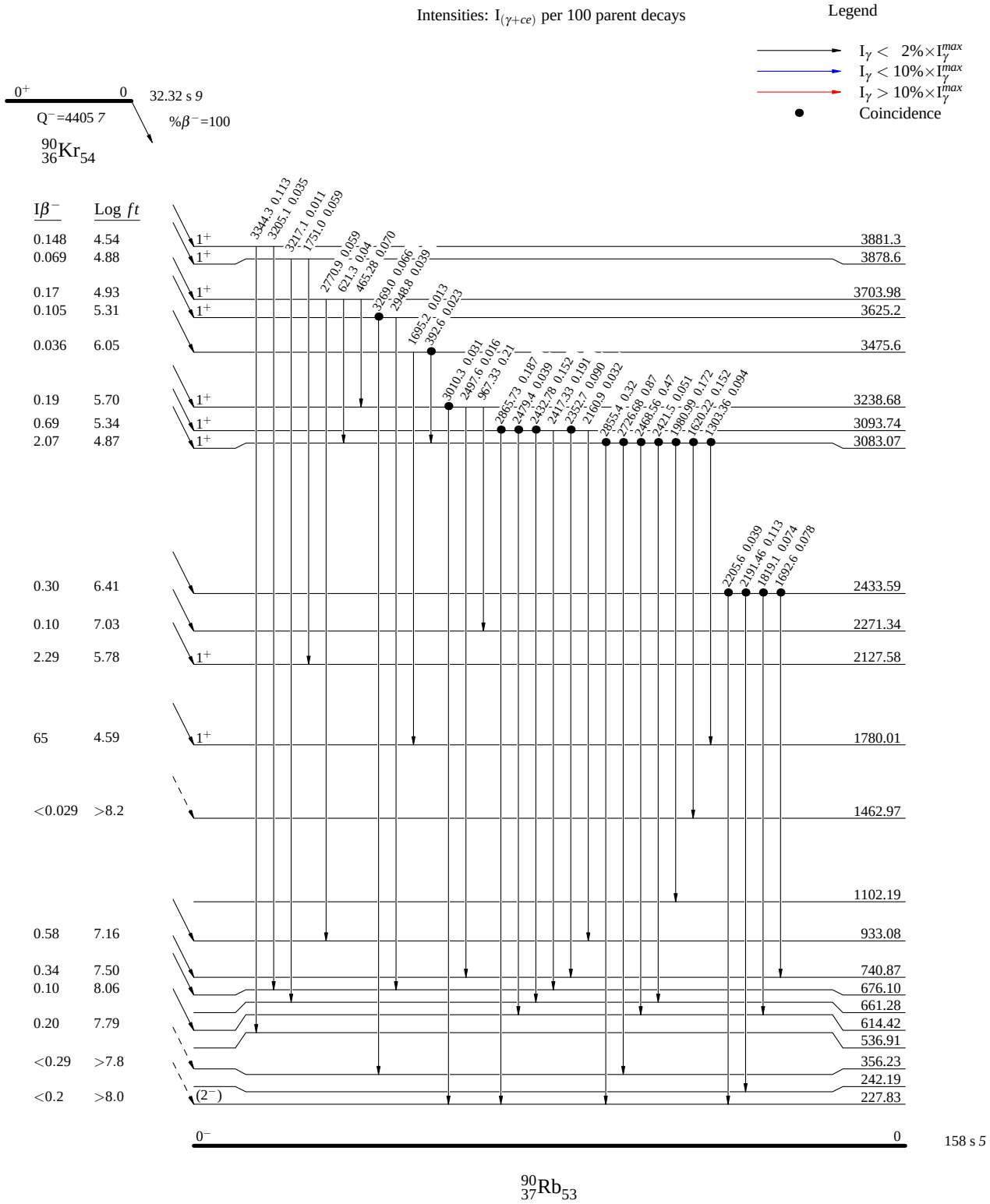
Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

x γ ray not placed in level scheme.

^{90}Kr β^- decay 1979Du04

Decay Scheme

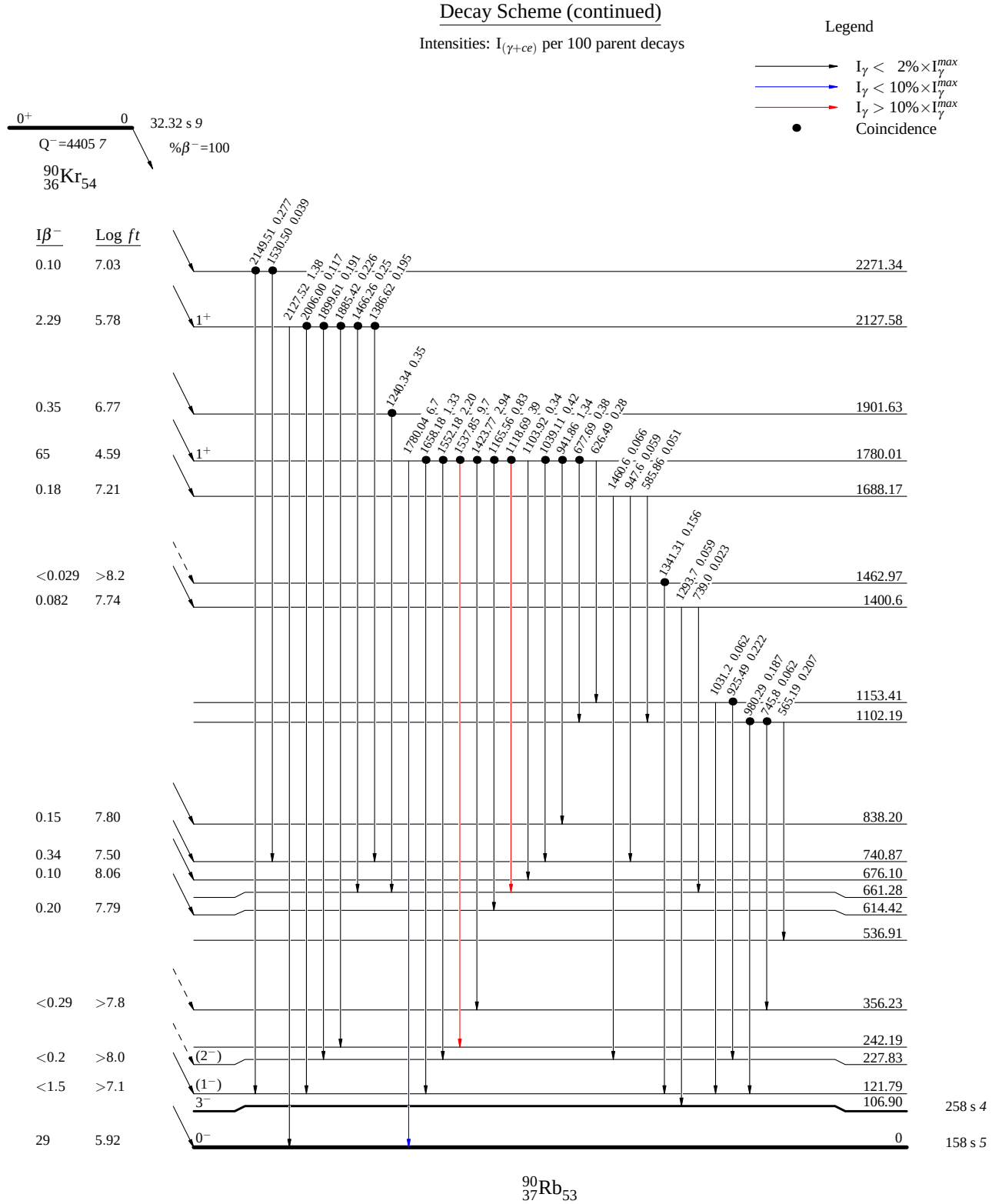
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Kr β^- decay 1979Du04

Decay Scheme (continued)

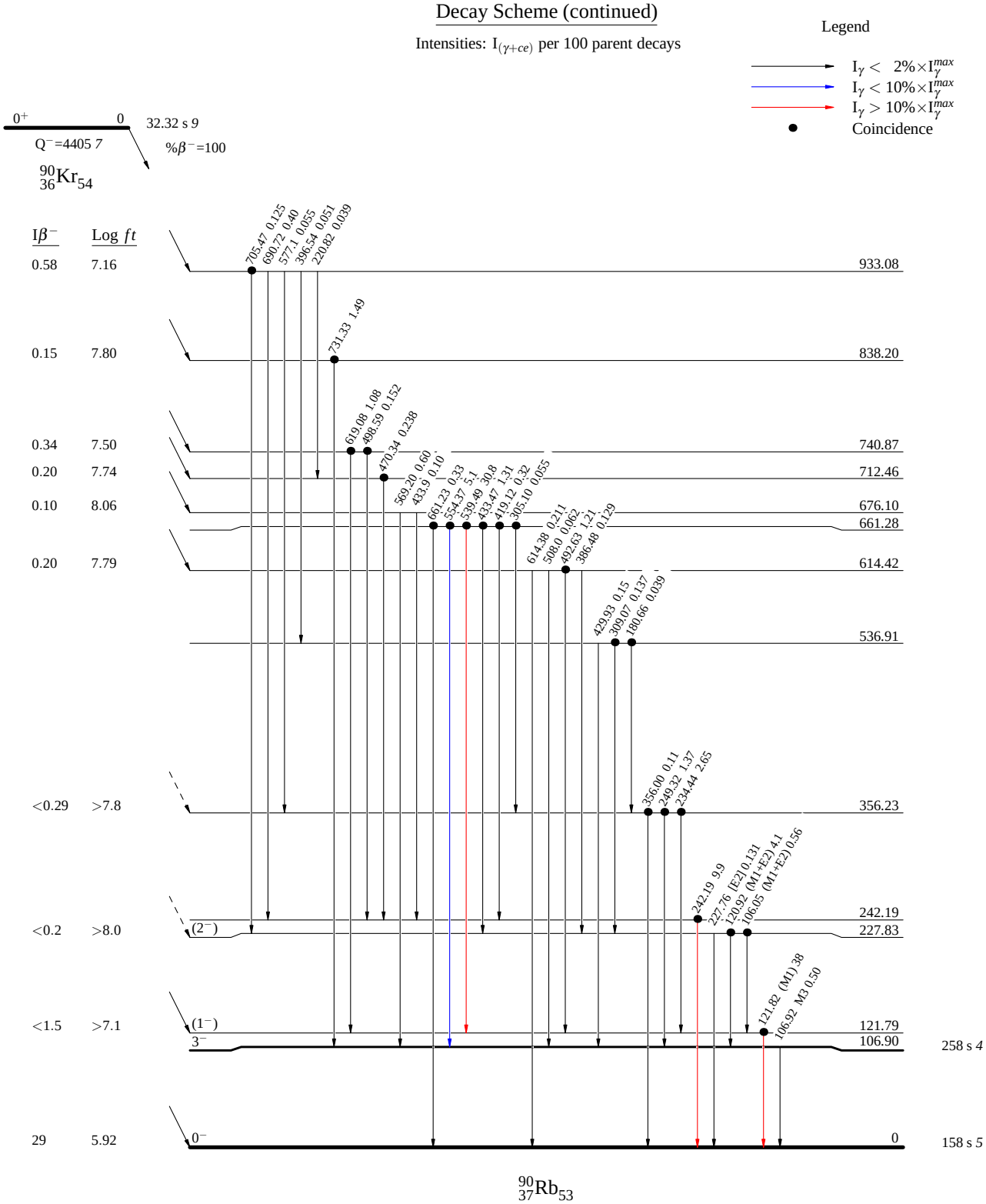
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Kr β^- decay 1979Du04

Decay Scheme (continued)

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Rb IT decay (258 s) 1981Ta05

Parent: ^{90}Rb: E=106.90 *3*; $J^{\pi}=3^-$; $T_{1/2}$=258 s *4*; %IT decay=2.5 *4*

1981Ta05: From ^{235}U(n,F). Mass separation of ^{90}Rb. NaI and Ge(Li). Measured Eγ, Iγ, $\gamma\gamma$ coin, $\gamma\gamma(\theta)$. The 158-s and 258-s ^{90}Rb activities were distinguished by varying collection and observation times.

See also ^{90}Rb β^- decay (258 s).

^{90}Rb Levels

E(level)†	J^{π}†	$T_{1/2}$†	Comments
0	0^-	158 s *5*	
106.90 *3*	3^-	258 s *4*	%IT=2.5 *4*; %β^-=97.5 *4* %IT,%β^-: from the Adopted Levels.

† From the Adopted Levels.

γ(^{90}Rb)

Iγ normalization: from ΣI(γ + ce)(to g.s.)= 2.5 % *4*.

E_{γ}	I_{γ}†§	E_i(level)	J^{π}_i	E_f	J^{π}_f	Mult.‡	α&
106.92 *15*	2.3 *3*	106.90	3^-	0	0^-	M3	10.76

† Relative to 1000 for 831 keV γ from ^{90}Rb β^- decay (258 s).

‡ From the Adopted Levels.

§ For absolute intensity per 100 decays, multiply by 0.093 *18*.

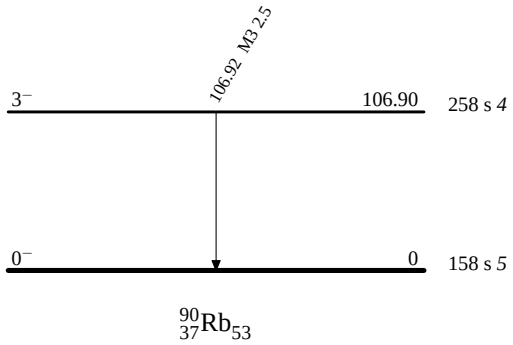
& Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

^{90}Rb IT decay (258 s) 1981Ta05

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays

%IT=2.5 *4*



^{235}U(n,Fγ) 2016Cz01

2016Cz01: E(n)=cold neutrons from PF1B facility of the Institut Laue-Langevin (ILL), Grenoble. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma\gamma(\theta)$, $\gamma\gamma$(t), and $\gamma\gamma\gamma$-coincidences between transitions in ^{90}Rb and those in complementary fission fragments ^{143}Cs and ^{144}Cs within a 200 ns time window using EXOGAM array.

^{90}Rb Levels

E(level)[†]	J$^{\pi}$[#]	T$_{1/2}$[@]	Comments
0.0	0$^-$		Configuration=$\pi p^{-1}_{3/2}\otimes\nu(d^3_{5/2})_{3/2}$ (2016Cz01).
106.92 *15*	3$^-$		E(level): from the Adopted Levels, held fixed in least-squares adjustment. Configuration=$\pi p^{-1}_{3/2}\otimes\nu(d^3_{5/2})$ or $\pi f^{-1}_{5/2}\otimes\nu(d^3_{5/2})$.
162.72 *18*	4$^-$	<7 ns	Configuration=$\pi p^{-1}_{3/2}\otimes\nu(d^3_{5/2})$ or less likely $\pi f^{-1}_{5/2}\otimes\nu(d^3_{5/2})$.
1127.90[‡] *20*	(5$^+$)	<7 ns	J$^{\pi}$: $\gamma\gamma(\theta)$ for 965-56 cascade gives 5 or 6; 365.1 (M1+E2) γ from 1493, 6$^{(+)}$ favors (5$^+$).
1204.75 *20*	5	<7 ns	J$^{\pi}$: J=4 and 6 are not consistent with $\gamma\gamma(\theta)$ result for the 1042-55.8 cascade, with δ(55.8)=0.302 (2016Cz01). Proposed configuration=$\pi f^{-1}_{5/2}\otimes\nu(d^3_{5/2})$ would give Jπ=5$^-$.
1492.98[‡] *21*	6$^{(+)}$	<7 ns	J$^{\pi}$: $\gamma\gamma(\theta)$ data for 365-965 cascade are consistent with 6 ->5 ->4 or 6 -> 6 ->4 sequences and large δ(Q/D) value for the 365γ in both spin sequences. This implies mult=M1+E2, and thus the same parity for 1493 and 1128 levels. The $\gamma\gamma(\theta)$ data for the 288-1042 cascade is consistent with J=5 or 6 for 1493 level. Absence of transition to 163, 4$^-$ level suggests positive parity for J=6 for the 1493 level.
1703.67[‡] *23*	(7)	<7 ns	J$^{\pi}$: $\gamma\gamma(\theta)$ consistent with J=6 or 7, but absence of transitions to 1128, (5$^+$) and 1204, 5 makes J=6 less likely.
2500.4 *4*	(7,8$^+$)		J$^{\pi}$: (8$^+$) is more likely if this is an yrast level.
2686.96 *25*	(8,9$^+$)		
3401.3 *3*			
3518.2 *4*			
3633.8 *6*			

[†] From least-squares fit to Eγ, by evaluators, except where noted.
[‡] Proposed member of $\pi g_{9/2}\otimes\nu d^3_{5/2}$ multiplet.
[#] As proposed by 2016Cz01, based on angular correlation measurements, yrast pattern of population of levels, decay characteristics, and comparison with shell-model predictions.
[@] From $\gamma\gamma$(t) (2016Cz01).

γ(^{90}Rb)

E$_{\gamma}$	I$_{\gamma}$	E$_i$(level)	J$^{\pi}_i$	E$_f$	J$^{\pi}_f$	Mult.[†]	δ[†]	α[‡]	Comments
55.8 *1*	90 *9*	162.72	4$^-$	106.92	3$^-$	M1+E2	0.298 *25*	1.35 *10*	α(exp)=1.35 *10* (2016Cz01) α(exp): deduced by 2016Cz01 from intensity balance. Mult.,δ: from α(exp).
106.92 *15*		106.92	3$^-$	0.0	0$^-$				E$_{\gamma}$: from the Adopted Gammas.
117.2 *2*	7 *2*	3518.2		3401.3					
186.5 *3*	5 *2*	2686.96	(8,9$^+$)	2500.4	(7,8$^+$)				
210.7 *1*	44 *8*	1703.67	(7)	1492.98	6$^{(+)}$				(211γ)(288γ)(θ): A$_2$=+0.029 *31*, A$_4$=+0.064 *68*. δ(Q/D)=+0.01 *+12−11* or +16 *+∞−11* for J(1703.67 level)=7. δ(Q/D)=+1.0 *+11−4* or −4.4 *+23−∞* for J(1703.67 level)=6. (211γ)(365γ)(θ): A$_2$=−0.036 *30*, A$_4$=−0.018 *64*.

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^{235}U(n,Fγ) 2016Cz01 (continued)

γ(^{90}Rb) (continued)

E_γ	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.†	δ†	Comments
								δ(Q/D)=+0.07 *5* or +8.8 *+54−25* for J(1703.67 level)=7 and J(1127.9 level)=5. δ(Q/D)=+0.06 *42* or +8.8 *+48−24* for J(1703.67 level)=7 and J(1127.9 level)=6. δ(Q/D)=+0.81 *+15−12* or −2.9 *+6−11* for J(1703.67 level)=6 and J(1127.9 level)=5.
288.2 *1*	58 *9*	1492.98	$6^{(+)}$	1204.75	5	D,D+Q		(288γ)(1042γ)(θ): A_2=+0.038 *26*, A_4=+0.007 *56*. δ(Q/D)=+0.05 *4* or +8.5 *+48−22* for J(1492.98 level)=6. δ(Q/D)=+0.76 *+13−11* or −3.5 *+8−14* for J(1492.98 level)=5.
365.1 *1*	39 *9*	1492.98	$6^{(+)}$	1127.90	(5^+)	(M1+E2)		Mult.: all $\gamma\gamma(\theta)$ solutions lead to significant quadrupole admixture suggestive of mult=(M1+E2) rather than (E1+M2). (365γ)(965γ)(θ): A_2=−0.059 *48*, A_4=+0.01 *10*. δ(Q/D)=+0.47 *+42−31* or +1.8 *+26−17* for J(1127.9 level)=5. δ(Q/D)=+0.45 *+18−16* or −1.46 *+56−39* for J(1127.9 level)=6.
714.6 *2*	7 *2*	3401.3		2686.96	$(8,9^+)$			
830.7 *3*	4 *2*	3518.2		2686.96	$(8,9^+)$			
[x]880.3 *1*	4 *2*							
965.2 *1*	44 *8*	1127.90	(5^+)	162.72	4^-			(965γ)(56γ)(θ): A_2=+0.044 *89*, A_4=+0.11 *21*. δ(Q/D)=+0.24 *+21−28* or +3 *+16−3* for J(1127.9 level)=5. δ(O/Q)=0 for J(1127.9 level)=6.
983.3 *1*	15 *3*	2686.96	$(8,9^+)$	1703.67	(7)			
1007.1 *5*	10 *3*	2500.4	$(7,8^+)$	1492.98	$6^{(+)}$			
1042.0 *1*	100 *4*	1204.75	5	162.72	4^-	D(+Q)	−0.08 *+26−29*	(1042γ)(56γ)(θ): A_2=−0.046 *86*, A_4=+0.07 *18*.
1133.4 *4*	8 *3*	3633.8		2500.4	$(7,8^+)$			

† From $\gamma\gamma(\theta)$ in 2016Cz01, except where noted.

‡ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

[x] γ ray not placed in level scheme.

Adopted Levels, Gammas

Q(β^-)=545.9 *14*; S(n)=7810.4 *21*; S(p)=11525 *6*; Q(α)=−5107.4 *21* 2017Wa10
S(2n)=14169.1 *21*; S(2p)=20835 *6* (2017Wa10).

^{90}Sr Levels

For charge radii of strontium nuclei by LASER spectroscopy, see 1987An02 and 1992Ne09.

Cross Reference (XREF) Flags

A	^{90}Rb β^- decay (158 s)
B	^{90}Rb β^- decay (258 s)
C	^{88}Sr(t,p)
D	^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$)

E(level)[†]	J$^\pi$	T$_{1/2}$	XREF	Comments
0.0[#]	0$^+$	28.91 y *3*	ABCD	%β^-=100 T$_{1/2}$: from 10558 y *11* obtained from weighted average of 10527 d *51* (1965An07, decay measured over 11.2 y), 10557 d *11* (2004Sc04, decay measured over 17 y), and 10561 d *14* (1994Ma50, decay measured over 33 y). Conversion from days to years calculated using tropic year (1 year =365.24 d). Others: 10702 d *584* (1958An40, specific activity), 10227 d *146* (1965Fl01, decay), 10410 d *329* (1965Fl01, specific activity), 10513 d *14* (1992ScZZ, decay measured over 4 y), 10495 d *4* (1996Wo06, decay measured over 6 y), 7270 d *110* (1950Po67, decay), 10117 d *146*, (1955Wi15, specific activity), 10282 d *13* (1978La21, decay), 10589 d *92* (1983Ra09, decay), 10665 d *37* (1989Ko57, decay). Δ<r^2>(^{89}Sr,^{90}Sr)=0.153 fm^2 *4*, LASER spectroscopy (1992Ne09).
831.68[#] *4*	2$^+$	7[‡] ps *2*	ABCD	μ=−0.24 *22* (2014Ku10) μ: from transient-field (TF) technique in inverse kinematics (2014Ku10). J$^\pi$: E2 832γ to 0$^+$.
1655.92[#] *7*	4$^+$	12[‡] ps *2*	ABCD	μ=−0.08 *68* (2014Ku10) μ: from transient-field (TF) technique in inverse kinematics (2014Ku10). J$^\pi$: E2 824γ to 2$^+$.
1892.36 *4*	2$^+$	2[‡] ps *1*	ABC	J$^\pi$: M1+E2 1060.7γ to 2$^+$, 1892.3γ to 0$^+$.
2207.02 *4*	(3$^-$)	≤1[‡] ps	ABCD	J$^\pi$: L(t,p)=3,(4); D(+Q) 1375.4γ to 2$^+$. $\gamma\gamma(\theta)$ in ^{90}Kr β^- decay yields J=2 or 3, with J=2 providing the better fit. Combined with data from (t,p) experiment, J=3 is tentatively adopted here.
2497.32 *6*	(2$^+$)	≤3[‡] ps	ABC	J$^\pi$: $\gamma\gamma(\theta)$ in ^{90}Kr β^- decay yields J=2 or 3; 2497.3γ to 0$^+$ makes J=3 less likely.
2527.92 *7*	3$^-$,4$^+$	≤6[‡] ps	BC	J$^\pi$: L(t,p)=3,4.
2570.60 *8*		10[‡] ps *7*	AB	
2586 *10*	2$^+$		C	J$^\pi$: L(t,p)=2.
2674.0 *5*	(0$^+$)		A C	J$^\pi$: L(t,p)=(0).
2927.70 *7*	4		AB D	J$^\pi$: D 720.7γ to (3$^-$), 1271.8γ to 4$^+$.
2971.12 *12*	0$^+$		ABC	J$^\pi$: L(t,p)=0.
3032.87 *7*		≤1[‡] ps	AB	
3039.26 *7*	1		ABC	J$^\pi$: from $\gamma\gamma(\theta)$ in ^{90}Kr β^- decay.
3144.45 *10*	(5$^-$)		ABCD	J$^\pi$: L(t,p)=(5).
3268.69 *24*	3$^-$,4$^+$		CD	J$^\pi$: L(t,p)=3,4.
3383.39 *7*			AB	
3394 *10*			C	E(level): probable doublet.
3449.83 *5*	3	≤4[‡] ps	B	J$^\pi$: from $\gamma\gamma(\theta)$ in ^{90}Kr β^- decay.
3468.43 *22*	(5$^-$)		D	J$^\pi$: D 1812.5γ to 4$^+$, 55.6γ from (7$^-$).
3479 *10*	3$^-$,4$^+$		C	J$^\pi$: L(t,p)=3,4.
3494.84 *11*	6$^{(+)}$		D	J$^\pi$: Q 1838.9γ to 4$^+$.
3508 *10*	(5$^-$)		C	J$^\pi$: L(t,p)=(5).

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Adopted Levels, Gammas (continued)

^{90}Sr Levels (continued)

E(level)[†]	J^π	XREF	Comments
3555.79 *13*		AB	
3584.43 *8*		B	
3594 *10*	$3^-,4^+$	C	J^π: L(t,p)=3,4. E(level): possibily the same as the 3584.4 level observed in ^{90}Kr β^- decay.
3627.01 *23*		AB	
3698.55 *12*	(7^-)	D	J^π: Q 554.1γ to (5^-).
3720 *10*	≥6	C	J^π: L(t,p)>5.
3742.16 *13*	6	D	J^π: Q 814.5γ to 4.
3764.36 *18*	(6^+)	D	J^π: Q 1291.2γ from (8^+), D 619.9γ to (5^-).
3784 *10*	(5^-)	C	J^π: L(t,p)=(5).
3804 *10*	2^+	C	J^π: L(t,p)=2.
3845 *10*		C	
3915 *10*		C	
3954.32 *18*		AB	
4019.4 *4*		A	
4036.88 *13*		B	
4037.12 *9*		A	
4043 *10*	$3^-,4^+$	C	J^π: L(t,p)=3,4.
4066.32[@] *16*	(7^-)	D	J^π: D 342.2γ to (6), Q 955.3γ from (9^-).
4073 *10*	$3^-,4^+$	C	J^π: L(t,p)=3,4.
4135.63 *10*	$(1,2^+)$	ABC	J^π: 4135.5γ to 0^+.
4137.6 *9*		A	
4148.85 *7*		AB	
4240 *10*	2^+	C	J^π: L(t,p)=2.
4288 *10*	$3^-,4^+$	C	J^π: L(t,p)=3,4.
4335.37 *7*		BC	
4366.06 *11*		AB	
4404.62 *18*		B	
4430.91 *24*		B	
4493 *10*		C	
4522 *10*		C	
4580.8 *3*		A C	
4646.35 *14*		A C	
4660 *10*		C	
4685.6 *3*		B	
4742 *10*	$3^-,4^+$	C	J^π: L(t,p)=3,4.
4748.93 *19*	8	D	J^π: Q 1006.7γ to 6, D 1050.3γ to (7^-).
4774 *10*	$3^-,4^+$	C	J^π: L(t,p)=3,4.
4790.3? *5*	$(1,2^+)$	A	J^π: 4790.2γ to 0^+.
4804.0 *5*		B	
4805.12 *22*		B	
4808.52 *23*		B	
4824 *10*	2^+	C	J^π: L(t,p)=2.
4854.2? *5*		B	
4881.7 *3*	8	D	J^π: D 1183.1γ to (7^-).
4919.07? *20*		A	
4947.5 *4*	(2^+)	BC	J^π: L(t,p)=(2).
4973.99 *17*		A C	
5021.62[@] *16*	(9^-)	D	J^π: Q 1323.1γ to (7^-), D 140.0γ to 8.
5024.54 *23*		B	
5026.8? *4*		BC	
5041.01 *13*		AB	
5041.44 *12*		B	
5055.56 *14*	(8^+)	CD	J^π: Q 1560.7γ to $6^{(+)}$, D 1357.0γ to (7^-).

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Adopted Levels, Gammas (continued)

^{90}Sr Levels (continued)

E(level)[†]	J^π	XREF	Comments
5089.46 *16*		B	
5095 *10*	$3^-,4^+$	C	J^π: L(t,p)=3,4.
5142 *10*		C	
5187.51 *6*	$(1^-,2^+)$	A C	J^π: 5187.4γ to 0^+, 2980.7γ to (3^-).
5239.2 *5*		B	
5254.32 *12*		A	
5285.89 *19*		BC	
5298.48 *21*	(9^-)	D	J^π: (E2) 1599.9γ to (7^-), D 549.6γ to 8.
5333.15? *23*		A	
5343 *10*		C	
5426.65 *13*		ABC	
5431.2 *3*		B	
5557.9 *3*		B	
5591.8 *3*	10	D	J^π: D 570.2γ to (9^-).
5600.3? *4*		A C	
5623.3 *3*		A	
5785.1? *7*		B	
5822.0 *5*		B	
5827.9 *3*		B	
5923.56 *16*	(10^+)	D	J^π: Q 868.0γ to (8^+).
5961.1[@] *3*	(11^-)	D	J^π: Q 939.5γ to (9^-).
6712.3 *3*	12	D	J^π: Q 1120.5γ to 10, D 751.2γ to (11^-).
6794.56 *19*	(12^+)	D	J^π: Q 871.0γ to (10^+).
7371.2 *5*	13	D	J^π: D 658.9γ to 12.
7705.77 *21*		D	
7959.7 *3*		D	
8772.4 *3*		D	
9060.7 *5*		D	
9199.7 *4*		D	
9957.5 *5*		D	

[†] From least-squares fit to Eγ, by evaluators for levels connected by γ-ray transitions. Levels with uncertainty of 10 keV are from (t,p).

[‡] From $\beta\gamma$(t) with scintillators in ^{90}Kr β^- decay.

[#] Band(A): γ sequence based on g.s.

[@] Seq.(B): γ sequence based on (7^-).

$\gamma(^{90}Sr)$

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.	δ	α[&]	Comments
831.68	2^+	831.69 *5*	100	0.0	0^+	E2		9.02×10^{-4}	B(E2)(W.u.)=8.5 *+33−19* Mult.: Q from $\gamma(\theta)$ in ^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$); M2 excluded by comparison to RUL.
1655.92	4^+	824.23 *10*	100	831.68	2^+	E2		9.22×10^{-4}	B(E2)(W.u.)=5.2 *+11−7* Mult.: Q from $\gamma(\theta)$ in ^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$) and $\gamma\gamma(\theta)$ in ^{90}Kr β^- decay; M2 excluded by comparison to RUL.
1892.36	2^+	1060.70 *4*	100 *3*	831.68	2^+	M1+E2	+0.50 *3*	4.97×10^{-4}	B(E2)(W.u.)=1.7 *+15−6*; B(M1)(W.u.)=0.0070 *+57−24* Mult.,δ: D+Q from $\gamma\gamma(\theta)$ in ^{90}Rb β^- decay, E1+M2 excluded by comparison to RUL.
		1892.28 *8*	6.0 *3*	0.0	0^+	[E2]		4.11×10^{-4}	B(E2)(W.u.)=0.028 *+24−10*
2207.02	(3^-)	314.5 *3*	4.97 *23*	1892.36	2^+	[E1]		0.00374	B(E1)(W.u.)>4.5×10^{-4}
		551.20 *25*	5.1 *4*	1655.92	4^+	[E1]		8.91×10^{-4}	B(E1)(W.u.)>8.3×10^{-5}
		1375.36 *3*	100 *4*	831.68	2^+	(E1(+M2))	−0.02 *6*	2.98×10^{-4}	B(E1)(W.u.)>0.00012 Mult.,δ: D(+Q) from $\gamma\gamma(\theta)$ in ^{90}Rb β^- decay; $\Delta\pi$=yes from adopted level scheme.
2497.32	(2^+)	1665.61 *7*	100 *3*	831.68	2^+				
		2497.27 *15*	15.9 *16*	0.0	0^+				
2527.92	$3^-,4^+$	872.00 *15*	32.0 *23*	1655.92	4^+				
		1696.16 *7*	100 *4*	831.68	2^+				
2570.60		1738.93 *8*	100	831.68	2^+				
2674.0	(0^+)	1842.3[@] *5*	100	831.68	2^+				
2927.70	4	720.70 *9*	35 *3*	2207.02	(3^-)	D[§]			
		1271.77 *7*	100 *7*	1655.92	4^+	D[§]			
2971.12	0^+	2139.33 *18*	100	831.68	2^+	E2		4.99×10^{-4}	Mult.: Q from $\gamma\gamma(\theta)$ in ^{90}Kr β^- decay; $\Delta\pi$=no from level scheme.
3032.87		1140.50 *6*	100	1892.36	2^+				
3039.26	1	1146.96 *25*	5.7 *7*	1892.36	2^+				
		2207.47 *11*	61 *3*	831.68	2^+	D			Mult.: from $\gamma\gamma(\theta)$ in ^{90}Kr β^- decay.
		3039.17 *12*	100 *4*	0.0	0^+				
3144.45	(5^-)	216.8[‡] *5*	0.70[‡] *18*	2927.70	4				
		937.3[‡] *5*	≈1.8[‡]	2207.02	(3^-)	(E2)		6.74×10^{-4}	Mult.: Q from $\gamma(\theta)$ in ^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$), $\Delta\pi$=no from level scheme.
		1488.5[‡] *1*	100.0[‡] *14*	1655.92	4^+	(E1)		3.59×10^{-4}	Mult.: D from $\gamma(\theta)$ in ^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$), $\Delta\pi$=yes from level scheme.
3268.69	$3^-,4^+$	1612.8[‡] *3*	100[‡]	1655.92	4^+				
3383.39		886.3 *3*	0.95 *18*	2497.32	(2^+)				
		1176.9 *9*	0.60 *24*	2207.02	(3^-)				
		3383.24 *12*	100 *3*	0.0	0^+				
3449.83	3	522.10 *13*	13.0 *10*	2927.70	4				

$^{90}_{38}Sr_{52}$-4

$\gamma(^{90}Sr)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.	α[&]	Comments
3449.83	3	921.20 *24*	9.9 *22*	2527.92	$3^-,4^+$			
		952.44 *7*	55.6 *19*	2497.32	(2^+)			
		1242.84 *4*	100 *6*	2207.02	(3^-)	D		Mult.: from $\gamma\gamma(\theta)$ in ^{90}Kr β^- decay.
		1793.89 *11*	27.6 *16*	1655.92	4^+	D		Mult.: from $\gamma\gamma(\theta)$ in ^{90}Kr β^- decay.
		2617.8 *3*	20 *3*	831.68	2^+			
3468.43	(5^-)	324.0[‡] *5*	[‡]	3144.45	(5^-)			
		1812.5[‡] *3*	100[‡]	1655.92	4^+	D[§]		
3494.84	$6^{(+)}$	1838.9[‡] *1*	100[‡]	1655.92	4^+	(E2)	3.94×10^{-4}	Mult.: Q from $\gamma\gamma(\theta)$ in ^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$), assumed E2.
3555.79		985.4 *5*	18 *6*	2570.60				
		2724.26 *21*	100 *13*	831.68	2^+			
3584.43		1013.95 *19*	2.21 *25*	2570.60				
		1086.7 *8*	0.61 *12*	2497.32	(2^+)			
		1377.2 *5*	20 *7*	2207.02	(3^-)			
		1692.07 *25*	2.4 *4*	1892.36	2^+			
		2752.68 *8*	100 *4*	831.68	2^+			
3627.01		3627.4 *7*	100	0.0	0^+			
3698.55	(7^-)	203.7[‡] *5*	≈3.0[‡]	3494.84	$6^{(+)}$			
		554.1[‡] *1*	100.0[‡] *18*	3144.45	(5^-)	(E2)	0.00271	Mult.: Q from $\gamma\gamma(\theta)$ in ^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$); assumed E2.
		2042.6[‡] *3*	19.3[‡] *3*	1655.92	4^+	(E3)	4.07×10^{-4}	Mult.: O from $\gamma\gamma(\theta)$ in ^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$); assumed E3.
3742.16	6	597.7[‡] *1*	100.0[‡] *24*	3144.45	(5^-)	D[§]		
		814.5[‡] *3*	16.6[‡] *12*	2927.70	4	Q[§]		
3764.36	(6^+)	495.7[‡] *3*	36[‡] *6*	3268.69	$3^-,4^+$	Q[§]		
		619.9[‡] *3*	82[‡] *12*	3144.45	(5^-)	D[§]		
		2108.4[‡] *3*	100[‡] *3*	1655.92	4^+			
3954.32		1027.1 *4*	36 *5*	2927.70	4			
		1456.7 *3*	68 *7*	2497.32	(2^+)			
		1747.3 *3*	68 *8*	2207.02	(3^-)			
		2298.1 *9*	1.0×10^2 *5*	1655.92	4^+			
4019.4		1522.1 *4*	100 *23*	2497.32	(2^+)			
		4019.3 *13*	$9.\times10^1$ *5*	0.0	0^+			
4036.88		1109.2 *8*	12 *7*	2927.70	4			
		1829.82 *20*	31 *5*	2207.02	(3^-)			
		2381.5 *5*	15 *6*	1655.92	4^+			
		3205.09 *16*	100 *8*	831.68	2^+			
4037.12		892.5 *7*	6 *3*	3144.45	(5^-)			
		997.85 *6*	100 *4*	3039.26	1			
4066.32	(7^-)	324.2[‡] *3*	100.0[‡] *10*	3742.16	6	D[§]		
		367.8[‡] *3*	83.8[‡] *20*	3698.55	(7^-)	D[§]		
		571.5[‡] *3*	14[‡] *4*	3494.84	$6^{(+)}$			

$\gamma(^{90}Sr)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.	α[&]
4066.32	(7⁻)	597.9[‡] *3*	55.6[‡] *20*	3468.43	(5⁻)		
4135.63	(1,2⁺)	752.1 *3*	1.05 *13*	3383.39			
		3303.91 *13*	13.2 *6*	831.68	2⁺		
		4135.51 *17*	100 *4*	0.0	0⁺		
4137.6		2245.2 *9*	100	1892.36	2⁺		
4148.85		765.1 *7*	0.60 *20*	3383.39			
		1003.9 *9*	0.39 *20*	3144.45	(5⁻)		
		1941.81 *17*	4.4 *4*	2207.02	(3⁻)		
		2256.55 *17*	4.6 *3*	1892.36	2⁺		
		3317.00 *12*	100 *3*	831.68	2⁺		
4335.37		779.9 *4*	5.3 *11*	3555.79			
		1764.5 *9*	1.8 *9*	2570.60			
		1838.15 *14*	15.8 *11*	2497.32	(2⁺)		
		2128.30 *7*	100 *3*	2207.02	(3⁻)		
		2442.9 *5*	5.1 *13*	1892.36	2⁺		
		3503.52 *15*	45.5 *20*	831.68	2⁺		
4366.06		739.2 *4*	0.63 *11*	3627.01			
		1326.46 *21*	1.65 *20*	3039.26	1		
		1438.3 *8*	0.40 *15*	2927.70	4		
		2473.94 *20*	7.7 *8*	1892.36	2⁺		
		4365.90 *18*	100 *4*	0.0	0⁺		
4404.62		1021.9 *7*	4.9 *19*	3383.39			
		3572.82 *18*	100 *7*	831.68	2⁺		
4430.91		1391.6 *3*	100 *18*	3039.26	1		
		1460.1 *6*	43 *11*	2971.12	0⁺		
		1903.1 *6*	30 *13*	2527.92	3⁻,4⁺		
		2537.8 *9*	39 *16*	1892.36	2⁺		
4580.8		543.6 *10*	52 *23*	4037.12			
		1547.8 *5*	52 *13*	3032.87			
		2688.9 *5*	100 *20*	1892.36	2⁺		
		2924.3 *7*	58 *20*	1655.92	4⁺		
4646.35		3814.36 *20*	26.1 *18*	831.68	2⁺		
		4646.45 *20*	100 *4*	0.0	0⁺		
4685.6		1302.2 *3*	100 *25*	3383.39			
		4685.0 *14*	20 *15*	0.0	0⁺		
4748.93	8	1006.7[‡] *3*	100.0[‡] *17*	3742.16	6	Q[§]	
		1050.3[‡] *3*	86[‡] *5*	3698.55	(7⁻)	D[§]	5.05×10^{-4}
4790.3?	(1,2⁺)	3958.4[@] *8*	1.0×10^{2} *3*	831.68	2⁺		
		4790.2[@] *7*	80 *20*	0.0	0⁺		
4804.0		2911.7 *11*	34 *19*	1892.36	2⁺		
		3972.2 *5*	100 *19*	831.68	2⁺		

$^{90}_{38}Sr_{52}$-6

$\gamma(^{90}Sr)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.	α[&]	Comments
4805.12		1877.40 *21*	100	2927.70	4			
4808.52		442.3 *4*	39 *10*	4366.06				
		1425.2 *3*	94 *10*	3383.39				
		2311.2 *6*	1.0×10^2 *4*	2497.32	(2^+)			
4854.2?		1298.5[@] *5*	100 *19*	3555.79				
		3197.9[@] *10*	$7.\times10^1$ *3*	1655.92	4^+			
4881.7	8	1183.1[‡] *3*	100[‡]	3698.55	(7^-)	D[§]		
4919.07?		4087.26[@] *23*	100 *7*	831.68	2^+			
		4919.0[@] *4*	30 *4*	0.0	0^+			
4947.5	(2^+)	2741.0[@] *12*	41 *22*	2207.02	(3^-)			
		4115.6[@] *4*	100 *17*	831.68	2^+			
4973.99		1590.3 *3*	67 *8*	3383.39				
		2476.7 *11*	$5.\times10^1$ *4*	2497.32	(2^+)			
		3081.3 *4*	75 *14*	1892.36	2^+			
		4974.14 *25*	100 *8*	0.0	0^+			
5021.62	(9^-)	140.0[‡] *5*	4.8[‡] *7*	4881.7	8	D[§]		
		272.5[‡] *3*	23.8[‡] *7*	4748.93	8	D[§]		
		955.3[‡] *1*	100.0[‡] *14*	4066.32	(7^-)	(E2)		Mult.: Q from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,p2n\gamma),^{12}C(^{86}Kr,2\alpha\gamma)$; assumed E2.
		1323.1[‡] *3*	31.3[‡] *7*	3698.55	(7^-)	(E2)		Mult.: Q from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,p2n\gamma),^{12}C(^{86}Kr,2\alpha\gamma)$; assumed E2.
5024.54		4192.75 *23*	100	831.68	2^+			
5026.8?		1576.9[@] *7*	29 *10*	3449.83	3			
		3370.8[@] *4*	100 *15*	1655.92	4^+			
5041.01		1485.6 *7*	16 *5*	3555.79				
		3148.58 *12*	100 *4*	1892.36	2^+			
5041.44		2543.9 *3*	17.9 *21*	2497.32	(2^+)			
		2834.43 *13*	100 *7*	2207.02	(3^-)			
		4209.5 *3*	49 *5*	831.68	2^+			
5055.56	(8^+)	1291.2[‡] *3*	32.6[‡] *7*	3764.36	(6^+)	(E2)	3.54×10^{-4}	Mult.: Q from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,p2n\gamma),^{12}C(^{86}Kr,2\alpha\gamma)$; assumed E2.
		1357.0[‡] *1*	100.0[‡] *21*	3698.55	(7^-)	(E1)	2.89×10^{-4}	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,p2n\gamma),^{12}C(^{86}Kr,2\alpha\gamma)$; $\Delta\pi$= yes from level scheme.
		1560.7[‡] *3*	69.5[‡] *14*	3494.84	$6^{(+)}$	(E2)	3.32×10^{-4}	Mult.: Q from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,p2n\gamma),^{12}C(^{86}Kr,2\alpha\gamma)$; assumed E2.
5089.46		2592.32 *20*	87 *9*	2497.32	(2^+)			
		4257.34 *24*	100 *8*	831.68	2^+			
5187.51	$(1^-,2^+)$	1038.63 *7*	26.7 *11*	4148.85				
		1631.78 *20*	7.2 *14*	3555.79				
		1804.10 *7*	52.1 *18*	3383.39				
		2148.2 *3*	18.8 *24*	3039.26	1			
		2216.29 *14*	42.8 *24*	2971.12	0^+			

$^{90}_{38}Sr_{52}$-7

Adopted Levels, Gammas (continued)

$\gamma(^{90}Sr)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.	α[&]	Comments
5187.51	$(1^-,2^+)$	2980.7 *6*	8.2 *18*	2207.02	(3^-)			
		3295.09 *14*	74 *4*	1892.36	2^+			
		4355.78 *22*	38.0 *21*	831.68	2^+			
		5187.44 *23*	100 *5*	0.0	0^+			
5239.2		3032.1 *5*	100	2207.02	(3^-)			
5254.32		1870.7 *4*	7.8 *17*	3383.39				
		3361.88 *13*	100 *5*	1892.36	2^+			
		5254.27 *25*	23.8 *17*	0.0	0^+			
5285.89		1658.9 *3*	37 *5*	3627.01				
		4454.07 *21*	100 *7*	831.68	2^+			
5298.48	(9^-)	416.8[‡] *5*	18[‡] *3*	4881.7	8	D[§]	0.00403	
		549.6[‡] *3*	71[‡] *6*	4748.93	8	D[§]	0.00211	
		1599.9[‡] *3*	100[‡] *3*	3698.55	(7^-)	(E2)	3.37×10^{-4}	Mult.: Q from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,p2n\gamma),^{12}C(^{86}Kr,2\alpha\gamma)$; assumed E2.
5333.15?		4500.8[@] *10*	8 *4*	831.68	2^+			
		5333.01[@] *24*	100 *5*	0.0	0^+			
5426.65		3534.24 *13*	100	1892.36	2^+			
5431.2		3538.6[@] *6*	100 *22*	1892.36	2^+			
		4599.4[@] *3*	96 *8*	831.68	2^+			
5557.9		1603.52 *20*	100 *11*	3954.32				
		4726.1 *7*	24 *7*	831.68	2^+			
5591.8	10	570.2[‡] *3*	100[‡]	5021.62	(9^-)	D[§]		
5600.3?		1973.3[@] *10*	1.0×10^2 *4*	3627.01				
		5600.1[@] *5*	83 *14*	0.0	0^+			
5623.3		196.8 *4*	59 *10*	5426.65				
		1668.9 *6*	$9.\times10^1$ *3*	3954.32				
		1996.0 *10*	24 *10*	3627.01				
		2239.7 *8*	1.0×10^2 *6*	3383.39				
5785.1?		2335.2[@] *10*	1.0×10^2 *4*	3449.83	3			
		3214.5[@] *11*	$6.\times10^1$ *3*	2570.60				
5822.0		395.8 *8*	27 *14*	5426.65				
		1686.2 *6*	43 *14*	4135.63	$(1,2^+)$			
		2789.1 *22*	1.0×10^2 *7*	3032.87				
		3929.4 *14*	$5.\times10^1$ *3*	1892.36	2^+			
5827.9		2200.9 *3*	84 *10*	3627.01				
		2900.3 *13*	20 *12*	2927.70	4			
		3620.8 *11*	1.0×10^2 *4*	2207.02	(3^-)			
		4996.2 *11*	11 *5*	831.68	2^+			
5923.56	(10^+)	625.1[‡] *3*	21.4[‡] *16*	5298.48	(9^-)	D[§]		
		868.0[‡] *1*	100.0[‡] *19*	5055.56	(8^+)	(E2)		Mult.: Q from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,p2n\gamma),^{12}C(^{86}Kr,2\alpha\gamma)$; assumed E2.

Adopted Levels, Gammas (continued)

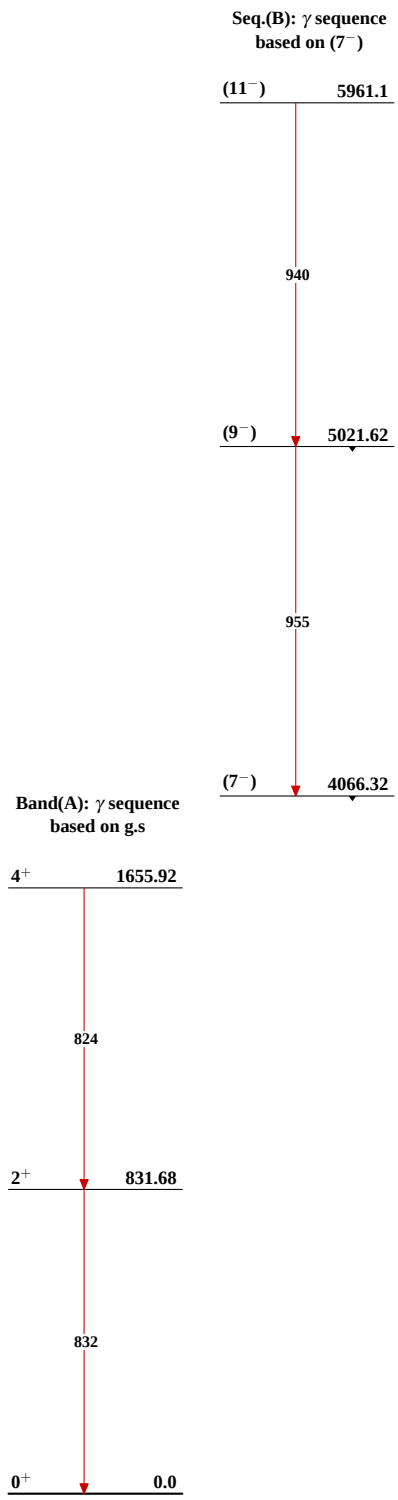
$\gamma(^{90}Sr)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.	α[&]	Comments
5923.56	(10+)	901.9[‡] *3*	8.2[‡] *8*	5021.62	(9−)			
5961.1	(11−)	939.5[‡] *3*	100[‡]	5021.62	(9−)	(E2)	6.70×10^{-4}	Mult.: Q from $\gamma\gamma(\theta)$ in ^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$); assumed E2.
6712.3	12	751.2[‡] *3*	100[‡] *3*	5961.1	(11−)	D[§]		
		1120.5[‡] *3*	48[‡] *3*	5591.8	10	Q[§]		
6794.56	(12+)	871.0[‡] *1*	100[‡]	5923.56	(10+)	(E2)	8.05×10^{-4}	Mult.: Q from $\gamma\gamma(\theta)$ in ^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$); assumed E2.
7371.2	13	658.9[‡] *3*	100[‡]	6712.3	12	D[§]		
7705.77		911.2[‡] *1*	100[‡]	6794.56	(12+)			
7959.7		253.9[‡] *3*	100[‡]	7705.77		Q[§]		
8772.4		812.7[‡] *5*	20[‡] *7*	7959.7				
		1066.6[‡] *3*	100[‡] *13*	7705.77		Q[§]		
9060.7		288.3[‡] *3*	100[‡]	8772.4		D[§]		
9199.7		1493.9[‡] *3*	100[‡]	7705.77				
9957.5		757.8[‡] *3*	100[‡]	9199.7		D[§]		

[†] From ^{90}Rb β^- decay, except where noted.
[‡] From ^{82}Se(^{11}B,p2nγ), ^{12}C(^{86}Kr,2$\alpha\gamma$).
[§] From $\gamma\gamma(\theta)$ (DCO) in ^{82}Se(^{11}B,p2nγ), ^{12}C(^{86}Kr,2$\alpha\gamma$).
[&] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[@] Placement of transition in the level scheme is uncertain.

$^{90}_{38}Sr_{52}$-9

Adopted Levels, Gammas



$^{90}_{38}Sr_{52}$

^{90}Rb β^- decay (158 s) 1981Ta05

Parent: ^{90}Rb: E=0; $J^\pi=0^-$; $T_{1/2}$=158 s *5*; Q(β^-)=6584 *7*; %β^- decay=100.0

1981Ta05: From ^{235}U(n,F). Mass separation of ^{90}Kr. NaI and Ge(Li). Measured Eγ, Iγ, $\gamma\gamma$ coin, $\gamma\gamma(\theta)$. The 158-s and 258-s ^{90}Rb activities were distinguished by varying collection and observation times.

1977Hu03: From ^{235}U(n,F). Mass separation. Measured $T_{1/2}$, Eγ, Iγ, $\gamma\gamma$ coin, Eβ.

1997Gr09: from ^{252}Cf. On-line mass separation and measurement of γ rays using a total absorption γ-ray spectrometer to determine β^- distributions of decay intensities of fission products. Detector consisted of a large NaI scintillator with a deep axial well for the radioactive source and a Si(Li) detector to measure $\beta\gamma$ coincidences.

Others: 1964Jo02, 1967Zh01, 1972Eh02, 1973Si12, 1973Cl02, 1974Gr29, 1976Wo05, 1978St02, 1978Wu04, 1978Wo15, 1980De02, 2017FI06.

All data are from 1981Ta05, except as noted.

^{90}Sr Levels

For results of $\gamma\gamma$ correlations see ^{90}Rb β^- decay (258 s).

E(level)	J^π †	$T_{1/2}$ ‡	E(level)	J^π †	E(level)	J^π †
0	0^+	28.79† y *6*	3144.9 *4*	$5^{(-)}$	4646.35 *15*	
831.68 *4*	2^+	7 ps *2*	3383.41 *8*		4790.3? *5*	
1655.92 *8*	4^+	12 ps *2*	3555.84 *15*		4919.06? *20*	
1892.36 *5*	2^+	2 ps *1*	3627.0 *4*		4973.99 *18*	
2207.04 *5*	(3^-)	≤1 ps	3954.33 *19*		5041.01 *13*	
2497.31 *7*	(2^+)	≤3 ps	4019.4 *4*		5187.52 *7*	$(1^-,2^+)$
2570.62 *9*		10 ps *7*	4037.12 *10*		5254.32 *12*	
2674.0? *5*	(0^+)		4135.63 *10*	$(1,2^+)$	5333.15? *24*	
2927.71 *9*	4		4137.6 *9*		5426.66 *14*	
2971.14 *12*	0^+		4148.86 *8*		5600.3? *5*	
3032.87 *8*		≤1 ps	4366.05 *12*		5623.3 *3*	
3039.26 *8*	1		4580.8 *3*			

† From the Adopted Levels.

‡ From $\beta\gamma$(t) (1991Ma05), except where noted.

β^- radiations

β^- branches are from I(γ+ce) imbalance at each level. Values from 1997Gr09 (total absorption γ-ray spectrometer) for excited levels are in reasonable agreement with those deduced from transition- intensity balances. However, that from transition-intensity balance to the 831-keV level is about a factor of two (on a relative scale) larger than values obtain by 1997Gr09 for other excited levels. In addition, these authors found no β^- population to levels above 5300 keV. These results disagree with the γ-rays measured by 1981Ta05 and placed on the decay scheme de-exciting levels up to 5623 keV. 1997Gr09 placed fictitious levels at about 2700, 2800, 2900, 3000, 3100, 3200, 3650, 3850, and 4950 keV to interpret their data.

E(decay)	E(level)	Iβ^- †	Log *ft*	Comments
(961 *7*)	5623.3	0.45 *11*	5.72 *11*	
(984 *7*)	5600.3?	0.073 *17*	6.54 *11*	
(1157 *7*)	5426.66	3.93 *25*	5.08 *4*	
(1251‡ *7*)	5333.15?	0.47 *4*	6.13 *4*	
(1330 *7*)	5254.32	1.28 *8*	5.80 *4*	Iβ^-: 1.39% (1997Gr09).
(1396 *7*)	5187.52	4.29 *25*	5.36 *3*	Iβ^-: 5.56% (1997Gr09).
(1543 *7*)	5041.01	0.49 *4*	6.47 *4*	Iβ^-: 0.58% (1997Gr09).
(1610 *7*)	4973.99	0.61 *8*	6.45 *6*	Iβ^-: 0.86% (1997Gr09).
(1665 *7*)	4919.06?	0.33 *3*	6.77 *5*	

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^{90}Rb β^- decay (158 s) 1981Ta05 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^- †	Log *ft*	Comments
(1794 *7*)	4790.3?	0.14 *3*	7.28 *10*	
(1938 *7*)	4646.35	2.84 *18*	6.11 *4*	Iβ^-: 2.32% (1997Gr09).
(2003 *7*)	4580.8	0.32 *5*	7.11 *7*	Iβ^-: 0.36% (1997Gr09).
(2218 *7*)	4366.05	8.8 *6*	5.86 *4*	Iβ^-: 11.20% (1997Gr09).
(2435 *7*)	4148.86	<0.03	>8.5	
(2446 *7*)	4137.6	<0.1	>8.0	
(2448 *7*)	4135.63	7.7 *5*	6.09 *4*	Iβ^-: 10.84% (1997Gr09).
(2547 *7*)	4037.12	0.42 *4*	7.43 *5*	Iβ^-: 0.45% (1997Gr09).
(2565 *7*)	4019.4	0.074 *19*	8.20 *12*	Iβ^-: 0.08% (1997Gr09).
(3201 *7*)	3383.41	5.7 *4*	6.72 *4*	Iβ^-: 6.17% (1997Gr09).
(3545 *7*)	3039.26	0.44 *6*	8.02 *6*	Iβ^-: 0.48% (1997Gr09).
(3551 *7*)	3032.87	<0.01	>9.7	
(3656 *7*)	2927.71	<0.01	>9.7	
(3910‡ *7*)	2674.0?	<0.05	>9.2	
(4692 *7*)	1892.36	2.7 *4*	7.77 *7*	Iβ^-: 4.01% (1997Gr09).
(5752 *7*)	831.68	26 *2*	7.19 *4*	Iβ^-: 13.12% (1997Gr09).
(6584 *7*)	0	33 *4*	7.35 *6*	Iβ^-: measured with a total absorption γ-ray spectrometer system operating in the 4 π γ- β coincidence mode (1996Gr20). Other values: 37% *5* (1976Wo05), and 53% *5* (1981Ta05) may be more inaccurate because of the difficulty for separating out the contributions from the decay of ^{90}Rb (158 s) and ^{90}Rb (258 s).

† Absolute intensity per 100 decays.

‡ Existence of this branch is questionable.

$\gamma(^{90}Sr)$

Iγ normalization: from ΣI(γ+ce) (to g.s.)=67% *3*, using a measured value of 33% *4* (1996Gr20) for the β^- feeding to the g.s..

E_γ †	I_γ †§	E_i(level)	J^π_i	E_f	J^π_f	Mult.‡	δ‡	α&	Comments
196.8 *4*	2.4 *4*	5623.3		5426.66					
314.5 *3*	0.22 *2*	2207.04	(3$^-$)	1892.36	2$^+$	[E1]			
543.6 *10*	1.6 *7*	4580.8		4037.12					
551.20 *25*	0.23 *3*	2207.04	(3$^-$)	1655.92	4$^+$	[E1]			
720.70 *9*	0.34 *3*	2927.71	4	2207.04	(3$^-$)				
739.2 *4*	1.26 *22*	4366.05		3627.0					
752.1 *3*	1.77 *22*	4135.63	(1,2$^+$)	3383.41					
765.1 *7*	0.04 *2*	4148.86		3383.41					
824.23 *10*	5.2 *4*	1655.92	4$^+$	831.68	2$^+$	E2		9.22×10^{-4}	Mult.: (824γ)(831γ)(θ): A_2=0.12 *5*, A_4=0.04 *6* (1981Ta05).
831.69 *5*	1000 *37*	831.68	2$^+$	0	0$^+$	E2		9.02×10^{-4}	
886.3 *3*	1.6 *3*	3383.41		2497.31	(2$^+$)				
892.5 *7*	0.7 *3*	4037.12		3144.9	5$^{(-)}$				
985.4 *5*	0.59 *18*	3555.84		2570.62					
997.85 *6*	11.4 *4*	4037.12		3039.26	1				
1003.9 *9*	0.028 *14*	4148.86		3144.9	5$^{(-)}$				I_γ: From branching relative to the 3317γ in 258-s β^- decay.
1027.1 *4*	0.50 *7*	3954.33		2927.71	4				
1038.63 *7*	7.8 *3*	5187.52	(1$^-$,2$^+$)	4148.86					
1060.70 *4*	239 *8*	1892.36	2$^+$	831.68	2$^+$	M1+E2	+0.50 *3*	4.97×10^{-4}	Mult.: D+Q from $\gamma\gamma(\theta)$. $\Delta\pi$=no required by the level scheme.
1140.50 *6*	1.63 *10*	3032.87		1892.36	2$^+$				
1146.96 *25*	1.07 *13*	3039.26	1	1892.36	2$^+$				
1176.9 *9*	1.0 *4*	3383.41		2207.04	(3$^-$)				
1271.77 *7*	0.98 *6*	2927.71	4	1655.92	4$^+$				
1326.46 *21*	3.3 *4*	4366.05		3039.26	1				
1375.36 *3*	4.5 *7*	2207.04	(3$^-$)	831.68	2$^+$	(E1(+M2))	−0.02 *6*	2.98×10^{-4}	
^{x}1430.4 *4*	1.26 *22*								
1438.3 *8*	0.8 *3*	4366.05		2927.71	4				
1456.7 *3*	0.95 *9*	3954.33		2497.31	(2$^+$)				
1485.6 *7*	1.7 *5*	5041.01		3555.84					
1489.0 *4*	0.77 *14*	3144.9	5$^{(-)}$	1655.92	4$^+$				
1522.1 *4*	0.96 *22*	4019.4		2497.31	(2$^+$)				
1547.8 *5*	1.6 *4*	4580.8		3032.87					
1590.3 *3*	3.5 *4*	4973.99		3383.41					
1631.78 *20*	2.1 *4*	5187.52	(1$^-$,2$^+$)	3555.84					
1665.61 *7*	5.40 *22*	2497.31	(2$^+$)	831.68	2$^+$				
1668.9 *6*	3.8 *13*	5623.3		3954.33					
1738.93 *8*	0.58 *2*	2570.62		831.68	2$^+$				

$^{90}_{38}Sr_{52}$-13

$\gamma(^{90}Sr)$ (continued)

E_γ †	I_γ †§	E_i(level)	J^π_i	E_f	J^π_f	Mult.‡	α&	Comments
1747.3 *3*	0.95 *11*	3954.33		2207.04	(3⁻)			
1804.10 *7*	15.2 *5*	5187.52	(1⁻,2⁺)	3383.41				
1842.3@ *5*	0.6 *4*	2674.0?	(0⁺)	831.68	2⁺			
1870.7 *4*	1.9 *4*	5254.32		3383.41				
1892.28 *8*	14.4 *6*	1892.36	2⁺	0	0⁺	[E2]	4.11×10^{-4}	
1941.81 *17*	0.31 *3*	4148.86		2207.04	(3⁻)			
1973.3@ *10*	1.0 *4*	5600.3?		3627.0				
1996.0 *10*	1.0 *4*	5623.3		3627.0				
x2119.7 *8*	1.9 *7*							
2139.33 *18*	11.1 *6*	2971.14	0⁺	831.68	2⁺	E2	4.99×10^{-4}	Mult.: (2139γ)(831γ)(θ): A_2=0.23 *12*, A_4=1.28 *14* (1981Ta05).
2148.2 *3*	5.5 *7*	5187.52	(1⁻,2⁺)	3039.26	1			
2207.47 *11*	11.4 *5*	3039.26	1	831.68	2⁺	D		Mult.: (2207γ)(831γ)(θ): A_2=−0.47 *10*, A_4=−0.01 *11* (1981Ta05).
2216.29 *14*	12.5 *7*	5187.52	(1⁻,2⁺)	2971.14	0⁺			
2239.7 *8*	4.1 *22*	5623.3		3383.41				
2245.2 *9*	1.6 *10*	4137.6		1892.36	2⁺			
2256.55 *17*	0.32 *2*	4148.86		1892.36	2⁺			
2298.1 *9*	1.4 *6*	3954.33		1655.92	4⁺			
2473.94 *20*	15.4 *15*	4366.05		1892.36	2⁺			
2476.7 *11*	2.7 *17*	4973.99		2497.31	(2⁺)			
2497.27 *15*	0.85 *9*	2497.31	(2⁺)	0	0⁺			
2688.9 *5*	3.1 *6*	4580.8		1892.36	2⁺			
2724.26 *21*	3.2 *4*	3555.84		831.68	2⁺			
2924.3 *7*	1.8 *6*	4580.8		1655.92	4⁺			
2980.7 *6*	2.4 *5*	5187.52	(1⁻,2⁺)	2207.04	(3⁻)			
3039.17 *12*	18.7 *7*	3039.26	1	0	0⁺			
3081.3 *4*	3.9 *7*	4973.99		1892.36	2⁺			
3148.58 *12*	10.5 *4*	5041.01		1892.36	2⁺			
3295.09 *14*	21.6 *10*	5187.52	(1⁻,2⁺)	1892.36	2⁺			
3303.91 *13*	22.1 *9*	4135.63	(1,2⁺)	831.68	2⁺			
3317.00 *12*	7.12 *22*	4148.86		831.68	2⁺			
3361.88 *13*	24.4 *10*	5254.32		1892.36	2⁺			
3383.24 *12*	168 *5*	3383.41		0	0⁺			
3534.24 *13*	101 *3*	5426.66		1892.36	2⁺			
3627.4 *7*	3.2 *13*	3627.0		0	0⁺			
x3664.0 *5*	2.1 *4*							
3814.36 *20*	14.7 *10*	4646.35		831.68	2⁺			
3958.4@ *8*	2.0 *6*	4790.3?		831.68	2⁺			
4019.3 *13*	0.9 *4*	4019.4		0	0⁺			
x4061.7 *3*	6.0 *7*							
4087.26@ *23*	6.4 *4*	4919.06?		831.68	2⁺			
4135.51 *17*	168 *6*	4135.63	(1,2⁺)	0	0⁺			

$^{90}_{38}Sr_{52}$-14

$\gamma(^{90}Sr)$ (continued)

E_γ[†]	I_γ[†§]	E_i(level)	J^π_i	E_f	J^π_f
[x]4278.4 *8*	1.3 *4*				
[x]4332.14 *20*	9.9 *6*				
4355.78 *22*	11.1 *6*	5187.52	$(1^-,2^+)$	831.68	2^+
4365.90 *18*	200 *7*	4366.05		0	0^+
4500.8[@] *10*	0.9 *4*	5333.15?		831.68	2^+
[x]4635.1 *4*	0.6 *3*				
4646.45 *20*	56.4 *22*	4646.35		0	0^+
4790.2[@] *7*	1.6 *4*	4790.3?		0	0^+
4919.0[@] *4*	1.92 *22*	4919.06?		0	0^+
[x]4934.8 *7*	0.89 *22*				
4974.14 *25*	5.2 *4*	4973.99		0	0^+
[x]5007.7 *9*	0.59 *22*				
[x]5070.2 *3*	3.6 *3*				
5187.44 *23*	29.2 *12*	5187.52	$(1^-,2^+)$	0	0^+
5254.27 *25*	5.8 *4*	5254.32		0	0^+
[x]5299.5 *9*	0.43 *14*				
5333.01[@] *24*	10.8 *5*	5333.15?		0	0^+
5600.1[@] *5*	0.83 *14*	5600.3?		0	0^+

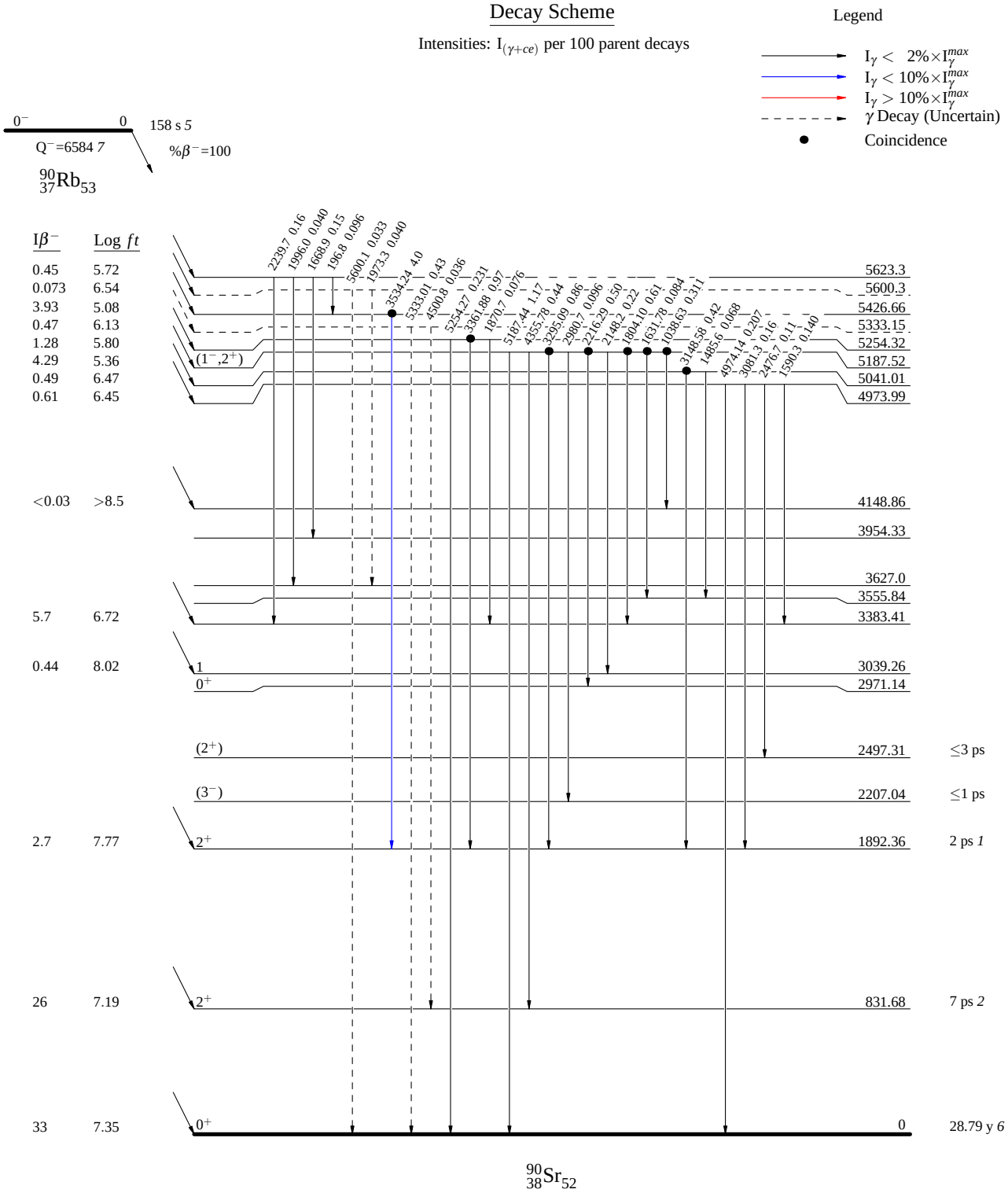
[†] From 1981Ta05, except where noted.
[‡] From the Adopted Gammas.
[§] For absolute intensity per 100 decays, multiply by 0.0399 *22*.
[&] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[@] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

$^{90}_{38}Sr_{52}$-15

^{90}Rb β^- decay (158 s) 1981Ta05

Decay Scheme

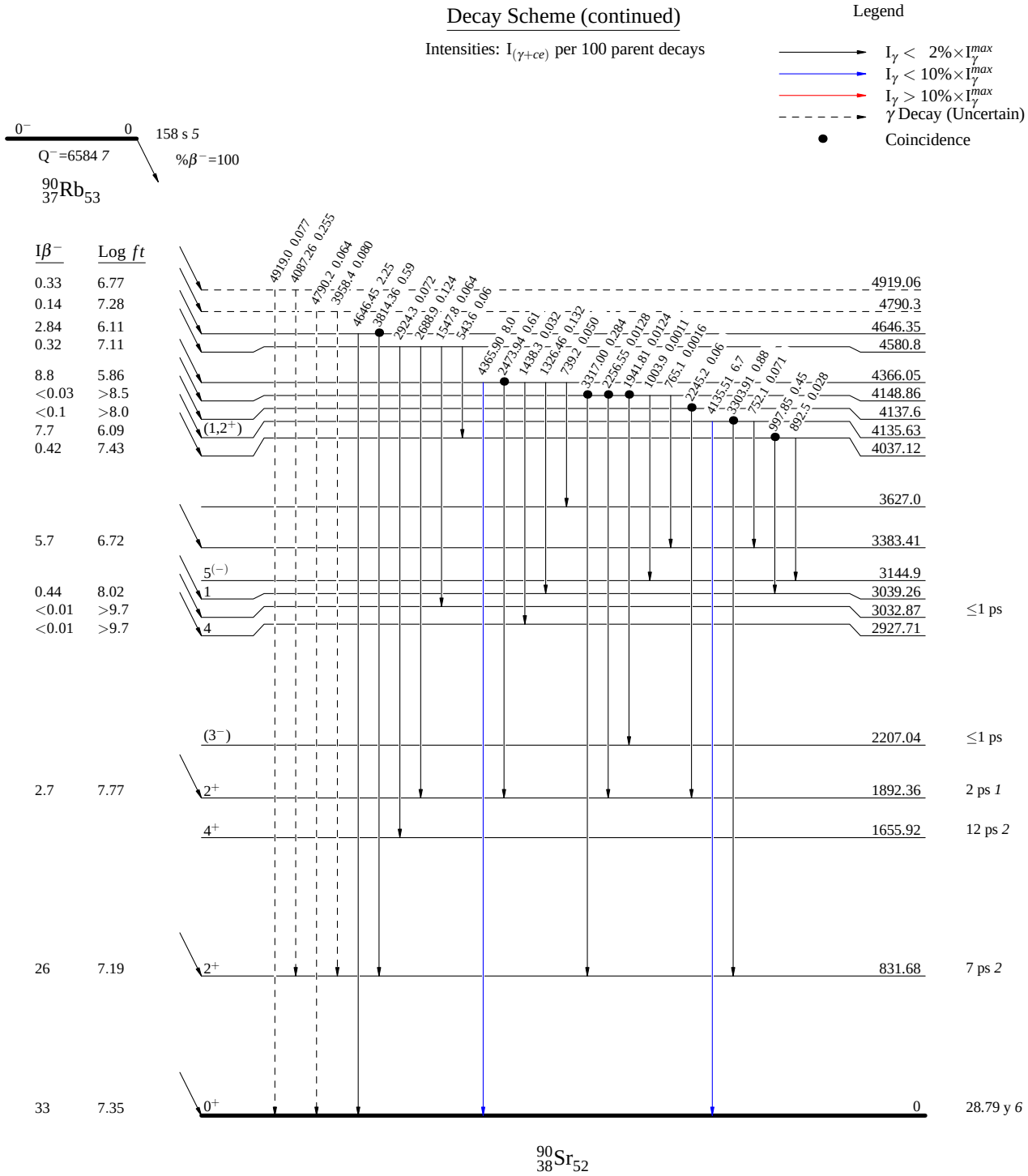
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Rb β^- decay (158 s) 1981Ta05

Decay Scheme (continued)

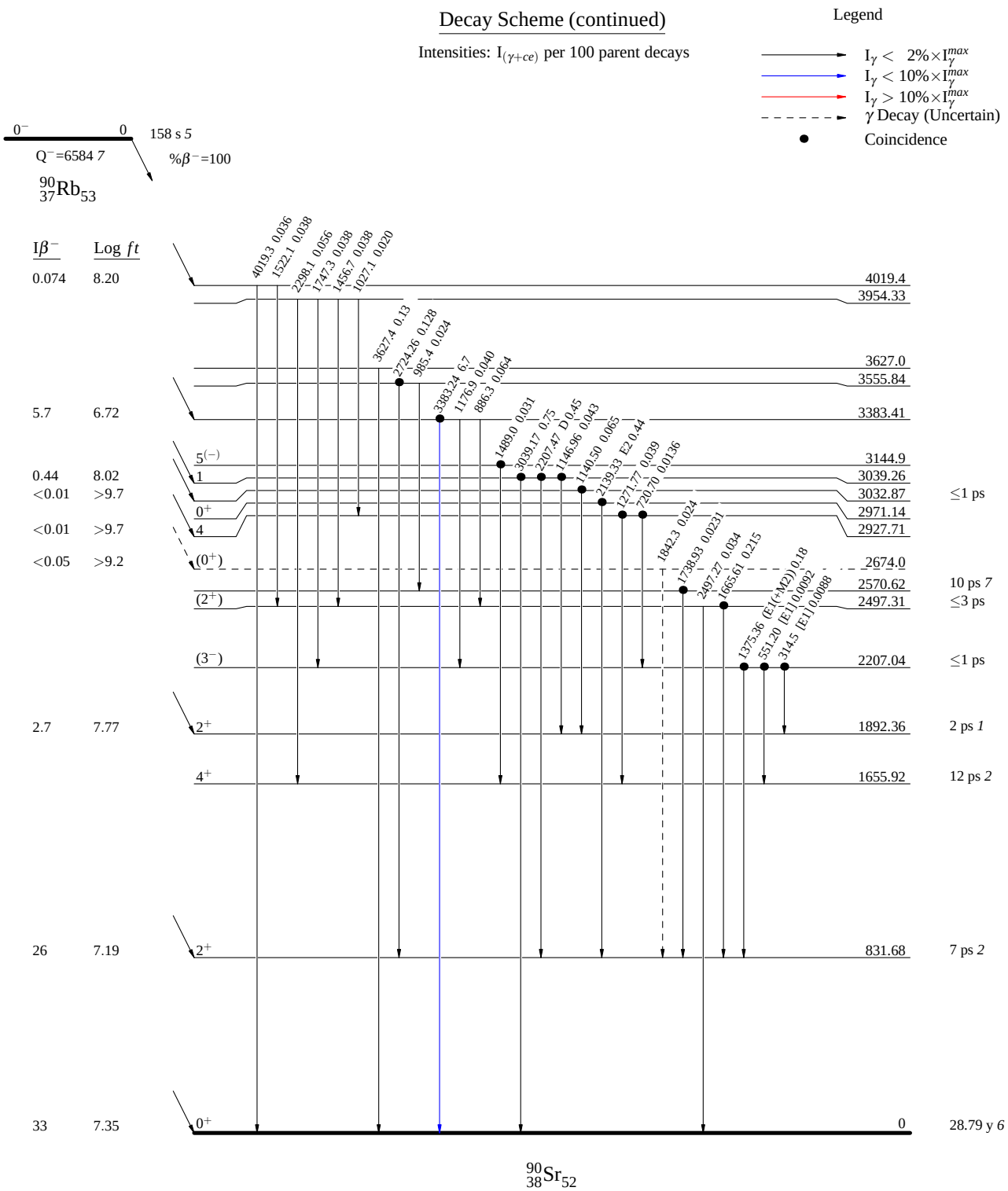
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Rb β^- decay (158 s) 1981Ta05

Decay Scheme (continued)

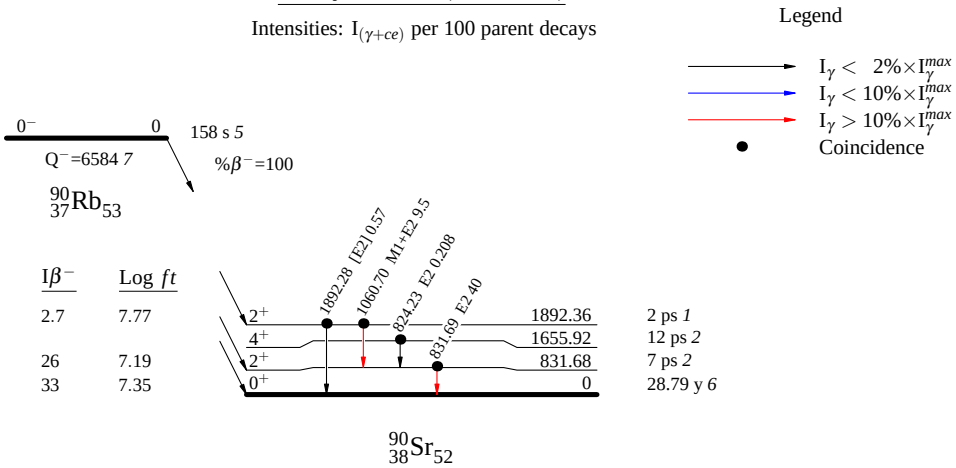
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Rb β^- decay (158 s) 1981Ta05

Decay Scheme (continued)

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Rb β^- decay (258 s) 1981Ta05

Parent: ^{90}Rb: E=106.90 *3*; J^π=3$^-$; $T_{1/2}$=258 s *4*; Q(β^-)=6584 *7*; %β^- decay=97.5 *5*

1981Ta05: From ^{235}U(n,F). Mass separation of ^{90}Kr. NaI and Ge(Li). Measured Eγ, Iγ, $\gamma\gamma$ coin, $\gamma\gamma(\theta)$. The 158-s and 258-s ^{90}Rb activities were distinguished by varying collection and observation times.

1977Hu03: From ^{235}U(n,F). Mass separation. Measured $T_{1/2}$, Eγ, Iγ, $\gamma\gamma$ coin, Eβ.

1997Gr09: from ^{252}Cf. On-line mass separation and measurement of γ rays using a total absorption γ-ray spectrometer to determine β^- distributions of decay intensities of fission products. Detector consisted of a large NaI scintillator with a deep axial well for the radioactive source and for a Si(Li) detector to measure $\beta\gamma$ coincidences.

Others: 1964Jo02, 1967Zh01, 1972Eh02, 1973Si12, 1973Cl02, 1974Gr29, 1976Wo05, 1978St02, 1978Wu04, 1978Wo15, 1980De02, 2017FI06.

All data are from 1981Ta05, except as noted.

^{90}Sr Levels

E(level)	J^π †	$T_{1/2}$ ‡	Comments
0	0$^+$	28.79† y *6*	
831.67 *4*	2$^+$	7 ps *2*	
1655.89 *7*	4$^+$	12 ps *2*	
1892.34 *5*	2$^+$	2 ps *1*	
2207.01 *5*	(3$^-$)	≤1 ps	
2497.30 *6*	(2$^+$)	≤3 ps	
2527.90 *8*	3$^-$,4$^+$	≤6 ps	
2570.59 *9*		10 ps *7*	
2927.68 *8*	4		
2971.00 *18*	0$^+$		
3032.85 *8*		≤1 ps	
3039.25 *8*	1		
3144.9 *4*	5$^{(-)}$		
3383.36 *10*			
3449.81 *6*	(2$^+$,3$^+$,4$^+$)	≤4 ps	
3555.87 *18*			
3584.41 *8*			
3627.0 *3*			
3954.3 *2*			
4036.86 *13*			
4135.62 *10*	(1,2$^+$)		
4148.80 *10*			
4335.35 *8*			
4366.05 *11*			
4404.60 *18*			
4430.9 *3*			
4685.5 *3*			
4804.0 *5*			
4805.10 *23*			
4808.50 *24*			
4854.3? *4*			
4947.4? *4*	(2$^+$)		
5024.52 *24*			
5026.8? *3*			
5041.42 *12*			
5089.44 *16*			
5239.2 *5*			
5285.87 *20*			
5426.65 *14*			Iβ=0.57% (1997Gr09). From I(γ+ce) balance at this level, the β feeding is 0.003 % *40*, consistent with zero feeding.
5431.1? *3*			
5557.8 *3*			

Continued on next page (footnotes at end of table)

^{90}Rb β^- decay (258 s) 1981Ta05 (continued)

^{90}Sr Levels (continued)

E(level)
5785.1? *8*
5822.0 *5*
5827.9 *4*

† From the Adopted Levels.
‡ From $\beta\gamma$(t) (1991Ma05), except where noted,

β^- radiations

β^- branches are from I(γ+ce) balance at each level. Values measured with a total absorption γ-ray spectrometer (1997Gr09) are also shown with individual levels. 1997Gr09 found an excess of β^- population to levels above 4394 keV, and a deficit for levels below 1994 keV, compared to those values deduced from transition-intensity balances. The most dramatic example is the β^- population to the 831-keV level: 15%, from transition-intensity balance; 1.8% from the total absorption γ-ray spectrometer measurement (1997Gr09). 1997Gr09 proposed a fictitious level at about 3900 keV with a β^- population of 1.64% in order to interpret their data.

E(decay)	E(level)	Iβ^-†	Log *ft*	Comments
(863 *7*)	5827.9	1.23 *23*	5.32 *9*	Iβ^-: 0.82% (1997Gr09).
(869 *7*)	5822.0	0.61 *20*	5.63 *15*	Iβ^-: 0.40% (1997Gr09).
(906 *7*)	5785.1?	0.34 *10*	5.96 *13*	Iβ^-: 0.23% (1997Gr09).
(1133 *7*)	5557.8	0.57 *6*	6.10 *5*	Iβ^-: 0.68% (1997Gr09).
(1260 *7*)	5431.1?	0.94 *11*	6.06 *6*	Iβ^-: 1.36% (1997Gr09).
(1405 *7*)	5285.87	1.61 *9*	6.01 *3*	Iβ^-: 2.99% (1997Gr09).
(1452 *7*)	5239.2	0.43 *7*	6.64 *8*	Iβ^-: 0.79% (1997Gr09).
(1601 *7*)	5089.44	1.37 *9*	6.30 *3*	Iβ^-: 2.69% (1997Gr09).
(1649 *7*)	5041.42	3.08 *15*	6.002 *24*	Iβ^-: 6.02% (1997Gr09).
(1664 *7*)	5026.8?	0.51 *7*	6.80 *6*	Iβ^-: 1.03% (1997Gr09).
(1666 *7*)	5024.52	1.14 *10*	6.45 *4*	Iβ^-: 2.22% (1997Gr09).
(1744 *7*)	4947.4?	0.49 *9*	6.90 *8*	
(1837 *7*)	4854.3?	0.34 *7*	7.15 *9*	Iβ^-: 0.82% (1997Gr09).
(1882 *7*)	4808.50	0.68 *10*	6.89 *7*	Iβ^-: 1.59% (1997Gr09).
(1886 *7*)	4805.10	0.44 *5*	7.08 *5*	Iβ^-: 1.03% (1997Gr09).
(1887 *7*)	4804.0	0.48 *9*	7.04 *9*	Iβ^-: 1.12% (1997Gr09).
(2005 *7*)	4685.5	0.23 *6*	7.47 *12*	Iβ^-: 0.27% (1997Gr09).
(2260 *7*)	4430.9	0.92 *12*	7.08 *6*	Iβ^-: 1.14% (1997Gr09).
(2286 *7*)	4404.60	1.61 *10*	6.86 *3*	Iβ^-: 1.99% (1997Gr09).
(2356 *7*)	4335.35	9.00 *21*	6.169 *14*	Iβ^-: 8.78% (1997Gr09).
(2542 *7*)	4148.80	15.7 *4*	6.067 *14*	Iβ^-: 18.87% (1997Gr09).
(2654 *7*)	4036.86	1.77 *14*	7.09 *4*	Iβ^-: 2.08% (1997Gr09).
(2737 *7*)	3954.3	0.47 *21*	7.73 *20*	Iβ^-: 0.83% (1997Gr09).
(3106 *7*)	3584.41	14.3 *8*	6.48 *3*	Iβ^-: 15.18% (1997Gr09).
(3241 *7*)	3449.81	6.54 *23*	6.897 *18*	Iβ^-: 7.29% (1997Gr09).
(3546 *7*)	3144.9	0.29 *6*	8.42 *9*	Iβ^-: 0.35% (1997Gr09).
(3658 *7*)	3032.85	0.60 *18*	8.16 *13*	Iβ^-: 0.70% (1997Gr09).
(3763 *7*)	2927.68	0.87 *24*	8.06 *12*	Iβ^-: 1.03% (1997Gr09).
(4120 *7*)	2570.59	1.32 *11*	8.05 *4*	Iβ^-: 1.17% (1997Gr09).
(4163 *7*)	2527.90	1.74 *11*	7.95 *3*	Iβ^-: 1.41% (1997Gr09).
(4194 *7*)	2497.30	1.49 *21*	8.03 *7*	Iβ^-: 1.21% (1997Gr09).
(4484 *7*)	2207.01	3.1 *11*	7.84 *16*	Iβ^-: 2.81% (1997Gr09).
(4799 *7*)	1892.34	4.2 *4*	7.84 *5*	Iβ^-: 1.82% (1997Gr09).
(5035 *7*)	1655.89	3.5 *6*	8.01 *8*	Iβ^-: 1.99% (1997Gr09).
(5859 *7*)	831.67	15 *4*	7.67 *12*	Iβ^-: 1.76% (1997Gr09).

† For absolute intensity per 100 decays, multiply by 1.001 *5*.

$\gamma(^{90}Sr)$

Iγ normalization: deduced by evaluators assuming no β^- feeding to g.s. (3^- to 0^+), and using ΣI(γ+ce)(to g.s. of ^{90}Sr) + ΣI(γ+ce)(to g.s. of ^{90}Rb)=100%.
For unplaced transitions possibly belonging to 258 s decay, see ^{90}Rb β^- decay (158 s).

E_γ[†]	I_γ[§]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[&]	Comments
314.5 *3*	8.8 *4*	2207.01	(3^-)	1892.34	2^+	[E1]		0.00374	
395.8 *8*	0.8 *4*	5822.0		5426.65					
442.3 *4*	1.2 *3*	4808.50		4366.05					
522.10 *13*	4.2 *3*	3449.81	(2^+,3^+,4^+)	2927.68	4	[E1]		1.01×10^{-3}	E_γ: author's value of 552.10 *13* in Table I is a misprint.
551.20 *25*	9.1 *7*	2207.01	(3^-)	1655.89	4^+	[E1]		8.91×10^{-4}	
720.70 *9*	5.7 *4*	2927.68	4	2207.01	(3^-)				
739.2 *4*	0.0071 *12*	4366.05		3627.0					I_γ: From Iγ/Iγ(4366γ) in 158-s decay.
752.1 *3*	0.0123 *17*	4135.62	(1,2^+)	3383.36					I_γ: From Iγ/Iγ(4136γ) in 158-s decay.
765.1 *7*	0.9 *3*	4148.80		3383.36					
779.9 *4*	2.9 *6*	4335.35		3555.87					
824.23 *10*	92 *5*	1655.89	4^+	831.67	2^+	E2		9.22×10^{-4}	
831.69 *5*	1000 *38*	831.67	2^+	0	0^+	E2		9.02×10^{-4}	
872.00 *15*	5.6 *4*	2527.90	3^-,4^+	1655.89	4^+				
886.3 *3*	0.062 *12*	3383.36		2497.30	(2^+)				I_γ: From Iγ/Iγ(3383γ) in 158-s decay.
921.20 *24*	3.2 *7*	3449.81	(2^+,3^+,4^+)	2527.90	3^-,4^+				
952.44 *7*	17.9 *6*	3449.81	(2^+,3^+,4^+)	2497.30	(2^+)				
985.4 *5*	0.85 *25*	3555.87		2570.59					
1003.9 *9*	0.6 *3*	4148.80		3144.9	$5^{(-)}$				
1013.95 *19*	2.7 *3*	3584.41		2570.59					
1021.9 *7*	0.8 *3*	4404.60		3383.36					
1027.1 *4*	1.3 *3*	3954.3		2927.68	4				
1060.70 *4*	81 *3*	1892.34	2^+	831.67	2^+	M1+E2	+0.50 *3*	4.97×10^{-4}	Mult.,δ: (1060γ)(831γ)(θ): A_2=−0.105 *16*, A_4=0.083 *18* (1981Ta05).
1086.7 *8*	0.74 *15*	3584.41		2497.30	(2^+)				
1109.2 *8*	1.4 *8*	4036.86		2927.68	4				
1140.50 *6*	9.4 *5*	3032.85		1892.34	2^+				
1146.96 *25*	0.16 *5*	3039.25	1	1892.34	2^+				
1176.9 *9*	0.039 *16*	3383.36		2207.01	(3^-)				I_γ: From Iγ/Iγ(3383γ) in 158-s decay.
1242.84 *4*	32.2 *18*	3449.81	(2^+,3^+,4^+)	2207.01	(3^-)	D			Mult.: (1243γ)(831γ)(θ): A_2=0.01 *4*, A_4=−0.02 *5* (1981Ta05).
1271.77 *7*	16.4 *22*	2927.68	4	1655.89	4^+				
1298.5[@] *5*	2.1 *4*	4854.3?		3555.87					
1302.2 *3*	2.0 *5*	4685.5		3383.36					
1326.46 *21*	0.0186 *23*	4366.05		3039.25	1				I_γ: From Iγ/Iγ(4366γ) in 158-s decay.
1375.36 *3*	177 *7*	2207.01	(3^-)	831.67	2^+	(E1(+M2))	−0.02 *6*	2.98×10^{-4}	Mult.,δ: (1375γ)(831γ)(θ): A_2=−0.089 *13*, A_4=0.051 *15* (1981Ta05), δ is for J=3 for 2207

$^{90}_{38}Sr_{52}$-22

$\gamma(^{90}Sr)$ (continued)

E_γ[†]	I_γ[§]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	α[&]	Comments
								level. δ: other: +0.464 *21* for J=2 (1981Ta05).
1377.2 *5*	24 *8*	3584.41		2207.01	(3$^-$)			
1391.6 *3*	4.6 *8*	4430.9		3039.25	1			
1425.2 *3*	2.9 *3*	4808.50		3383.36				
1438.3 *8*	0.0045 *17*	4366.05		2927.68	4			I_γ: From Iγ/Iγ(4366γ) in 158-s decay.
1456.7 *3*	2.5 *7*	3954.3		2497.30	(2$^+$)			
1460.1 *6*	2.0 *5*	4430.9		2971.00	0$^+$			
1489.0 *4*	3.7 *5*	3144.9	5$^{(-)}$	1655.89	4$^+$			
1576.9[@] *7*	1.2 *4*	5026.8?		3449.81	(2$^+$,3$^+$,4$^+$)			
1603.52 *20*	4.9 *5*	5557.8		3954.3				
1658.9 *3*	4.6 *6*	5285.87		3627.0				
1665.61 *7*	51.0 *12*	2497.30	(2$^+$)	831.67	2$^+$			
1686.2 *6*	1.3 *4*	5822.0		4135.62	(1,2$^+$)			
1692.07 *25*	2.9 *5*	3584.41		1892.34	2$^+$			
1696.16 *7*	17.5 *6*	2527.90	3$^-$,4$^+$	831.67	2$^+$			
1738.93 *8*	20.0 *8*	2570.59		831.67	2$^+$			(1738γ)(831γ)(θ): A_2=−0.17 *7*, A_4=0.11 *8* (1981Ta05). δ: −0.12 *12* for J(2570)=3 or +0.64 *18* for J(2570)=2 or −0.06 *8* for J(2570)=1 (1981Ta05).
1747.3 *3*	2.5 *4*	3954.3		2207.01	(3$^-$)			
1764.5 *9*	1.0 *5*	4335.35		2570.59				
1793.89 *11*	8.9 *5*	3449.81	(2$^+$,3$^+$,4$^+$)	1655.89	4$^+$	D		Mult.: (1793γ)(831γ)(θ): A_2=−0.02 *15*, A_4=0.02 *17* (1981Ta05).
1829.82 *20*	3.7 *5*	4036.86		2207.01	(3$^-$)			
1838.15 *14*	8.7 *6*	4335.35		2497.30	(2$^+$)			
1877.40 *21*	4.7 *5*	4805.10		2927.68	4			
1892.28 *8*	4.9 *5*	1892.34	2$^+$	0	0$^+$	[E2]	4.11×10^{-4}	
1903.1 *6*	1.4 *6*	4430.9		2527.90	3$^-$,4$^+$			
1941.81 *17*	6.5 *6*	4148.80		2207.01	(3$^-$)			
2128.30 *7*	55.2 *15*	4335.35		2207.01	(3$^-$)			
2139.33 *18*	1.4 *6*	2971.00	0$^+$	831.67	2$^+$	(E2)	4.99×10^{-4}	
2200.9 *3*	5.1 *6*	5827.9		3627.0				
2207.47 *11*	1.71 *12*	3039.25	1	831.67	2$^+$			
2256.55 *17*	7.0 *5*	4148.80		1892.34	2$^+$			
2298.1 *9*	3.6 *20*	3954.3		1655.89	4$^+$			
2311.2 *6*	3.1 *10*	4808.50		2497.30	(2$^+$)			
2335.2[@] *10*	2.2 *9*	5785.1?		3449.81	(2$^+$,3$^+$,4$^+$)			
2381.5 *5*	1.8 *7*	4036.86		1655.89	4$^+$			
2442.9 *5*	2.8 *7*	4335.35		1892.34	2$^+$			
2473.94 *20*	0.09 *1*	4366.05		1892.34	2$^+$			
2497.27 *15*	8.1 *8*	2497.30	(2$^+$)	0	0$^+$			(1665γ)(831γ)(θ): A_2=0.23 *3*, A_4=0.02 *3* (1981Ta05). δ: +0.53 *18-11* for J=3 or +0.03 *4* for J=2 (1981Ta05).

$^{90}_{38}Sr_{52}$-23

$\gamma(^{90}Sr)$ (continued)

E_γ †	I_γ §	E_i(level)	J^π_i	E_f	J^π_f	Comments
2537.8 *9*	1.8 *7*	4430.9		1892.34	2^+	
2543.9 *3*	3.5 *4*	5041.42		2497.30	(2^+)	
2592.32 *20*	6.8 *7*	5089.44		2497.30	(2^+)	
2617.8 *3*	6.5 *9*	3449.81	$(2^+,3^+,4^+)$	831.67	2^+	
2724.26 *21*	4.6 *6*	3555.87		831.67	2^+	
2741.0@ *12*	1.5 *8*	4947.4?	(2^+)	2207.01	(3^-)	
2752.68 *8*	122 *4*	3584.41		831.67	2^+	
2789.1 *22*	3.0 *19*	5822.0		3032.85		
2834.43 *13*	19.6 *12*	5041.42		2207.01	(3^-)	
2900.3 *13*	1.2 *7*	5827.9		2927.68	4	
2911.7 *11*	1.3 *7*	4804.0		1892.34	2^+	
3032.1 *5*	4.6 *7*	5239.2		2207.01	(3^-)	
3039.17 *12*	2.76 *21*	3039.25	1	0	0^+	
3197.9@ *10*	1.5 *6*	4854.3?		1655.89	4^+	
3205.09 *16*	11.9 *9*	4036.86		831.67	2^+	
3214.5@ *11*	1.4 *6*	5785.1?		2570.59		
3303.91 *13*	0.15 *1*	4135.62	$(1,2^+)$	831.67	2^+	
3317.00 *12*	152 *4*	4148.80		831.67	2^+	
3370.8@ *4*	4.2 *6*	5026.8?		1655.89	4^+	
3383.24 *12*	6.52 *14*	3383.36		0	0^+	
3503.52 *15*	25.1 *11*	4335.35		831.67	2^+	
3534.24 *13*	0.77 *3*	5426.65		1892.34	2^+	
3538.6@ *6*	5.1 *11*	5431.1?		1892.34	2^+	
3572.82 *18*	16.3 *10*	4404.60		831.67	2^+	
3620.8 *11*	6.1 *23*	5827.9		2207.01	(3^-)	
3627.4 *7*	10 *4*	3627.0		0	0^+	
3929.4 *14*	1.4 *8*	5822.0		1892.34	2^+	
3972.2 *5*	3.8 *7*	4804.0		831.67	2^+	
4115.6@ *4*	3.7 *6*	4947.4?	(2^+)	831.67	2^+	
4135.51 *17*	1.17 *4*	4135.62	$(1,2^+)$	0	0^+	
4192.75 *23*	12.1 *11*	5024.52		831.67	2^+	
4209.5 *3*	9.6 *9*	5041.42		831.67	2^+	
4257.34 *24*	7.8 *6*	5089.44		831.67	2^+	
4365.90 *18*	1.13 *8*	4366.05		0	0^+	
4454.07 *21*	12.5 *8*	5285.87		831.67	2^+	
4599.4@ *3*	4.9 *4*	5431.1?		831.67	2^+	
4685.0 *14*	0.4 *3*	4685.5		0	0^+	
4726.1 *7*	1.2 *3*	5557.8		831.67	2^+	
4996.2 *11*	0.7 *3*	5827.9		831.67	2^+	

† From 1981Ta05, except where noted.

$^{90}_{38}Sr_{52}$-24

$\gamma(^{90}Sr)$ (continued)

‡ From the Adopted Gammas. In cases where adopted values derive from this dataset, supporting details are given in the comments.

§ For absolute intensity per 100 decays, multiply by 0.094 *4*.

& Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

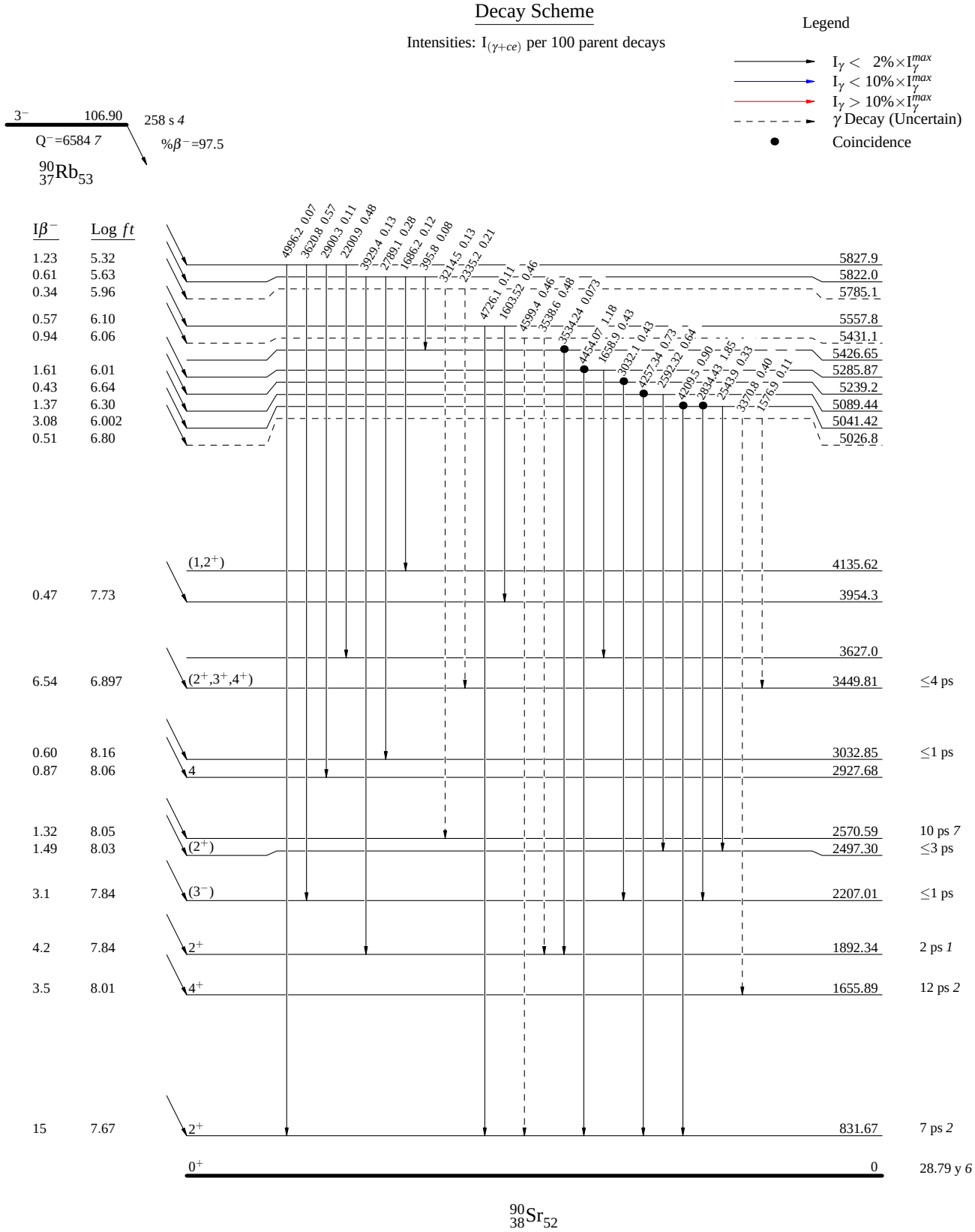
@ Placement of transition in the level scheme is uncertain.

$^{90}_{38}Sr_{52}$-25

^{90}Rb β^- decay (258 s) 1981Ta05

Decay Scheme

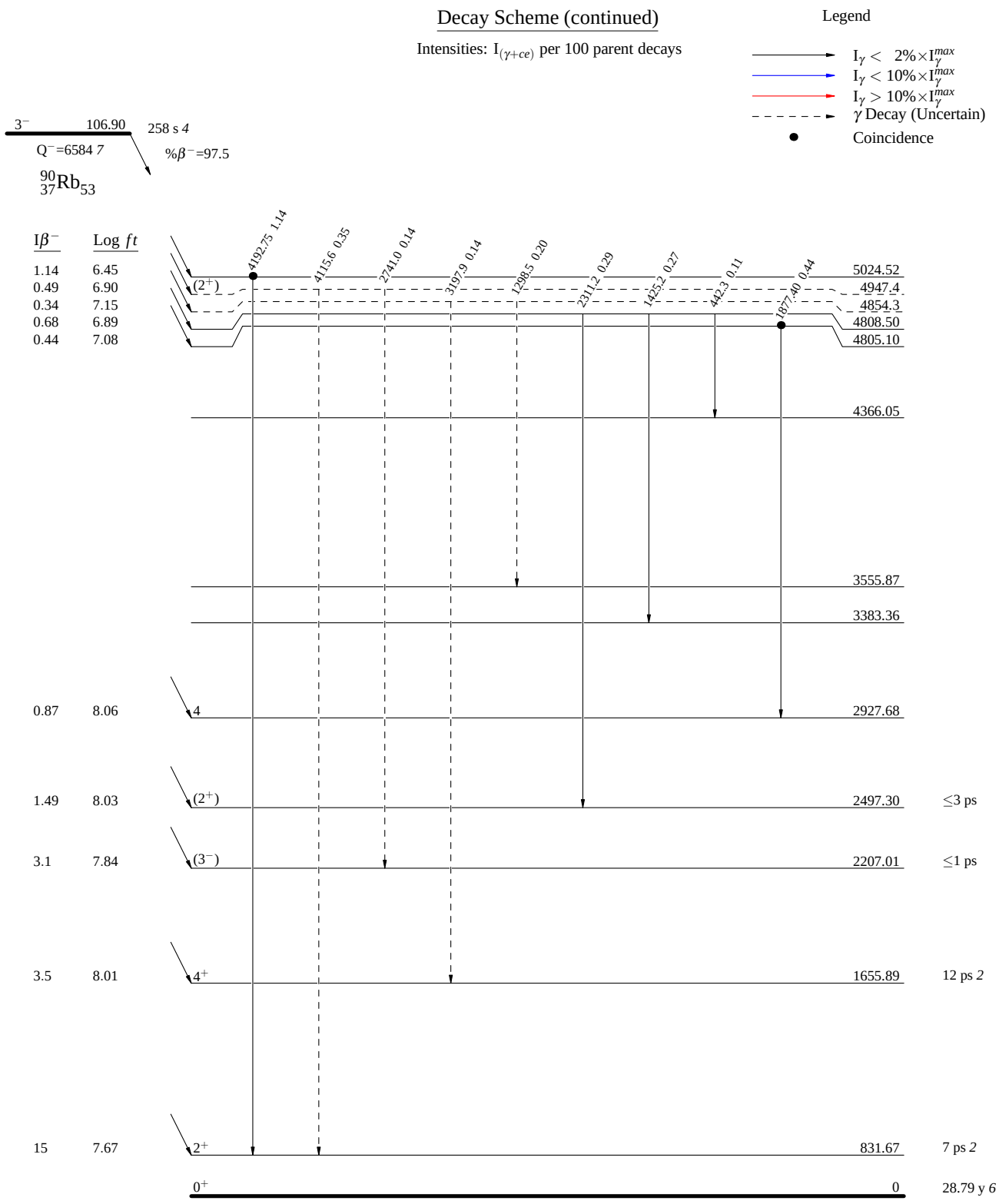
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Rb β^- decay (258 s) 1981Ta05

Decay Scheme (continued)

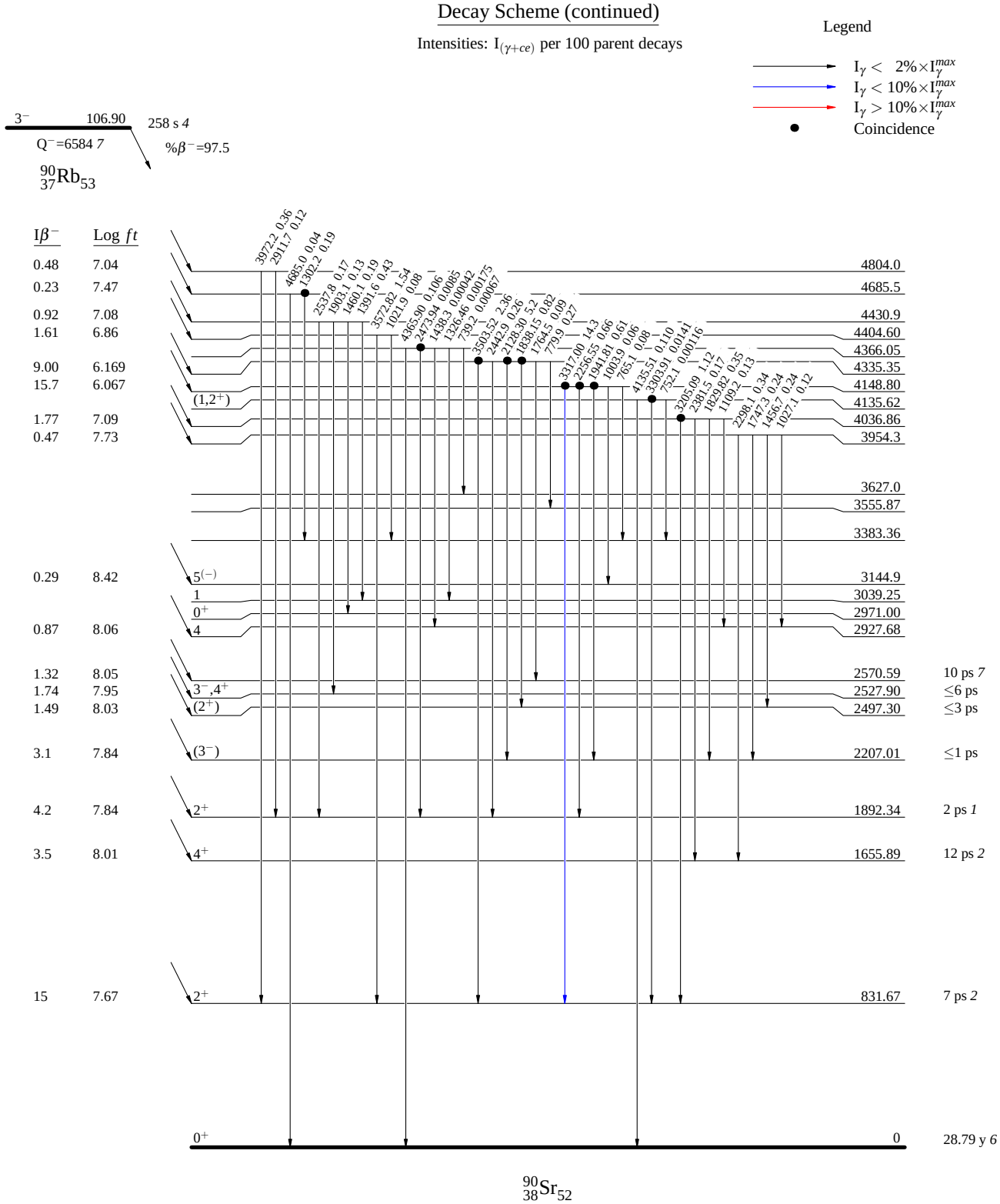
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Rb β^- decay (258 s) 1981Ta05

Decay Scheme (continued)

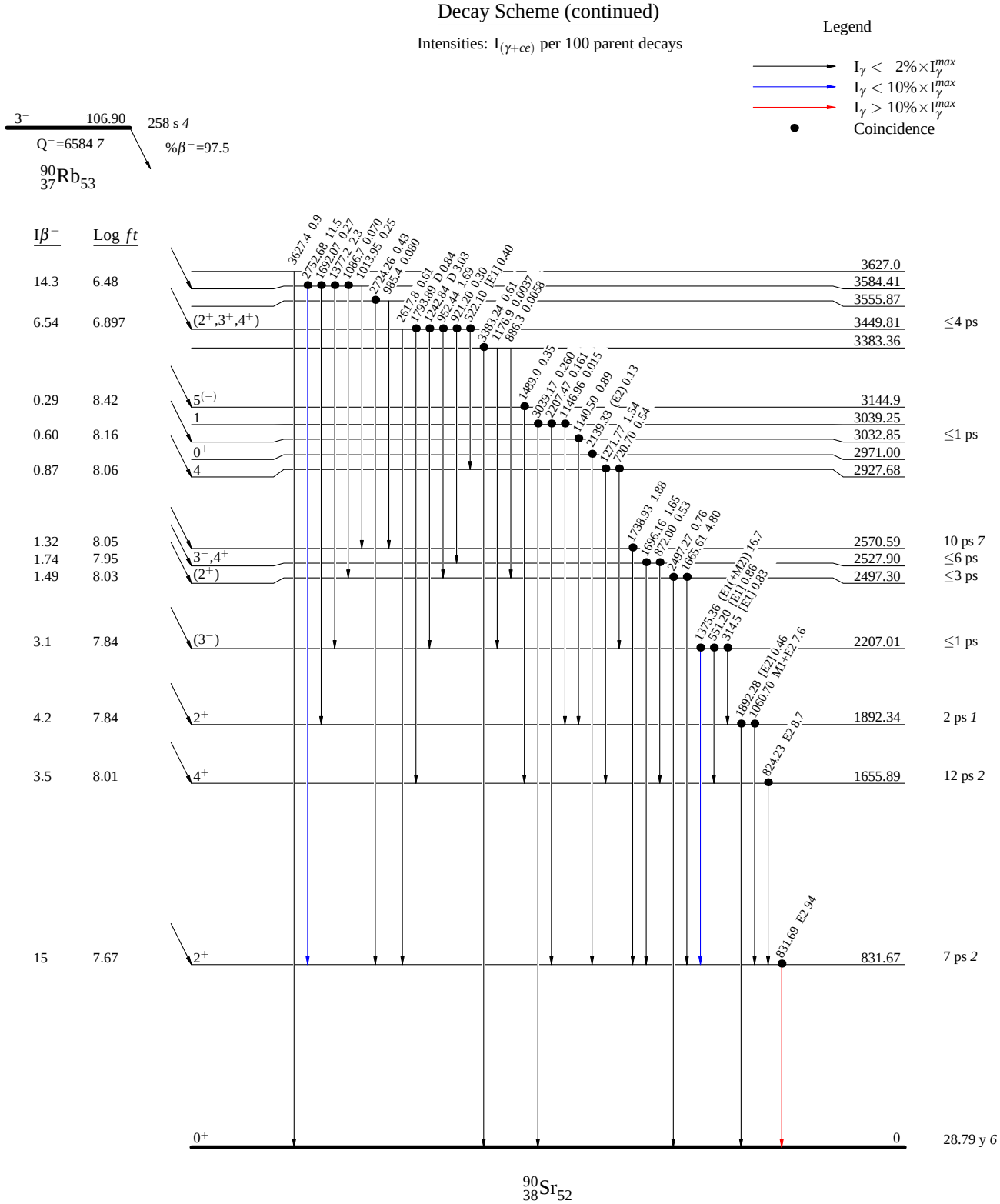
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Rb β^- decay (258 s) 1981Ta05

Decay Scheme (continued)

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$) 2001St14,2014Ku10

2001St14: ^{82}Se(^{11}B,p2nγ) at E=37 MeV. Measured Eγ, Iγ, $\gamma\gamma$, and $\gamma\gamma(\theta)$(DCO) using GASP spectrometer consisting of 40 escape-suppressed HPGe detectors and an inner ball containing 80 BGO detectors.

2000Fo13: ^{173}Yb(^{24}Mg,F) at E=134.5 MeV. Measured Eγ, Iγ, $\gamma\gamma$ coincidence following compound nucleus fission using GAMMASPHERE array; decduced fission fragment charge and mass distributions. No significant details available except the level scheme and relative intensities shown therein.

2013Hw01: reanalyzed published (2001St14) DCO data and extended Jπ-assignments.

2014Ku10: ^{12}C(^{86}Kr,2$\alpha\gamma$), E= 3.1, 3.2 and 3.2 MeV/nucleon; isotopically pure ^{86}Kr beam from K=500 Cyclotron at TAMU; multi-layered target consisting of C, Gd, Ta and Cu; measured α,γ,α-γ coin, particle-γ angular correlation and g-factors of excited states using the transient-field (TF) technique in inverse kinematics; Clover HPGe detectors and Si-SB particle detector.

^{90}Sr Levels

E(level)[†]	J$^\pi$[‡]	Comments
0.0[@]	0$^+$	
831.60[@] *10*	2$^+$	g=−0.12 *11* (2014Ku10) g: weighted average of g=−0.16 *30*, −0.02 *20*, and −0.16 *15* measured at E(^{86}Kr)=3.2, 3.1 and 3.0 MeV/nucleon, respectively (2014Ku10).
1655.80[@] *14*	4$^+$	g=−0.02 *17* (2014Ku10) g: weighted average of g=−0.03 *25*, +0.06 *38*, and −0.06 *28* measured at E(^{86}Kr)=3.2, 3.1 and 3.0 MeV/nucleon, respectively (2014Ku10).
2207.01 *24*	3$^-$	
2927.51 *23*	4$^{(-)}$	
3144.31 *16*	5$^{(-)}$	
3268.6 *3*	(4$^+$)	
3468.30 *25*	5$^{(-)}$	
3494.71 *17*	6$^{(+)}$	
3698.42 *18*	7$^{(-)}$	
3742.02 *18*	6$^{(-)}$	
3764.23 *22*	6$^{(+)}$	
4066.19[&] *20*	7$^{(-)}$	
4748.79 *23*	8$^{(-)}$	
4881.5 *3*	8$^{(-)}$	
5021.48[&] *21*	9$^{(-)}$	
5055.43 *19*	(8$^+$)[#]	
5298.35 *25*	9$^{(-)}$	
5591.7 *4*	10$^{(-)}$	
5923.43 *21*	(10$^+$)[#]	
5961.0[&] *4*	11$^{(-)}$	
6712.2[&] *4*	12$^{(-)}$	
6794.43 *23*	(12$^+$)[#]	
7371.1[&] *5*	13$^{(-)}$	
7705.63 *25*		
7959.5 *4*		
8772.2 *4*		
9060.5 *5*		
9199.5 *4*		
9957.4 *5*		

[†] From a least-squares fit to Eγ by evaluators.
[‡] From 2001St14, except where noted.
[#] Spins and parities assigned by 2013Hw01 from energy systematics.
[@] Seq.(A): γ sequence based on ground state.
[&] Seq.(B): γ sequence based on 7$^{(-)}$.

^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$) 2001St14,2014Ku10 (continued)

γ(^{90}Sr)

DCO values are derived from detectors placed at 35° and 90° to the beam direction. For this geometry, values of 0.54 and 1.0 are expected for stretched dipole and quadrupole transitions, respectively, gated on stretched quadrupole transitions (2001St14).

E_γ[†]	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	Comments
140.0 *5*	0.7 *1*	5021.48	$9^{(-)}$	4881.5	$8^{(-)}$	D	DCO=0.44 *5*.
203.7 *5*	≈1[§]	3698.42	$7^{(-)}$	3494.71	$6^{(+)}$		
216.8 *5*	0.4 *1*	3144.31	$5^{(-)}$	2927.51	$4^{(-)}$		
253.9 *3*	1.6[§] *1*	7959.5		7705.63		Q	DCO=0.99 *19*.
272.5 *3*	3.5 *1*	5021.48	$9^{(-)}$	4748.79	$8^{(-)}$	D	DCO=0.49 *5*.
288.3 *3*	1.0 *1*	9060.5		8772.2		D	DCO=0.34 *3*.
324.0 *5*		3468.30	$5^{(-)}$	3144.31	$5^{(-)}$		
324.2 *3*	9.9[&] *1*	4066.19	$7^{(-)}$	3742.02	$6^{(-)}$	D	DCO=0.41 *2*.
367.8 *3*	8.3 *2*	4066.19	$7^{(-)}$	3698.42	$7^{(-)}$	D	DCO=0.95 *6*. Mult.: 2001St14 assign ΔJ=0 dipole.
416.8 *5*	0.6 *1*	5298.35	$9^{(-)}$	4881.5	$8^{(-)}$	D	DCO=0.40 *4*.
495.7 *3*	1.2[§] *2*	3764.23	$6^{(+)}$	3268.6	(4^+)	(Q)	DCO=1.09 *40*.
549.6 *3*	2.4 *2*	5298.35	$9^{(-)}$	4748.79	$8^{(-)}$	D	DCO=0.41 *9*.
554.1 *1*	33.6 *6*	3698.42	$7^{(-)}$	3144.31	$5^{(-)}$	Q	DCO=0.95 *3*.
570.2 *3*	4.8 *4*	5591.7	$10^{(-)}$	5021.48	$9^{(-)}$	D	DCO=0.62 *10*.
571.5 *3*	1.4 *4*	4066.19	$7^{(-)}$	3494.71	$6^{(+)}$		
597.7 *1*	16.9[&§] *4*	3742.02	$6^{(-)}$	3144.31	$5^{(-)}$	D	DCO=0.62 *2*.
597.9 *3*	5.5[&§] *2*	4066.19	$7^{(-)}$	3468.30	$5^{(-)}$		
619.9 *3*	2.7 *4*	3764.23	$6^{(+)}$	3144.31	$5^{(-)}$	(D)	DCO=0.33 *26*.
625.1 *3*	5.5 *4*	5923.43	(10^+)	5298.35	$9^{(-)}$	D	DCO=0.37 *7*.
658.9 *3*	1.7 *2*	7371.1	$13^{(-)}$	6712.2	$12^{(-)}$	D	DCO=0.64 *8*.
720.5 *3*	1.4 *1*	2927.51	$4^{(-)}$	2207.01	3^-	D	DCO=0.42 *6*.
751.2 *3*	3.1 *1*	6712.2	$12^{(-)}$	5961.0	$11^{(-)}$	D	DCO=0.48 *8*.
757.8 *3*	1.1 *1*	9957.4		9199.5		D	DCO=0.47 *4*.
812.7 *5*	0.3[§] *1*	8772.2		7959.5			
814.5 *3*	2.8[§] *2*	3742.02	$6^{(-)}$	2927.51	$4^{(-)}$	(Q)	DCO=1.03 *35*.
824.2 *1*	92.3 *2*	1655.80	4^+	831.60	2^+	Q	DCO=0.99 *1*.
831.6 *1*	100 *1*	831.60	2^+	0.0	0^+	Q	DCO=0.98 *2*.
868.0 *1*	25.7 *5*	5923.43	(10^+)	5055.43	(8^+)	Q	DCO=0.90 *5*.
871.0 *1*	24.7 *5*	6794.43	(12^+)	5923.43	(10^+)	Q	DCO=0.89 *5*, 0.94 *3*.
901.9 *3*	2.1 *2*	5923.43	(10^+)	5021.48	$9^{(-)}$		
911.2 *1*	14 *1*	7705.63		6794.43	(12^+)		I_γ: strongly influenced by 909γ from ^{89}Y.
937.3 *5*	≈1[§]	3144.31	$5^{(-)}$	2207.01	3^-	Q	DCO=0.85 *10*.
939.5 *3*	9.3 *2*	5961.0	$11^{(-)}$	5021.48	$9^{(-)}$	Q	DCO=1.13 *9*.
955.3 *1*	14.7 *2*	5021.48	$9^{(-)}$	4066.19	$7^{(-)}$	Q	DCO=1.04 *6*.
1006.7 *3*	5.9 *1*	4748.79	$8^{(-)}$	3742.02	$6^{(-)}$	Q	DCO=1.01 *8*.
1050.3 *3*	5.1 *3*	4748.79	$8^{(-)}$	3698.42	$7^{(-)}$	D	DCO=0.52 *7*.
1066.6 *3*	1.5 *2*	8772.2		7705.63		Q	DCO=0.94 *10*.
1120.5 *3*	1.5 *1*	6712.2	$12^{(-)}$	5591.7	$10^{(-)}$	Q	DCO=0.90 *18*, 0.80 *8*.
1183.1 *3*	2.2 *1*	4881.5	$8^{(-)}$	3698.42	$7^{(-)}$	D	DCO=0.34 *10*.
1271.7 *3*	2.6[§] *1*	2927.51	$4^{(-)}$	1655.80	4^+	D	DCO=0.78 *12*.
1291.2 *3*	4.6 *1*	5055.43	(8^+)	3764.23	$6^{(+)}$	Q	DCO=1.01 *11*.
1323.1 *3*	4.6 *1*	5021.48	$9^{(-)}$	3698.42	$7^{(-)}$	Q	DCO=1.02 *13*.
1357.0 *1*	14.1 *3*	5055.43	(8^+)	3698.42	$7^{(-)}$	D	DCO=0.54 *3*.
1375.4 *3*	2.7 *2*	2207.01	3^-	831.60	2^+	D	DCO=0.51 *12*.
1488.5 *1*	56.8 *8*	3144.31	$5^{(-)}$	1655.80	4^+	D	DCO=0.51 *1*.

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^{82}Se(^{11}B,p2nγ),^{12}C(^{86}Kr,2$\alpha\gamma$) 2001St14,2014Ku10 (continued)

γ(^{90}Sr) (continued)

E_γ †	I_γ †	E_i(level)	J^π_i	E_f	J^π_f	Mult. ‡	Comments
1493.9 *3*	3.2 *3*	9199.5		7705.63			
1560.7 *3*	9.8 *2*	5055.43	(8^+)	3494.71	$6^{(+)}$	Q	DCO=1.08 *7*.
1599.9 *3*	3.4 *1*	5298.35	$9^{(-)}$	3698.42	$7^{(-)}$	Q	DCO=0.92 *7*.
1612.8 *3*	2.1§ *1*	3268.6	(4^+)	1655.80	4^+		
1812.5 *3*	4.7 *1*	3468.30	$5^{(-)}$	1655.80	4^+	D	DCO=0.39 *5*.
1838.9 *1*	12.0§ *2*	3494.71	$6^{(+)}$	1655.80	4^+	Q	DCO=0.81 *4*.
2042.6 *3*	6.5 *1*	3698.42	$7^{(-)}$	1655.80	4^+	(O)	DCO=1.10 *4*.
2108.4 *3*	3.3 *1*	3764.23	$6^{(+)}$	1655.80	4^+		

† From 2001St14. Δ(Eγ)=0.5 keV for Iγ<1, 0.3 keV for 1<Iγ<10, and 0.1 keV for Iγ>10, based on a general comment by 2001St14.

‡ From DCO measurements in 2001St14.

§ Contaminated transition. If DCO ratio is given, it may contain a contribution from an impurity.

& Unresolved structure. Iγ from $\gamma\gamma$ coin.

^{88}Sr(t,p) 1976Fl10

1976Fl10: E=20 MeV. Measured σ(E(p),θ), ten angles between 12° and 55°. Magnetic spectrometer, FWHM=11 keV. L values from comparison with DWBA calculations. L=0 and L=2 can be assigned with a high degree of confidence. The $\sigma(\theta)$ data do not distinguish between L=3 and L=4.

Other: 1974Co24.

^{90}Sr Levels

E(level)	L	E(level)	L	E(level)	L	E(level)	L
0†	0	3268 *10*	3,4	4128 *10*	2	4937 *10*	(2)
832†	2	3394‡ *10*		4240 *10*	2	4971 *10*	
1656†	4	3479 *10*	3,4	4288 *10*	3,4	5034 *10*	
1892†	2	3508 *10*	(5)	4333 *10*		5066 *10*	
2207 *10*	3,(4)	3594 *10*	3,4	4493 *10*		5095 *10*	3,4
2484 *10*		3720 *10*	>5	4522 *10*		5142 *10*	
2513 *10*	3,4	3784 *10*	(5)	4576 *10*		5198 *10*	3,4
2586 *10*	2	3804 *10*	2	4643 *10*		5296 *10*	
2674 *10*	(0)	3845 *10*		4660 *10*		5343 *10*	
2958 *10*	0	3915 *10*		4742 *10*	3,4	5370 *10*	
3038 *10*		4043 *10*	3,4	4774 *10*	3,4	5428 *10*	
3146 *10*	(5)	4073 *10*	3,4	4824 *10*	2	5605 *10*	

† Used for calibration.
‡ Probable doublet.

Adopted Levels, Gammas

Q(β^-)=2278.5 *16*; S(n)=6857.03 *10*; S(p)=7574.0 *16*; Q(α)=−6172.0 *16* 2017Wa10
S(2n)=18338.8 *22*; S(2p)=18463.0 *16* (2017Wa10).

^{90}Y Levels

Cross Reference (XREF) Flags

A	^{89}Y(n,γ) E=thermal	F	^{90}Y IT decay (3.19 h)	K	^{92}Zr(d,α)
B	^{89}Y(pol d,p)	G	^{90}Sr β^- decay (28.91 y)	L	^{91}Zr(t,α)
C	^{89}Y(d,pγ)	H	^{89}Y(α,^{3}He)	M	^{82}Se(^{11}B,3nγ)
D	^{74}Ge(^{18}O,npγ),^{76}Ge(^{18}O,3npγ)	I	^{88}Sr(^{3}He,p)	N	^{89}Y(n,n′)
E	^{87}Rb(α,nγ)	J	^{91}Zr(d,^{3}He)		

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$	XREF	Comments
0.0	2$^-$	64.05 h *5*	ABCDEFGHIJKLM	%β^-=100 Q=−0.125 *11*; μ=−1.630 *8* J$^\pi$: J from atomic beam (1978Fu06); π from L=2 in (d,p) and (α,^{3}He); L=1 in (t,α) and (d,^{3}He). T$_{1/2}$: weighted average (using the limitation of relative statistical weights method (1988WoZO)) of 64.053 h *20* (2004Ko18), 63.46 h *13* (1969Gr38), 64.6 h *8* (1967Bi02), 64.21 h *8* (1968La10), 64.06 h *11* (1966Ri01), 63.74 h *10* (1963Vo02), 64.8 h *2* (1956He77), and 64.24 h *30* (1955Vo03). μ: from atomic beam measurement (1962Pe01). Q: from 2016St14 evaluation based on 2008Py02 and 1998Bi20. Other: −0.155 *3* (1962Pe01).
202.496 *12*	3$^-$	250 ps *7*	ABCDEF H JKLM	μ=−0.85 *7* J$^\pi$: L=2 in (d,p) and (α,^{3}He); L=1 in (t,α) and (d,^{3}He). $\gamma\gamma(\theta)$ in ^{90}Y IT decay (3.19 h). T$_{1/2}$: from delayed coin in ^{90}Y IT decay (3.19 h). μ: from integral perturbed angular correlations (IPAC) (1974Kl06).
682.01[b] *5*	7$^+$	3.19 h *6*	A CDEF JKLM	%IT=99.9982 *2*; %β^-=0.0018 *2* Q=−0.65 *8*; μ=+5.28 *3* J$^\pi$: L=4 in (t,α) and (d,^{3}He); 479γ E5 to 2$^-$. T$_{1/2}$: weighted average (using the limitation of relative statistical weights method) of: 3.244 h *5* (1992An19), 3.19 h *1* (1967Gr02), 3.15 h *5* (1962Ab03), 3.2 h *1* (1961Ca12), 3.14 h *10* (1961He09), and 3.19 h *6* (1961Ha17). The uncertainty has been increased to include the most precise value of 3.244 h *5* (1992An19). μ: from Colinear Laser Spectroscopy (CLS) (2007Ch07); other: +5.1 *5* from low temperature nuclear orientation of 480 kev transition (1988Be46). Q: from Colinear Laser Spectroscopy (CLS) (2007Ch07,2016St14). %β^-: from measured I(2319γ)/I(480γ); see ^{90}Y β^- decay (3.19 h).
776.593 *15*	2$^+$		A C E JKL	J$^\pi$: L=4 in (t,α) and (d,^{3}He); circular polarization of primary γ ray to this level in (n,γ); 776γ E1+M2 to 2$^-$.
953.512 *17*	2$^+$,3$^+$		A C E JKL	J$^\pi$: L=4 in (t,α) and (d,^{3}He); 177γ to 2$^+$, 953γ to 2$^-$, 751γ to 3$^-$.
1047.22 *12*	(5$^+$)		A C E JKL	J$^\pi$: tentative assignment from (n,γ); supported by L=4 transfer in (t,α) and (d,^{3}He) reaction; 365.2γ to 7$^+$.
1189.68 *8*			A C E J L	
1211.578 *17*	0$^-$		ABC E H KL	J$^\pi$: L=0 in (d,p). S-factor(1211)/S-factor(1371)=2.9 *1* agrees with 3.0 (theory) for Jπ(1211)=0$^-$ and Jπ(1371)=1$^-$.
1298.0 *4*	(5,6,7)$^+$		C E J L	J$^\pi$: L=4 in (t,α) and (d,^{3}He); 616γ to 7$^+$, 250.8γ to (5$^+$).
1371.133 *15*	1$^-$		ABC E H KL	J$^\pi$: L=0 in (d,p); see arguments for 1211.6 level.
1416.581 *16*	(2$^-$),3$^-$[@]		ABC E JKL	

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Adopted Levels, Gammas (continued)

^{90}Y Levels (continued)

E(level)[†]	J^{π}[‡]	XREF	Comments
1561.9[@] *5*	$3^-,4^-$[@]	B L	
1571.614 *17*	$2^-,(3)^-$[@]	ABC H JK	
1640.914 *16*	1^-[@]	ABC J	
1647 *5*	(4^-)	H KL	J^{π}: as proposed in (t,α) based on L=3.
1760.977 *18*	2^-[@]	ABC H JKL	
1811.02 *4*	$(2^-),3^-$	ABC J L	
1815.152 *22*	1^+	A HI K	J^{π}: L=0+2 in (^{3}He,p).
1962.1[@] *2*	$5^+,6^+$[@]	BC H L	
2021.4?[@] *4*		B JKL	XREF: J(2030)K(2030)L(2030).
2088.8[@] *8*	$5^+,6^+$[@]	BC H L	
2133.502 *23*	$1,2^-$[@]	AB	J^{π}: 922γ to 0^-, 1357γ to 2^+, 2133γ to 2^- is consistent with Jπ from (pol d,p).
2179.4[@] *7*	$(2^-,3^-)$[@]	B	
2196.120 *21*	$(1^-,2)$[#]	AB	J^{π}: 1993γ to 3^-, 380.8γ to 1^+, 825.2γ to 1^-.
2216.66[b] *7*	8^+	D M	J^{π}: from $\gamma(\theta)$ and lin pol in ^{74}Ge(^{18}O,npγ),^{76}Ge(^{18}O,3npγ); 1534γ M1+E2 to 7^+.
2240.6 *8*	$5^+,6^+$[@]	BC	
2244.30 *3*	$(1,2^-)$	A H	J^{π}: 1032.6γ to 0^-.
2313 *10*	1^+	I L	J^{π}: L=0+2 in (^{3}He,p). E(level): from ^{88}Sr(^{3}He,p).
2327.4[@] *4*		B	
2365.964 *21*	1^-[@]	ABC L	
2454.84? *6*	9^+	D	J^{π}: $\gamma(\theta)$ and lin pol in (^{18}O,npγ) and (^{18}O,3npγ); 238γ M1+E2 to 8^+. E(level): the ordering of 239γ and 642γ may be reversed, which would result in a level at 2859.0.
2475.92 *3*	2^-	ABC H	J^{π}: L=2 in (d,p). S-factor(2476)/S-factor(2624)=1.96 *10* agrees with 1.67 (theory) for Jπ(2475)=2^- and Jπ(2624)=1^-.
2495.48 *3*	$(2,1^-)$[#]	A	J^{π}: 2292.9γ to 3^-, 680.4γ to 1^+. Primary γ from Jπ=1^-.
2504.613 *23*	2^-[@]	ABC	
2520.9[@] *5*	$5^+,6^+$[@]	B H	
2558.4[@] *3*	3^-[@]	B	
2590.2[@] *5*	$3^-,4^-$[@]	B	
2623.99 *4*	1^-	ABC H L	J^{π}: L=2 in (d,p); see argument for 2475 level.
2631.93 *4*	$(1^-,2,3^-)$[#]	A	J^{π}: 2429γ to 3^-, primary γ from Jπ=1^-.
2663.28 *4*	$(1^-,2^-)$	AB	J^{π}: 2461γ to 3^-, 1452γ to 0^-.
2678.1[@] *4*	3^-[@]	B	
2702.6[@] *5*		B	
2719.35 *3*	$(1,2^-)$	A	J^{π}: 1509γ to 0^-.
2745.9[@] *5*		B	
2749.240 *19*	$(1^-,2,3^-)$[#]	A C H L	J^{π}: 2547γ to 3^-, primary γ from Jπ=1^-.
2755.4[@] *3*	3^-[@]	B	
2758.078 *20*	$(1^-,2^-)$	A	J^{π}: 1546.5γ to 0^-, 2555.6γ to 3^-.
2784.6[@] *3*		B	
2819.7[@] *3*	1^-[@]	B L	
2838.32 *3*	1,2	A C H L	J^{π}: 2838γ to 2^-, primary γ from Jπ=1^-.
2847.42 *4*	1^-[@]	ABC	
2858.86[b] *18*	(9^+)	D M	J^{π}: (M1+E2) 642γ to 8^+.
2859.35 *3*	2^-	AB	J^{π}: L(pol d,p)=2, 1648γ to 0^-.
2870.4[@] *2*	$3^-,4^-$[@]	B H	

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Adopted Levels, Gammas (continued)

^{90}Y Levels (continued)

E(level)[†]	J^{π}[‡]	XREF	Comments
2905 *15*	(2,3)	L	E(level),J^{π}: from (t,α).
2932.8[@] *2*	$3^-,4^-$[@]	BC H L	
2937.5 *5*		C H	E(level): from ^{89}Y(d,pγ).
2986.10 *3*	$(1^-,2)$[#]	A	J^{π}: 2784γ to 3^-, 1171γ to 1^+, primary γ from Jπ=1^-.
2992.35 *4*	$(1^-),2^-$[@]	ABC L	
3002.3[@] *2*	3^-	BC H L	J^{π}: L=4 in (d,p); 2226γ to 2^+. Primary γ from Jπ=1^-.
3002.69 *4*	$(1^-,2)$[#]	A	J^{π}: 2800γ to 3^-, 1188γ to 1^+.
3043.50 *4*	$(1^-,2,3^-)$	A	J^{π}: 1403γ to 1^-, 2841γ to 3^-.
3048.2[@] *2*	$3^-,4^-$[@]	BC H L	
3097.06[b] *20*	(10^+)	D M	J^{π}: M1(+E2) 238γ to (9^+).
3119.5?[@] *4*		B L	
3137.1[@] *2*	$3^-,4^-$[@]	BC L	
3143.84 *3*	$(1^-,2,3^-)$[#]	A	J^{π}: 2941γ to 3^-. Primary γ from Jπ=1^-.
3160.211 *24*	1^-[@]	ABC H	
3203.9[@] *4*	$3^-,4^-$[@]	B	
3270.0[@] *4*		B	
3309.5[@&] *3*	3^-[@]	B	
3312.408 *25*	$(2,1^-)$	A	J^{π}: 1497γ to 1^+, 1671γ to 1^-, 3110γ to 3^-.
3342.3[@&] *3*		B H	
3354.3[&] *3*		B	
3404.83 *5*	$(1^-,2,3^-)$	AB	J^{π}: 3202.6γ to 3^-, primary γ from Jπ=1^-.
3413.4[@] *8*		B	
3438.8[@] *8*	1^+	B I	J^{π}: L=0(+2) in (^{3}He,p).
3469.14 *4*	$(1^-,2,3^-)$[#]	A	J^{π}: 3266γ to 3^-, primary γ from Jπ=1^-.
3476.06 *3*	$(1,2^-)$	A	J^{π}: 2264γ to 0^-.
3490 *5*	1^+	I	J^{π}: L=0(+2) in (^{3}He,p).
3496.8[@] *4*	(3^-)[@]	B	
3522.6[@] *4*	$5^+,6^+$[@]	B H	
3534.4[@] *5*	$(5^+,6^+)$[@]	B	
3555.727 *19*	$(1^-,2,3^-)$	AB	J^{π}: 1915γ to 1^-, 3353γ to 3^-.
3574.501 *23*	1^-[@]	AB	
3584.5?[@] *5*		B H	
3592.9[@] *6*	$5^+,6^+$[@]	B	
3602.07 *3*	1^-[@]	AB	
3625 *6*	1^+	I	E(level): from ^{88}Sr(^{3}He,p). J^{π}: L=0+2 in (^{3}He,p).
3627.647 *25*	1^-[@]	AB	
3644.2[@] *5*	$5^+,6^+$[@]	B	
3667.3?[@] *8*		B	
3685.23 *4*	$(1,2^-)$	A	J^{π}: 2474γ to 0^-.
3692.29 *3*	1^-[@]	AB	
3736.1?[@] *3*		B	
3757.8[@] *3*		B	
3792.1[@] *3*	3^-[@]	B	
3801.3[@] *4*	(1^-)[@]	B	
3833.6[@] *4*		B	
3858.7[@] *3*	3^-[@]	B	

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Adopted Levels, Gammas (continued)

^{90}Y Levels (continued)

E(level)[†]	J^{π}[‡]	XREF	Comments
3881.4[@] *3*	3^-[@]	B	
3907.2[@] *4*	(1^-)[@]	B	
3934.47 *3*	1^-[@]	AB	J^{π}: L=0 in (pol d, p).
3942.5?[@] *2*		B	
3953.54 *4*	$(1^-,2^-)$	AB	J^{π}: 3751γ to 3^-, 2742γ to 0^-.
3972.3[@] *7*		B	
3980.4[@] *3*	(3^-)[@]	B	
3996.4[@] *7*		B	
4015.5[@] *4*	$(5^+,6^+)$[@]	B	
4024.2[@] *3*	(3^-)[@]	B	
4037.54 *3*	$(1,2^-)$[@]	A	J^{π}: 2826γ to 0^-.
4038.0[@] *3*	(3^-)[@]	B	
4065.0[@&] *3*		B H	
4080.3?[@] *4*		B	
4100.49 *4*	$(1^-,2^-)$	AB	J^{π}: 2889γ to 0^-, 1098γ to 3^-.
4127.5[@] *3*	1^-[@]	B	
4140.0 *8*		B	
4161.28 *4*	(0,1,2)	AB	XREF: B(4158.8). J^{π}: 1795γ to 1^-, 2345.9γ to 1^+.
4166.8[@&] *3*		B	
4197.7[@] *3*	$(2^-,3^-)$[@]	B	
4210.81 *4*	$(0^-,1,2,3^-)$	A	J^{π}: 1588γ to 1^-, 4210.8γ to 2^-.
4212.50[b] *21*	(11^+)	D M	J^{π}: M1(+E2) 1115γ (10^+), Q 1354γ to (9^+).
4219.7[@] *3*	(2^-)[@]	B	
4267.38 *3*	(1,2)	A	J^{π}: 693γ to 1^-, 2452γ to 1^+, 3491γ to 2^+, 4267γ to 2^-.
4288.6[@] *4*		B	
4302.3[@&] *3*		B	
4325.06 *5*	$1^-,2^-$[@]	AB	
4341.2[@] *3*	$5^+,6^+$[@]	B	
4352.8[@] *4*		B	
4377.9[@] *3*	1^-[@]	B	
4411.3[@] *4*	$(5^+,6^+)$[@]	B	
4425.7[@] *3*	$(5^+,6^+)$[@]	B	
4451.576 *24*	$(1,2^-)$	A	J^{π}: 3240γ to 0^-.
4482.1[@] *3*	$(5^+,6^+)$[@]	B	
4504.7[@] *3*	$5^+,6^+$[@]	B	
4515.93 *3*	$(1,2^-)$	AB	XREF: B(4518.8). J^{π}: 4210.8γ to 0^-.
4518.5[b] *3*	(12^+)	D M	J^{π}: M1(+E2) 306γ to (11^+), (E2) 1421γ to (10^+).
4529.65 *4*	$(0^-,1,2,3^-)$[#]	A	J^{π}: primary γ from $J\pi=1^-$.
4533.14 *4*	$(1^-),2^-$[@]	AB	
4543.6 *3*	(11^+)	M	J^{π}: D+Q 1447γ to (10^+).
4548.0?[@] *4*		B	
4558.5[@] *5*	$(0^-,1^-)$[@]	B	
4572.0[@] *4*	$2^-,1^-$[@]	B	
4587.3?[@] *5*		B	
4619.5?[@] *5*		B	

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Adopted Levels, Gammas (continued)

^{90}Y Levels (continued)

E(level)[†]	J^{π}[‡]	$T_{1/2}$	XREF	Comments
4636.8[@] *5*	$(5^+,6^+)$[@]		B	
4645.4?[@] *11*			B	
4656.1[@] *7*	$(5^+,6^+)$[@]		B	
4662.8[@] *6*	3^-[@]		B	
4672.6[@] *7*	3^-[@]		B	
4685.8[@] *7*	1^-[@]		B	
4694.2[@&] *7*			B	
4713.0[@] *7*	$5^+,6^+$[@]		B	
4725.4?[@] *18*			B	
4735.2?[@] *8*			B	
4749.4?[@] *8*			B	
4777.1?[@] *10*			B	
4784.7[@] *9*	$3^-,4^-$[@]		B	
4802.9?[@] *10*			B	
4814.7?[@] *11*			B	
4822.7?[@] *11*			B	
4835.05 *4*	$(1,2^-)$		AB	J^{π}: 3623.14γ to 0^-.
4865.9[@] *12*	$5^+,6^+$[@]		B	
4881.4[@] *12*			B	
4895.4[@] *13*	(2^-)[@]		B	
4914.8[@] *13*	$(1^-,2^-)$[@]		B	
4927.3?[@] *15*			B	
4940.1[@] *14*	(3^-)[@]		B	
4953.2[@] *15*	(1^-)[@]		B	
4971.2[@] *16*	$5^+,6^+$[@]		B	
4986.0[@] *16*	$(0^-,1^-)$[@]		B	
4997.9[@] *25*	$2^-,3^-$[@]		B	
5068.39 *20*			M	
5102.6 *3*	(12)		M	J^{π}: D 1728.4γ from $13^{(+)}$, D 890.2γ to (11^+).
5111.46[b] *24*	(13^+)		M	J^{π}: Q 898.8γ to (11^+); assignment to γ-ray sequence.
5359.7[b] *3*	(14^+)		M	J^{π}: D 248.2γ to (13^+); assignment to γ-ray sequence.
5525.6 *4*	(12^+)		M	J^{π}: D 539.4γ from (13^-); 2428.4γ to (10^+).
5541.1 *4*	(12^+)		M	J^{π}: D 523.9γ from (13^-); 2444.3γ to (10^+).
5674.2 *4*	(12^+)		M	J^{π}: D 390.9γ from (13); 2577.4γ to (10^+).
6065.0 *3*	(13^-)		M	J^{π}: D+Q 962.5γ to 12^-, D 1546.0γ to (12^+), 2968.3γ to (10^+).
6234.7[c] *4*	(13^-)		M	J^{π}: D 1716.1γ to (12^+), E2 663.3γ from (15^-).
6822.52 *22*	(13^+)		M	J^{π}: 2303.9γ to (12^+), 2279.4γ to (11^+).
6831.13 *23*	$13^{(+)}$		M	J^{π}: D 524.4γ from (14^+), D 1728.4γ to (12), 2287.5γ to $11^{(+)}$.
6856.992 *12*	1^-		A	
6898.1[c] *3*	(15^-)		M	J^{π}: E2 833.1γ to 13^-, 2379.6γ to (12^+); assignment to γ-ray sequence.
7355.53[a] *23*	(14^+)		M	J^{π}: D 533.0γ to (13^+).
7882.7?[a] *3*	(15^+)	0.111 ps *28*	M	E(level): since the reversed ordering of the 538.7-527.2 cascade is not ruled out, this level is either at 7882.9 or 7894.4. $T_{1/2}$: from DSA measurement in ^{82}Se(^{11}B,3nγ). J^{π}: D 527.2γ to (14^+); band assignment.
7994.0[c] *4*	$16^{(-)}$		M	J^{π}: D 1095.9γ to 15^-, assignment to γ-ray sequence.
8421.4[a] *3*	(16^+)	0.57 ps *8*	M	$T_{1/2}$: from DSA measurement in ^{82}Se(^{11}B,3nγ).

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{90}Y Levels (continued)

E(level)[†]	J^{π}[‡]	$T_{1/2}$	XREF	Comments
				J^{π}: D 538.7γ to (15$^+$), 1065.8γ to (14$^+$); band assignment.
9005.9[a] *4*	(17$^+$)	0.37 ps *6*	M	$T_{1/2}$: from DSA measurement in ^{82}Se(^{11}B,3nγ). J^{π}: D 584.5γ to (16$^+$), band assignment.
9317.1 *5*			M	
9635.1[a] *5*	(18$^+$)	0.38 ps *6*	M	$T_{1/2}$: from DSA measurement in ^{82}Se(^{11}B,3nγ). J^{π}: 629.2γ to 17$^{(+)}$, band assignment.

[†] From a least-squares fit to Eγ, by evaluators, except where noted.

[‡] From (pol d,p) based on measured values of L-transfers and analyzing powers, except where noted. The spin and parity of states populated by mixed L-transfers may be unambiguously determined because of the high sensitivity of the analyzing power to the two possible couplings of the transferred orbital angular momenta.

[#] Spin and parity assignments from (n,γ) assume capture and secondary γ rays to be E1, M1, or E2, and that the neutron-capture state has $J\pi=1^-$.

[@] From ^{89}Y(pol d,p) (1993Mi04).

[&] Multiplet.

[a] Band(A): Band based on 14$^{(+)}$.

[b] Seq.(B): γ cascade based on 7$^+$.

[c] Seq.(C): Cascade based on 13$^-$.

Adopted Levels, Gammas (continued)

$\gamma(^{90}Y)$

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	δ[†]	α[#]	Comments
202.496	3^-	202.53 *3*	100	0.0	2^-	M1(+E2)	−0.04 *4*	0.0273 *5*	B(M1)(W.u.)=0.01030 *+27−31*; B(E2)(W.u.)<1.9 E_γ,I_γ,Mult.,δ: from ^{90}Y IT decay (3.19 h).
682.01	7^+	479.51 *5*	100.00 *3*	202.496	3^-	M4(+E5)	<0.1	0.0965	B(M4)(W.u.)=1.540 *+37−43* E_γ,I_γ,Mult.,δ: from ^{90}Y IT decay (3.19 h).
		681.8 *6*	0.35 *3*	0.0	2^-	E5		0.0226	B(E5)(W.u.)=1.66 *15* E_γ,I_γ,Mult.: from ^{90}Y IT decay (3.19 h).
776.593	2^+	574.10 *3*	27 *5*	202.496	3^-				
		776.64 *3*	100 *2*	0.0	2^-	E1+M2	−0.066 *9*	4.56×10^{-4}	
953.512	$2^+,3^+$	176.91 *3*	61 *12*	776.593	2^+				
		751.32 *13*	6.9 *16*	202.496	3^-				
		953.54 *3*	100 *20*	0.0	2^-				
1047.22	(5^+)	365.21 *11*	100	682.01	7^+				
1189.68		142.47[b] *13*	13 *3*	1047.22	(5^+)				I_γ: from (α,nγ). Others: 13 *7* in (n,γ), E=thermal, 23.5 in (d,pγ).
		236.17 *7*	100 *6*	953.512	$2^+,3^+$				I_γ: from (α,nγ).
1211.578	0^-	1211.56 *3*	100	0.0	2^-				
1298.0	$(5,6,7)^+$	250.8[&] *5*	5.0[&] *23*	1047.22	(5^+)				
		616.1[&] *5*	100[&] *5*	682.01	7^+				
1371.133	1^-	159.50 *13*	0.6 *3*	1211.578	0^-				
		1168.62 *4*	12 *3*	202.496	3^-				
		1371.13 *3*	100 *19*	0.0	2^-				
1416.581	$(2^-),3^-$	1214.05 *3*	47 *9*	202.496	3^-				
		1416.55 *3*	100 *21*	0.0	2^-				
1571.614	$2^-,(3)^-$	618.58 *18*	1.9 *5*	953.512	$2^+,3^+$				
		1369.10 *3*	81 *16*	202.496	3^-				
		1571.62 *3*	100 *20*	0.0	2^-				
1640.914	1^-	269.79 *11*	6.1 *13*	1371.133	1^-				
		429.27 *6*	14 *3*	1211.578	0^-				
		864.28 *5*	23 *4*	776.593	2^+				
		1640.93 *3*	100 *20*	0.0	2^-				
1760.977	2^-	1558.45 *3*	100 *20*	202.496	3^-				
		1760.92 *4*	49 *10*	0.0	2^-				
1811.02	$(2^-),3^-$	1608.52 *9*	93 *25*	202.496	3^-				
		1810.82 *9*	100 *20*	0.0	2^-				
1815.152	1^+	603.37 *20*	1.8 *5*	1211.578	0^-				
		1038.1[b] *5*	2.8 *9*	776.593	2^+				
		1815.02 *4*	100 *20*	0.0	2^-				
1962.1	$5^+,6^+$	664[§]	85[§]	1298.0	$(5,6,7)^+$				
		772[§]	100[§]	1189.68					
		914[§]	100[§]	1047.22	(5^+)				

$^{90}_{39}Y_{51}$-7

$\gamma(^{90}Y)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	δ[†]	α[#]	Comments
2088.8	$5^+,6^+$	791[§]	100[§]	1298.0	$(5,6,7)^+$				
		899[§]	80[§]	1189.68					
2133.502	$1,2^-$	718.0[a] *4*	6.3[a] *25*	1416.581	$(2^-),3^-$				
		762.39 *4*	94 *19*	1371.133	1^-				
		921.7 *4*	6.9 *25*	1211.578	0^-				
		1356.91 *4*	100 *20*	776.593	2^+				
		2133.30 *17*	21 *3*	0.0	2^-				
2196.120	$(1^-,2)$	380.81 *14*	10 *3*	1815.152	1^+				
		825.15 *14*	4.2 *10*	1371.133	1^-				
		1242.56 *4*	35 *7*	953.512	$2^+,3^+$				
		1419.48 *4*	16 *3*	776.593	2^+				
		1993.47[b] *19*	18 *3*	202.496	3^-				
		2196.00 *5*	100 *10*	0.0	2^-				
2216.66	8^+	1534.64[@] *4*	100[@]	682.01	7^+	M1+E2	−0.73 *14*	3.39×10^{-4}	Mult.,δ: from $\gamma(\theta)$ and lin pol in ^{74}Ge(^{18}O,npγ),^{76}Ge(^{18}O,3npγ). Other: δ=−0.68 *5* in (^{11}B,3nγ).
2240.6	$5^+,6^+$	943[§]	100[§]	1298.0	$(5,6,7)^+$				
		1193[§]	82[§]	1047.22	(5^+)				
2244.30	$(1,2^-)$	1032.60 *6*	16 *3*	1211.578	0^-				
		1290.83 *10*	14 *3*	953.512	$2^+,3^+$				
		1467.63 *7*	48 *10*	776.593	2^+				
		2244.28 *6*	100 *10*	0.0	2^-				
2365.964	1^-	605.00 *3*	100 *19*	1760.977	2^-				
		724.98 *7*	12.1 *25*	1640.914	1^-				
		794.38 *4*	60 *12*	1571.614	$2^-,(3)^-$				
		994.76 *8*	11.4 *23*	1371.133	1^-				
		2163.35 *12*	13.2 *16*	202.496	3^-				
		2365.92 *6*	19.1 *19*	0.0	2^-				
2454.84?	9^+	238.50[@b] *3*	100[@]	2216.66	8^+	M1(+E2)	+0.03 *8*	0.0178 *4*	Mult.,δ: from $\gamma(\theta)$ and lin pol in ^{74}Ge(^{18}O,npγ),^{76}Ge(^{18}O,3npγ).
2475.92	2^-	715.5[a] *5*	1.1[a] *4*	1760.977	2^-				
		835.43 *20*	4.3 *12*	1640.914	1^-				
		904.7[a] *4*	1.8[a] *9*	1571.614	$2^-,(3)^-$				
		1059.09 *15*	5.0 *12*	1416.581	$(2^-),3^-$				
		1104.72 *13*	5.0 *11*	1371.133	1^-				
		1264.25 *6*	10.7 *22*	1211.578	0^-				
		2273.39 *6*	100 *11*	202.496	3^-				
		2475.98 *8*	23.0 *25*	0.0	2^-				
2495.48	$(2,1^-)$	680.39 *15*	15 *3*	1815.152	1^+				
		923.66[a] *42*	8[a] *3*	1571.614	$2^-,(3)^-$				

$^{90}_{39}Y_{51}$-8

$\gamma(^{90}Y)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f
2495.48	(2,1⁻)	1079.02 *11*	19 *4*	1416.581	(2⁻),3⁻
		1542.3 *3*	24 *10*	953.512	2⁺,3⁺
		2292.87 *6*	100 *10*	202.496	3⁻
		2495.38 *5*	68 *7*	0.0	2⁻
2504.613	2⁻	689.45[a] *8*	3.9[a] *8*	1815.152	1⁺
		693.80 *17*	4.5 *13*	1811.02	(2⁻),3⁻
		743.21[a] *21*	1.3[a] *4*	1760.977	2⁻
		1087.94 *4*	15 *3*	1416.581	(2⁻),3⁻
		1133.62 *12*	4.3 *10*	1371.133	1⁻
		1293.07 *17*	2.2 *6*	1211.578	0⁻
		1551.18[a] *10*	4.4[a] *10*	953.512	2⁺,3⁺
		2302.05 *6*	22.2 *24*	202.496	3⁻
		2504.61 *5*	100 *10*	0.0	2⁻
2623.99	1⁻	862.3[a] *3*	7.9[a] *21*	1760.977	2⁻
		1847.99 *21*	4.8 *12*	776.593	2⁺
		2623.95 *5*	100 *10*	0.0	2⁻
2631.93	(1⁻,2,3⁻)	871.01 *14*	17 *5*	1760.977	2⁻
		1060.8[a] *3*	13[a] *4*	1571.614	2⁻,(3)⁻
		1855.07 *18*	20 *5*	776.593	2⁺
		2429.48 *5*	100 *10*	202.496	3⁻
2663.28	(1⁻,2⁻)	1452.05 *21*	12 *3*	1211.578	0⁻
		2461.06 *17*	32 *8*	202.496	3⁻
		2663.27 *5*	100 *10*	0.0	2⁻
2719.35	(1,2⁻)	904.7[a] *4*	9[a] *5*	1815.152	1⁺
		1302.57[a] *24*	13[a] *3*	1416.581	(2⁻),3⁻
		1347.96 *22*	13 *3*	1371.133	1⁻
		1507.7 *2*	53 *20*	1211.578	0⁻
		1942.73 *5*	100 *20*	776.593	2⁺
		2719.29 *8*	25 *3*	0.0	2⁻
2749.240	(1⁻,2,3⁻)	937.75[b] *14*	2.9 *6*	1811.02	(2⁻),3⁻
		988.37 *14*	2.0 *5*	1760.977	2⁻
		1177.54 *6*	2.7 *6*	1571.614	2⁻,(3)⁻
		1332.68 *3*	12.3 *25*	1416.581	(2⁻),3⁻
		1378.08 *3*	9.7 *19*	1371.133	1⁻
		1972.3[b] *3*	4.5 *12*	776.593	2⁺
		2546.71 *5*	89 *9*	202.496	3⁻
		2749.24 *5*	100 *10*	0.0	2⁻
2758.078	(1⁻,2⁻)	997.02 *5*	39 *8*	1760.977	2⁻
		1117.06 *7*	15 *3*	1640.914	1⁻
		1186.47 *4*	85 *16*	1571.614	2⁻,(3)⁻
		1341.0 *3*	9 *3*	1416.581	(2⁻),3⁻

$^{90}_{39}Y_{51}$-9

Adopted Levels, Gammas (continued)

$\gamma(^{90}Y)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	α[#]	Comments
2758.078	$(1^-,2^-)$	1386.97 *9*	13 *3*	1371.133	1^-			
		1546.51 *5*	59 *13*	1211.578	0^-			
		2555.62 *5*	47 *5*	202.496	3^-			
		2758.04 *6*	100 *10*	0.0	2^-			
2838.32	1,2	705.0 *3*	6.7 *22*	2133.502	$1,2^-$			
		1023.07 *5*	65 *13*	1815.152	1^+			
		1884.78 *5*	84 *17*	953.512	$2^+,3^+$			
		2838.42 *5*	100 *10*	0.0	2^-			
2847.42	1^-	1086.19[b] *22*	10 *3*	1760.977	2^-			
		1206.30 *12*	40 *13*	1640.914	1^-			
		1635.32[b] *19*	25 *6*	1211.578	0^-			
		2070.94 *18*	10.9 *21*	776.593	2^+			
		2847.39 *5*	100 *9*	0.0	2^-			
2858.86	(9^+)	642.2[‡] *3*	100[‡]	2216.66	8^+	(M1+E2)	0.00177 *15*	Mult.: from $\gamma(\theta)$ and lin pol in $^{74}Ge(^{18}O,np\gamma)$,$^{76}Ge(^{18}O,3np\gamma)$;
2859.35	2^-	1098.1[a] *3*	16[a] *5*	1760.977	2^-			
		1648.01 *18*	15 *4*	1211.578	0^-			
		1904.9[b] *5*	26 *14*	953.512	$2^+,3^+$			
		2656.75 *5*	100 *10*	202.496	3^-			
		2859.36 *5*	89 *9*	0.0	2^-			
2937.5		1125[§]	70[§]	1811.02	$(2^-),3^-$			
		1178[§]	60[§]	1760.977	2^-			
		1520[§]	60[§]	1416.581	$(2^-),3^-$			
		1985[§]	100[§]	953.512	$2^+,3^+$			
2986.10	$(1^-,2)$	789.91 *12*	51 *11*	2196.120	$(1^-,2)$			
		1170.89 *13*	28 *7*	1815.152	1^+			
		1345.28 *9*	45 *10*	1640.914	1^-			
		1615.04 *9*	31 *7*	1371.133	1^-			
		2032.34 *10*	100 *11*	953.512	$2^+,3^+$			
		2783.74 *10*	50 *7*	202.496	3^-			
		2986.18 *9*	83 *11*	0.0	2^-			
2992.35	$(1^-),2^-$	748.0 *3*	4.4 *13*	2244.30	$(1,2^-)$			
		1181.42[a] *22*	3.3[a] *11*	1811.02	$(2^-),3^-$			
		1231.30 *8*	11.6 *24*	1760.977	2^-			
		1780.61[b] *11*	100 *20*	1211.578	0^-			
		2789.93 *7*	26 *3*	202.496	3^-			
		2992.13 *9*	6.0 *7*	0.0	2^-			
3002.3	3^-	2226[§]	40[§]	776.593	2^+			
		3003[§]	100[§]	0.0	2^-			
3002.69	$(1^-,2)$	758.26 *23*	43 *13*	2244.30	$(1,2^-)$			

$^{90}_{39}Y_{51}$-10

Adopted Levels, Gammas (continued)

$\gamma(^{90}Y)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	δ[†]	α[#]	Comments
3002.69	$(1^-,2)$	1188.1 *3*	37 *12*	1815.152	1^+				
		1430.59[a] *19*	31[a] *7*	1571.614	$2^-,(3)^-$				
		2049.31 *10*	81 *9*	953.512	$2^+,3^+$				
		2800.24 *12*	47 *6*	202.496	3^-				
		3002.47 *10*	100 *6*	0.0	2^-				
3043.50	$(1^-,2,3^-)$	1402.67 *11*	34 *7*	1640.914	1^-				
		1471.88 *11*	36 *8*	1571.614	$2^-,(3)^-$				
		1626.82 *12*	60 *13*	1416.581	$(2^-),3^-$				
		2090.6 *4*	27 *10*	953.512	$2^+,3^+$				
		2840.95 *6*	100 *11*	202.496	3^-				
		3043.42 *7*	70 *4*	0.0	2^-				
3048.2	$3^-,4^-$	3047[§b]	100[§]	0.0	2^-				
3097.06	(10^+)	238.2[‡] *1*	100[‡]	2858.86	(9^+)	M1(+E2)	+0.03 *8*	0.0179 *4*	Mult.,δ: from $\gamma(\theta)$ and lin pol in $^{74}Ge(^{18}O,np\gamma)$,$^{76}Ge(^{18}O,3np\gamma)$;
3143.84	$(1^-,2,3^-)$	1727.22 *4*	100 *21*	1416.581	$(2^-),3^-$				
		2190.33 *5*	59 *6*	953.512	$2^+,3^+$				
		2941.30 *5*	53 *5*	202.496	3^-				
		3143.0 *3*	5.3 *15*	0.0	2^-				
3160.211	1^-	915.78 *7*	8.8 *18*	2244.30	$(1,2^-)$				
		1399.24 *4*	19 *4*	1760.977	2^-				
		1519.31 *4*	26 *5*	1640.914	1^-				
		3160.18 *6*	100 *5*	0.0	2^-				
3312.408	$(2,1^-)$	648.87[a] *16*	5.2[a] *12*	2663.28	$(1^-,2^-)$				
		837.2[a] *3*	4.8[a] *17*	2475.92	2^-				
		1497.25 *6*	18 *4*	1815.152	1^+				
		1551.18[a] *10*	13[a] *3*	1760.977	2^-				
		1671.41[a] *22*	5.0[a] *12*	1640.914	1^-				
		1895.81 *4*	100 *19*	1416.581	$(2^-),3^-$				
		3109.87 *6*	32.6 *17*	202.496	3^-				
		3312.36 *8*	11.0 *7*	0.0	2^-				
3404.83	$(1^-,2,3^-)$	909.26 *11*	51 *12*	2495.48	$(2,1^-)$				
		1988.53 *13*	100 *21*	1416.581	$(2^-),3^-$				
		2628.37 *20*	35 *7*	776.593	2^+				
		3202.55 *10*	46 *4*	202.496	3^-				
		3404.62 *24*	63 *9*	0.0	2^-				
3469.14	$(1^-,2,3^-)$	630.4[a] *3*	12[a] *4*	2838.32	1,2				
		749.9 *3*	25 *8*	2719.35	$(1,2^-)$				
		837.2[a] *3*	14[a] *5*	2631.93	$(1^-,2,3^-)$				
		845.5[a] *5*	19[a] *8*	2623.99	1^-				
		2515.60 *5*	100 *10*	953.512	$2^+,3^+$				
		3266.30 *11*	27.1 *21*	202.496	3^-				

$^{90}_{39}Y_{51}$-11

$\gamma(^{90}Y)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f
3469.14	(1⁻,2,3⁻)	3469.24 *15*	9.7 *7*	0.0	2⁻
3476.06	(1,2⁻)	628.78 *24*	8.2 *25*	2847.42	1⁻
		637.85 *12*	10.7 *25*	2838.32	1,2
		756.71 *7*	36 *8*	2719.35	(1,2⁻)
		843.69[a] *19*	13[a] *3*	2631.93	(1⁻,2,3⁻)
		972.1 *3*	14 *5*	2504.613	2⁻
		980.95 *22*	7.5 *18*	2495.48	(2,1⁻)
		1835.4[b] *5*	43 *14*	1640.914	1⁻
		2104.87 *5*	100 *10*	1371.133	1⁻
		2264.53 *7*	78 *8*	1211.578	0⁻
		2699.45 *15*	13.6 *21*	776.593	2⁺
		3475.96 *7*	46.4 *25*	0.0	2⁻
3555.727	(1⁻,2,3⁻)	696.38 *7*	10.5 *22*	2859.35	2⁻
		718.0[a] *4*	1.7[a] *7*	2838.32	1,2
		923.7[a] *4*	2.2[a] *9*	2631.93	(1⁻,2,3⁻)
		1190.6[a] *3*	2.5[a] *9*	2365.964	1⁻
		1359.55 *4*	35 *7*	2196.120	(1⁻,2)
		1422.33 *5*	9.7 *20*	2133.502	1,2⁻
		1744.58 *11*	5.9 *14*	1811.02	(2⁻),3⁻
		1795.08[a] *25*	5.8[a] *19*	1760.977	2⁻
		1914.76 *5*	25 *5*	1640.914	1⁻
		2138.97 *6*	100 *10*	1416.581	(2⁻),3⁻
		2184.65 *5*	52 *5*	1371.133	1⁻
		2779.15 *8*	6.6 *7*	776.593	2⁺
		3353.07 *8*	8.1 *5*	202.496	3⁻
		3555.61 *7*	57 *3*	0.0	2⁻
3574.501	1⁻	715.5[a] *5*	2.1[a] *8*	2859.35	2⁻
		816.45 *6*	18 *4*	2758.078	(1⁻,2⁻)
		855.30 *20*	4.4 *13*	2719.35	(1,2⁻)
		943.24 *24*	11 *3*	2631.93	(1⁻,2,3⁻)
		1069.75 *5*	25 *5*	2504.613	2⁻
		1330.01[a] *24*	4.2[a] *13*	2244.30	(1,2⁻)
		1441.10[a] *20*	6.0[a] *16*	2133.502	1,2⁻
		1933.47 *5*	42 *9*	1640.914	1⁻
		2002.98 *6*	22.1 *24*	1571.614	2⁻,(3)⁻
		2362.93 *5*	100 *10*	1211.578	0⁻
		2797.95 *12*	7.8 *10*	776.593	2⁺
		3574.55 *8*	15.3 *8*	0.0	2⁻
3602.07	1⁻	743.21[a] *21*	7.1[a] *22*	2858.86	(9⁺)
		754.21 *16*	11 *3*	2847.42	1⁻
		843.69[a] *19*	16[a] *4*	2758.078	(1⁻,2⁻)
3602.07	1⁻	881.5[a] *5*	8[a] *4*	2719.35	(1,2⁻)
		882.8 *3*	8 *4*	2719.35	(1,2⁻)
		970.8 *3*	16 *7*	2631.93	(1⁻,2,3⁻)
		977.96 *9*	26 *5*	2623.99	1⁻
		1790.24[b] *22*	42 *10*	1811.02	(2⁻),3⁻
		1961.9 *3*	11 *3*	1640.914	1⁻
		2030.5[b] *5*	44 *18*	1571.614	2⁻,(3)⁻
		2230.88 *7*	47 *5*	1371.133	1⁻
		2648.56 *6*	52 *5*	953.512	2⁺,3⁺
		3399.55 *9*	38 *3*	202.496	3⁻
		3602.03 *7*	100 *5*	0.0	2⁻
3627.647	1⁻	964.38 *6*	56 *12*	2663.28	(1⁻,2⁻)
		1132.03 *9*	32 *7*	2495.48	(2,1⁻)
		1151.54 *9*	21 *4*	2475.92	2⁻
		1383.16 *7*	22 *5*	2244.30	(1,2⁻)
		1494.48 *20*	7.8 *22*	2133.502	1,2⁻
		1812.35 *11*	52 *11*	1815.152	1⁺
		1867.01 *18*	9.5 *22*	1760.977	2⁻
		1986.6 *4*	9 *3*	1640.914	1⁻
		2256.51 *6*	100 *10*	1371.133	1⁻
		2416.11 *6*	27 *3*	1211.578	0⁻
		3627.71 *8*	26.3 *13*	0.0	2⁻
3685.23	(1,2⁻)	692.64[a] *19*	28[a] *9*	2992.35	(1⁻),2⁻
		699.01 *14*	15 *3*	2986.10	(1⁻,2)
		845.5[a] *5*	15[a] *6*	2838.32	1,2
		965.92 *12*	35 *8*	2719.35	(1,2⁻)
		1319.26 *13*	18 *4*	2365.964	1⁻
		1441.10[a] *20*	13[a] *3*	2244.30	(1,2⁻)
		1488.92 *8*	23 *5*	2196.120	(1⁻,2)
		1869.98[a] *10*	26[a] *5*	1815.152	1⁺
		2043.7 *3*	13.1 *23*	1640.914	1⁻
		2268.81 *14*	13.1 *17*	1416.581	(2⁻),3⁻
		2314.57 *23*	9.7 *23*	1371.133	1⁻
		2473.97 *16*	100 *11*	1211.578	0⁻
		2731.9 *3*	9.1 *23*	953.512	2⁺,3⁺
		2908.80 *9*	20.5 *23*	776.593	2⁺
3692.29	1⁻	648.87[a] *16*	14[a] *3*	3043.50	(1⁻,2,3⁻)
		689.45[a] *8*	30[a] *6*	3002.69	(1⁻,2)
		833.33 *21*	16 *4*	2859.35	2⁻
		2320.97 *7*	90 *9*	1371.133	1⁻
		2915.76 *5*	100 *10*	776.593	2⁺

$^{90}_{39}Y_{51}$-12

$\gamma(^{90}Y)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f
3692.29	1^-	3692.19 *7*	17.3 *12*	0.0	2^-
3934.47	1^-	890.8 *3*	11 *4*	3043.50	$(1^-,2,3^-)$
		948.73 *15*	22 *7*	2986.10	$(1^-,2)$
		1438.97 *11*	41 *9*	2495.48	$(2,1^-)$
		1568.45 *5*	100 *21*	2365.964	1^-
		2563.81 *19*	33 *7*	1371.133	1^-
		2722.72 *6*	66 *7*	1211.578	0^-
		3731.98 *8*	39.6 *19*	202.496	3^-
		3934.41 *8*	84 *5*	0.0	2^-
3953.54	$(1^-,2^-)$	793.14 *10*	100 *23*	3160.211	1^-
		1321.93[a] *23*	32[a] *8*	2631.93	$(1^-,2,3^-)$
		1330.01[a] *24*	19[a] *6*	2623.99	1^-
		1587.6[a] *4*	23[a] *11*	2365.964	1^-
		1757.25 *9*	55 *12*	2196.120	$(1^-,2)$
		2142.55 *8*	82 *10*	1811.02	$(2^-),3^-$
		2312.65 *13*	39 *6*	1640.914	1^-
		2381.9[a] *3*	14[a] *4*	1571.614	$2^-,(3)^-$
		2742.35 *21*	14 *4*	1211.578	0^-
		3751.03 *14*	16.7 *12*	202.496	3^-
		3953.55 *9*	41.7 *24*	0.0	2^-
4037.54	$(1,2^-)$	893.56 *12*	40 *9*	3143.84	$(1^-,2,3^-)$
		1190.6[a] *3*	16[a] *6*	2847.42	1^-
		1279.31 *10*	65 *14*	2758.078	$(1^-,2^-)$
		1288.25 *13*	35 *9*	2749.240	$(1^-,2,3^-)$
		1533.21 *15*	27 *7*	2504.613	2^-
		1561.76 *9*	48 *11*	2475.92	2^-
		1671.41[a] *22*	23[a] *6*	2365.964	1^-
		1842.0[a] *3*	12[a] *3*	2196.120	$(1^-,2)$
		2396.70 *7*	66 *7*	1640.914	1^-
		2465.64 *19*	13.2 *22*	1571.614	$2^-,(3)^-$
		2825.90 *6*	90 *9*	1211.578	0^-
		3260.94 *8*	100 *6*	776.593	2^+
4100.49	$(1^-,2^-)$	630.4[a] *3*	11[a] *4*	3469.14	$(1^-,2,3^-)$
		1098.1[a] *3*	12[a] *4*	3002.3	3^-
		1476.24 *9*	26 *5*	2623.99	1^-
		1604.86 *9*	33 *7*	2495.48	$(2,1^-)$
		1624.33 *19*	37 *9*	2475.92	2^-
		1966.84[a] *16*	26[a] *6*	2133.502	$1,2^-$
		2285.37[a] *8*	70[a] *7*	1815.152	1^+
		2459.92 *20*	32 *10*	1640.914	1^-
		2889.06 *7*	100 *10*	1211.578	0^-

$^{90}_{39}Y_{51}$-13

$\gamma(^{90}Y)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	δ[†]	α[#]	Comments
4100.49	(1⁻,2⁻)	3324.30 *22*	23 *5*	776.593	2⁺				
4161.28	(0,1,2)	1158.7 *3*	9 *3*	3002.69	(1⁻,2)				
		1302.57[a] *24*	13[a] *3*	2859.35	2⁻				
		1323.8 *4*	10 *3*	2838.32	1,2				
		1795.08[a] *25*	23[a] *8*	2365.964	1⁻				
		1964.7[b] *6*	42 *16*	2196.120	(1⁻,2)				
		2345.94 *10*	35 *4*	1815.152	1⁺				
		2520.15 *8*	52 *5*	1640.914	1⁻				
		4161.30 *10*	100 *5*	0.0	2⁻				
4210.81	(0⁻,1,2,3⁻)	1050.71 *10*	42 *8*	3160.211	1⁻				
		1208.29 *11*	54 *12*	3002.69	(1⁻,2)				
		1461.96 *20*	19 *5*	2749.240	(1⁻,2,3⁻)				
		1587.6[a] *4*	23[a] *11*	2623.99	1⁻				
		1966.84[a] *16*	49[a] *11*	2244.30	(1,2⁻)				
		2077.06 *11*	74 *10*	2133.502	1,2⁻				
		2399.66[a] *6*	95[a] *10*	1811.02	(2⁻),3⁻				
		2639.07 *14*	27 *4*	1571.614	2⁻,(3)⁻				
		4210.79 *9*	100 *5*	0.0	2⁻				
4212.50	(11⁺)	1115.4[‡] *1*	100.0[‡] *5*	3097.06	(10⁺)	M1(+E2)	0.00 *5*	4.89×10^{-4}	Mult.,δ: from $\gamma(\theta)$ and lin pol in ^{74}Ge(^{18}O,npγ),^{76}Ge(^{18}O,3npγ);
		1353.7[‡] *3*	37.8[‡] *5*	2858.86	(9⁺)	E2		3.61×10^{-4}	Mult.: Q from $\gamma\gamma(\theta)$(DCO) in ^{82}Se(^{11}B,3nγ), $\Delta J\pi$=no from level scheme.
4267.38	(1,2)	692.64[a] *19*	21[a] *7*	3574.501	1⁻				
		862.3[a] *3*	11[a] *3*	3404.83	(1⁻,2,3⁻)				
		1107.45 *16*	27 *7*	3160.211	1⁻				
		1281.32[a] *10*	32[a] *7*	2986.10	(1⁻,2)				
		1428.79 *23*	7.4 *21*	2838.32	1,2				
		1643.46 *6*	34 *7*	2623.99	1⁻				
		1772.08 *12*	63 *13*	2495.48	(2,1⁻)				
		2452.34 *24*	6.2 *12*	1815.152	1⁺				
		2896.05 *15*	6.2 *8*	1371.133	1⁻				
		3490.64 *10*	9.9 *8*	776.593	2⁺				
		4267.35 *8*	100 *5*	0.0	2⁻				
4325.06	1⁻,2⁻	723.03 *12*	48 *10*	3602.07	1⁻				
		1181.42[a] *22*	19[a] *7*	3143.84	(1⁻,2,3⁻)				
		1281.32[a] *10*	100[a] *21*	3043.50	(1⁻,2,3⁻)				
		1321.93[a] *23*	35[a] *9*	3002.69	(1⁻,2)				
		1829.0 *3*	17 *5*	2495.48	(2,1⁻)				
		2129.32 *23*	25 *5*	2196.120	(1⁻,2)				
		2509.98 *11*	34 *4*	1815.152	1⁺				

$^{90}_{39}Y_{51}$-14

$\gamma(^{90}Y)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[†]	δ[†]	α[#]	Comments
4325.06	$1^-,2^-$	4122.69 *17*	22.1 *13*	202.496	3^-				
4451.576	$(1,2^-)$	895.74 *6*	51 *11*	3555.727	$(1^-,2,3^-)$				
		976.2 *3*	9 *3*	3476.06	$(1,2^-)$				
		1448.88 *4*	73 *15*	3002.69	$(1^-,2)$				
		1732.24 *11*	58 *13*	2719.35	$(1,2^-)$				
		2086.01 *20*	12.4 *24*	2365.964	1^-				
		2636.33 *5*	69 *7*	1815.152	1^+				
		2690.64 *22*	5.9 *12*	1760.977	2^-				
		2810.75 *7*	25 *3*	1640.914	1^-				
		3239.67 *16*	8.3 *12*	1211.578	0^-				
		3498.02 *8*	100 *7*	953.512	$2^+,3^+$				
		3674.98 *11*	20.1 *12*	776.593	2^+				
4515.93	$(1,2^-)$	959.9 *3*	11 *6*	3555.727	$(1^-,2,3^-)$				
		1039.75 *10*	48 *10*	3476.06	$(1,2^-)$				
		1796.66 *13*	80 *18*	2719.35	$(1,2^-)$				
		2381.9[a] *3*	14[a] *3*	2133.502	$1,2^-$				
		2875.08 *6*	100 *10*	1640.914	1^-				
		2944.42 *9*	51 *6*	1571.614	$2^-,(3)^-$				
		3144.59 *10*	86 *7*	1371.133	1^-				
		4313.17 *11*	28.7 *11*	202.496	3^-				
4518.5	(12^+)	306.10[‡b] *10*	65.2[‡] *4*	4212.50	(11^+)	M1(+E2)	−0.03 *6*	0.00950 *15*	Mult.,δ: from $\gamma(\theta)$ and lin pol in ^{74}Ge(^{18}O,npγ),^{76}Ge(^{18}O,3npγ). I_γ: other: 68 *5* in ^{74}Ge(^{18}O,npγ),^{76}Ge(^{18}O,3npγ).
		1421.30[‡b] *20*	100.0[‡] *18*	3097.06	(10^+)	(E2)		3.49×10^{-4}	Mult.: from $\gamma(\theta)$ and lin pol in ^{74}Ge(^{18}O,npγ),^{76}Ge(^{18}O,3npγ);
4529.65	$(0^-,1,2,3^-)$	1060.8[a] *3*	18[a] *6*	3469.14	$(1^-,2,3^-)$				
		1125.04 *9*	35 *7*	3404.83	$(1^-,2,3^-)$				
		1217.08 *8*	44 *9*	3312.408	$(2,1^-)$				
		1543.60 *12*	100 *25*	2986.10	$(1^-,2)$				
		1691.6[a] *3*	11[a] *4*	2838.32	1,2				
		2034.7 *3*	48 *7*	2495.48	$(2,1^-)$				
		2285.37[a] *8*	98[a] *10*	2244.30	$(1,2^-)$				
		4529.48 *10*	46 *3*	0.0	2^-				
4533.14	$(1^-),2^-$	930.82 *17*	11 *3*	3602.07	1^-				
		1128.87 *23*	8.4 *24*	3404.83	$(1^-,2,3^-)$				
		1673.66 *10*	29 *6*	2859.35	2^-				
		1869.98[a] *10*	27[a] *5*	2663.28	$(1^-,2^-)$				
		2057.9 *4*	7.8 *24*	2475.92	2^-				
		2336.64 *18*	17 *3*	2196.120	$(1^-,2)$				
		2399.66[a] *6*	48[a] *5*	2133.502	$1,2^-$				

$^{90}_{39}Y_{51}$-15

$\gamma(^{90}Y)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	α[#]	Comments
4533.14	(1⁻),2⁻	3579.54 *10*	16.2 *12*	953.512	2⁺,3⁺			
		4532.91 *9*	100 *5*	0.0	2⁻			
4543.6	(11⁺)	1446.6[‡] *2*	100[‡]	3097.06	(10⁺)	D+Q	3.43×10^{-4} *6*	Mult.: D+Q from $\gamma\gamma(\theta)$(DCO) in $^{82}Se(^{11}B,3n\gamma)$.
4835.05	(1,2⁻)	673.6 *3*	24 *8*	4161.28	(0,1,2)			
		881.5[a] *5*	25[a] *13*	3953.54	(1⁻,2⁻)			
		1143.38 *25*	22 *6*	3692.29	1⁻			
		1430.59[a] *19*	31[a] *8*	3404.83	(1⁻,2,3⁻)			
		1691.6[a] *3*	18[a] *6*	3143.84	(1⁻,2,3⁻)			
		1842.0[a] *3*	16[a] *5*	2992.35	(1⁻),2⁻			
		2203.14 *8*	100 *10*	2631.93	(1⁻,2,3⁻)			
		2469.53 *24*	18 *3*	2365.964	1⁻			
		2701.23 *10*	91 *12*	2133.502	1,2⁻			
		3073.84 *17*	19.4 *15*	1760.977	2⁻			
		3193.96 *10*	46 *3*	1640.914	1⁻			
		3263.29 *20*	37 *5*	1571.614	2⁻,(3)⁻			
		3623.14 *12*	26.9 *15*	1211.578	0⁻			
		3882.9 *8*	6 *3*	953.512	2⁺,3⁺			
		4058.39 *9*	57 *3*	776.593	2⁺			
		4834.84 *17*	37 *3*	0.0	2⁻			
5068.39		1971.3[‡] *9*	7.0[‡] *14*	3097.06	(10⁺)			
		2209.5[‡] *1*	100[‡] *4*	2858.86	(9⁺)			
5102.6	(12)	890.2[‡] *6*	100[‡]	4212.50	(11⁺)	D	3.37×10^{-4}	Mult.: from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$.
5111.46	(13⁺)	593.0[‡] *2*	70[‡] *4*	4518.5	(12⁺)			
		898.8[‡] *2*	100[‡] *2*	4212.50	(11⁺)	E2	8.02×10^{-4}	Mult.: Q from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, assumed E2 from assignment to γ-ray sequence.
5359.7	(14⁺)	248.2[‡] *2*	100[‡]	5111.46	(13⁺)	(M1)	0.01610	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, $\Delta\pi$=no from level scheme.
5525.6	(12⁺)	2428.4[‡] *7*	100[‡]	3097.06	(10⁺)			
5541.1	(12⁺)	2444.3[‡] *7*	100[‡]	3097.06	(10⁺)			
5674.2	(12⁺)	2577.4[‡] *4*	100[‡]	3097.06	(10⁺)			
6065.0	(13⁻)	390.9[‡] *3*	6.0[‡] *12*	5674.2	(12⁺)	(E1)	0.00225	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, $\Delta\pi$=yes from level scheme.
		523.9[‡] *2*	11.9[‡] *12*	5541.1	(12⁺)	(E1)	1.08×10^{-3}	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, $\Delta\pi$=yes from level scheme.
		539.4[‡] *3*	11.9[‡] *12*	5525.6	(12⁺)	(E1)	1.01×10^{-3}	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, $\Delta\pi$=yes from level scheme.
		962.5[‡] *2*	100.0[‡] *24*	5102.6	(12)	(M1+E2)	6.74×10^{-4} *13*	Mult.: D+Q from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, $\Delta\pi$=no from level scheme.

$^{90}_{39}Y_{51}$-16

$\gamma(^{90}Y)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	α[#]	Comments
6065.0	(13⁻)	1546.0[‡] *3*	91.7[‡] *12*	4518.5	(12⁺)	(E1)	4.05×10^{-4}	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, $\Delta\pi$=yes from level scheme.
		2968.3[‡] *9*	11.9[‡] *12*	3097.06	(10⁺)	[E3]	6.41×10^{-4}	
6234.7	(13⁻)	1716.1[‡] *5*	100[‡]	4518.5	(12⁺)	(E1)	5.19×10^{-4}	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, $\Delta\pi$=yes from level scheme.
6822.52	(13⁺)	1711.0[‡] *6*	84[‡] *6*	5111.46	(13⁺)			
		1719.9[‡] *4*	21.6[‡] *20*	5102.6	(12)	(E1)	5.21×10^{-4}	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, $\Delta\pi$=yes from level scheme.
		1754.1[‡] *1*	100[‡] *14*	5068.39				
		2279.4[‡] *6*	18[‡] *4*	4543.6	(11⁺)			
		2303.9[‡] *3*	15.7[‡] *20*	4518.5	(12⁺)			
6831.13	13⁽⁺⁾	1719.6[‡] *2*	85[‡] *4*	5111.46	(13⁺)	(M1)	3.54×10^{-4}	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, $\Delta\pi$=no from level scheme.
		1728.4[‡] *3*	35[‡] *4*	5102.6	(12)	(E1)	5.27×10^{-4}	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, $\Delta\pi$=yes from level scheme.
		1760.7[‡b] *5*	54[‡] *15*	5068.39				E_γ: poor fit. Level-energy difference=1762.6.
		2287.5[‡] *4*	100[‡] *4*	4543.6	(11⁺)			
		2313.1[‡] *4*	31[‡] *4*	4518.5	(12⁺)			
6856.992	1⁻	2021.84 *5*	0.39 *4*	4835.05	(1,2⁻)			
		2323.83 *6*	0.35 *3*	4533.14	(1⁻),2⁻			
		2327.37 *5*	1.05 *11*	4529.65	(0⁻,1,2,3⁻)			
		2341.05 *5*	0.54 *5*	4515.93	(1,2⁻)			
		2405.39 *5*	0.97 *10*	4451.576	(1,2⁻)			
		2531.86 *7*	0.154 *16*	4325.06	1⁻,2⁻			
		2589.68 *5*	1.21 *13*	4267.38	(1,2)			
		2646.19 *5*	0.63 *6*	4210.81	(0⁻,1,2,3⁻)			
		2695.64 *5*	0.62 *6*	4161.28	(0,1,2)			
		2756.46 *5*	0.97 *10*	4100.49	(1⁻,2⁻)			
		2819.56 *7*	0.84 *8*	4037.54	(1,2⁻)			
		2903.45 *5*	0.51 *5*	3953.54	(1⁻,2⁻)			
		2922.47 *5*	0.79 *8*	3934.47	1⁻			
		3164.59 *6*	1.05 *5*	3692.29	1⁻			
		3171.75 *6*	0.66 *3*	3685.23	(1,2⁻)			
		3229.25 *6*	1.02 *5*	3627.647	1⁻			
		3254.87 *6*	1.05 *5*	3602.07	1⁻			
		3282.48 *6*	1.68 *8*	3574.501	1⁻			
		3301.30 *6*	2.43 *13*	3555.727	(1⁻,2,3⁻)			
		3380.94 *6*	1.40 *6*	3476.06	(1,2⁻)			
		3387.77 *7*	0.149 *8*	3469.14	(1⁻,2,3⁻)			

$^{90}_{39}Y_{51}$-17

$\gamma(^{90}Y)$ (continued)

E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f	Mult.†	α#	Comments
6856.992	1^-	3452.07 *8*	0.194 *10*	3404.83	$(1^-,2,3^-)$			
		3544.55 *7*	1.43 *8*	3312.408	$(2,1^-)$			
		3696.73 *7*	1.21 *6*	3160.211	1^-			
		3713.07 *7*	0.69 *3*	3143.84	$(1^-,2,3^-)$			
		3813.53 *8*	0.121 *6*	3043.50	$(1^-,2,3^-)$			
		3854.38 *13*	0.063 *6*	3002.69	$(1^-,2)$			
		3864.60 *8*	0.100 *5*	2992.35	$(1^-),2^-$			
		3870.84 *7*	0.79 *4*	2986.10	$(1^-,2)$			
		3997.40 *11*	0.098 *5*	2859.35	2^-			
		4009.56 *9*	0.79 *5*	2847.42	1^-			
		4018.68 *8*	0.421 *21*	2838.32	1,2			
		4098.92 *8*	0.95 *5*	2758.078	$(1^-,2^-)$			
		4107.74 *8*	7.4 *4*	2749.240	$(1^-,2,3^-)$			
		4137.35 *9*	0.186 *10*	2719.35	$(1,2^-)$			
		4193.73 *8*	0.214 *11*	2663.28	$(1^-,2^-)$			
		4225.11 *11*	0.0365 *16*	2631.93	$(1^-,2,3^-)$			
		4233.17 *18*	0.035 *3*	2623.99	1^-			
		4352.27 *8*	1.83 *10*	2504.613	2^-			
		4361.16 *12*	0.049 *3*	2495.48	$(2,1^-)$			
		4380.90 *9*	0.75 *4*	2475.92	2^-			
		4490.90 *9*	0.83 *5*	2365.964	1^-			
		4612.60 *9*	0.332 *17*	2244.30	$(1,2^-)$			
		4660.68 *9*	0.77 *4*	2196.120	$(1^-,2)$			
		4723.38 *12*	0.083 *5*	2133.502	$1,2^-$			
		5041.62 *10*	0.49 *3*	1815.152	1^+			
		5095.74 *10*	0.51 *3*	1760.977	2^-			
		5215.74 *20*	0.027 *3*	1640.914	1^-			
		5285.08 *11*	0.254 *13*	1571.614	$2^-,(3)^-$			
		5485.56 *12*	0.370 *19*	1371.133	1^-			
		5645.15 *13*	2.65 *13*	1211.578	0^-			
		6080.05 *14*	100 *5*	776.593	2^+			
		6654.07 *21*	0.314 *16*	202.496	3^-			
		6856.55 *3*	0.246 *13*	0.0	2^-			
6898.1	(15^-)	663.3‡ *3*	9‡ *4*	6234.7	(13^-)	E2	1.75×10^{-3}	Mult.: Q from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, assumed E2.
		833.1‡ *3*	100‡ *4*	6065.0	(13^-)	E2	9.66×10^{-4}	Mult.: Q from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, assumed E2.
		1538.4‡ *1*	45.0‡ *14*	5359.7	(14^+)	E1	4.00×10^{-4}	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, $\Delta\pi$=yes from level scheme.
		2379.6‡ *3*	10.0‡ *7*	4518.5	(12^+)	[E3]	4.83×10^{-4}	
7355.53	(14^+)	524.4‡ *1*	100‡ *4*	6831.13	$13^{(+)}$	(M1)	0.00259	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, M1 from assignment to band structure.
		533.0‡ *1*	75.0‡ *18*	6822.52	(13^+)	(M1)	0.00250	Mult.: D from $\gamma\gamma(\theta)$ in $^{82}Se(^{11}B,3n\gamma)$, M1 from assignment to band structure.

$^{90}_{39}Y_{51}$-18

Adopted Levels, Gammas (continued)

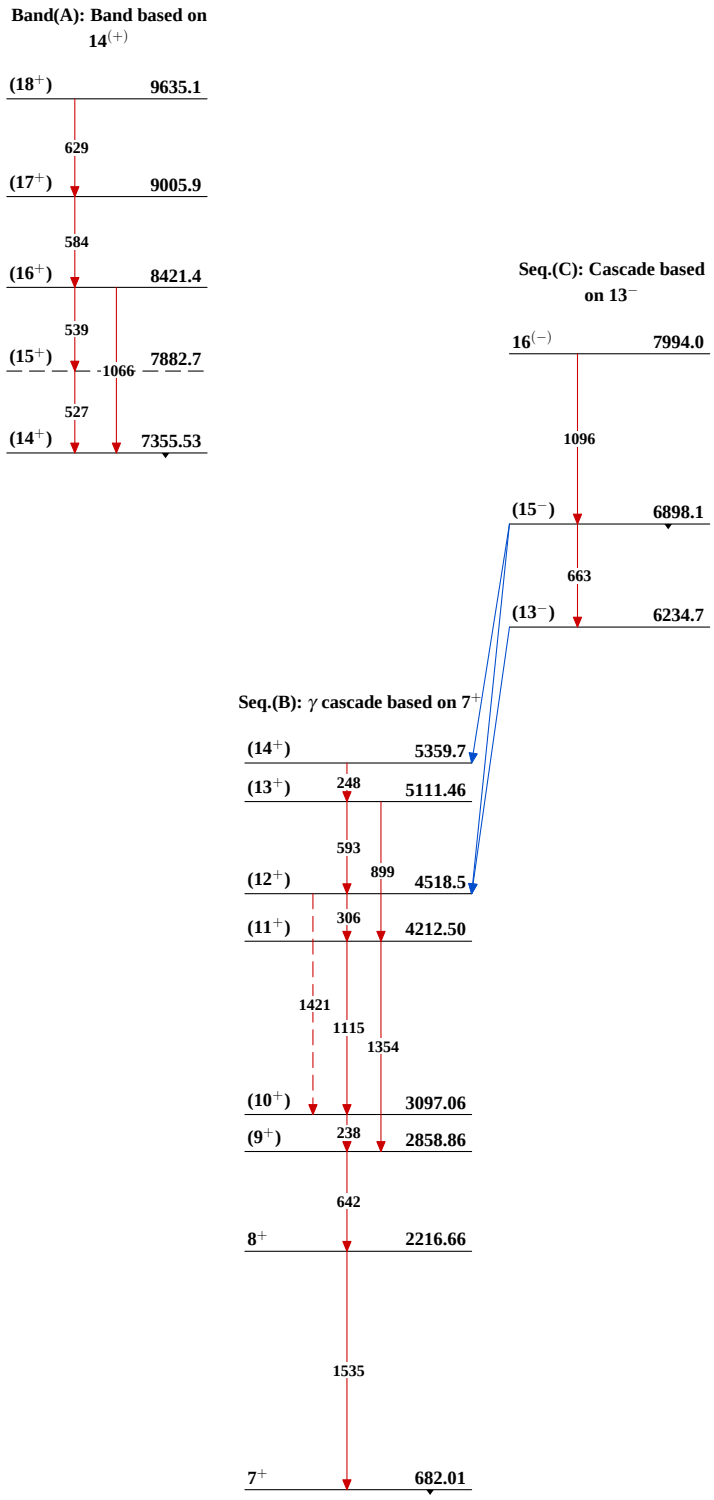
$\gamma(^{90}Y)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	α[#]	Comments
7882.7?	(15^+)	527.2[‡] *2*	100[‡]	7355.53	(14^+)	(M1)	0.00256	B(M1)(W.u.)=1.35 *+46−28* Mult.: D from $\gamma\gamma(\theta)$ in ^{82}Se(^{11}B,3nγ), M1 from assignment to band structure.
7994.0	$16^{(-)}$	1095.9[‡] *2*	100[‡]	6898.1	(15^-)	(M1)	5.06×10^{-4}	Mult.: D from $\gamma\gamma(\theta)$ in ^{82}Se(^{11}B,3nγ), M1 from assignment to γ sequence.
8421.4	(16^+)	538.7[‡] *1*	100[‡] *3*	7882.7?	(15^+)	(M1)	0.00243	B(M1)(W.u.)=0.181 *+29−23* Mult.: D from $\gamma\gamma(\theta)$ in ^{82}Se(^{11}B,3nγ), M1 from assignment to band structure.
		1065.8[‡] *7*	36[‡] *3*	7355.53	(14^+)	[E2]	5.39×10^{-4}	B(E2)(W.u.)=8.0 *+14−11*
9005.9	(17^+)	584.5[‡] *1*	100[‡]	8421.4	(16^+)	(M1)	0.00202	B(M1)(W.u.)=0.30 *+6−4* Mult.: D from $\gamma\gamma(\theta)$ in ^{82}Se(^{11}B,3nγ), M1 from assignment to band structure.
9317.1		1323.1[‡] *3*	100[‡]	7994.0	$16^{(-)}$			
9635.1	(18^+)	629.2[‡] *3*	100[‡]	9005.9	(17^+)			

[†] From (n,γ), E=thermal, except where noted.
[‡] From ^{82}Se(^{11}B,3nγ).
[§] From (d,pγ).
[&] From (α,nγ).
[@] From ^{74}Ge(^{18}O,npγ),^{76}Ge(^{18}O,3npγ).
[#] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[a] Multiply placed with undivided intensity.
[b] Placement of transition in the level scheme is uncertain.

$^{90}_{39}Y_{51}$-19

Adopted Levels, Gammas



$^{90}_{39}Y_{51}$

^{90}Sr β^- decay (28.91 y) 1983Ha35

Parent: ^{90}Sr: E=0; $J^\pi=0^+$; $T_{1/2}$=28.91 y *3*; Q(β^-)=545.9 *14*; %β^- decay=100.0

1983Ha35: Measured Eβ, Iβ. Magnetic spectrometer.

Others: 1964Da16, 1983Wa26.

For measurements of β^- using liquid scintillator detectors see 1993Gr09, 1993Gr18, 1994Gr21, 1994Gr30; using solid scintillator detectors, see 1993Va11, 1993Ya17, 1994Us01, 1994Sz09; detecting electron-induced Cerenkov radiation, see 1994Ci10,1994Br45,1995Ra27; using very high-gain avalanche diodes, see 1994Fa24. Using gas-flow proportional counters, see 1992Ba19; using photomultipliers, see 1992Bo35. Others: 1992Gr04, 1994Sa70, 1994He26.

For an investigation on the chirality of the electrons from ^{90}Sr β^- decay, see 1985Co31.

For measured first-forbidden shape factors, see 1964Da16 and 1983Ha35.

^{90}Y Levels

E(level)	J^π †	$T_{1/2}$ †
0	2^-	64.05 h *5*

† From the Adopted Levels.

β^- radiations

E(decay)	E(level)	Iβ^- †	Log *ft*	Comments
(545.9 *14*)	0	100	9.4^{1u} *1*	E(decay): other: 546.0 *16* (1983Ha35).

† Absolute intensity per 100 decays.

^{90}Y IT decay (3.19 h) 1974Kl06,1973Ha18

Parent: ^{90}Y: E=682.01 *5*; J$^{\pi}$=7^{+}; $T_{1/2}$=3.19 h *6*; %IT decay=99.99820 *20*
1978Ra05: ^{90}Y activity from ^{87}Rb(α,n). Measured Iγ. Ge(Li) detector.
1974Kl06: ^{90}Y activity from ^{89}Y(n,γ), ^{89}Y(d,p). Measured Iγ, $\gamma\gamma$ coin, $\gamma\gamma$(t), $\gamma\gamma(\theta)$. Plastic scintillators, Ge(Li) and NaI detectors.
1973Ha18: Measured Eγ, Iγ. Ge(Li) and Si detectors (1973Ha18).
See also: 1989Mu15, 1990Mu11, 1990Ne08.
Others: 1961He09, 1961Ha17, 1970Si21.

^{90}Y Levels

E(level)†	J$^{\pi}$†	$T_{1/2}$	Comments
0	2^{-}	64.05 h *5*	$T_{1/2}$: from the Adopted Levels.
202.53 *3*	3^{-}	250 ps *7*	g=−0.283 *23* g: from IPAC (1974Kl06). $T_{1/2}$: from 1974Kl06, delayed coin. Other: 180 ps *30* (1970Si21).
682.01 *5*	7^{+}	3.19 h *6*	%IT=99.9982 *2*; %β^{-}=0.0018 *2* E(level),$T_{1/2}$: from the Adopted Levels. %β^{-}: from measured Iγ(2319γ)/Iγ(479.5γ)=1.89×10^{-5} *18* (1976Gr16).

† From the Adopted Levels.

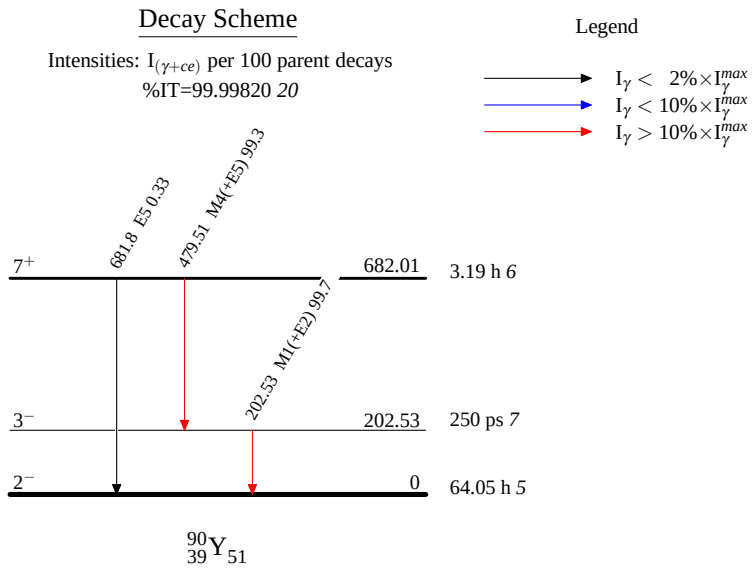
γ(^{90}Y)

Iγ normalization: From ΣI(γ+ce)(to g.s.)=99.9982 *2*.

E$_{\gamma}$†	I$_{\gamma}$§	E$_i$(level)	J$^{\pi}_i$	E$_f$	J$^{\pi}_f$	Mult.‡	δ‡	α&	Comments
202.53 *3*	106.8 *4*	202.53	3^{-}	0	2^{-}	M1(+E2)	−0.04 *4*	0.0273 *5*	I$_{\gamma}$: from Iγ(202γ)/Iγ(479γ)=1.072 *4* (1973Ha18). See comment on 479γ for derivation of Iγ(479γ). δ: From α(K)exp=0.0243 *14* and 479.5γ-202.5γ correlation with A$_2$=−0.178 *5* and A$_4$=0.009 *8* (1973Ha18).
479.51 *5*	99.65 *3*	682.01	7^{+}	202.53	3^{-}	M4(+E5)	<0.1	0.0965	I$_{\gamma}$: from Iγ(682γ)/Iγ(479γ)=0.0035 *3* (1978Ra05). Other: 0.0040 *8* (1974Kl06). δ: From B(E5)(W.u.)<300. α: α(exp)=0.101 *4* from intensity balance, using α(202)=0.0273 *3* and measured Iγ(202γ)/Iγ(479γ)=1.072 *4* (1973Ha18).
681.8 *6*	0.35 *3*	682.01	7^{+}	0	2^{-}	E5		0.0226	E$_{\gamma}$: from 1978Ra05. I$_{\gamma}$: from Iγ(682γ)/Iγ(479γ)=0.0035 *3* (1978Ra05). Other: 0.0040 *8* (1974Kl06).

† From 1973Ha18, except as noted.
‡ From the Adopted Gammas. For cases where multipolarity and δ were determined in this dataset, support is given in the comments.
§ For absolute intensity per 100 decays, multiply by 0.908 *3*.
& Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

^{90}Y IT decay (3.19 h) 1974Kl06,1973Ha18



^{74}Ge(^{18}O,npγ),^{76}Ge(^{18}O,3npγ) 1986Wa25

1986Wa25: E=40-80 MeV. Measured Eγ, I$\gamma(\theta)$, Iγ(E(^{18}O)), linear polarization, $\gamma\gamma$ coin, recoil-distance, DSA. Enriched targets.

^{90}Y Levels

1986Wa25 state that the order of the 239γ and 642γ may be reversed, so the level shown at 2455.26 could perhaps be at 2859.05. In subsequent experimental work by 2002Ra13 in ^{82}Se(^{11}B,3nγ) the reversed order is confirmed. The evaluators adopt the order of 2002Ra13 in the Adopted Levels, Gammas, however, preserve the ordering proposed by 1986Wa25 in this dataset.

All γ's from and above the 2217 level have apparent lifetimes in the range 29-44 ps. It is not known which level lifetime is reflected by these results.

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$	Comments
0	2$^-$[#]		
202.554 *20*	3$^-$[#]		
682.11 *4*	7$^+$[#]	3.19 h *6*	T$_{1/2}$: from the Adopted Levels.
2216.76 *5*	8$^+$		
2455.26? *6*	(9)$^+$		
3097.55 *12*	(10$^+$)		
4212.73 *13*	(11$^+$)		
4518.84 *15*	(12$^+$)		

[†] From a least-squares fit to Eγ, by evaluators.
[‡] From I$\gamma(\theta)$ and linear polarization, assuming J(initial)≥J(final) and using empirically determined alignment and recommended upper limits on transition strengths, except where noted.
[#] From the Adopted Levels.

γ(^{90}Y)

E$_\gamma$	I$_\gamma$[†]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.[§]	δ[§]
202.554 *20*	[‡]	202.554	3$^-$	0	2$^-$		
238.50[&] *3*	230 *7*	2455.26?	(9)$^+$	2216.76	8$^+$	M1(+E2)	+0.03 *8*
306.10 *10*	44 *3*	4518.84	(12$^+$)	4212.73	(11$^+$)	M1(+E2)	−0.03 *6*
479.55 *3*	[‡]	682.11	7$^+$	202.554	3$^-$		
642.29[&] *10*	210 *30*	3097.55	(10$^+$)	2455.26?	(9)$^+$	(M1+E2)	
1115.17 *5*	133 *8*	4212.73	(11$^+$)	3097.55	(10$^+$)	M1(+E2)	+0.00 *5*
1421.30 *20*	65 *6*	4518.84	(12$^+$)	3097.55	(10$^+$)	(E2)	
1534.64 *4*	260 *8*	2216.76	8$^+$	682.11	7$^+$	M1+E2	−0.73 *14*

[†] Relative photon intensities from $\gamma(\theta)$.
[‡] Intensity time dependent following 3.19-h isomer.
[§] From I$\gamma(\theta)$ and linear polarization data.
[&] Placement of transition in the level scheme is uncertain.

^{82}Se(^{11}B,3nγ) 2002Ra13

2002Ra13: E=37 MeV. Measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma(\theta)$(DCO); lifetimes by Doppler-shift attenuation method using GASP array consisting of 40 escape-suppressed HPGe detectors and an inner ball containing 80 BGO elements.

^{90}Y Levels

For detailed shell-model configurations see Tables III, IV, VI and VII in 2002Ra13.

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]	Comments
0.0	2$^-$	64.05[@] h *5*	
202.51 *3*	3$^-$		
682.02[b] *6*	7$^+$	3.19[@] h *6*	J$^\pi$: from Adopted Levels.
2216.7[b] *4*	8$^+$		
2858.9[b] *5*	9$^+$		
3097.1[b] *6*	10$^+$		
4212.6[b] *6*	11$^+$		
4518.6[b] *6*	12$^+$		
4543.6 *6*	11$^+$		
5068.5 *6*			
5102.6 *6*	12$^-$		
5111.5[b] *6*	13$^+$		
5359.7[b] *6*	14$^+$		
5525.6 *6*	12$^{(+)}$		
5541.2 *6*	12$^{(+)}$		
5674.3 *6*	12$^{(+)}$		
6065.0 *6*	13$^-$		
6234.8[c] *6*	13$^-$		
6822.6 *6*	13$^+$		
6831.1 *6*	13$^+$		
6898.2[c] *6*	15$^-$		
7355.6[a] *6*	14$^{(+)}$		
7882.7?[a] *6*	15$^{(+)}$	0.111[&] ps *28*	E(level): since the reversed ordering of the 538.7-527.2 cascade is not ruled out, this level is either at 7882.9 or 7894.4.
7994.1[c] *6*	16$^{(-)}$		
8421.4[a] *6*	16$^{(+)}$	0.57[&] ps *8*	
9006.0[a] *6*	17$^{(+)}$	0.37 ps *6*	
9317.2[c] *7*			
9635.2[a] *7*	(18$^+$)	0.38 ps *6*	

[†] From least-squares fit to Eγ, by evaluators.
[‡] As proposed in 2002Ra13, based on literature values for lower-lying states and multipolarity deduced from $\gamma\gamma(\theta)$(DCO).
[#] From DSAM measurements (2002Ra13), except where noted.
[@] From the Adopted Levels.
[&] Since the reversed ordering of the 538.7-527.2 cascade is not ruled out, the lifetimes of the levels at 7882.9 and 8421.5 are affected by the ordering of this cascade.
[a] Band(A): Band based on 14$^{(+)}$.
[b] Seq.(B): γ cascade based on 7$^+$.
[c] Seq.(C): Band based on 13$^-$.

^{82}Se(^{11}B,3nγ) 2002Ra13 (continued)

γ(^{90}Y)

DCO ratios correspond to gates on ΔJ=2, Q transitions, unless otherwise stated. DCO ratios constructed from ratio of γ rays detected at an average of 35° and 145°, with γ rays detected at 90°. Expected ratios are 1.0 if gating and observed transitions are stretched transitions of pure and equal multipole order, 0.54 for a pure dipole transition gated on a stretched Q transition, and 1.85 for a Q transition gated on a dipole transition.

E_γ†	I_γ†	E_i(level)	J^π_i	E_f	J^π_f	Mult.‡	δ‡	Comments
202.51 *3*		202.51	3^-	0.0	2^-			E_γ: from the Adopted Gammas. Other: 202.6 (2002Ra13).
238.2 *1*	74.0 *2*	3097.1	10^+	2858.9	9^+	D		DCO=0.98 *1* (ΔJ=1 dipole gated).
248.2 *2*	11.0 *2*	5359.7	14^+	5111.5	13^+	D		DCO=0.51 *6*.
305.9 *1*	18.0 *1*	4518.6	12^+	4212.6	11^+	D		DCO=0.54 *1*.
390.9 *3*	0.5 *1*	6065.0	13^-	5674.3	$12^{(+)}$	D		DCO=1.0 *2* (ΔJ=1 dipole gated).
479.51 *5*		682.02	7^+	202.51	3^-			E_γ: from the Adopted Gammas. Other: 479.5 (2002Ra13).
523.9 *2*	1.0 *1*	6065.0	13^-	5541.2	$12^{(+)}$	D		DCO=0.52 *7*.
524.4 *1*	5.6 *2*	7355.6	$14^{(+)}$	6831.1	13^+	D		DCO=0.50 *1*.
527.2 *2*	6.2 *2*	7882.7?	$15^{(+)}$	7355.6	$14^{(+)}$	D		DCO=0.30 *2*.
533.0 *1*	4.2 *1*	7355.6	$14^{(+)}$	6822.6	13^+	D		DCO=0.43 *4*.
538.7 *1*	5.8 *2*	8421.4	$16^{(+)}$	7882.7?	$15^{(+)}$	D		DCO=0.30 *2*.
539.4 *3*	1.0 *1*	6065.0	13^-	5525.6	$12^{(+)}$	D		DCO=0.63 *8*.
584.5 *1*	5.9 *2*	9006.0	$17^{(+)}$	8421.4	$16^{(+)}$	D		DCO=0.65 *8*.
593.0 *2*	7.8 *4*	5111.5	13^+	4518.6	12^+			
629.2 *3*	4.0 *1*	9635.2	(18^+)	9006.0	$17^{(+)}$			
642.2 *3*	97.7 *5*	2858.9	9^+	2216.7	8^+	D		DCO=0.53 *1*.
663.3 *3*	1.3 *6*	6898.2	15^-	6234.8	13^-	Q		DCO=1.3 *2*.
833.1 *3*	14.0 *5*	6898.2	15^-	6065.0	13^-	Q		DCO=1.00 *5*.
890.2 *6*	23.9 *8*	5102.6	12^-	4212.6	11^+	D		DCO=1.01 *8* (ΔJ=1 dipole gated).
898.8 *2*	11.1 *2*	5111.5	13^+	4212.6	11^+	Q		DCO=0.90 *3*.
962.5 *2*	8.4 *2*	6065.0	13^-	5102.6	12^-	D+Q		DCO=0.7 *2* (ΔJ=1 dipole gated).
1065.8 *7*	2.1 *2*	8421.4	$16^{(+)}$	7355.6	$14^{(+)}$			
1095.9 *2*	1.3 *1*	7994.1	$16^{(-)}$	6898.2	15^-	D		DCO=0.5 *1*.
1115.4 *1*	38.4 *2*	4212.6	11^+	3097.1	10^+	D		DCO=0.91 *1* (ΔJ=1 dipole gated).
1323.1 *3*	0.4 *1*	9317.2		7994.1	$16^{(-)}$			
1353.7 *3*	14.5 *2*	4212.6	11^+	2858.9	9^+	Q		DCO=1.81 *3* (ΔJ=1 dipole gated).
1421.6 *1*	27.6 *5*	4518.6	12^+	3097.1	10^+	Q		DCO=1.75 *2* (ΔJ=1 dipole gated).
1446.6 *2*	4.1 *1*	4543.6	11^+	3097.1	10^+	D+Q		DCO=0.79 *4* (ΔJ=1 dipole gated).
1534.7 *4*	100.0 *3*	2216.7	8^+	682.02	7^+	M1+E2	−0.68 *5*	Mult.,δ: DCO=1.10 *2* gives D+Q, non-zero value of δ suggests M1+E2.
1538.4 *1*	6.3 *2*	6898.2	15^-	5359.7	14^+	D		DCO=0.60 *6*.
1546.0 *3*	7.7 *1*	6065.0	13^-	4518.6	12^+	D		DCO=1.07 *2* (ΔJ=1 dipole gated).
1711.0 *6*	4.3 *3*	6822.6	13^+	5111.5	13^+			
1716.1 *5*	1.3 *6*	6234.8	13^-	4518.6	12^+	D		DCO=0.45 *2*.
1719.6 *2*	2.2 *1*	6831.1	13^+	5111.5	13^+	D		DCO=1.4 *3* (ΔJ=1 dipole gated).
1719.9 *4*	1.1 *1*	6822.6	13^+	5102.6	12^-	D		DCO=1.2 *1* (ΔJ=1 dipole gated).
1728.4 *3*	0.9 *1*	6831.1	13^+	5102.6	12^-	D		DCO=1.1 *1* (ΔJ=1 dipole gated);
1754.1 *1*	5.1 *7*	6822.6	13^+	5068.5				
1760.7 *5*	1.4 *4*	6831.1	13^+	5068.5				E_γ: poor fit. Level-energy difference=1762.6.
1971.3 *9*	0.5 *1*	5068.5		3097.1	10^+			
2209.5 *1*	7.1 *3*	5068.5		2858.9	9^+			
2279.4 *6*	0.9 *2*	6822.6	13^+	4543.6	11^+			
2287.5 *4*	2.6 *1*	6831.1	13^+	4543.6	11^+			
2303.9 *3*	0.8 *1*	6822.6	13^+	4518.6	12^+			
2313.1 *4*	0.8 *1*	6831.1	13^+	4518.6	12^+			

Continued on next page (footnotes at end of table)

^{82}Se(^{11}B,3nγ) 2002Ra13 (continued)

γ(^{90}Y) (continued)

E_γ †	I_γ †	E_i(level)	J^π_i	E_f	J^π_f
2379.6 *3*	1.4 *1*	6898.2	15^-	4518.6	12^+
2428.4 *7*	1.2 *1*	5525.6	$12^{(+)}$	3097.1	10^+
2444.3 *7*	1.1 *3*	5541.2	$12^{(+)}$	3097.1	10^+
2577.4 *4*	0.9 *1*	5674.3	$12^{(+)}$	3097.1	10^+
2968.3 *9*	1.0 *1*	6065.0	13^-	3097.1	10^+

† From 2002Ra13, except where noted.
‡ Based on $\gamma\gamma(\theta)$(DCO) measurements in 2002Ra13.

^{87}Rb(α,nγ) 1974Ba06

1974Ba06: E=11.8-13.0 MeV. Measured Eγ, Iγ. Ge(Li) detector; enriched (99.20%) target.

^{90}Y Levels

For use of excitation function in Jπ assignment see also 1972Li05.

E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡
0	2$^-$	776.7 *4*	2$^+$	1189.4 *6*	(4$^+$)	1370.5 *10*	1$^-$
202.6 *4*	3$^-$	953.6 *4*	(3$^+$)	1214.7 *6*	0$^-$	1416.9 *10*	
682.0 *5*	7$^+$	1047.3 *6*	(5$^+$)	1298.1 *6*	(6$^+$)		

† From a least-squares fit to Eγ, by evaluators.
‡ As proposed in 1974Ba06.

γ(^{90}Y)

E$_\gamma$	I$_\gamma$†	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	E$_\gamma$	I$_\gamma$†	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$
142.1 *4*	2.2 *5*	1189.4	(4$^+$)	1047.3	(5$^+$)	616.1 *5*	22 *1*	1298.1	(6$^+$)	682.0	7$^+$
176.7 *4*	25 *1*	953.6	(3$^+$)	776.7	2$^+$	776.7 *5*	20 *1*	776.7	2$^+$	0	2$^-$
202.4 *4*		202.6	3$^-$	0	2$^-$	954.0 *6*	18 *1*	953.6	(3$^+$)	0	2$^-$
235.9 *5*	17 *1*	1189.4	(4$^+$)	953.6	(3$^+$)	1214.7 *6*	8 *1*	1214.7	0$^-$	0	2$^-$
250.8 *5*	1.1 *5*	1298.1	(6$^+$)	1047.3	(5$^+$)	^{x}1360.1 *10*	11 *1*				
365.2 *5*	26 *1*	1047.3	(5$^+$)	682.0	7$^+$	1370.5 *10*	8 *1*	1370.5	1$^-$	0	2$^-$
^{x}439.8 *5*	9 *1*					1416.9 *10*	7 *1*	1416.9		0	2$^-$
479.4 *5*		682.0	7$^+$	202.6	3$^-$	^{x}1816.9 *10*	3.5 *10*				
574.0 *5*	5.5 *10*	776.7	2$^+$	202.6	3$^-$						

† Relative photon intensity for E(α)=13 MeV. Authors also report values for E(α)=11.8 MeV. See also 1972Li05, where (α,nγ) data for E(level)<1300 are given.
^{x} γ ray not placed in level scheme.

^{88}Sr(^{3}He,p) 1977Fo12

1977Fo12: E=18 MeV. Measured E(p), $\sigma(\theta)$, θ(c.m.)≈2° to 50°. Multi-angle spectrograph.
L values are from comparison with DWBA calculations.

^{90}Y Levels

E(level)	L
0	
1816 *5*	0+2
2313 *10*	0+2
3432 *5*	0(+2)
3490 *5*	0(+2)
3625 *6*	0+2

^{89}Y(n,γ) E=thermal 1993Mi04

Jπ(^{89}Y)=1/2$^-$.

1993Mi04: detector: HPGe surrounded by two NaI scintillator detectors. This detecting system was operated in Compton-suppressed mode for γ-ray energies <3500 keV, and as a pair spectrometer for γ-ray energies >2000 keV. FWHM=1.9 keV for 2000-keV γ rays, and 4 keV for 7000-keV γ rays. The energy and efficiency of the detector were calibrated with ^{36}Cl. Since a strong γ ray in ^{36}Cl is at 517 keV, this was the lowest calibration energy for the detector efficiency. Consequently, the authors did not report intensities for γ rays below this energy. Values given here for Eγ<517 keV are from 1983De27. The detector efficiency was calibrated on an absolute scale (per 100 neutrons captured) by using a target of NaCl mixed with the Yttrium target and using thermal-neutron cross section values of 1.28 b and 43.6 b for ^{89}Y and ^{35}Cl, respectively. The neutron binding energy was determined to be S(n)=6857.02 keV *17*, in good agreement with S(n)=6857.26 keV *30* (1983De27).

1993Mi04 did not confirm the following levels reported by 1983De27: 2003, 2055, 2139, 2184, 2208, 2324, 2405, 2423, 2430, 2565, 2590, 2646, 2903, 3172, and 3301. 1993Mi04 found alternative placements in the level scheme of ^{90}Y for most of the transitions that defined these levels.

Other measurements:
1983De27: E=thermal. Measured Eγ, Iγ. Detectors: Ge(Li) and annulus.
1970Ei03: E=thermal. Polarized neutrons. Measured Eγ, circular polarization. Detector: NaI.
1969Ch30: E=thermal. Measured $\gamma\gamma(\theta)$. Detector: NaI.
1981Ra07: E=1-6 keV. Measured γ rays. Detector: Ge(Li).
Others: 1967Ir01, 1986Vo03, 1987Zo02, 1988Ho06, 1991Cu01, 1991Zh22, 1995Li31.

^{90}Y Levels

E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡
0.0	2$^-$	2196.119 *21*	(1$^-$,2)	2992.35 *4*	2$^-$,(1$^-$)	3953.54 *4*	1,2
202.493 *12*	3$^-$	2244.30 *3*	1$^+$,2$^-$	3002.68 *4*	(1$^-$,2)	4037.54 *3*	1,2$^-$
681.66 *9*	7$^+$	2365.963 *21*	1$^-$	3043.50 *4*	(2,3$^-$)	4100.49 *4*	1,2$^-$
776.592 *15*	2$^+$#	2475.92 *3*	2$^-$	3143.83 *3*	2	4161.28 *4*	(1,2)
953.512 *17*	3$^+$	2495.48 *3*	(2)	3160.210 *24*	1$^-$	4210.80 *4*	(1,2)
1046.87 *15*	5$^+$	2504.612 *23*	2$^-$	3312.407 *25*	2,(1$^-$)	4267.38 *3*	1,2
1189.68 *8*	4$^+$	2623.99 *4*	1$^-$	3404.82 *5*	2$^-$,(3$^-$)	4325.06 *5*	1$^-$,2$^-$
1211.577 *17*	0$^-$	2631.93 *4*	(2,3$^-$)	3469.13 *4*	2,3$^-$	4451.574 *24*	1,2
1371.132 *15*	1$^-$	2663.28 *4*	(1,2)$^-$	3476.06 *3*	1,2	4515.93 *3*	(1,2)
1416.579 *16*	3$^-$,(2$^-$)	2719.35 *3*	(1,2$^-$)	3555.725 *19*	1,2	4529.65 *4*	0$^-$,1,2
1571.613 *17*	2$^-$,(3$^-$)	2749.239 *19*	2	3574.501 *23*	1$^-$	4533.14 *4*	2$^-$,(1$^-$)
1640.914 *16*	1$^-$	2758.076 *20*	1$^-$,2$^-$	3602.07 *3*	1$^-$	4835.05 *4*	1,2
1760.976 *18*	2$^-$	2838.32 *3*	1$^+$,2	3627.647 *25*	1$^-$	6856.992 *12*	1$^-$
1811.01 *4*	3$^-$,(2$^-$)	2847.42 *4*	1$^-$	3685.23 *4*	1,2		
1815.151 *22*	1$^+$	2859.34 *3*	2$^-$,(3$^-$)	3692.29 *3*	1$^-$		
2133.501 *23*	1,2$^-$	2986.10 *3*	2	3934.47 *3*	1$^-$		

† From a least-squares fit to γ-ray energies from 1993Mi04.
‡ Spin and parity assignments are those in 1993Mi04. These assignments are based on the assumption that γ-ray multi-polarities are E1, M1, or E2. For levels also populated in (d,p), spin and parity assignments are mainly from (d,p).
# From measured circular polarization of primary γ ray (assumed E1) to this level (1970Ei03).

^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y)

A total of 893 γ rays assigned to ^{90}Y were observed, but only 391 placed in the decay scheme, and 27 unplaced have been reported in 1993Mi04.

E_γ [†]	I_γ [†&]	E_i(level)	J^π_i	E_f	J^π_f
[x]139.00[§] *18*	0.008[§] *8*				
142.47[§#] *13*	0.016[§] *8*	1189.68	4^+	1046.87	5^+
[x]155.44[§] *21*	0.008[§] *8*				
159.50 *13*	0.016[‡] *8*	1371.132	1^-	1211.577	0^-
176.91 *3*	0.59[‡] *12*	953.512	3^+	776.592	2^+
[x]182.05[§] *11*	0.094[§] *23*				
202.51 *3*	16[‡] *4*	202.493	3^-	0.0	2^-
236.17 *7*	0.12[‡] *2*	1189.68	4^+	953.512	3^+
[x]266.66[§] *21*	0.016[§] *8*				
269.79 *11*	0.070[‡] *15*	1640.914	1^-	1371.132	1^-
[x]334.01[§] *11*	0.094[§] *16*				
[x]355.57[§] *21*	0.016[§] *8*				
[x]362.5[§] *3*	0.008[§] *8*				
365.21 *11*	0.062[‡] *16*	1046.87	5^+	681.66	7^+
380.81 *14*	0.062[‡] *16*	2196.119	$(1^-,2)$	1815.151	1^+
429.27 *6*	0.16[‡] *3*	1640.914	1^-	1211.577	0^-
[x]439.62[§] *11*	0.055[§] *16*				
479.17 *9*	0.008[‡] *8*	681.66	7^+	202.493	3^-
[x]517.07[§] *13*	0.039[§] *8*				
574.10 *3*	15 *3*	776.592	2^+	202.493	3^-
[x]594.97[§] *15*	0.039[§] *8*				
603.37 *20*	0.030 *8*	1815.151	1^+	1211.577	0^-
605.00 *3*	0.57 *11*	2365.963	1^-	1760.976	2^-
618.58 *18*	0.020 *5*	1571.613	$2^-,(3^-)$	953.512	3^+
628.78 *24*	0.023 *7*	3476.06	1,2	2847.42	1^-
630.4[@] *3*	0.017[@] *6*	3469.13	$2,3^-$	2838.32	$1^+,2$
630.4[@] *3*	0.017[@] *6*	4100.49	$1,2^-$	3469.13	$2,3^-$
637.85 *12*	0.030 *7*	3476.06	1,2	2838.32	$1^+,2$
648.87[@] *16*	0.022[@] *5*	3312.407	$2,(1^-)$	2663.28	$(1,2)^-$
648.87[@] *16*	0.022[@] *5*	3692.29	1^-	3043.50	$(2,3^-)$
[x]655.95[§] *18*	0.06[§] *2*				
[x]658.65[§] *17*	0.055[§] *15*				
673.6 *3*	0.016 *5*	4835.05	1,2	4161.28	(1,2)
680.39 *15*	0.023 *5*	2495.48	(2)	1815.151	1^+
689.45[@] *8*	0.049[@] *10*	2504.612	2^-	1815.151	1^+
689.45[@] *8*	0.049[@] *10*	3692.29	1^-	3002.68	$(1^-,2)$
692.64[@] *19*	0.050[@] *16*	3685.23	1,2	2992.35	$2^-,(1^-)$
692.64[@] *19*	0.050[@] *16*	4267.38	1,2	3574.501	1^-
693.80 *17*	0.057 *16*	2504.612	2^-	1811.01	$3^-,(2^-)$
696.38 *7*	0.062 *13*	3555.725	1,2	2859.34	$2^-,(3^-)$
699.01 *14*	0.026 *6*	3685.23	1,2	2986.10	2
705.0 *3*	0.012 *4*	2838.32	$1^+,2$	2133.501	$1,2^-$
715.5[@] *5*	0.008[@] *3*	2475.92	2^-	1760.976	2^-
715.5[@] *5*	0.008[@] *3*	3574.501	1^-	2859.34	$2^-,(3^-)$

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^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	δ	Comments
718.0[@] *4*	0.010[@] *4*	2133.501	1,2$^-$	1416.579	3$^-$,(2$^-$)			
718.0[@] *4*	0.010[@] *4*	3555.725	1,2	2838.32	1$^+$,2			
723.03 *12*	0.037 *8*	4325.06	1$^-$,2$^-$	3602.07	1$^-$			
724.98 *7*	0.069 *14*	2365.963	1$^-$	1640.914	1$^-$			
[x]730.80[§] *23*	0.016[§] *8*							
743.21[@] *21*	0.016[@] *5*	2504.612	2$^-$	1760.976	2$^-$			
743.21[@] *21*	0.016[@] *5*	3602.07	1$^-$	2859.34	2$^-$,(3$^-$)			
748.0 *3*	0.020 *6*	2992.35	2$^-$,(1$^-$)	2244.30	1$^+$,2$^-$			
749.9 *3*	0.036 *11*	3469.13	2,3$^-$	2719.35	(1,2$^-$)			
751.32 *13*	0.067 *16*	953.512	3$^+$	202.493	3$^-$			
754.21 *16*	0.025 *7*	3602.07	1$^-$	2847.42	1$^-$			
756.71 *7*	0.102 *22*	3476.06	1,2	2719.35	(1,2$^-$)			
758.26 *23*	0.029 *9*	3002.68	(1$^-$,2)	2244.30	1$^+$,2$^-$			
762.39 *4*	0.15 *3*	2133.501	1,2$^-$	1371.132	1$^-$			
776.64 *3*	56.0 *11*	776.592	2$^+$	0.0	2$^-$	E1+M2	−0.066 *9*	Mult.,δ: from $\gamma\gamma(\theta)$ (1983De27).
[x]786.8[§] *4*	0.047[§] *15*							
789.91 *12*	0.063 *14*	2986.10	2	2196.119	(1$^-$,2)			
793.14 *10*	0.084 *19*	3953.54	1,2	3160.210	1$^-$			
794.38 *4*	0.34 *7*	2365.963	1$^-$	1571.613	2$^-$,(3$^-$)			
[x]813.89[§] *21*	0.031[§] *8*							
816.45 *6*	0.068 *14*	3574.501	1$^-$	2758.076	1$^-$,2$^-$			
825.15 *14*	0.025 *6*	2196.119	(1$^-$,2)	1371.132	1$^-$			
833.33 *21*	0.026 *7*	3692.29	1$^-$	2859.34	2$^-$,(3$^-$)			
835.43 *20*	0.033 *9*	2475.92	2$^-$	1640.914	1$^-$			
837.2[@] *3*	0.020[@] *7*	3312.407	2,(1$^-$)	2475.92	2$^-$			
837.2[@] *3*	0.020[@] *7*	3469.13	2,3$^-$	2631.93	(2,3$^-$)			
843.69[@] *19*	0.035[@] *9*	3476.06	1,2	2631.93	(2,3$^-$)			
843.69[@] *19*	0.035[@] *9*	3602.07	1$^-$	2758.076	1$^-$,2$^-$			
845.5[@] *5*	0.027[@] *11*	3469.13	2,3$^-$	2623.99	1$^-$			
845.5[@] *5*	0.027[@] *11*	3685.23	1,2	2838.32	1$^+$,2			
[x]846.79 *5*	0.27 *6*							
855.30 *20*	0.017 *5*	3574.501	1$^-$	2719.35	(1,2$^-$)			
862.3[@] *3*	0.026[@] *7*	2623.99	1$^-$	1760.976	2$^-$			
862.3[@] *3*	0.026[@] *7*	4267.38	1,2	3404.82	2$^-$,(3$^-$)			
864.28 *5*	0.26 *5*	1640.914	1$^-$	776.592	2$^+$			
871.01 *14*	0.027 *7*	2631.93	(2,3$^-$)	1760.976	2$^-$			
[x]873.43 *4*	0.15 *3*							
881.5[@] *5*	0.017[@] *9*	3602.07	1$^-$	2719.35	(1,2$^-$)			
881.5[@] *5*	0.017[@] *9*	4835.05	1,2	3953.54	1,2			
882.8 *3*	0.019 *8*	3602.07	1$^-$	2719.35	(1,2$^-$)			
890.8 *3*	0.012 *4*	3934.47	1$^-$	3043.50	(2,3$^-$)			
893.56 *12*	0.036 *8*	4037.54	1,2$^-$	3143.83	2			
895.74 *6*	0.087 *18*	4451.574	1,2	3555.725	1,2			
[x]898.68[§] *15*	0.11[§] *2*							
904.7[@] *4*	0.014[@] *7*	2475.92	2$^-$	1571.613	2$^-$,(3$^-$)			
904.7[@] *4*	0.014[@] *7*	2719.35	(1,2$^-$)	1815.151	1$^+$			
909.26 *11*	0.029 *7*	3404.82	2$^-$,(3$^-$)	2495.48	(2)			
915.78 *7*	0.053 *11*	3160.210	1$^-$	2244.30	1$^+$,2$^-$			
921.7 *4*	0.011 *4*	2133.501	1,2$^-$	1211.577	0$^-$			
923.66[@] *42*	0.013[@] *5*	2495.48	(2)	1571.613	2$^-$,(3$^-$)			

Continued on next page (footnotes at end of table)

^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J^π_i	E_f	J^π_f
923.7[@] *4*	0.013[@] *5*	3555.725	1,2	2631.93	(2,3$^-$)
930.82 *17*	0.019 *5*	4533.14	2$^-$,(1$^-$)	3602.07	1$^-$
937.75[§#] *14*	0.070[§] *15*	2749.239	2	1811.01	3$^-$,(2$^-$)
943.24 *24*	0.044 *13*	3574.501	1$^-$	2631.93	(2,3$^-$)
[x]944.02[§] *14*	0.086[§] *23*				
948.73 *15*	0.023 *7*	3934.47	1$^-$	2986.10	2
953.54 *3*	0.97 *19*	953.512	3$^+$	0.0	2$^-$
959.9 *3*	0.010 *5*	4515.93	(1,2)	3555.725	1,2
[x]962.1[§] *3*	0.031[§] *7*				
964.38 *6*	0.13 *3*	3627.647	1$^-$	2663.28	(1,2)$^-$
965.92 *12*	0.062 *14*	3685.23	1,2	2719.35	(1,2$^-$)
970.8 *3*	0.036 *15*	3602.07	1$^-$	2631.93	(2,3$^-$)
972.1 *3*	0.040 *15*	3476.06	1,2	2504.612	2$^-$
976.2 *3*	0.016 *5*	4451.574	1,2	3476.06	1,2
977.96 *9*	0.059 *12*	3602.07	1$^-$	2623.99	1$^-$
980.95 *22*	0.021 *5*	3476.06	1,2	2495.48	(2)
988.37 *14*	0.049 *11*	2749.239	2	1760.976	2$^-$
[x]990.24[§] *21*	0.062[§] *16*				
994.76 *8*	0.065 *13*	2365.963	1$^-$	1371.132	1$^-$
997.02 *5*	0.125 *25*	2758.076	1$^-$,2$^-$	1760.976	2$^-$
[x]1003.8[§] *5*	0.039[§] *16*				
[x]1006.9[§] *7*	0.023[§] *8*				
[x]1020.84[§] *20*	0.070[§] *16*				
1023.07 *5*	0.116 *24*	2838.32	1$^+$,2	1815.151	1$^+$
[x]1028.5[§] *3*	0.047[§] *16*				
1032.60 *6*	0.063 *13*	2244.30	1$^+$,2$^-$	1211.577	0$^-$
1038.1[§#] *5*	0.047[§] *15*	1815.151	1$^+$	776.592	2$^+$
1039.75 *10*	0.042 *9*	4515.93	(1,2)	3476.06	1,2
[x]1049.3[§] *10*	0.031[§] *23*				
1050.71 *10*	0.035 *7*	4210.80	(1,2)	3160.210	1$^-$
1059.09 *15*	0.038 *9*	2475.92	2$^-$	1416.579	3$^-$,(2$^-$)
1060.8[@] *3*	0.020[@] *6*	2631.93	(2,3$^-$)	1571.613	2$^-$,(3$^-$)
1060.8[@] *3*	0.020[@] *6*	4529.65	0$^-$,1,2	3469.13	2,3$^-$
[x]1065.96[§] *13*	0.08[§] *2*				
1069.75 *5*	0.095 *19*	3574.501	1$^-$	2504.612	2$^-$
1079.02 *11*	0.029 *6*	2495.48	(2)	1416.579	3$^-$,(2$^-$)
[x]1081.1[§] *7*	0.008[§] *8*				
1086.19[§#] *22*	0.055[§] *16*	2847.42	1$^-$	1760.976	2$^-$
1087.94 *4*	0.19 *4*	2504.612	2$^-$	1416.579	3$^-$,(2$^-$)
1098.1[@] *3*	0.019[@] *6*	2859.34	2$^-$,(3$^-$)	1760.976	2$^-$
1098.1[@] *3*	0.019[@] *6*	4100.49	1,2$^-$	3002.68	(1$^-$,2)
1104.72 *13*	0.038 *8*	2475.92	2$^-$	1371.132	1$^-$
1107.45 *16*	0.065 *17*	4267.38	1,2	3160.210	1$^-$
1117.06 *7*	0.047 *10*	2758.076	1$^-$,2$^-$	1640.914	1$^-$
[x]1122.50[§] *13*	0.039[§] *8*				
1125.04 *9*	0.039 *8*	4529.65	0$^-$,1,2	3404.82	2$^-$,(3$^-$)
1128.87 *23*	0.014 *4*	4533.14	2$^-$,(1$^-$)	3404.82	2$^-$,(3$^-$)
1132.03 *9*	0.075 *16*	3627.647	1$^-$	2495.48	(2)
1133.62 *12*	0.054 *12*	2504.612	2$^-$	1371.132	1$^-$
[x]1140.9[§] *4*	0.039[§] *16*				

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^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J^π_i	E_f	J^π_f
1143.38 *25*	0.015 *4*	4835.05	1,2	3692.29	1⁻
1151.54 *9*	0.049 *10*	3627.647	1⁻	2475.92	2⁻
1158.7 *3*	0.013 *5*	4161.28	(1,2)	3002.68	(1⁻,2)
[x]1165.11[§] *15*	0.055[§] *16*				
1168.62 *4*	0.32 *7*	1371.132	1⁻	202.493	3⁻
1170.89 *13*	0.035 *8*	2986.10	2	1815.151	1⁺
1177.54 *6*	0.067 *14*	2749.239	2	1571.613	2⁻,(3⁻)
1181.42[@] *22*	0.015[@] *5*	2992.35	2⁻,(1⁻)	1811.01	3⁻,(2⁻)
1181.42[@] *22*	0.015[@] *5*	4325.06	1⁻,2⁻	3143.83	2
1186.47 *4*	0.27 *5*	2758.076	1⁻,2⁻	1571.613	2⁻,(3⁻)
1188.11 *31*	0.025 *8*	3002.68	(1⁻,2)	1815.151	1⁺
1190.6[@] *3*	0.015[@] *5*	3555.725	1,2	2365.963	1⁻
1190.6[@] *3*	0.015[@] *5*	4037.54	1,2⁻	2847.42	1⁻
1206.30 *12*	0.21 *7*	2847.42	1⁻	1640.914	1⁻
1208.29 *11*	0.045 *10*	4210.80	(1,2)	3002.68	(1⁻,2)
1211.56 *3*	3.6 *7*	1211.577	0⁻	0.0	2⁻
1214.05 *3*	0.66 *13*	1416.579	3⁻,(2⁻)	202.493	3⁻
1217.08 *8*	0.048 *10*	4529.65	0⁻,1,2	3312.407	2,(1⁻)
[x]1226.02[§] *13*	0.08[§] *2*				
1231.30 *8*	0.052 *11*	2992.35	2⁻,(1⁻)	1760.976	2⁻
1242.56 *4*	0.21 *4*	2196.119	(1⁻,2)	953.512	3⁺
[x]1254.0[§] *4*	0.023[§] *16*				
1264.25 *6*	0.081 *17*	2475.92	2⁻	1211.577	0⁻
1279.31 *10*	0.059 *13*	4037.54	1,2⁻	2758.076	1⁻,2⁻
1281.32[@] *10*	0.077[@] *16*	4267.38	1,2	2986.10	2
1281.32[@] *10*	0.077[@] *16*	4325.06	1⁻,2⁻	3043.50	(2,3⁻)
1288.25 *13*	0.032 *8*	4037.54	1,2⁻	2749.239	2
1290.83 *10*	0.056 *13*	2244.30	1⁺,2⁻	953.512	3⁺
1293.07 *17*	0.028 *8*	2504.612	2⁻	1211.577	0⁻
1302.57[@] *24*	0.019[@] *5*	2719.35	(1,2⁻)	1416.579	3⁻,(2⁻)
1302.57[@] *24*	0.019[@] *5*	4161.28	(1,2)	2859.34	2⁻,(3⁻)
[x]1309.9[§] *4*	0.016[§] *8*				
[x]1315.5[§] *4*	0.08[§] *8*				
1319.26 *13*	0.031 *7*	3685.23	1,2	2365.963	1⁻
1321.93[@] *23*	0.027[@] *7*	3953.54	1,2	2631.93	(2,3⁻)
1321.93[@] *23*	0.027[@] *7*	4325.06	1⁻,2⁻	3002.68	(1⁻,2)
1323.9 *4*	0.015 *5*	4161.28	(1,2)	2838.32	1⁺,2
1330.01[@] *24*	0.016[@] *5*	3574.501	1⁻	2244.30	1⁺,2⁻
1330.01[@] *24*	0.016[@] *5*	3953.54	1,2	2623.99	1⁻
1332.68 *3*	0.30 *6*	2749.239	2	1416.579	3⁻,(2⁻)
[x]1336.91[§] *21*	0.039[§] *8*				
1341.0 *3*	0.027 *9*	2758.076	1⁻,2⁻	1416.579	3⁻,(2⁻)
1345.28 *9*	0.055 *12*	2986.10	2	1640.914	1⁻
1347.96 *22*	0.019 *5*	2719.35	(1,2⁻)	1371.132	1⁻
[x]1354.6[§] *4*	0.031[§] *8*				
1356.91 *4*	0.16 *3*	2133.501	1,2⁻	776.592	2⁺
1359.55 *4*	0.20 *4*	3555.725	1,2	2196.119	(1⁻,2)
1369.10 *3*	0.84 *17*	1571.613	2⁻,(3⁻)	202.493	3⁻
1371.13 *3*	2.6 *5*	1371.132	1⁻	0.0	2⁻
1378.08 *3*	0.24 *5*	2749.239	2	1371.132	1⁻

Continued on next page (footnotes at end of table)

^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J^π_i	E_f	J^π_f
1383.16 *7*	0.050 *11*	3627.647	1^-	2244.30	$1^+,2^-$
1386.97 *9*	0.041 *9*	2758.076	$1^-,2^-$	1371.132	1^-
1399.24 *4*	0.115 *23*	3160.210	1^-	1760.976	2^-
1402.67 *11*	0.028 *6*	3043.50	$(2,3^-)$	1640.914	1^-
[x]1404.1[§] *3*	0.031[§] *8*				
[x]1408.25[§] *18*	0.047[§] *16*				
1416.55 *3*	1.4 *3*	1416.579	$3^-,(2^-)$	0.0	2^-
1419.48 *4*	0.095 *19*	2196.119	$(1^-,2)$	776.592	2^+
1422.33 *5*	0.057 *12*	3555.725	1,2	2133.501	$1,2^-$
1428.79 *23*	0.018 *5*	4267.38	1,2	2838.32	$1^+,2$
1430.59[@] *19*	0.021[@] *5*	3002.68	$(1^-,2)$	1571.613	$2^-,(3^-)$
1430.59[@] *19*	0.021[@] *5*	4835.05	1,2	3404.82	$2^-,(3^-)$
1438.97 *11*	0.043 *9*	3934.47	1^-	2495.48	(2)
1441.10[@] *20*	0.023[@] *6*	3574.501	1^-	2133.501	$1,2^-$
1441.10[@] *20*	0.023[@] *6*	3685.23	1,2	2244.30	$1^+,2^-$
[x]1446.13[§] *17*	0.070[§] *16*				
1448.88 *4*	0.124 *25*	4451.574	1,2	3002.68	$(1^-,2)$
1452.05 *21*	0.022 *5*	2663.28	$(1,2)^-$	1211.577	0^-
1461.96 *20*	0.016 *4*	4210.80	(1,2)	2749.239	2
[x]1466.44 *7*	0.17 *4*				
1467.63 *7*	0.19 *4*	2244.30	$1^+,2^-$	776.592	2^+
1471.88 *11*	0.030 *7*	3043.50	$(2,3^-)$	1571.613	$2^-,(3^-)$
1476.24 *9*	0.040 *8*	4100.49	$1,2^-$	2623.99	1^-
[x]1481.50[§] *16*	0.12[§] *2*				
1488.92 *8*	0.041 *9*	3685.23	1,2	2196.119	$(1^-,2)$
1494.48 *20*	0.018 *5*	3627.647	1^-	2133.501	$1,2^-$
1497.25 *6*	0.076 *15*	3312.407	$2,(1^-)$	1815.151	1^+
[x]1501.32[§] *16*	0.08[§] *2*				
1507.7 *2*	0.08 *3*	2719.35	$(1,2^-)$	1211.577	0^-
[x]1508.7 *5*	0.03 *3*				
[x]1515.7[§] *8*	0.031[§] *16*				
1519.31 *4*	0.16 *3*	3160.210	1^-	1640.914	1^-
1533.21 *15*	0.025 *6*	4037.54	$1,2^-$	2504.612	2^-
1542.3 *3*	0.037 *16*	2495.48	(2)	953.512	3^+
1543.60 *12*	0.11 *3*	4529.65	$0^-,1,2$	2986.10	2
1546.51 *5*	0.19 *4*	2758.076	$1^-,2^-$	1211.577	0^-
1551.18[@] *10*	0.055[@] *12*	2504.612	2^-	953.512	3^+
1551.18[@] *10*	0.055[@] *12*	3312.407	$2,(1^-)$	1760.976	2^-
1558.45 *3*	1.13 *23*	1760.976	2^-	202.493	3^-
1561.76 *9*	0.044 *10*	4037.54	$1,2^-$	2475.92	2^-
1568.45 *5*	0.106 *22*	3934.47	1^-	2365.963	1^-
1571.62 *3*	1.04 *21*	1571.613	$2^-,(3^-)$	0.0	2^-
1587.6[@] *4*	0.019[@] *9*	3953.54	1,2	2365.963	1^-
1587.6[@] *4*	0.019[@] *9*	4210.80	(1,2)	2623.99	1^-
[x]1603.2[§] *6*	0.031[§] *16*				
1604.86 *9*	0.051 *11*	4100.49	$1,2^-$	2495.48	(2)
[x]1606.3[§] *5*	0.055[§] *16*				
1608.52 *9*	0.22 *6*	1811.01	$3^-,(2^-)$	202.493	3^-
[x]1609.47 *11*	0.18 *5*				
1615.04 *9*	0.038 *8*	2986.10	2	1371.132	1^-
1624.33 *19*	0.058 *14*	4100.49	$1,2^-$	2475.92	2^-

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^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J^π_i	E_f	J^π_f
1626.82 *12*	0.050 *11*	3043.50	(2,3⁻)	1416.579	3⁻,(2⁻)
[x]1629.63[§] *21*	0.14[§] *3*				
1635.32[§#] *19*	0.13[§] *3*	2847.42	1⁻	1211.577	0⁻
1640.93 *3*	1.14 *23*	1640.914	1⁻	0.0	2⁻
1643.46 *6*	0.083 *17*	4267.38	1,2	2623.99	1⁻
1648.01 *18*	0.018 *5*	2859.34	2⁻,(3⁻)	1211.577	0⁻
[x]1663.36[§] *19*	0.094[§] *23*				
1671.41[@] *22*	0.021[@] *5*	3312.407	2,(1⁻)	1640.914	1⁻
1671.41[@] *22*	0.021[@] *5*	4037.54	1,2⁻	2365.963	1⁻
1673.66 *10*	0.049 *10*	4533.14	2⁻,(1⁻)	2859.34	2⁻,(3⁻)
[x]1681.37[§] *18*	0.11[§] *2*				
[x]1686.44[§] *18*	0.10[§] *2*				
1691.6[@] *3*	0.012[@] *4*	4529.65	0⁻,1,2	2838.32	1⁺,2
1691.6[@] *3*	0.012[@] *4*	4835.05	1,2	3143.83	2
[x]1696.5[§] *20*	0.05[§] *4*				
[x]1706.21[§] *14*	0.12[§] *2*				
[x]1712.2[§] *3*	0.062[§] *16*				
[x]1717.62[§] *23*	0.055[§] *16*				
[x]1724.7[§] *9*	0.05[§] *2*				
1727.22 *4*	0.34 *7*	3143.83	2	1416.579	3⁻,(2⁻)
1732.24 *11*	0.098 *22*	4451.574	1,2	2719.35	(1,2⁻)
[x]1733.99 *7*	0.16 *3*				
1744.58 *11*	0.035 *8*	3555.725	1,2	1811.01	3⁻,(2⁻)
[x]1747.97[§] *17*	0.10[§] *2*				
[x]1754.59[§] *15*	0.12[§] *2*				
1757.25 *9*	0.046 *10*	3953.54	1,2	2196.119	(1⁻,2)
1760.92 *4*	0.55 *11*	1760.976	2⁻	0.0	2⁻
[x]1767.0[§] *3*	0.055[§] *16*				
1772.08 *12*	0.15 *3*	4267.38	1,2	2495.48	(2)
[x]1773.89 *6*	0.48 *10*				
[x]1775.83 *6*	0.31 *6*				
1780.61[§#] *11*	0.45[§] *9*	2992.35	2⁻,(1⁻)	1211.577	0⁻
1790.24[§#] *22*	0.094[§] *23*	3602.07	1⁻	1811.01	3⁻,(2⁻)
1795.08[@] *25*	0.034[@] *11*	3555.725	1,2	1760.976	2⁻
1795.08[@] *25*	0.034[@] *11*	4161.28	(1,2)	2365.963	1⁻
1796.66 *13*	0.070 *16*	4515.93	(1,2)	2719.35	(1,2⁻)
[x]1800.84[§] *18*	0.11[§] *2*				
1810.82 *9*	0.24 *5*	1811.01	3⁻,(2⁻)	0.0	2⁻
1812.35 *11*	0.12 *3*	3627.647	1⁻	1815.151	1⁺
1815.02 *4*	1.7 *3*	1815.151	1⁺	0.0	2⁻
1829.0 *3*	0.013 *4*	4325.06	1⁻,2⁻	2495.48	(2)
1835.4[§#] *5*	0.12[§] *4*	3476.06	1,2	1640.914	1⁻
1842.0[@] *3*	0.011[@] *3*	4037.54	1,2⁻	2196.119	(1⁻,2)
1842.0[@] *3*	0.011[@] *3*	4835.05	1,2	2992.35	2⁻,(1⁻)
1847.99 *21*	0.016 *4*	2623.99	1⁻	776.592	2⁺
[x]1852.17 *4*	0.22 *4*				
1855.07 *18*	0.031 *7*	2631.93	(2,3⁻)	776.592	2⁺
[x]1859.2[§] *17*	0.016[§] *16*				
1867.01 *18*	0.022 *5*	3627.647	1⁻	1760.976	2⁻

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^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y) (continued)

E_γ [†]	I_γ [†&]	E_i(level)	J^π_i	E_f	J^π_f
1869.98[@] *10*	0.045[@] *9*	3685.23	1,2	1815.151	1^+
1869.98[@] *10*	0.045[@] *9*	4533.14	2^-,(1^-)	2663.28	(1,2)$^-$
1884.78 *5*	0.15 *3*	2838.32	1^+,2	953.512	3^+
[x]1889.25[§] *22*	0.086[§] *23*				
[x]1894.1[§] *4*	0.08[§] *4*				
1895.81 *4*	0.42 *8*	3312.407	2,(1^-)	1416.579	3^-,(2^-)
[x]1902.7[§] *3*	0.055[§] *16*				
1904.9[§#] *5*	0.031[§] *16*	2859.34	2^-,(3^-)	953.512	3^+
1914.76 *5*	0.14 *3*	3555.725	1,2	1640.914	1^-
1933.47 *5*	0.16 *3*	3574.501	1^-	1640.914	1^-
[x]1936.5[§] *4*	0.094[§] *23*				
[x]1940.0[§] *7*	0.047[§] *16*				
1942.73 *5*	0.15 *3*	2719.35	(1,2^-)	776.592	2^+
[x]1947.53[§] *21*	0.094[§] *2*				
[x]1951.4[§] *3*	0.062[§] *23*				
1961.9 *3*	0.025 *6*	3602.07	1^-	1640.914	1^-
1964.7[§#] *6*	0.062[§] *23*	4161.28	(1,2)	2196.119	(1^-,2)
1966.84[@] *16*	0.041[@] *9*	4100.49	1,2^-	2133.501	1,2^-
1966.84[@] *16*	0.041[@] *9*	4210.80	(1,2)	2244.30	1^+,2^-
1972.3[§#] *3*	0.11[§] *3*	2749.239	2	776.592	2^+
[x]1974.61 *5*	0.19 *4*				
[x]1982.8[§] *5*	0.023[§] *8*				
1986.6 *4*	0.021 *6*	3627.647	1^-	1640.914	1^-
1988.53 *13*	0.057 *12*	3404.82	2^-,(3^-)	1416.579	3^-,(2^-)
1993.47[§#] *19*	0.11[§] *2*	2196.119	(1^-,2)	202.493	3^-
[x]1999.8[§] *7*	0.039[§] *16*				
2002.98 *6*	0.084 *9*	3574.501	1^-	1571.613	2^-,(3^-)
[x]2011.7[§] *5*	0.031[§] *8*				
[x]2014.6[§] *10*	0.016[§] *8*				
2021.84 *5*	0.248 *25*	6856.992	1^-	4835.05	1,2
[x]2022.2[§] *3*	0.18[§] *5*				
2030.5[§#] *5*	0.10[§] *4*	3602.07	1^-	1571.613	2^-,(3^-)
2032.34 *10*	0.123 *13*	2986.10	2	953.512	3^+
2034.7 *3*	0.053 *8*	4529.65	0^-,1,2	2495.48	(2)
2043.7 *3*	0.023 *4*	3685.23	1,2	1640.914	1^-
[x]2047.2[§] *3*	0.031[§] *16*				
2049.31 *10*	0.055 *6*	3002.68	(1^-,2)	953.512	3^+
2057.9 *4*	0.013 *4*	4533.14	2^-,(1^-)	2475.92	2^-
[x]2065.23[§] *21*	0.094[§] *23*				
2070.94 *18*	0.058 *11*	2847.42	1^-	776.592	2^+
2077.06 *11*	0.062 *8*	4210.80	(1,2)	2133.501	1,2^-
2086.01 *20*	0.021 *4*	4451.574	1,2	2365.963	1^-
2090.6 *4*	0.022 *8*	3043.50	(2,3^-)	953.512	3^+
[x]2094.5[§] *5*	0.055[§] *16*				
2104.87 *5*	0.28 *3*	3476.06	1,2	1371.132	1^-
2129.32 *23*	0.019 *4*	4325.06	1^-,2^-	2196.119	(1^-,2)
2133.30 *17*	0.033 *5*	2133.501	1,2^-	0.0	2^-
[x]2136.19 *7*	0.26 *3*				
2138.97 *6*	0.59 *6*	3555.725	1,2	1416.579	3^-,(2^-)

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^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J^π_i	E_f	J^π_f
2142.55 *8*	0.069 *8*	3953.54	1,2	1811.01	3⁻,(2⁻)
[x]2153.01[§] *19*	0.16[§] *4*				
[x]2156.86[§] *22*	0.12[§] *3*				
2163.35 *12*	0.075 *9*	2365.963	1⁻	202.493	3⁻
[x]2166.0[§] *5*	0.10[§] *4*				
2184.65 *5*	0.30 *3*	3555.725	1,2	1371.132	1⁻
2190.33 *5*	0.201 *20*	3143.83	2	953.512	3⁺
2196.00 *5*	0.60 *6*	2196.119	(1⁻,2)	0.0	2⁻
2203.14 *8*	0.067 *7*	4835.05	1,2	2631.93	(2,3⁻)
[x]2208.88 *7*	0.26 *3*				
[x]2216.42 *8*	0.159 *18*				
[x]2220.7[§] *3*	0.22[§] *5*				
[x]2227.86 *6*	0.28 *3*				
2230.88 *7*	0.105 *11*	3602.07	1⁻	1371.132	1⁻
2244.28 *6*	0.40 *4*	2244.30	1⁺,2⁻	0.0	2⁻
2256.51 *6*	0.232 *23*	3627.647	1⁻	1371.132	1⁻
2264.53 *7*	0.217 *23*	3476.06	1,2	1211.577	0⁻
2268.81 *14*	0.023 *3*	3685.23	1,2	1416.579	3⁻,(2⁻)
[x]2270.1[§] *10*	0.02[§] *2*				
2273.39 *6*	0.76 *8*	2475.92	2⁻	202.493	3⁻
2285.37[@] *8*	0.108[@] *11*	4100.49	1,2⁻	1815.151	1⁺
2285.37[@] *8*	0.108[@] *11*	4529.65	0⁻,1,2	2244.30	1⁺,2⁻
2292.87 *6*	0.154 *16*	2495.48	(2)	202.493	3⁻
2302.05 *6*	0.28 *3*	2504.612	2⁻	202.493	3⁻
2312.65 *13*	0.033 *5*	3953.54	1,2	1640.914	1⁻
2314.57 *23*	0.017 *4*	3685.23	1,2	1371.132	1⁻
2320.97 *7*	0.146 *15*	3692.29	1⁻	1371.132	1⁻
2323.83 *6*	0.221 *22*	6856.992	1⁻	4533.14	2⁻,(1⁻)
2327.37 *5*	0.66 *7*	6856.992	1⁻	4529.65	0⁻,1,2
2336.64 *18*	0.028 *5*	4533.14	2⁻,(1⁻)	2196.119	(1⁻,2)
2341.05 *5*	0.34 *3*	6856.992	1⁻	4515.93	(1,2)
2345.94 *10*	0.051 *6*	4161.28	(1,2)	1815.151	1⁺
2362.93 *5*	0.38 *4*	3574.501	1⁻	1211.577	0⁻
2365.92 *6*	0.109 *11*	2365.963	1⁻	0.0	2⁻
[x]2374.4[§] *5*	0.07[§] *3*				
2381.9[@] *3*	0.012[@] *3*	3953.54	1,2	1571.613	2⁻,(3⁻)
2381.9[@] *3*	0.012[@] *3*	4515.93	(1,2)	2133.501	1,2⁻
[x]2386.97 *5*	0.158 *16*				
2396.70 *7*	0.060 *6*	4037.54	1,2⁻	1640.914	1⁻
2399.66[@] *6*	0.080[@] *8*	4210.80	(1,2)	1811.01	3⁻,(2⁻)
2399.66[@] *6*	0.080[@] *8*	4533.14	2⁻,(1⁻)	2133.501	1,2⁻
2405.39 *5*	0.61 *6*	6856.992	1⁻	4451.574	1,2
2416.11 *6*	0.063 *7*	3627.647	1⁻	1211.577	0⁻
[x]2423.09[§] *22*	0.12[§] *3*				
2429.48 *5*	0.155 *16*	2631.93	(2,3⁻)	202.493	3⁻
[x]2433.6[§] *6*	0.023[§] *16*				
[x]2443.8[§] *3*	0.12[§] *3*				
2452.34 *24*	0.015 *3*	4267.38	1,2	1815.151	1⁺
2459.92 *20*	0.049 *15*	4100.49	1,2⁻	1640.914	1⁻
2461.06 *17*	0.059 *15*	2663.28	(1,2)⁻	202.493	3⁻
2465.64 *19*	0.012 *2*	4037.54	1,2⁻	1571.613	2⁻,(3⁻)

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^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y) (continued)

E_γ †	I_γ †&	E_i(level)	J^π_i	E_f	J^π_f
2469.53 *24*	0.012 *2*	4835.05	1,2	2365.963	1⁻
2473.97 *16*	0.176 *20*	3685.23	1,2	1211.577	0⁻
2475.98 *8*	0.175 *19*	2475.92	2⁻	0.0	2⁻
^{x}2478.1§ *6*	0.19§ *5*				
2495.38 *5*	0.104 *11*	2495.48	(2)	0.0	2⁻
2504.61 *5*	1.26 *13*	2504.612	2⁻	0.0	2⁻
2509.98 *11*	0.026 *3*	4325.06	1⁻,2⁻	1815.151	1⁺
2515.60 *5*	0.144 *15*	3469.13	2,3⁻	953.512	3⁺
2520.15 *8*	0.077 *8*	4161.28	(1,2)	1640.914	1⁻
2531.86 *7*	0.097 *10*	6856.992	1⁻	4325.06	1⁻,2⁻
2546.71 *5*	2.16 *22*	2749.239	2	202.493	3⁻
^{x}2552.8§ *6*	0.070§ *23*				
2555.62 *5*	0.149 *15*	2758.076	1⁻,2⁻	202.493	3⁻
2563.81 *19*	0.035 *7*	3934.47	1⁻	1371.132	1⁻
^{x}2565.73 *6*	0.36 *4*				
^{x}2583.84 *5*	0.220 *23*				
2589.68 *5*	0.76 *8*	6856.992	1⁻	4267.38	1,2
^{x}2617.5§ *5*	0.047§ *16*				
2623.95 *5*	0.33 *3*	2623.99	1⁻	0.0	2⁻
2628.37 *20*	0.020 *4*	3404.82	2⁻,(3⁻)	776.592	2⁺
2636.33 *5*	0.117 *12*	4451.574	1,2	1815.151	1⁺
2639.07 *14*	0.023 *3*	4210.80	(1,2)	1571.613	2⁻,(3⁻)
2646.19 *5*	0.40 *4*	6856.992	1⁻	4210.80	(1,2)
2648.56 *6*	0.116 *12*	3602.07	1⁻	953.512	3⁺
2656.75 *5*	0.117 *12*	2859.34	2⁻,(3⁻)	202.493	3⁻
2663.27 *5*	0.185 *19*	2663.28	(1,2)⁻	0.0	2⁻
^{x}2674.6§ *4*	0.086§ *23*				
2690.64 *22*	0.010 *2*	4451.574	1,2	1760.976	2⁻
2695.64 *5*	0.39 *4*	6856.992	1⁻	4161.28	(1,2)
2699.45 *15*	0.038 *6*	3476.06	1,2	776.592	2⁺
2701.23 *10*	0.061 *8*	4835.05	1,2	2133.501	1,2⁻
^{x}2710.3§ *4*	0.078§ *23*				
2719.29 *8*	0.037 *4*	2719.35	(1,2⁻)	0.0	2⁻
2722.72 *6*	0.070 *7*	3934.47	1⁻	1211.577	0⁻
^{x}2726.98 *5*	0.208 *21*				
2731.9 *3*	0.016 *4*	3685.23	1,2	953.512	3⁺
2742.35 *21*	0.012 *3*	3953.54	1,2	1211.577	0⁻
2749.24 *5*	2.44 *24*	2749.239	2	0.0	2⁻
2756.46 *5*	0.61 *6*	6856.992	1⁻	4100.49	1,2⁻
2758.04 *6*	0.32 *3*	2758.076	1⁻,2⁻	0.0	2⁻
2779.15 *8*	0.039 *4*	3555.725	1,2	776.592	2⁺
2783.74 *10*	0.062 *8*	2986.10	2	202.493	3⁻
2789.93 *7*	0.116 *12*	2992.35	2⁻,(1⁻)	202.493	3⁻
2797.95 *12*	0.030 *4*	3574.501	1⁻	776.592	2⁺
2800.24 *12*	0.032 *4*	3002.68	(1⁻,2)	202.493	3⁻
2810.75 *7*	0.043 *5*	4451.574	1,2	1640.914	1⁻
2819.56 *7*	0.53 *5*	6856.992	1⁻	4037.54	1,2⁻
2825.90 *6*	0.082 *8*	4037.54	1,2⁻	1211.577	0⁻
^{x}2831.83 *5*	0.36 *4*				
2838.42 *5*	0.179 *18*	2838.32	1⁺,2	0.0	2⁻
2840.95 *6*	0.083 *9*	3043.50	(2,3⁻)	202.493	3⁻
2847.39 *5*	0.53 *5*	2847.42	1⁻	0.0	2⁻
2859.36 *5*	0.104 *11*	2859.34	2⁻,(3⁻)	0.0	2⁻

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^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J^π_i	E_f	J^π_f
2875.08 *6*	0.087 *9*	4515.93	(1,2)	1640.914	1⁻
[x]2881.2[§] *6*	0.039[§] *16*				
[x]2885.06 *5*	0.31 *3*				
2889.06 *7*	0.155 *16*	4100.49	1,2⁻	1211.577	0⁻
2896.05 *15*	0.015 *2*	4267.38	1,2	1371.132	1⁻
2903.45 *5*	0.32 *3*	6856.992	1⁻	3953.54	1,2
2908.80 *9*	0.036 *4*	3685.23	1,2	776.592	2⁺
2915.76 *5*	0.162 *16*	3692.29	1⁻	776.592	2⁺
2922.47 *5*	0.50 *5*	6856.992	1⁻	3934.47	1⁻
[x]2931.0[§] *8*	0.031[§] *16*				
[x]2935.5[§] *3*	0.13[§] *3*				
2941.30 *5*	0.179 *18*	3143.83	2	202.493	3⁻
2944.42 *9*	0.044 *5*	4515.93	(1,2)	1571.613	2⁻,(3⁻)
[x]2949.09[§] *24*	0.14[§] *3*				
[x]2954.7[§] *12*	0.031[§] *16*				
[x]2962.7[§] *9*	0.031[§] *16*				
[x]2965.3[§] *15*	0.02[§] *2*				
[x]2969.5[§] *5*	0.039[§] *16*				
[x]2975.8[§] *6*	0.039[§] *8*				
[x]2981.68[§] *16*	0.18[§] *4*				
2986.18 *9*	0.102 *14*	2986.10	2	0.0	2⁻
2992.13 *9*	0.027 *3*	2992.35	2⁻,(1⁻)	0.0	2⁻
[x]3000.5[§] *6*	0.055[§] *23*				
3002.47 *10*	0.068 *4*	3002.68	(1⁻,2)	0.0	2⁻
[x]3005.5[§] *9*	0.039[§] *16*				
[x]3020.8[§] *13*	0.023[§] *16*				
[x]3025.11 *7*	0.180 *9*				
3043.42 *7*	0.058 *3*	3043.50	(2,3⁻)	0.0	2⁻
[x]3050.6[§] *4*	0.047[§] *16*				
[x]3056.7[§] *4*	0.055[§] *16*				
[x]3062.0[§] *3*	0.055[§] *16*				
[x]3067.6[§] *5*	0.031[§] *8*				
3073.84 *17*	0.013 *1*	4835.05	1,2	1760.976	2⁻
[x]3089.8[§] *3*	0.11[§] *3*				
[x]3098.88 *6*	0.387 *19*				
3109.87 *6*	0.137 *7*	3312.407	2,(1⁻)	202.493	3⁻
3143.0 *3*	0.018 *5*	3143.83	2	0.0	2⁻
3144.59 *10*	0.075 *6*	4515.93	(1,2)	1371.132	1⁻
3160.18 *6*	0.60 *3*	3160.210	1⁻	0.0	2⁻
3164.59 *6*	0.66 *3*	6856.992	1⁻	3692.29	1⁻
3171.75 *6*	0.413 *21*	6856.992	1⁻	3685.23	1,2
[x]3181.34 *6*	0.180 *9*				
[x]3190.69 *6*	0.230 *12*				
3193.96 *10*	0.031 *2*	4835.05	1,2	1640.914	1⁻
3202.55 *10*	0.026 *2*	3404.82	2⁻,(3⁻)	202.493	3⁻
[x]3212.20 *6*	0.274 *14*				
3229.25 *6*	0.64 *3*	6856.992	1⁻	3627.647	1⁻
3239.67 *16*	0.014 *2*	4451.574	1,2	1211.577	0⁻
[x]3250.8[§] *13*	0.023[§] *16*				
3254.87 *6*	0.66 *3*	6856.992	1⁻	3602.07	1⁻

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^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y) (continued)

E_γ †	I_γ †&	E_i(level)	J^π_i	E_f	J^π_f
3260.94 *8*	0.091 *5*	4037.54	1,2$^-$	776.592	2$^+$
3263.29 *20*	0.025 *3*	4835.05	1,2	1571.613	2$^-$,(3$^-$)
3266.30 *11*	0.039 *3*	3469.13	2,3$^-$	202.493	3$^-$
3282.48 *6*	1.06 *5*	6856.992	1$^-$	3574.501	1$^-$
^{x}3296.8§ *5*	0.078§ *23*				
3301.30 *6*	1.53 *8*	6856.992	1$^-$	3555.725	1,2
3312.36 *8*	0.046 *3*	3312.407	2,(1$^-$)	0.0	2$^-$
3324.30 *22*	0.036 *8*	4100.49	1,2$^-$	776.592	2$^+$
3353.07 *8*	0.048 *3*	3555.725	1,2	202.493	3$^-$
^{x}3362.0§ *7*	0.055§ *23*				
^{x}3377.5§ *5*	0.070§ *23*				
3380.94 *6*	0.88 *4*	6856.992	1$^-$	3476.06	1,2
3387.77 *7*	0.094 *5*	6856.992	1$^-$	3469.13	2,3$^-$
^{x}3391.5§ *8*	0.031§ *8*				
3399.55 *9*	0.085 *6*	3602.07	1$^-$	202.493	3$^-$
3404.62 *24*	0.036 *5*	3404.82	2$^-$,(3$^-$)	0.0	2$^-$
^{x}3437.9§ *4*	0.070§ *16*				
^{x}3444.1§ *4*	0.078§ *23*				
3452.07 *8*	0.122 *6*	6856.992	1$^-$	3404.82	2$^-$,(3$^-$)
3469.24 *15*	0.014 *1*	3469.13	2,3$^-$	0.0	2$^-$
3475.96 *7*	0.130 *7*	3476.06	1,2	0.0	2$^-$
^{x}3481.1§ *4*	0.055§ *16*				
3490.64 *10*	0.024 *2*	4267.38	1,2	776.592	2$^+$
3498.02 *8*	0.169 *11*	4451.574	1,2	953.512	3$^+$
^{x}3514.65 *7*	0.158 *8*				
3544.55 *7*	0.90 *5*	6856.992	1$^-$	3312.407	2,(1$^-$)
3555.61 *7*	0.338 *17*	3555.725	1,2	0.0	2$^-$
3574.55 *8*	0.058 *3*	3574.501	1$^-$	0.0	2$^-$
3579.54 *10*	0.027 *2*	4533.14	2$^-$,(1$^-$)	953.512	3$^+$
3602.03 *7*	0.225 *12*	3602.07	1$^-$	0.0	2$^-$
3623.14 *12*	0.018 *1*	4835.05	1,2	1211.577	0$^-$
3627.71 *8*	0.061 *3*	3627.647	1$^-$	0.0	2$^-$
3674.98 *11*	0.034 *2*	4451.574	1,2	776.592	2$^+$
3692.19 *7*	0.028 *2*	3692.29	1$^-$	0.0	2$^-$
3696.73 *7*	0.76 *4*	6856.992	1$^-$	3160.210	1$^-$
^{x}3704.2§ *9*	0.078§ *23*				
3713.07 *7*	0.432 *22*	6856.992	1$^-$	3143.83	2
3731.98 *8*	0.042 *2*	3934.47	1$^-$	202.493	3$^-$
3751.03 *14*	0.014 *1*	3953.54	1,2	202.493	3$^-$
3813.53 *8*	0.076 *4*	6856.992	1$^-$	3043.50	(2,3$^-$)
^{x}3823.2§ *6*	0.031§ *8*				
^{x}3834.1§ *5*	0.031§ *16*				
^{x}3838.4§ *10*	0.016§ *8*				
3854.38 *13*	0.040 *4*	6856.992	1$^-$	3002.68	(1$^-$,2)
3864.60 *8*	0.063 *3*	6856.992	1$^-$	2992.35	2$^-$,(1$^-$)
3870.84 *7*	0.495 *25*	6856.992	1$^-$	2986.10	2
3882.9 *8*	0.004 *2*	4835.05	1,2	953.512	3$^+$
3934.41 *8*	0.089 *5*	3934.47	1$^-$	0.0	2$^-$
^{x}3945.2§ *4*	0.12§ *3*				
3953.55 *9*	0.035 *2*	3953.54	1,2	0.0	2$^-$
^{x}3973.8§ *7*	0.016§ *8*				

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^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J^π_i	E_f	J^π_f
3997.40 *11*	0.062 *3*	6856.992	1⁻	2859.34	2⁻,(3⁻)
[x]4005.3[§] *5*	0.062[§] *16*				
4009.56 *9*	0.50 *3*	6856.992	1⁻	2847.42	1⁻
4018.68 *8*	0.265 *13*	6856.992	1⁻	2838.32	1⁺,2
4058.39 *9*	0.038 *2*	4835.05	1,2	776.592	2⁺
[x]4069.8[§] *6*	0.070[§] *23*				
[x]4088.9[§] *13*	0.05[§] *3*				
4098.92 *8*	0.60 *3*	6856.992	1⁻	2758.076	1⁻,2⁻
[x]4100.75 *10*	0.205 *15*				
4107.74 *8*	4.69 *23*	6856.992	1⁻	2749.239	2
4122.69 *17*	0.017 *1*	4325.06	1⁻,2⁻	202.493	3⁻
4137.35 *9*	0.117 *6*	6856.992	1⁻	2719.35	(1,2⁻)
4161.30 *10*	0.147 *7*	4161.28	(1,2)	0.0	2⁻
[x]4175.2[§] *16*	0.031[§] *16*				
[x]4178.8[§] *18*	0.031[§] *16*				
4193.73 *8*	0.135 *7*	6856.992	1⁻	2663.28	(1,2)⁻
[x]4201.4[§] *15*	0.016[§] *8*				
4210.79 *9*	0.084 *4*	4210.80	(1,2)	0.0	2⁻
4225.11 *11*	0.023 *1*	6856.992	1⁻	2631.93	(2,3⁻)
4233.17 *18*	0.022 *2*	6856.992	1⁻	2623.99	1⁻
4267.35 *8*	0.242 *12*	4267.38	1,2	0.0	2⁻
[x]4301.4[§] *5*	0.055[§] *16*				
[x]4306.0[§] *6*	0.047[§] *16*				
4313.17 *11*	0.025 *1*	4515.93	(1,2)	202.493	3⁻
4352.27 *8*	1.15 *6*	6856.992	1⁻	2504.612	2⁻
4361.16 *12*	0.031 *2*	6856.992	1⁻	2495.48	(2)
[x]4379.4[§] *4*	0.12[§] *4*				
4380.90 *9*	0.471 *24*	6856.992	1⁻	2475.92	2⁻
[x]4426.47 *9*	0.152 *8*				
[x]4451.2[§] *6*	0.031[§] *8*				
4490.90 *9*	0.52 *3*	6856.992	1⁻	2365.963	1⁻
4529.48 *10*	0.051 *3*	4529.65	0⁻,1,2	0.0	2⁻
4532.91 *9*	0.167 *9*	4533.14	2⁻,(1⁻)	0.0	2⁻
4612.60 *9*	0.209 *11*	6856.992	1⁻	2244.30	1⁺,2⁻
[x]4630.3[§] *4*	0.039[§] *16*				
[x]4648.6[§] *4*	0.047[§] *16*				
4660.68 *9*	0.484 *24*	6856.992	1⁻	2196.119	(1⁻,2)
[x]4719.9[§] *10*	0.047[§] *23*				
4723.38 *12*	0.052 *3*	6856.992	1⁻	2133.501	1,2⁻
4834.84 *17*	0.025 *2*	4835.05	1,2	0.0	2⁻
5041.62 *10*	0.311 *16*	6856.992	1⁻	1815.151	1⁺
5095.74 *10*	0.319 *16*	6856.992	1⁻	1760.976	2⁻
5215.74 *20*	0.017 *2*	6856.992	1⁻	1640.914	1⁻
[x]5248.7[§] *4*	0.039[§] *16*				
[x]5269.9[§] *6*	0.031[§] *8*				
5285.08 *11*	0.160 *8*	6856.992	1⁻	1571.613	2⁻,(3⁻)
5485.56 *12*	0.233 *12*	6856.992	1⁻	1371.132	1⁻
5645.15 *13*	1.67 *8*	6856.992	1⁻	1211.577	0⁻
6080.05 *14*	63 *3*	6856.992	1⁻	776.592	2⁺
[x]6620.9[§] *7*	0.008[§] *8*				

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^{89}Y(n,γ) E=thermal 1993Mi04 (continued)

γ(^{90}Y) (continued)

E_γ †	I_γ †&	E_i(level)	J^π_i	E_f	J^π_f
6654.07 *21*	0.198 *10*	6856.992	1^-	202.493	3^-
6856.55 *3*	0.155 *8*	6856.992	1^-	0.0	2^-

† From 1993Mi04, unless otherwise specified.
‡ From 1983De27.
§ Reported by 1983De27 only.
& Intensity per 100 neutron captures.
@ Multiply placed with undivided intensity.
# Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

^{89}Y(n,n′) 1973Ei03

For measurements indicating the existence of three resonances at neutron energies 0.9-1.2 MeV, see 1973El03.

^{89}Y(pol d,p) 1993Mi04

Jπ(^{89}Y)=1/2$^-$.

1993Mi04: E=22 MeV. Measured E(p), σ(θ), θ=5° − 70°. Deduced cross-sections, analyzing powers, and angular momentum transfers. Detector: magnetic spectrometer with an energy resolution of 5-8 keV (FWHM).

All data are from 1993Mi04, except where noted.

Other measurements:

1972Go11: E=33.3 MeV. Measured E(p), σ(θ), θ(lab)=12.5°−47.5°. FWHM=25 keV.

1969Ya01: E=3.2-4.2 MeV. Measured E(p), σ(E(d),θ), θ=10° to 148°. Surface-barrier detectors.

1965Ha16: E=15 MeV. Measured E(p), σ(θ), six angles 8° to 85°. FWHM=30-60 keV (1965Ha16).

1964Wa14: E=12 MeV. Measured E(p), σ(θ), θ=20° to 170°, FWHM=10-15 keV.

1968Mi04: E=12.0 MeV. Measured E(p), σ(θ), θ=20° to 140°, FWHM=16 keV.

1966Bl07: E=11.95 MeV. Measured E(p), σ(θ), θ(c.m.)≈5° to 90° FWHM≈20 keV (estimated by evaluators).

Magnetic spectrograph and nuclear emulsions were used in all measurements.

Others: 1965Ha16, 1966Bl07, 1969Ya01, 1972Ya02, 1973Mo27, 1975Ya09.

^{90}Y Levels

E(level)	J$^\pi$ †	L	S &	Comments
0.0 ‡	2$^-$	2	2.25	L: from 1972Go11.
202.5 ‡ *1*	3$^-$	2	2.95	L: from 1972Go11.
1211.3 *2*	0$^-$	0	0.54	
1371.3 *2*	1$^-$	0	1.55	
1416.8 *3*	(2$^-$),3$^-$	2	0.029	
1561.9 *5*	3$^-$,4$^-$	4	0.11	
1571.4 *4*	2$^-$,(3$^-$)	2	0.045	
1640.6 *3*	1$^-$	0+2		S: 0.016 (L=0), 0.030 (L=2).
1760.8 *2*	2$^-$	2	0.11	
1810.6 *2*	(2$^-$),3$^-$	2	0.23	
1962.1 *2*	5$^+$,6$^+$	5	1.18	
2021.4 # *4*				
2085.7 *3*	5$^+$,6$^+$	5	0.22	
2133.2 # *9*				
2179.4 *7*	(2$^-$,3$^-$)	(2)	0.011	
2195.4 # *9*				
2240.5 *2*	5$^+$,6$^+$	5	1.65	
2327.4 # *4*				
2365.6 *3*	1$^-$	0	0.069	
2475.9 *2*	2$^-$	2	1.92	
2504.6 *3*	2$^-$	2	0.12	
2520.9 *5*	5$^+$,6$^+$	5	0.40	
2558.4 *3*	3$^-$	2+4		S: 0.012 (L=2), 0.24 (L=4).
2590.2 *5*	3$^-$,4$^-$	4	0.10	
2624.2 *2*	1$^-$	2	0.98	
2663.1 # *7*				
2678.1 *4*	3$^-$	2+4		S: 0.020 (L=2), 0.025 (L=4).
2702.6 *5*				
2745.9 *5*				
2755.4 *3*	3$^-$	2+4		S: 0.034 (L=2), 0.25 (L=4).
2784.6 *3*				
2819.7 *3*	1$^-$	0+2		S: 0.005 (L=0), 0.008 (L=2).
2847.3 *2*	1$^-$	0+2		S: 0.19 (L=0 or 2).
2858.9 *4*	2$^-$,(3$^-$)	2	0.040	
2870.4 *2*	3$^-$,4$^-$	4	0.47	
2932.8 *2*	3$^-$,4$^-$	4	2.12	
2992.4 *2*	(1$^-$),2$^-$	2	0.35	

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^{89}Y(pol d,p) 1993Mi04 (continued)

^{90}Y Levels (continued)

E(level)	J^{π} †	L	S &	Comments
3002.3 *2*	$3^-,4^-$	4	2.61	
3048.2 *2*	$3^-,4^-$	4	1.56	
3119.5 # *4*				
3137.1 *2*	$3^-,4^-$	4	0.61	
3160.2 *2*	1^-	0+2		S: 0.11 (L=0), 0.24 (L=2).
3203.9 *4*	$3^-,4^-$	4	0.077	
3270.0 *4*				
3309.5 *3*	3^-	2+4		S: 0.005 (L=2), 0.037 (L=4).
3342.3 @ *3*		(1,5)		
3354.3 @ *3*		(2,5)		
3405.7 *6*	$(2^-),3^-$	2	0.022	
3413.4 *8*				
3438.8 *8*				
3496.8 *4*	(3^-)	(2+4)		S: 0.011 (L=2), 0.020 (L=4).
3522.6 *4*	$5^+,6^+$	5	0.33	
3534.4 *5*	$(5^+,6^+)$	(5)	0.11	
3556.2 *6*				
3574.7 *5*	1^-	0+2		S: 0.020 (L=0), 0.004 (L=2).
3584.5 *5*				
3592.9 *6*	$5^+,6^+$	5	0.13	
3602.1 *5*	1^-	0+2		S: 0.014 (L=0), 0.009 (L=2).
3627.5 *6*	1^-	0+2		S: 0.015 (L=0), 0.004 (L=2).
3644.2 *5*	$5^+,6^+$	5	0.32	
3667.3 # *8*				
3692.7 *6*	1^-	0+2		S: 0.010 (L=0), 0.009 (L=2).
3736.1 # *3*				
3757.8 *3*				
3792.1 *3*	3^-	2+4		S: 0.017 (L=2), 0.039 (L=4).
3801.3 *4*	(1^-)	(0+2)		S: 0.005 (L=0), 0.011 (L=2).
3833.6 # *4*				
3858.7 *3*	3^-	2+4		S: 0.069 (L=2), 0.17 (L=4).
3881.4 *3*	3^-	2+4		S: 0.025 (L=2), 0.15 (L=4).
3907.2 *4*	(1^-)	(0+2)		S: 0.009 (L=0), 0.008 (L=2).
3934.6 *4*	1^-	0	0.026	
3942.5 # *2*				
3954.1 # *4*				
3972.3 *7*				
3980.4 *3*	(3^-)	(2+4)		S: 0.032 (L=2), 0.05 (L=4).
3996.4 # *7*				
4015.1 *4*	$(5^+,6^+)$	(5)	0.088	
4024.2 *3*	(3^-)	(2+4)		S: 0.013 (L=2 and L=4).
4038.0 *3*	(3^-)	(2+4)		S: 0.005 (L=2), 0.017 (L=4).
4065.0 @ *3*		(2,5)		
4080.3 # *4*				
4100.0 # *4*				
4127.5 *3*	1^-	0+2		S: 0.049 (L=0), 0.015 (L=2).
4140.0 # *8*				
4158.8 # *4*				
4166.8 @ *3*		(2,5)		
4197.7 *3*	$(2^-,3^-)$	(2)	0.010	
4219.7 *3*	(2^-)	2	0.024	

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^{89}Y(pol d,p) 1993Mi04 (continued)

^{90}Y Levels (continued)

E(level)	J^{π} †	L	S&	Comments
4288.6# *4*				
4302.3@ *3*				
4325.6 *3*	$1^-,2^-$	2	0.012	
4341.2 *3*	$5^+,6^+$	5	0.25	
4352.8# *4*				
4377.9 *3*	1^-	0+2		S: 0.025 (L=0), 0.009 (L=2).
4411.3 *4*	$(5^+,6^+)$	(5)	0.037	
4425.7 *3*	$(5^+,6^+)$	(5)	0.040	
4482.1 *3*	$(5^+,6^+)$	(5)	0.097	
4504.7 *3*	$5^+,6^+$	5	0.19	
4518.8 *4*	$1^-,2^-$	2	0.010	
4532.9 *4*	$(1^-),2^-$	2	0.013	
4548.0# *4*				
4558.5 *5*	$(0^-,1^-)$	(0)	0.022	
4572.0 *4*	(2^-)	2	0.012	
4587.3# *5*				
4619.5# *5*				
4636.8 *5*	$(5^+,6^+)$	(5)	0.12	
4645.4# *11*				
4656.1 *7*	$(5^+,6^+)$	(5)	0.07	
4662.8 *6*	3^-	2+4		S: 0.015 (L=2), 0.043 (L=4).
4672.6 *7*	3^-	2+4		S: 0.006 (L=2), 0.020 (L=4).
4685.8 *7*	1^-	0+2		S: 0.015 (L=0), 0.009 (L=2).
4694.2@ *7*				
4713.0 *7*	$5^+,6^+$	5	0.095	
4725.4# *18*				
4735.2# *8*				
4749.4# *8*				
4777.1# *10*				
4784.7 *9*	$3^-,4^-$	4	0.045	
4802.9# *10*				
4814.7# *11*				
4822.7# *11*				
4835.4@ *10*		(2,5)		
4865.9 *12*	$5^+,6^+$	5	0.055	
4881.4@ *12*		(2,5)		
4895.4 *13*	(2^-)	2	0.011	
4914.8 *13*	$(1^-,2^-)$	(2)	0.019	
4927.3# *15*				
4940.1 *14*	(3^-)	(2+4)		S: 0.014 (L=2), 0.036 (L=4).
4953.2 *15*	(1^-)	(0+2)		S: 0.015 (L=0), 0.007 (L=2).
4971.2 *16*	$5^+,6^+$	5	0.082	
4986.0 *16*	$(0^-,1^-)$	(0)	0.018	
4997.9 *25*	$2^-,3^-$	2	0.009	

† Spin and parity assignments are based on angular momentum transfers and analyzing powers.
‡ Cross-sections measured at two angles only.
# Peak not well resolved or has poor statistics.
@ Multiplet with several L-transfer values.
& S-factors defined as S= $[d\sigma/d\Omega]_{exp}$ / $[d\sigma/d\Omega]_{DWBA}$, with the cross-section values taken at first maximum of the angular distribution. DWBA calculations performed using the CHUCK3 code (1993Mi04).

^{89}Y(d,pγ) 1972Li05

1972Li05: E=6 MeV. Measured E(p), Eγ, Iγ, pγ coin. Ge(Li) and silicon detectors. FWHM=100 keV. Below 1300 keV the results are from ^{87}Rb(α,nγ) measurements also reported in 1972Li05.

^{90}Y Levels

E(level)†	J$^\pi$‡	T$_{1/2}$	Comments
0	2$^-$	64.05 h *5*	T$_{1/2}$: From Adopted Levels.
202.3 *5*	3$^-$		
682.1 *9*	7$^+$	3.19 h *6*	T$_{1/2}$: From Adopted Levels.
776.7 *6*	2$^+$		
953.4 *6*	(3$^+$)		
1047.8 *9*	(5$^+$)		
1189.8 *9*	(4$^+$)		E(level): Iγ(142γ)/Iγ(236γ)=0.249 *23*.
1211.0 *10*	0$^-$		
1298.2 *10*	(6$^+$)		E(level): Iγ(251γ)/Iγ(616γ)=0.061 *14*.
1371.3 *8*	1$^-$		
1418.1 *8*			
1570.1 *7*	(3$^-$)		
1641.1 *7*	(1$^-$)		
1760.2 *5*	(2$^-$)		
1813.2 *7*	(2$^-$)		
1960.9 *10*	(5)		
2089.0 *11*	(5)		
2241.0 *11*	(5)		
2364.2 *9*			
2474.1 *8*	2$^-$		
2502.0 *10*			
2623.3 *8*	1$^-$		
2749.0 *9*	(4)		
2847.1 *8*			
2938.2 *7*	4$^-$		
2993.2 *8*			
3002.9 *8*			
3047.1 *10*	3$^-$		
3140.1 *10*			
3158.1 *7*			

† From 1972Li05.
‡ Assignments are based on decay properties and other measurements.

γ(^{90}Y)

E$_\gamma$†	I$_\gamma$‡	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	E$_\gamma$†	I$_\gamma$‡	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$
141.9	19	1189.8	(4$^+$)	1047.8	(5$^+$)	751.0	3	953.4	(3$^+$)	202.3	3$^-$
176.7	52	953.4	(3$^+$)	776.7	2$^+$	771	35	1960.9	(5)	1189.8	(4$^+$)
202.4	100	202.3	3$^-$	0	2$^-$	776.7	78	776.7	2$^+$	0	2$^-$
236.2	81	1189.8	(4$^+$)	953.4	(3$^+$)	791	55	2089.0	(5)	1298.2	(6$^+$)
250.8	6	1298.2	(6$^+$)	1047.8	(5$^+$)	794	35	2364.2		1570.1	(3$^-$)
365.5	100	1047.8	(5$^+$)	682.1	7$^+$	863	7	2623.3	1$^-$	1760.2	(2$^-$)
479.8	100	682.1	7$^+$	202.3	3$^-$	899	45	2089.0	(5)	1189.8	(4$^+$)
574.3	22	776.7	2$^+$	202.3	3$^-$	913	35	1960.9	(5)	1047.8	(5$^+$)
604	65	2364.2		1760.2	(2$^-$)	943	55	2241.0	(5)	1298.2	(6$^+$)
616.3	94	1298.2	(6$^+$)	682.1	7$^+$	953.4	45	953.4	(3$^+$)	0	2$^-$
663	30	1960.9	(5)	1298.2	(6$^+$)	1125	25	2938.2	4$^-$	1813.2	(2$^-$)

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^{89}Y(d,pγ) 1972Li05 (continued)

γ(^{90}Y) (continued)

E_γ †	I_γ ‡	E_i(level)	J^π_i	E_f	J^π_f	Comments
1169.0	8	1371.3	1^-	202.3	3^-	
1178	20	2938.2	4^-	1760.2	(2^-)	
1193	45	2241.0	(5)	1047.8	(5^+)	
1206	25	2847.1		1641.1	(1^-)	
1211.0	100	1211.0	0^-	0	2^-	
1233	35	2993.2		1760.2	(2^-)	
1368	80	1570.1	(3^-)	202.3	3^-	
1371.4	92	1371.3	1^-	0	2^-	
1398	22	3158.1		1760.2	(2^-)	
1418	100	1418.1		0	2^-	
1439§		1641.1	(1^-)	202.3	3^-	I_γ: Weak.
1517	13	3158.1		1641.1	(1^-)	
1520	20	2938.2	4^-	1418.1		
1558	75	1760.2	(2^-)	202.3	3^-	
1570	20	1570.1	(3^-)	0	2^-	
1611	55	1813.2	(2^-)	202.3	3^-	
1641	100	1641.1	(1^-)	0	2^-	
1701	30	2749.0	(4)	1047.8	(5^+)	
1760	25	1760.2	(2^-)	0	2^-	
1813	45	1813.2	(2^-)	0	2^-	
1985	35	2938.2	4^-	953.4	(3^+)	
2226	30	3002.9		776.7	2^+	
2271.7	77	2474.1	2^-	202.3	3^-	
2474.1	23	2474.1	2^-	0	2^-	
2502	100	2502.0		0	2^-	
2547	70	2749.0	(4)	202.3	3^-	
2623.4	93	2623.3	1^-	0	2^-	
2791	65	2993.2		202.3	3^-	
2847	75	2847.1		0	2^-	
3003	70	3002.9		0	2^-	
3047	100	3047.1	3^-	0	2^-	
3140	100	3140.1		0	2^-	
3158	65	3158.1		0	2^-	

† Deduced from level energy difference, data below 1300 keV are from (α,nγ) measurements also reported in 1972Li05.

‡ Photon branching at θ=90° in coincidence with protons detected at θ=155°. The stated uncertainty is 10%−20%. Data below 1300 are from (α,nγ) measurements.

§ Placement of transition in the level scheme is uncertain.

^{89}Y(α,^{3}He) 1972Go11

Jπ(^{89}Y)=1/2$^-$.
1972Go11: E=65.7 MeV. Measured E(^{3}He), $\sigma(\theta)$, θ=15° and 20°. Magnetic spectrograph, nuclear emulsions. FWHM≈60 keV.

^{90}Y Levels

E(level)†	L†	S′‡	E(level)†	L†	S′‡	E(level)†	L†	S′‡
0	2	2.47	2088 *5*	5	0.26	3004# *5*	(2,5)	0.72,1.84
203 *5*	2	3.53	2245 *5*	5	2.28	3052 *5*		
1221 *5*			2475 *5*			3160# *5*	(2,5)	0.58,0.18
1376 *5*			2517# *5*	5	0.48	3347#	(4)	0.43
1574 *5*			2626 *5*			3516 *5*	5	0.66
1646 *5*			2753# *5*	(2,5)	0.17,0.13	3590 *5*		
1762 *5*			2840# *5*	4	1.13	3634# *5*	(4,5)	1.12,0.50
1814 *5*			2873 *5*			4069 *5*	5	0.84
1962 *5*	5	1.55	2939 *5*					

† 1972Go11 report values for excitation energies from their (d,p) measurement presented in the same article.
‡ From comparison of 15° data with DWBA calculations. Data normalized to ^{89}Y(d,p) results for the 203 keV state. Data for 2517 keV, 2840 keV, 3004 keV and 3634 keV were corrected for unresolved transitions before analysis.
# Unresolved level.

^{91}Zr(d,^{3}He) 1980Ho05

Jπ(^{91}Zr)=5/2^{+}.
1980Ho05: E=24.3 MeV. Measured $\sigma(\theta)$, θ=6°−50°, magnetic spectrograph, multi-wire proportional chamber. FWHM = 30-35 keV.
Other: 1974Co34.
L values and spectroscopic factors are from comparison with DWBA calculations.

^{90}Y Levels

E(level)	L	C^{2}S†	E(level)	L	C^{2}S†	E(level)	L	C^{2}S†	E(level)	L	C^{2}S†
0	1	0.48	950	4	0.09	1420	1+3	0.47+0.53	1810	1+3	0.22+0.46
200	1	0.63	1050	4	0.13	1570	1+3	0.90+0.85	2030	3	1.07
680	4	0.31	1190			1640	1+3	0.21+1.09			
780	4	0.09	1300	4	0.11	1760	1+3	0.12+0.37			

† The results deviate a factor of two from 1974Co34, probably due to non-locality corrections in wave functions.

^{91}Zr(t,α) 1983De27

Jπ(^{91}Zr)=5/2$^+$.

1983De27: E=17 MeV. Measured Eα, $\sigma(\theta)$, θ=15° to 50°. Enriched target (89%), Q3D spectrometer, position sensitive detector, FWHM≈18 keV .

L values and spectroscopic factors are from comparison with DWBA calculations, considering Jπ(^{91}Zr)=5/2$^+$.

^{90}Y Levels

E(level)	J$^\pi$ †	L	C^{2}S	E(level)	J$^\pi$ †	L	C^{2}S	E(level)	J$^\pi$ †	L
0	2$^-$	1	0.40	1417 *5*	(3$^-$)	(1,3)		2623 *15*	1$^-$	
202 *5*	3$^-$	1	0.63	1566 *5*	(4$^-$)	1	1.20	2750 *15*	(2)	
682 *5*	7$^+$	4	0.16	1647 *5*	(4$^-$)	3	1.94	2820 *15*		
777 *5*	2$^+$	4	0.10	1761 *5*	(2$^-$)	3	0.83	2840 *15*	(1)	
953 *5*	3$^+$	4	0.10	1813 *5*	(3$^-$)	(1,3)		2905 *15*	(2,3)	
1047 *5*	5$^+$	4	0.12	1965 *5*				2925 *15*		
1189 *5*	4$^+$			2030 *15*	(5$^-$)	3	1.28	2990 *15*	(1)	
1212 *5*	0$^-$			2090 *15*				3050 *15*	3$^-$	
1298 *5*	6$^+$	4	0.12	2290 *15*				3120 *15*		
1371 *5*	1$^-$			2366 *15*	(0,1)	(1,3)		3130 *15*	(0$^-$)	(1,3)

† As given by 1983De27. Assignments based on spectroscopic data, decay properties and previously known Jπ's. See also the ^{89}Y(n,γ) data set (1993Mi04).

^{92}Zr(d,α) 1966Bl07

1966Bl07: E=12.0 MeV. Measured σ. Magnetic spectrograph, emulsion plates, enriched (95.3%) target.
Other: 1974Gi09.

^{90}Y Levels

E(level)	E(level)	E(level)	E(level)
0	965	1430	1819
202	1050	1572	2030
683	1214	1645	
777	1374	1763	

Adopted Levels, Gammas

Q(β^-)=−6111 *3*; S(n)=11968 *3*; S(p)=8353.2 *16*; Q(α)=−6674.3 *612* 2017Wa10
S(2n)=21286 *5*; S(2p)=15428.86 *12* (2017Wa10).

^{90}Zr Levels

Cross Reference (XREF) Flags

A	^{90}Y β^- decay (64.00 h)	N	^{90}Zr(α,α')	Others:	
B	^{90}Y β^- decay (3.19 h)	O	^{91}Zr(^{3}He,α)	AA	^{90}Zr(e,e′)
C	^{90}Nb ε decay	P	^{89}Y(p,γ)	AB	^{92}Zr(p,t)
D	^{90}Zr IT decay (809.2 ms)	Q	^{90}Zr(e,e′p),(γ,p)	AC	^{91}Zr(d,t)
E	^{76}Ge(^{18}O,4nγ)	R	^{90}Zr(γ,n)	AD	^{88}Sr(^{3}He,n)
F	^{87}Sr(α,nγ)	S	^{89}Y(p,n),(p,nγ)	AE	^{88}Sr(^{16}O,^{14}C),(^{12}C,^{10}Be)
G	^{89}Y(^{3}He,d)	T	^{89}Y(p,p),(pol p,p)	AF	^{90}Zr(n,n′)
H	^{90}Zr(t,t′)	U	^{89}Y(p,p′),(p,p′γ)	AG	^{92}Zr(α,^{6}He)
I	^{91}Zr(p,d)	V	^{90}Zr(p,p′)	AH	^{94}Mo(d,^{6}Li)
J	^{90}Zr(^{3}He,dp)	W	^{90}Zr(p,p′γ)	AI	^{92}Mo(^{14}C,^{16}O)
K	^{89}Y(d,n)	X	^{90}Zr(n,n′γ)	AJ	Coulomb excitation
L	^{90}Zr(d,d′)	Y	^{93}Nb(p,α)	AK	^{90}Zr(^{17}O,^{17}O′),(^{17}O,^{17}O′γ)
M	^{90}Zr(^{3}He,^{3}He′)	Z	^{90}Zr(γ,γ')	AL	^{208}Pb(^{90}Zr,^{90}Zr′γ)

E(level)†	J$^\pi$	T$_{1/2}$‡	XREF	Comments
0	0$^+$	stable	ABCDEFGHIJKLMNOP VWXYZ	XREF: Others: AA, AB, AC, AD, AE, AF, AG, AH, AI, AJ, AK
1760.74 *14*	0$^+$	61.3 ns *25*	A CDE GH KL P VWXY	XREF: Others: AB, AC, AD, AF, AH, AI, AK, AL T$_{1/2}$: from delayed coincidence in ^{90}Zr(p,p′e). Other: 62 ns *4* (1959Kl46). J$^\pi$: E0 1760.7 transition to 0$^+$.
2186.273 *14*	2$^+$	87.9 fs *21*	A CDEF HIJ LMNOP VWXYZ	XREF: Others: AA, AB, AE, AF, AG, AH, AI, AJ, AK, AL μ=2.5 *4* T$_{1/2}$: from DSA measurements following projectile Coulomb excitation using ^{90}Zr (2000Ja11). Others: 87.0 fs *28* from (e,e′) Coulomb excitation (1984He02), 93 fs *5* from nuclear resonance fluorescence (1972Me04), 82 fs *+16−12* from Doppler-Shift Attenuation in ^{89}Y(p,γ) (1993Sa38) and 86.6 fs *+49−42* from ^{90}Zr(n,n′γ) (2013Pe16). μ: from Transient Field Integral Perturbed Angular Correlation (2000Ja11,2014StZZ). J$^\pi$: E2 2186γ to 0$^+$.
2319.000 *9*	5$^-$	809.2 ms *20*	BCDEFGH KL N P VWXY	XREF: Others: AB, AE, AG, AH, AK, AL %IT=100 μ=6.25 *13* T$_{1/2}$: from (n,n′γ). μ: From Nuclear Magnetic Resonance on Oriented Nuclei (1987Ed02,1987Ra17,2014StZZ). J$^\pi$: E5 2319.0γ to 0$^+$.
2739.29 *5*	(4)$^-$		C EFG I K M O	XREF: Others: AK, AL J$^\pi$: 2252.9γ from 2$^-$, 420.3γ to 5$^-$.
2747.875 *16*	3$^-$	15.2 ps *28*	C EF H J L N P VWX	XREF: Others: AB, AE, AG, AH, AI, AK, AL μ=3.0 *2* μ: From Nuclear Magnetic Resonance on Oriented Nuclei (2000Ja11,2014StZZ). J$^\pi$: E3 2747.5γ to 0$^+$.
3076.925 *15*	4$^+$		C EF HI L NOP VWXY	XREF: Others: AA, AE, AF, AH, AK, AL

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Adopted Levels, Gammas (continued)

^{90}Zr Levels (continued)

E(level)[†]	J^π	$T_{1/2}$[‡]	XREF	Comments
				J^π: E2 890.6γ to 2^+.
3308.10 *8*	2^+	67.9 fs *+42−35*	F HI L NOP VWXYZ	XREF: Others: AA, AE, AF, AG, AH, AK, AL $T_{1/2}$: from measurement with metallic sample in (n,n′γ) (2013Pe16). Others: 69 fs *13* from Coul. ex. in (e,e′) (1984He02), 72 fs *21* from nuclear resonance fluorescence (1974Me13), 96 fs *+6−5* from Doppler-Shift Attenuation in ^{89}Y(p,γ) (1993Sa38), and 97 fs *14* from Doppler-Shift Attenuation in ^{90}Zr(n,n′γ) (1993BeZL). J^π: E2 3308.1γ to 0^+.
3448.230 *14*	6^+	>1.46 ps	C EF H L N V XY	XREF: Others: AA, AH, AK, AL J^π: E2 371.3γ to 4^+.
3557 *5*			I	E(level): From ^{91}Zr(p,d).
3589.418 *15*	8^+	131 ns *4*	C EF H V XY	XREF: Others: AA, AH, AL Q=−0.51 *3*; μ=+10.84 *6* $T_{1/2}$: weighted average of 125 ns *6* from delayed coincidence in ^{90}Nb ε decay (1964Lo02) and 134 ns *4* from γ(t) (1977Ha49). Q: from time-differential Perturbed Angular Distribution (1977Ha49,1989Ra17,2014StZZ). μ: from time-differential Perturbed Angular Distribution, corrected for diamagnetic shift and Knight shift (1985Ra09,1989Ra17,2014StZZ). J^π: E2 141.2γ to 6^+.
3842.34 *11*	2^+	15.1 fs *12*	HI LMNOP VWXYZ	XREF: Others: AA, AG, AH, AL $T_{1/2}$: weighted average of 15.1 fs *9* from Coul. ex. in (e,e′) (1984He02), 19.0 fs *27* from nuclear resonance fluorescence, $\Gamma_{\gamma0}/\Gamma_\gamma$=1 was assumed, 14 fs *+6−4* from Doppler-Shift Attenuation in ^{89}Y(p,γ) (1993Sa38), 10 fs *3* from Doppler-Shift Attenuation in 90Zr(n,n′γ) (1993BeZL) and 24 fs *5* from DSA measurements in (n,n′γ) (2003Ga23). J^π: E2 3842γ to 0^+.
3932.4 *6*			Z	
3958.59 *10*	5^-	33 fs *6*	H L N V XY	XREF: Others: AA, AH J^π: from DWBA analysis of $\sigma(\theta)$ in (e,e′), L(p,p′)=5.
4058.07 *9*	4^+	0.12 ps *+6−4*	H V X	XREF: Others: AA, AL
4124.49 *14*	0^+		N P V XY	XREF: Others: AB, AG, AH J^π: from L(p,p′)=0, L(p,t)=0.
4223[&] *2*	$(2)^+$		HI L Y	XREF: Others: AA, AK J^π: from L(d,d′)=2.
4225.35 *12*	(4^-)	20 fs *5*	K N X	XREF: Others: AA J^π: (M1+E2) 1905.5γ to 5^-, 1478.0γ to 3^-.
4229.05 *9*	2^+	27 fs *3*	G X	XREF: Others: AA, AG J^π: E2 4229.3γ to 0^+.
4232.220 *24*	(6^-)	45 fs *+37−19*	C P V X	XREF: Others: AB J^π: (M1+E2) 1913.19γ to 5^-, feeding from 8^+ parent in ^{90}Nb ε decay.
4236.96 *10*	$(1,2^+)$	104 fs *21*	WX	J^π: 2476.2γ to 0^+.
4262.37 *8*	(3^+)	0.28 ps *+13−7*	X	J^π: (M1+E2) 1185.6γ to 4^+, (M1+E2) 2076.2γ to 2^+.
4299.12 *11*	(5^-)	31 fs *6*	X	J^π: (M1+E2) 1908.1γ to 5^-, (M1+E2) 1559.9γ to $(4)^-$.

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Adopted Levels, Gammas (continued)

^{90}Zr Levels (continued)

E(level)[†]	J^π	$T_{1/2}$[‡]	XREF	Comments
4305[@] *6*	4^+		N V	J^π: from L(α,α')=4.
4319.2? *3*			C HI Y	XREF: Others: AH
4331.93 *9*	4^+	37 fs *6*	NO V X	XREF: Others: AA, AB, AG J^π: from L(p,t)=4. Suggested to be the 4^+ member of the configuration=((ν $1g_{9/2}$)$^{-1}$(ν $d_{5/2}$)) multiplet.
4348.10 *13*	(4^+)	29 fs *7*	LM X	J^π: shape of excitation function consistent with J=4 in (n,n$'\gamma$), 2161.9γ to 2^+.
4375.07 *6*	7^-		C H N V XY	XREF: Others: AL J^π: from L(α,α')=7.
4426.43 *13*	0^+	0.20 ps *+24−8*	K P V XY	XREF: Others: AB, AH J^π: from L(p,t)=0.
4454.71 *10*	(5^+)		HI O XY	XREF: Others: AA J^π: shape of excitation function in (n,n$'\gamma$) consistent with J=4 or 5; L(^{3}He,α)=(4) and suggested to be the 5^+ member of the configuration=((ν $1g_{9/2}$)$^{-1}$(ν $d_{5/2}$)) multiplet.
4455.58 *10*	(2)	0.14 ps *+5−3*	V XY	J^π: D+Q 1707.9γ to 3^-.
4474.31 *14*	4^+	0.15 ps *+18−6*	N V XY	XREF: Others: AA J^π: from comparison of DWBA calculations to $\sigma(\theta)$ in (e,e$'$).
4494.79 *12*	(3^-)	42 fs *8*	V X	J^π: D+Q 1755.5γ to $(4)^-$, 1747.2γ to 3^-, L(p,p$'$)=(3).
4500[f] *15*	0^+,1^+,2^+		G	J^π: from L(^{3}He,d)=1.
4507.0 *8*			Z	
4533.52 *10*	(3^-)	69 fs *+35−28*	HI X	J^π: (M1+E2) 1794.2γ to $(4)^-$, 2347.3γ to 2^+.
4537.70 *11*	(4^-)	0.13 ps *+7−5*	K XY	XREF: Others: AG, AH J^π: (M1+E2) 2218.7γ to 5^-.
4541.37 *3*	6^+	59 fs *+17−12*	C NO V X	XREF: Others: AA, AB J^π: from L(p,t)=6; suggested to be the 6^+ member of the configuration=((ν $1g_{9/2}$)$^{-1}$(ν $d_{5/2}$)) multiplet.
4562.02 *14*	5	0.14 ps *+10−4*	G I X	XREF: Others: AA J^π: shape of excitation function in (n,n$'\gamma$) consistent with J=5.
4578.93 *13*	(1)	5.1 fs *20*	P X Z	$T_{1/2}$: other=8.7 fs *+13−9* from DSA in ^{89}Y(p,γ). J^π: population in (γ,γ').
4591.37 *10*	(3^+)	0.14 ps *+4−3*	H O V X	J^π: shape of excitation function in (n,n$'\gamma$) consistent with J=5;ssuggested to be the 3^+ member of the configuration=((ν $1g_{9/2}$)$^{-1}$(ν $d_{5/2}$)) multiplet in (^{3}He,α).
4614.42 *13*	(6^+)		X	J^π: shape of excitation function in (n,n$'\gamma$) consistent with J=6, 1537.6γ to 4^+.
4640.94 *4*	7,8		C X	J^π: feeding from 8^+ parent in ^{90}Nb beta decay, 1192.7γ to 6^+.
4646.7 *3*	1,2^+	5 fs *4*	GHI P V X	XREF: Others: AG, AH J^π: 4646.6γ to 0^+.
4681.26 *12*	2^+	31 fs *7*	NOP V X	XREF: Others: AA, AB, AK J^π: E2 4680.8γ to 0^+; suggested to be the 2^+ member of the configuration=((ν $1g_{9/2}$)$^{-1}$(ν $d_{5/2}$)) multiplet in (^{3}He,d).
4701.10 *10*	2^+	46 fs *7*	X	J^π: E2 2940.6γ to 0^+.
4710[@] *6*			V	E(level): possibly the same as the 4701 level.

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Adopted Levels, Gammas (continued)

^{90}Zr Levels (continued)

E(level)[†]	J^π	$T_{1/2}$[‡]	XREF	Comments
				L(p,p′)=2 would be consistent with Jπ of 4701 level.
4774.29 *13*			G X	
4781.81 *20*	4,(3⁻)	14 fs *+22−13*	V X	J^π: shape of excitation function in (n,n′γ) consistent with J=3 or 4; 2462.8γ to 5⁻.
4795.6 *3*	2⁺	7 fs *+6−3*	HI X	XREF: Others: AH J^π: E2 4795.5γ to 0⁺.
4814.44 *11*	(3⁻)		X	XREF: Others: AB J^π: from L(p,t)=3, assuming the 4814 level corresponds to that observed in (p,t).
4818.02 *12*	(3,4⁺)	0.14 ps *+19−7*	N X	XREF: Others: AB, AG J^π: shape of excitation function in (n,n′γ) consistent with J=3 or 4, 975.8γ to 2⁺.
4824.21 *13*	2⁺	40 fs *+10−8*	V X	J^π: L(p,t)=2; 1747.2γ to 4⁺, 4823.9γ to 0⁺.
4840.27 *14*	5⁻	83 fs *+28−14*	X	J^π: shape of excitation function in (n,n′γ) consistent with J=5, 2092.7γ to 3⁻.
4849[@] *6*			V	
4867.47 *12*	5⁺	0.14 ps *+5−4*	X	J^π: shape of excitation function in (n,n′γ) consistent with J=5, M1+E2 1790.7γ to 4⁺.
4875[@] *6*			V	
4932.6 *4*	1,2⁺	0.18 ps *+35−11*	X	J^π: 4932.5γ to 0⁺.
4941.89 *13*	(4⁺)	49 fs *10*	N V X	J^π: from L(α,α′)=4.
4992.36 *12*		0.21 ps *+13−6*	G I P V X	
5059.975 *21*	7⁺		C I NO V X	XREF: Others: AA, AB J^π: E3 2741γ to 5⁻, E1 827.7γ to 6⁻; suggested to be the 7⁺ member of the configuration=((ν $1g_{9/2}$)⁻¹(ν $d_{5/2}$)) multiplet in (³He,α).
5068.6 *6*	1,2⁺	7 fs *+13−6*	X	J^π: 5068.4γ to 0⁺.
5084.03 *14*	2,3	46 fs *+12−10*	G K V X	XREF: Others: AA J^π: shape of excitation function in (n,n′γ) consistent with J=2 or 3.
5090.30 *23*	(3⁻)		G I P XY	J^π: shape of excitation function in (n,n′γ) consistent with J=3.
5107.92 *21*	(3),4⁺	0.07 ps *+4−3*	H P X	XREF: Others: AB, AG J^π: 2368.6γ to (4)⁻, 2921.7γ to 2⁺.
5112.6 *14*	3⁻		N V X	J^π: from L(α,α′)=3.
5164.484 *23*	(8)⁺		C E	J^π: (E2) 1717.3γ to 6⁺, M1,E2 1575.0γ to 8⁺.
5171.90 *16*	(4)	23 fs *+8−6*	X	J^π: shape of excitation function in (n,n′γ) consistent with J=4.
5175.8 *3*	3,4⁺	22 fs *+21−8*	G V X Z	J^π: shape of excitation function in (n,n′γ) consistent with J=3 or 4, 2989.5γ to 2⁺.
5183.61 *18*	1,2⁺	6.9 fs *35*	P X Z	J^π: 5183.2γ to 0⁺.
5222.97 *23*	(4⁺)		H N V X	J^π: from L(p,p′)=4.
5232.3 *3*		34.0 fs *28*	X	
5247.52 *4*	9⁺	<28[g] ps	C E	J^π: E2(+M1) 1658.1γ to 8⁺.
5270.74 *20*		17 fs *+53−16*	X	
5275.4 *10*	(2⁺)	0.80[h] ps *+20−11*	P	J^π: 5275γ (E2) to 0⁺.
5305.97 *20*	2⁺	17 fs *5*	X Z	J^π: E2 5305.8γ to 0⁺.
5307.75 *15*	(3⁻,4⁺)	0.07 ps *+8−2*	G P X	J^π: 2988.9γ to 5⁻, 3121.3γ to 2⁺.
5312.77 *20*	1,2⁺	59 fs *10*	N V X	XREF: Others: AB J^π: 5312.6γ to 0⁺.
5317.7 *3*	3⁻	0.19 ps *+11−6*	O X	XREF: Others: AB, AH J^π: from L(p,t)=3.
5359.22 *19*	3,4	22.9 fs *28*	X	J^π: shape of excitation function in (n,n′γ)

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Adopted Levels, Gammas (continued)

^{90}Zr Levels (continued)

E(level)[†]	J^π	$T_{1/2}$[‡]	XREF	Comments
				consistent with J=3 or 4.
5379.8 *3*	(4+)	20 fs *4*	H N V X	J^π: from L(p,p′)=L(α,α′)=4.
5426.01 *13*	3−	52 fs *+19−14*	C G I X	XREF: Others: AH J^π: E2 3106.8γ to 5−, 2118.1γ to 2+.
5432.790 *22*	7+,8+		C	J^π: feeding from 8+ parent in ^{90}Nb ε decay, M1,E2 1843.3γ to 8+, 1984.5γ to 6+.
5437.33 *13*	2+	24.3 fs *35*	V X	XREF: Others: AG XREF: V(5433). J^π: from L(p,p′)=2, E2 5436.9γ to 0+.
5441[#] *5*	0+			XREF: Others: AB J^π: from L(p,t)=0.
5457.70 *18*	(4+)	115.9 fs *28*	H N V X	XREF: N(5464)V(5462). J^π: from L(t,t′)=4.
5504.75 *19*		7.7 fs *7*	I N VWX Z	
5513.41 *16*	(3,4)	0.16 ps *+8−6*	X	XREF: Others: AB XREF: AB(5507). J^π: from L(p,t)=3,4.
5564.2 *4*		7.6 fs *28*	I X	XREF: Others: AH
5582[@] *6*	(3−)		N V	J^π: from L(α,α′)=(3).
5590.58 *14*	2+	15.9 fs *21*	X	XREF: Others: AB J^π: from L(p,t)=2.
5601.8 *4*		24 fs *4*	X	
5607.6 *4*		14 fs *+9−7*	G MN X	XREF: Others: AA
5631[@] *7*	3−		I K V	B(E3)↑=0.0068 *10* (1975Si21) J^π: from (e,e′).
5644.02 *4*	10+	<28[g] ps	E H	XREF: Others: AH, AL J^π: E2 2054.6γ to 8+.
5651.1 *3*		45 fs *5*	G X	
5666[@] *7*	3−		NO V	J^π: from L(α,α′)=3.
5703[@] *7*			V	
5724.3 *4*		22 fs *4*	X	
5753[@] *7*			G K V	XREF: Others: AA
5775.1 *5*		24 fs *+21−6*	H N X	
5781[@] *7*	3−		V	XREF: Others: AA B(E3)↑=0.00145 *22* (1975Si21) J^π: from (e,e′), L(p,p′)=3.
5785.0 *4*			Z	
5792.05 *3*	(9+)		E	J^π: (M1+E2) 2202.6γ to 8+.
5808 *4*			O Z	
5821.8 *6*			X	
5829[@] *7*			V	
5846.4 *5*		14 fs *+44−13*	G K X	
5884.4 *4*			N VW Z	
5938[#] *5*			HI N V	XREF: Others: AB, AH J^π: L(p,p′)=3 and L(p,t)=(1) are in conflict.
5977[@] *7*			V	
6006[@] *7*			V	
6020[f] *15*	1−,2−,3−		G K	J^π: L(^{3}He,d)=L(d,n)=2.
6058[@] *7*			V	
6070[f] *15*	1−,2−,3−		GH V	J^π: L(^{3}He,d)=2.
6106[@] *7*			V	

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Adopted Levels, Gammas (continued)

^{90}Zr Levels (continued)

E(level)[†]	J^π	$T_{1/2}$[‡]	XREF	Comments
6128[@] *7*			V	
6167[@] *7*			V	
6200[f] *15*	$1^-,2^-,3^-$		G K V	J^π: L(^{3}He,d)=2.
6229[@] *7*			V	
6250[f] *15*	$1^-,2^-,3^-$		G K V	J^π: L(^{3}He,d)=L(d,n)=2.
6279.70 *8*	11^+		E	J^π: E2 1032.2γ to 9^+.
6290[@]			V	
6296 *3*	1^-		H O Z	
6308[@] *7*			V	
6320[f] *15*	$1^-,2^-,3^-$		G	J^π: L(^{3}He,d)=2.
6370[f] *15*			G	
6376.10 *5*	(10^-)	<28[g] ps	E	J^π: E1(+M2) 818.2γ from (11^+).
6389.8 *3*	1		Z	J^π: D 6389.6γ to 0^+.
6397[@] *7*			G VW	
6424.3 *3*	1^-[i]		H V Z	XREF: Others: AK
6479[@]			V	
6496[@] *7*			V	
6517[@]			V	
6547[@] *7*			H V	
6565.7 *3*	1		Z	J^π: D 6565.4γ to 0^+.
6574[@] *7*			V	E(level): Unresolved doublet.
6640.1 *10*	(2^+)	21[h] fs *+7−6*	G P V	J^π: (E2) 6640γ to 0^+.
6669.2 *7*	1		G K Z	J^π: D 6668.9γ to 0^+.
6694[@]			V	
6710[f] *15*			G V	
6721.11 *5*	(10^-)		E	J^π: 1473.7γ to 9^+.
6742[@]			G V	XREF: Others: AH
6761.4 *2*	1^-[i]		Z	
6769.51 *14*	(12^+)		E	J^π: (M1+E2) 489.8γ to (11^+).
6794[@] *7*			V	
6810[f] *15*	$1^-,2^-,3^-$		G K V	J^π: L(^{3}He,d)=2.
6853[@]			V	
6867[@]			V	
6876 *3*	1^-[i]		G Z	
6895[@]			V	
6924[@] *8*			V	
6953.94 *6*	$(11)^-$	<28[g] ps	E	J^π: E1(+M2) 1309.8γ to 10^+.
6960.4 *7*	1		Z	J^π: D 6960.1γ to 0^+.
6974[@]			V	
7000[f] *15*	$0^-,1^-$		G K V	J^π: L(^{3}He,d)=0.
7008.63 *6*	(11^-)		E	J^π: (E1(+(M2)) 1364.7γ to 10^+.
7025.59 *4*	(10^+)		E	J^π: (E2) 1861.4γ to $(8)^+$.
7042.0 *7*	1		Z	J^π: D 7041.7γ to 0^+.
7047[@]			V	
7060[@]			V	
7085.6 *10*	(1)		Z	J^π: (D) 7085.3γ to 0^+.
7089[@]			V	
7110[f] *15*	$0^-,1^-$		G K	J^π: from L(^{3}He,d)=0.

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Adopted Levels, Gammas (continued)

^{90}Zr Levels (continued)

E(level)[†]	J^π	$T_{1/2}$[‡]	XREF	Comments
7120[@]			V	
7136[@] *8*			V	
7151[@]			V	
7160[f] *15*	$1^-,2^-,3^-$		G V	J^π: from L(^{3}He,d)=2.
7194.35 *4*	(11^+)	<28 ps	E	J^π: M1+E2 168.8γ to (10^+).
7198.2 *6*	1		Z	J^π: D 7197.9γ to 0^+.
7200[@]			V	
7223.89 *6*	$(12)^+$	59 ps *10*	E	J^π: E1(+M2) 269.9γ to $(11)^-$.
7235[@]			V	
7250 *3*	1^-[i]		G K Z	
7263[@]			V	
7275[@]			V	
7280.9 *7*			Z	
7350[f] *15*	$1^-,2^-,3^-$		G V	J^π: from L(^{3}He,d)=2.
7361.0 *6*	1		Z	J^π: D 7360.8γ to 0^+.
7378[@] *8*			V	
7387.6 *4*	1		Z	J^π: D 7387.3γ to 0^+.
7402[@]			V	
7420[f] *15*			G V	
7424.5 *10*			Z	
7433.8 *8*	1		Z	J^π: D 7433.5γ to 0^+.
7437.82 *7*	$(13)^+$	2.9[g] ps *5*	E	J^π: M1+E2 213.9γ to $(12)^+$.
7461[@]			V	
7468 *2*			Z	
7474.9 *3*	(1)		Z	J^π: (D) 7474.6γ to 0^+.
7480[f] *15*			G K	
7530[f] *15*			G V	
7580[f] *15*			G	
7614[@]			V	
7633[@]			V	
7649.9 *10*	(2^+)	0.55[h] ps *+9−7*	P	J^π: (E2) 7650γ to 0^+.
7650[f] *15*	$1^-,2^-,3^-$		G	J^π: from L(^{3}He,d)=2.
7685.8 *4*	1		Z	J^π: D 7685.4γ to 0^+.
7702.9 *3*	1^-[i]		Z	
7723.1 *9*			V Z	
7750[@]			V	
7759.7 *6*	(1)		Z	J^π: (D) 7759.3γ to 0^+.
7767[@]			G V	
7774[&] *10*			K	XREF: Others: AA
7779.0 *6*	1		Z	J^π: D 7778.6γ to 0^+.
7796[@]			V	
7806[&] *10*	(2^-)			XREF: Others: AA J^π: from (e,e′).
7807.9 *3*	1		Z	J^π: D 7807.5γ to 0^+.
7840[f] *15*	$1^-,2^-,3^-$		G K	J^π: from L(^{3}He,d)=2.
7857.8 *7*	(1)		Z	J^π: (D) 7857.4γ to 0^+.
7868[&] *10*	$(1^+,2^-)$			XREF: Others: AA J^π: from (e,e′).

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{90}Zr Levels (continued)

E(level)[†]	J^π	$T_{1/2}$[‡]	XREF	Comments
7877[@]			V	
7907[&] *10*			G V	XREF: Others: AA
7926[@]			V	
7935.6 *3*	1		Z	J^π: D 7935.2γ to 0^+.
7976.6 *4*	1		Z	J^π: D 7976.2γ to 0^+.
7984[@]			V	
7996[&] *10*	(3^-)		G K	XREF: Others: AA J^π: from (e,e′).
8006.9 *8*	1		Z	J^π: D 8006.5γ to 0^+.
8032[&] *10*	2^-		G	XREF: Others: AA J^π: from (e,e′).
8058.41 *8*	$(14)^+$	0.28[g] ps *14*	E	J^π: M1+E2 620.6γ to $(13)^+$.
8067.4 *5*	(1)		Z	J^π: (D) 8067.0γ to 0^+.
8110 *3*	1^-[i]		Z	XREF: Others: AA
8120[f] *15*			G V	
8131 *3*	(1^-)		Z	XREF: Others: AA J^π: (E1) 8131.5γ to 0^+.
8144 *2*			Z	
8166.7 *5*	(1)		V Z	J^π: (D) 8166.3γ to 0^+.
8221.2 *8*	1		Z	J^π: D 8220.8γ to 0^+.
8235.6 *3*	1		Z	J^π: D 8235.2γ to 0^+.
8250.7 *5*	1		Z	J^π: D 8250.3γ to 0^+.
8276[@]			V	
8291[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
8295.3 *10*	(1)		Z	J^π: (D) 8294.9γ to 0^+.
8313.0 *7*	1		Z	J^π: D 8312.6γ to 0^+.
8316[&] *10*	(2^-)			XREF: Others: AA J^π: from (e,e′).
8334.1 *5*	1		Z	J^π: D 8333.7γ to 0^+.
8357.5 *18*	1		Z	J^π: D 8357.1γ to 0^+.
8366[&] *10*	(1^+)			XREF: Others: AA J^π: from (e,e′).
8382.1 *10*	(1)		Z	J^π: (D) 8381.7γ to 0^+.
8400[&] *10*	(2^-)			XREF: Others: AA J^π: from (e,e′).
8403.7 *11*			Z	
8413.5 *4*	1		V Z	J^π: D 8413.1γ to 0^+.
8430[@]			V	
8440.6 *4*	1		Z	J^π: D 8440.2γ to 0^+.
8442[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
8467.7 *15*			Z	
8501.2 *4*	1^-[i]		Z	XREF: Others: AA
8515[@]			V	
8518 *3*			Z	
8542[&] *10*	2^-		V	XREF: Others: AA J^π: from (e,e′).
8544 *4*			Z	
8553.5 *12*	1		Z	J^π: D 8553.1γ to 0^+.
8588.3 *7*	1		Z	J^π: D 8587.9γ to 0^+.

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Adopted Levels, Gammas (continued)

^{90}Zr Levels (continued)

E(level)[†]	J^π	$T_{1/2}$[‡]	XREF	Comments
8598.2 *10*	1		Z	J^π: D 8597.8γ to 0^+.
8625.6 *10*	1		Z	J^π: D 8625.2γ to 0^+.
8627[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
8664.1 *5*	1		Z	J^π: D 8663.7γ to 0^+.
8701[&] *10*	(2^-)			XREF: Others: AA J^π: from (e,e′).
8716.6 *5*	1^-[i]		Z	
8751.0 *8*	1		Z	J^π: D 8750.5γ to 0^+.
8760.4 *5*	1		Z	J^π: D 8759.9γ to 0^+.
8809[&] *10*	(2^-)			XREF: Others: AA J^π: from (e,e′).
8812.0 *13*	1[j]		Z	
8833.2 *8*	1[j]		Z	
8853[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
8874.9 *9*	1[j]		Z	
8882[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
8903.0 *8*			Z	
8911[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
8927.4 *4*			Z	
8934[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
8958.13 *15*	$(15)^-$	0.5[g] ps *3*	E	J^π: E1 899.7γ to $(14)^+$.
8971[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
8978.4 *9*	(1)		Z	J^π: (D) 8977.9γ to 0^+.
8985 *2*			Z	
9004.7 *5*	1[j]		Z	
9014.0 *8*			Z	
9034.0 *8*			Z	
9043.6 *4*	1[j]		Z	
9053.5 *7*			Z	
9061[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
9085.1 *3*	1[j]		Z	
9101[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
9111.1 *6*	1[j]		Z	
9123.6 *7*			Z	
9127[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
9137.5 *7*			Z	
9148.5 *3*	1^-[i]		Z	XREF: Others: AA
9164.9 *7*			Z	
9177.5 *5*			Z	
9187 *3*			Z	
9196.5 *3*	(1^-)		Z	J^π: (E1) 9196.0γ to 0^+.
9260.5 *6*	1[j]		Z	

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Adopted Levels, Gammas (continued)

^{90}Zr Levels (continued)

E(level)[†]	J^π	$T_{1/2}$[‡]	XREF	Comments
9265[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
9292.8 *5*	1[j]		Z	
9294[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
9309.4 *7*	1[j]		Z	
9327[&] *10*	2^-			XREF: Others: AA J^π: from (e,e′).
9333.4 *6*	1^-[i]		Z	
9373.2 *7*			Z	XREF: Others: AA
9392.4 *8*	1[j]		Z	
9409.4 *11*			Z	
9424.3 *10*			Z	
9444.7 *4*	1[j]		Z	XREF: Others: AA
9465.1 *5*	1[j]		Z	
9486.8 *4*	1[j]		Z	
9489[&] *10*	2^-			XREF: Others: AA
9510.5 *13*	(1)		Z	XREF: Others: AA J^π: (D) 9510.0γ to 0^+.
9524.1 *13*	1[j]		Z	
9539.2 *5*	1[j]		Z	
9541[&] *10*	2^-			XREF: Others: AA
9551.4 *6*	1[j]		Z	
9563.0 *6*	1[j]		Z	
9601[&] *10*	$(1^-,2^-)$			XREF: Others: AA
9609.2 *7*			Z	
9625.1 *8*			Z	
9640.4 *8*	1[j]		Z	
9666.0 *8*	(1)		Z	J^π: (D) 9665.4γ to 0^+.
9678.3 *7*	(1^-)		Z	J^π: (E1) 9677.7γ to 0^+.
9686.9 *6*	1[j]		Z	
9694[&] *10*	2^-			XREF: Others: AA
9707.00? *25*	(16^-)	0.49[g] ps *14*	E	J^π: (M1+E2) 748.9γ to (15^-).
9733.2 *5*	1[j]		Z	
9741.7 *7*			Z	
9754.0 *6*	1[j]		Z	
9784.6 *5*			Z	
9805.4 *10*			Z	
9836.01 *18*	$(15)^+$		E	J^π: 1777.6γ to $(14)^+$.
9843.4 *6*	1[j]		Z	
9855.5 *8*	1[j]		Z	
9863[&] *10*	$(1^-,2^-)$			XREF: Others: AA
9872.4 *4*	1[j]		Z	
9890.7 *13*	(1)		Z	J^π: (D) 9890.1γ to 0^+.
9901.9 *13*			Z	
9932.1 *12*	1[j]		Z	
9962.8 *5*	1[j]		Z	
9984.1 *11*			Z	
10004.2 *10*	1[j]		Z	
10019.6 *11*	1[j]		Z	
10031 *2*			Z	

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Adopted Levels, Gammas (continued)

^{90}Zr Levels (continued)

E(level)[†]	J^π	$T_{1/2}$[‡]	XREF	Comments
10042.9 *4*	(1⁻)		Z	J^π: (E1) 10042.3γ to 0^+.
10083.8 *6*	1[j]		Z	
10094.2 *7*	1[j]		Z	
10104.9 *12*	(1)		Z	J^π: (D) 10104.3γ to 0^+.
10123.7 *18*	1[j]		Z	
10125.84 *18*	$(16)^+$	0.6[g] ps *2*	E	J^π: M1(+E2) 289.8γ to $(15)^+$.
10146.8 *9*	1[j]		Z	
10163.4 *8*	1[j]		Z	
10193.0 *5*	1[j]		Z	
10216.8 *10*	1[j]		Z	
10233 *4*			Z	
10241 *2*	(1)		Z	J^π: (D) 10240γ to 0^+.
10260.9 *11*			Z	
10270.0 *7*			Z	
10286.2 *6*	1[j]		Z	
10298.3 *10*	(1)		Z	J^π: (D) 10297.7γ to 0^+.
10306.6 *9*	1[j]		Z	
10315.1 *4*	1[j]		Z	
10334.9 *6*	1[j]		Z	
10361 *2*	(1)		Z	J^π: (D) 10360γ to 0^+.
10376.8 *4*	1[j]		Z	
10402.5 *9*	1[j]		Z	
10494.5 *11*	(1)		Z	J^π: (D) 10493.8γ to 0^+.
10507.9 *8*	1[j]		Z	
10524.6 *4*	1[j]		Z	
10595.0 *7*	1[j]		Z	
10618.7 *8*	1[j]		Z	
10638.5 *9*	1[j]		Z	
10682.2 *6*	1[j]		Z	
10713.2 *12*	(1)		Z	J^π: (D) 10712.5γ to 0^+.
10728.2 *11*	1[j]		Z	
10764.9 *4*	(17^+)	0.14[g] ps *14*	E	J^π: (M1+E2) 639.0γ to $(16)^+$.
10827.1 *5*	1[j]		Z	
10914 *2*	(1)		Z	J^π: (D) 10913γ to 0^+.
10957 *2*	1[j]		Z	
10987.0 *10*	1[j]		Z	
11044 *2*			Z	
11094.2 *15*			Z	
11108.0 *16*			Z	
11120.4 *9*	1[j]		Z	
11129.2 *17*			Z	
11140 *2*			Z	
11232.4 *7*	1[j]		Z	
11243.2 *6*	1[j]		Z	
11337.7 *6*	1[j]		Z	
11403.9 *6*	(18^+)	0.21[g] ps *11*	E	J^π: (M1+E2) 639.0γ to (17^+).
11417.5 *7*	(1)		Z	J^π: (D) 11416.7γ to 0^+.
11452.2 *10*	1[j]		Z	
11479.7 *8*	1[j]		Z	
11501 *3*			Z	
11510 *7*			Z	

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Adopted Levels, Gammas (continued)

^{90}Zr Levels (continued)

E(level)[†]	J^π	$T_{1/2}$[‡]	XREF	Comments
11531 *2*	1[j]		Z	
11627.9 *9*			Z	
11651.5 *8*	(1)		Z	J^π: (D) 11650.7γ to 0^+.
11777.4 *10*	1[j]		Z	
11788 *3*	1[j]		Z	
11963.3 *18*	(1)		Z	J^π: (D) 11962.4γ to 0^+.
11984 *2*	1[j]		Z	
12020.6 *8*	1[j]		Z	
12067.8 *9*	1[j]		Z	
12110.7 *6*	(19^+)	0.14[g] ps *5*	E	
12208.3 *12*	1[j]		Z	
12219.6 *25*			P	
12243.6 *14*	1[j]		Z	
12496.3 *18*			Z	
12880.3 *10*			Z	
12964.7 *7*	(20^+)	<0.35[g] ps	E	J^π: 1560.8γ to (18^+), 854.0γ to (19^+).
13110.2[a] *4*	$(2)^-$		K P ST	E(level),J^π: Probable analog of ^{90}Y g.s.
13310[a] *4*	$(3)^-$		K P STU	E(level),J^π: Probable analog of ^{90}Y, 203 keV.
13940[a]			S	E(level): Possible analog of ^{90}Y, 777 keV.
14090[a]			S	E(level): Possible analog of ^{90}Y, 954 keV.
14220[a]			S	E(level): Possible analog of ^{90}Y, 1048 keV.
14270[d] *30*	$(0^-,1^-)$		Q ST	E(level),J^π: Probable analog of ^{90}Y, 1212 keV.
14310[a]			S	
14410[a]			ST	
14430[b]	(1^-)		P S	E(level),J^π: Probable analog of ^{90}Y, 1371 keV.
14748[e]	(3^-)		U	
14878[e]	(0^-)		U	
14928[e]	(1^-)		U	
15500[b] *30*	$2^-,(1^-)$		P S	E(level),J^π: Probable analog of ^{90}Y, 2474 keV.
15700[b] *30*	$1^-,(2^-)$		P ST	E(level),J^π: Probable analog of ^{90}Y, 2624 keV.
15900[b]	(2^-)		P	
16148[e]	(2^-)		U	
16258[e]	(1^-)		U	E(level),J^π: Possible analog of ^{90}Y, 3145 keV.
16290[b]			P	
17300[b]			P	
19400[b]			PQR	
20800[b]			P	
21800[c]			R	
23700[c]			R	

[†] From least-squares fit to Eγ, by evaluators, except where noted.
[‡] From DSAM measurements in ^{90}Zr(n,n$'\gamma$) reaction, except where noted.
[#] From ^{92}Zr(p,t).
[@] From ^{90}Zr(p,p$'$).
[&] From ^{90}Zr(e,e$'$).
[a] From ^{89}Y(p,n),(p,nγ).
[b] From ^{89}Y(p,γ).
[c] From ^{90}Zr(γ,n).
[d] From ^{89}Y(p,p).

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Adopted Levels, Gammas (continued)

^{90}Zr Levels (continued)

[e] From ^{89}Y(p,p′),(p,p′γ).
[f] From ^{89}Y(^{3}He,d).
[g] From Doppler-Shift Attenuation and Recoil-Distance measurements in ^{76}Ge(^{18}O,4nγ).
[h] Doppler-shift attenuation in ^{89}Y(p,γ) (1993Sa38).
[i] From E1 transition to 0^+ ground state.
[j] From D transition to 0^+ ground state.

$\gamma(^{90}Zr)$

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[b]	Comments
1760.74	0^+	1760.70[§] *20*	[§]	0	0^+	E0[§]			E_γ: from ^{90}Nb ε decay. Probability of two-photon decay is 0.040% *5*, see ^{90}Y β^- decay. Other: 0.018% *2* with a ratio <2E1>/<2M1>of 1.9 *7* (1984Sc37). Probability of one-photon E0 transition for 1760.7 relative to internal conversion is 5×10^{-7} *2* (1990Zh20), see ^{90}Y β^- decay.
2186.273	2^+	425.5 *2*	0.027 *5*	1760.74	0^+	[E2][§]		0.00688	B(E2)(W.u.)=5.2 *10*
		2186.242[§] *25*	100.0[§] *9*	0	0^+	E2[§]		5.36×10^{-4}	B(E2)(W.u.)=5.38 *13*
2319.000	5^-	132.716[§] *18*	5.04[§] *5*	2186.273	2^+	E3(+M4)[§]	<0.07	3.0 *9*	B(E3)(W.u.)=0.180 *10* δ: from ^{90}Nb ε decay.
		2318.959[§] *25*	100.0[§] *2*	0	0^+	E5[§]		4.64×10^{-4}	B(E5)(W.u.)=8.74 *33*
2739.29	$(4)^-$	420.28[§] *5*	100[§]	2319.000	5^-	[§]			
2747.875	3^-	429.0[e] *3*	0.53 *11*	2319.000	5^-	[E2]			B(E2)(W.u.)=0.53 *+18−13*
		561.604 *11*	100.0 *3*	2186.273	2^+	E1			B(E1)(W.u.)=1.17×10^{-4} *+27−18* E_γ: from ^{90}Nb ε decay. Mult.: D from $\gamma(\theta)$ in (n,n′γ); E1 from $\Delta\pi$=yes.
		2747.47 *5*	6.1 *3*	0	0^+	E3			B(E3)(W.u.)=8.0 *+18−13* Mult.: O from $\gamma(\theta)$ in (n,n′γ); M3 excluded by comparison to RUL.
3076.925	4^+	329.09 *3*	6.74 *18*	2747.875	3^-	E1			E_γ: weighted average of 329.058 *16* (^{90}Nb ε decay) and 329.125 *15* (^{90}Zr(n,n′γ)). I_γ: weighted average of 6.82 *23* (^{90}Nb ε decay) and 6.6 *3* (^{90}Zr(n,n′γ)). Mult.: D from $\gamma(\theta)$ in (n,n′γ); $\Delta\pi$=yes from level scheme.
		337.61 *14*	0.90 *11*	2739.29	$(4)^-$				E_γ: weighted average of 337.50 *15* (^{90}Nb ε decay) and 337.8 *2* (^{90}Zr(n,n′γ)). I_γ: weighted average of 1.4 *5* (^{90}Nb ε decay) and 0.88 *11* (^{90}Zr(n,n′γ)).
		757.86 *7*	2.66 *21*	2319.000	5^-				E_γ: weighted average of 757.95 *5* (^{90}Nb ε decay) and 757.80 *4* (^{90}Zr(n,n′γ)). I_γ: weighted average of 2.23 *23* (^{90}Nb ε decay) and 2.76 *11* (^{90}Zr(n,n′γ)).
		890.629 *14*	100.0 *3*	2186.273	2^+	E2[a]		8.82×10^{-4}	
3308.10	2^+	1121.990 *22*	45 *4*	2186.273	2^+	M1+E2	+0.25		B(E2)(W.u.)=3.5 *+15−13*; B(M1)(W.u.)=0.065 *6* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ); $\Delta\pi$=no from level scheme.
		1547.5	3.9 *10*	1760.74	0^+	[E2]			B(E2)(W.u.)=1.03 *26*
		3308.1 *2*	100 *4*	0	0^+	E2			B(E2)(W.u.)=0.589 *38* Mult.: Q from $\gamma(\theta)$ in (n,n′γ); M2 excluded by comparison to RUL.
3448.230	6^+	371.307[§] *8*	1.95[§] *7*	3076.925	4^+	E2[§]		0.01064	B(E2)(W.u.)<46

$^{90}_{40}Zr_{50}$-14

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[b]	Comments
3448.230	6^+	1129.224[§] *15*	100.0[§] *4*	2319.000	5^-	E1[§]		2.42×10^{-4} *8*	B(E1)(W.u.)<1.6×10^{-4}
3589.418	8^+	141.178[§] *15*	100.0[§] *10*	3448.230	6^+	E2[§]			B(E2)(W.u.)=2.41 *7*
		1270.396[§] *18*	1.94[§] *4*	2319.000	5^-	(E3)[§]		7.63×10^{-4}	B(E3)(W.u.)=0.0523 *20*
3842.34	2^+	1656.05 *11*	17.0 *15*	2186.273	2^+	M1+E2	+1.1	3.72×10^{-4} *10*	B(E2)(W.u.)=10.0 *+20−23*; B(M1)(W.u.)=0.022 *5* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ); $\Delta\pi$=no from level scheme.
		3842.2 *10*	100.0 *15*	0	0^+	E2			B(E2)(W.u.)=1.60 *+14−12* Mult.: Q from $\gamma(\theta)$ in (n,n′γ); M2 excluded by comparison to RUL.
3932.4		3932.3[#] *6*	100[#]	0	0^+	[#]			
3958.59	5^-	1219.33 *3*	53.8 *12*	2739.29	$(4)^-$	(M1+E2)	+0.08		B(E2)(W.u.)=0.59 *+32−22*; B(M1)(W.u.)=0.128 *+29−20* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ); $\Delta\pi$=no from level scheme.
		1639.60 *4*	100.0 *12*	2319.000	5^-	(M1+E2)	+0.06		B(E2)(W.u.)=0.14 *+7−5*; B(M1)(W.u.)=0.098 *+22−15* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ); $\Delta\pi$=no from level scheme.
4058.07	4^+	981.31 *7*	7.8 *15*	3076.925	4^+	(M1+E2)	−0.11		B(E2)(W.u.)=0.18 *+13−9*; B(M1)(W.u.)=0.013 *+7−5* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ); $\Delta\pi$=no from level scheme.
		1310.00 *18*	4.3 *14*	2747.875	3^-	[E1]			B(E1)(W.u.)=4.7×10^{-5} *+27−21*
		1318.92 *19*	2.4 *13*	2739.29	$(4)^-$	[E1]			B(E1)(W.u.)=2.6×10^{-5} *+20−14*
		1871.90 *3*	100 *3*	2186.273	2^+	E2			B(E2)(W.u.)=7.5 *+38−25* Mult.: Q from $\gamma(\theta)$ in (n,n′γ); M2 excluded by comparison to RUL.
4124.49	0^+	1938.26 *6*	100	2186.273	2^+				
4225.35	(4^-)	1478.02 *16*	22 *4*	2747.875	3^-				
		1485.75 *14*	100 *4*	2739.29	$(4)^-$	(M1+E2)	+0.31		B(E2)(W.u.)=10.7 *45*; B(M1)(W.u.)=0.21 *+7−5* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), non zero value of δ suggests $\Delta\pi$=no.
		1906.50 *17*	27 *6*	2319.000	5^-	(M1+E2)	−0.57		B(E2)(W.u.)=2.1 *+11−8*; B(M1)(W.u.)=0.022 *+9−6* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), non zero value of δ suggests $\Delta\pi$=no.
4229.05	2^+	1481.40 *6*	65 *15*	2747.875	3^-				
		2042.73 *4*	100 *12*	2186.273	2^+	M1+E2	+0.04		B(E2)(W.u.)=0.020 *+10−8*; B(M1)(W.u.)=0.050 *8*
		4229.3 *2*	28 *5*	0	0^+	E2			B(E2)(W.u.)=0.094 *+22−19* Mult.: Q from $\gamma(\theta)$ in (n,n′γ), M2 excluded by comparison to RUL.
4232.220	(6^-)	643[§e]	<1.5[§]	3589.418	8^+				
		784[§e]	<0.5[§]	3448.230	6^+				
		1155[§e]	<0.4[§]	3076.925	4^+				

$^{90}_{40}Zr_{50}$-15

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[b]	Comments
4232.220	(6⁻)	1493[§e]	<0.7[§]	2739.29	(4)⁻				
		1913.194[§] *25*	100.0[§] *13*	2319.000	5⁻	(M1+E2)	+0.5	4.27×10^{-4} *16*	B(E2)(W.u.)=4.0 *+34−21*; B(M1)(W.u.)=0.055 *+40−25* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), non zero value of δ suggests $\Delta\pi$=no.
4236.96	(1,2⁺)	929.01 *18*	7.7 *3*	3308.10	2⁺				
		2050.81 *9*	27 *5*	2186.273	2⁺				
		2476.22 *4*	100 *5*	1760.74	0⁺				
		4237.0[e] *15*		0	0⁺				E_γ: observed only in (p,p′γ) (1974Ce03).
4262.37	(3⁺)	954.2 *1*	19.9 *17*	3308.10	2⁺	(M1+E2)	+0.06		B(E2)(W.u.)=0.026 *+15−13*; B(M1)(W.u.)=0.0063 *21* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ); $\Delta\pi$=no from level scheme.
		1185.56 *5*	41 *4*	3076.925	4⁺	(M1+E2)	−3.1		B(E2)(W.u.)=4.6 *16*; B(M1)(W.u.)=6.3×10^{-4} *+39−26* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), non zero value of δ suggests $\Delta\pi$=no.
		1514.8 *1*	43 *7*	2747.875	3⁻				
		1523.07 *4*	84.7 *20*	2739.29	(4)⁻				
		2076.20 *4*	100 *5*	2186.273	2⁺	(M1+E2)	+0.6		B(E2)(W.u.)=0.20 *9*; B(M1)(W.u.)=0.0022 *8* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), non zero value of δ suggests $\Delta\pi$=no.
4299.12	(5⁻)	1559.91 *7*	50.4 *17*	2739.29	(4)⁻	(M1+E2)	+0.34		B(E2)(W.u.)=2.9 *+13−10*; B(M1)(W.u.)=0.056 *+14−10* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), non zero value of δ suggests $\Delta\pi$=no.
		1980.06 *8*	100.0 *17*	2319.000	5⁻	(M1+E2)	+0.85		B(E2)(W.u.)=7.0 *+24−19*; B(M1)(W.u.)=0.035 *+11−8* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), non zero value of δ suggests $\Delta\pi$=no.
4319.2?		2000.2[d§e] *3*	100[d§]	2319.000	5⁻				
4331.93	4⁺	1255.18 *3*	74.5 *21*	3076.925	4⁺	M1+E2			B(E2)(W.u.)<99; B(M1)(W.u.)<0.15 Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), $\Delta\pi$=no from level scheme.
		1584.25 *4*	100 *3*	2747.875	3⁻	[E1]			B(E1)(W.u.)=0.00118 *+22−17*
		2012.9 *2*	20 *4*	2319.000	5⁻	[E1]			B(E1)(W.u.)=1.15×10^{-4} *+30−26*
4348.10	(4⁺)	1608.8		2739.29	(4)⁻				
		2161.87 *3*		2186.273	2⁺				
4375.07	7⁻	2055.77 *7*	100	2319.000	5⁻	E2			Mult.: Q from $\gamma(\theta)$ in (n,n′γ), $\Delta\pi$=no from level scheme.
4426.43	0⁺	2240.20 *5*	100	2186.273	2⁺	[E2]			B(E2)(W.u.)=2.1 *+15−11*
4454.71	(5⁺)	1377.74 *12*	16 *3*	3076.925	4⁺				
		1715.73 *14*	19 *7*	2739.29	(4)⁻				
		2135.70 *5*	100 *7*	2319.000	5⁻				
4455.58	(2)	1707.90 *5*	75 *4*	2747.875	3⁻	D+Q	+0.024		
		2269.40 *4*	100 *4*	2186.273	2⁺				

$^{90}_{40}Zr_{50}$-16

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	Comments
4474.31	4^+	1726.68 *7*	100 *5*	2747.875	3^-	[E1]		B(E1)(W.u.)=3.1×10^{-4} *+21−16*
		1735.0	40 *5*	2739.29	$(4)^-$	[E1]		B(E1)(W.u.)=1.2×10^{-4} *+8−6*
4494.79	(3^-)	1747.2 *2*	5 *3*	2747.875	3^-			
		1755.49 *4*	100 *3*	2739.29	$(4)^-$	D+Q	−0.02	
4507.0		4506.9[#] *8*	100[#]	0	0^+			
4533.52	(3^-)	1225.3[e] *2*	17.7 *22*	3308.10	2^+			
		1456.78 *4*	100 *11*	3076.925	4^+			
		1794.15 *6*	39 *4*	2739.29	$(4)^-$	(M1+E2)	+2.0	B(E2)(W.u.)=3.4 *+23−13*; B(M1)(W.u.)=0.0025 *+23−10* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), non zero value of δ suggests $\Delta\pi$=no.
		2347.3	14 *4*	2186.273	2^+			
4537.70	(4^-)	1460.95 *6*	63 *6*	3076.925	4^+			
		2218.65 *7*	100 *6*	2319.000	5^-	(M1+E2)	−0.36	B(E2)(W.u.)=0.24 *+18−11*; B(M1)(W.u.)=0.008 *+5−3* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), non zero value of δ suggests $\Delta\pi$=no.
4541.37	6^+	222[§]	<1.0[§]	4319.2?				
		309[§e]	<1.4[§]	4232.220	(6^-)	[E1]		B(E1)(W.u.)<0.0033
		952[§e]	<1.4[§]	3589.418	8^+	[E2]		B(E2)(W.u.)<8.6
		1092.97 *9*	8.1 *22*	3448.230	6^+			I_γ: other: 15.8 *13* in ^{90}Nb ε decay.
		1464[§e]	<3.7[§]	3076.925	4^+	[E2]		B(E2)(W.u.)<2.6
		2222.43 *3*	100.0 *22*	2319.000	5^-	[E1]		B(E1)(W.u.)=4.7×10^{-4} *11*
4562.02	5	1822.74 *5*	100	2739.29	$(4)^-$			
4578.93	(1)	2818.33 *10*	100 *8*	1760.74	0^+			
		4578.7 *2*	83 *8*	0	0^+			
4591.37	(3^+)	1843.70 *5*	100.0 *12*	2747.875	3^-			
		2405.18 *7*	36.6 *12*	2186.273	2^+	(M1+E2)	−0.07	B(E2)(W.u.)=0.0027 *+15−11*; B(M1)(W.u.)=0.0031 *8* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ); $\Delta\pi$=no from level scheme.
4614.42	(6^+)	1166.24 *12*	100 *10*	3448.230	6^+			
		1537.64 *12*	75 *10*	3076.925	4^+			
		2295.5	75 *8*	2319.000	5^-			
4640.94	7,8	409[§e]	<4.2[§]	4232.220	(6^-)			
		1051.53[§] *4*	100[§] *4*	3589.418	8^+			
		1192.7[§] *1*	7.7[§] *8*	3448.230	6^+			
		2322[§e]	<3.8[§]	2319.000	5^-			
4646.7	$1,2^+$	2884.8 *13*	100 *3*	1760.74	0^+			
		4646.6 *3*	18 *3*	0	0^+			
4681.26	2^+	1933.77 *8*	100 *10*	2747.875	3^-	[E1]		B(E1)(W.u.)=7.5×10^{-4} *+23−15*
		2495.1	42 *6*	2186.273	2^+			
		4680.8 *2*	58 *8*	0	0^+	E2		B(E2)(W.u.)=0.098 *+32−21* Mult.: Q from $\gamma(\theta)$ in (n,n′γ), M2 excluded by comparison to RUL.
4701.10	2^+	1953.26 *17*	100 *5*	2747.875	3^-	[E1]		B(E1)(W.u.)=4.0×10^{-4} *6*
		2514.76 *13*	39 *3*	2186.273	2^+			

$^{90}_{40}Zr_{50}$-17

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	Comments
4701.10	2^+	2940.60 *12*	95 *4*	1760.74	0^+	E2		B(E2)(W.u.)=0.88 *+15−12* Mult.: Q from $\gamma(\theta)$ in (n,n′γ), M2 excluded by comparison to RUL.
		4701.2 *3*	19 *4*	0	0^+	E2		B(E2)(W.u.)=0.0168 *+46−40* Mult.: Q from $\gamma(\theta)$ in (n,n′γ), M2 excluded by comparison to RUL.
4774.29		537.34 *5*	34 *3*	4236.96	$(1,2^+)$			
		2587.96 *25*	100 *3*	2186.273	2^+			
4781.81	$4,(3^-)$	2462.81 *19*	100	2319.000	5^-			
4795.6	2^+	4795.5 *3*	100	0	0^+	E2		B(E2)(W.u.)=1.3 *+10−6* Mult.: Q from $\gamma(\theta)$ in (n,n′γ), M2 excluded by comparison to RUL.
4814.44	(3^-)	2066.95 *8*	100 *7*	2747.875	3^-	D+Q	+0.34	
		2495.5	16 *3*	2319.000	5^-			
		2628.01 *10*	16 *3*	2186.273	2^+			
4818.02	$(3,4^+)$	975.75 *15*	16 *3*	3842.34	2^+			
		2070.39 *7*	100 *3*	2747.875	3^-			
4824.21	2^+	1747.2 *2*	8 *5*	3076.925	4^+	[E2]		B(E2)(W.u.)=2.3 *+15−12*
		2638.07 *11*	100 *5*	2186.273	2^+	M1+E2		B(E2)(W.u.)<5.0; B(M1)(W.u.)<0.032 Mult.: D+Q from γ(q) in (n,n′γ), $\Delta\pi$=no from level scheme.
		4823.9 *5*	17 *3*	0	0^+	[E2]		B(E2)(W.u.)=0.031 *9*
4840.27	5^-	1763.46 *6*	100 *6*	3076.925	4^+			
		2092.7	43 *6*	2747.875	3^-			
4867.47	5^+	1419.23 *10*	53 *5*	3448.230	6^+	M1+E2	−1.0	B(E2)(W.u.)=4.6 *+21−16*; B(M1)(W.u.)=0.0086 *+41−27* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), E1+M2 excluded by comparison to RUL.
		1790.73 *8*	100 *8*	3076.925	4^+	M1+E2	+0.8	B(E2)(W.u.)=2.1 *+10−8*; B(M1)(W.u.)=0.0098 *+45−29* Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), E1+M2 excluded by comparison to RUL.
		2128.2	17 *7*	2739.29	$(4)^-$			
4932.6	$1,2^+$	4932.5 *4*	100	0	0^+			
4941.89	(4^+)	1865.03 *8*	100 *3*	3076.925	4^+			
		2623.0 *2*	32 *3*	2319.000	5^-	[E1]		B(E1)(W.u.)=9.2×10^{-5} *+25−17*
4992.36		1150.3	30 *3*	3842.34	2^+			
		1684.35 *8*	100 *5*	3308.10	2^+			
		2244.5 *3*	31 *3*	2747.875	3^-			
		2252.9 *2*	20 *3*	2739.29	$(4)^-$			
5059.975	7^+	518.60[§] *6*	29.0[§] *21*	4541.37	6^+			
		827.74[§] *4*	46.6[§] *7*	4232.220	(6^-)	E1[§]		
		1470.528[§] *24*	19.3[§] *7*	3589.418	8^+			
		1611.76[§] *3*	100[§] *3*	3448.230	6^+	M1,E2[§]		
		2741.0[§] *3*	0.31[§] *10*	2319.000	5^-	E3		
5068.6	$1,2^+$	5068.4 *6*	100	0	0^+			
5084.03	2,3	2336.18 *10*	100 *7*	2747.875	3^-			

$^{90}_{40}Zr_{50}$-18

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[b]	Comments
5084.03	2,3	2345.7 *3*	37 *7*	2739.29	(4)$^-$				
5090.30	(3$^-$)	2904.03 *23*	100	2186.273	2$^+$				
5107.92	(3),4$^+$	2368.6		2739.29	(4)$^-$				
		2921.7 *2*		2186.273	2$^+$				
5112.6	3$^-$	2365.0 *10*	100	2747.875	3$^-$	(M1+E2)	−0.1		Mult.: D+Q from $\gamma(\theta)$ in (n,n′γ), $\Delta\pi$=no from level scheme.
5164.484	(8)$^+$	524[§e]	<3.7[§]	4640.94	7,8				
		623[§e]	<3.7[§]	4541.37	6$^+$				
		932[§e]	<22[§]	4232.220	(6$^-$)				
		1575.035[§] *23*	100[§] *4*	3589.418	8$^+$	M1,E2[§]		3.64×10^{-4} *8*	
		1716.27[§] *3*	97[§] *4*	3448.230	6$^+$	(E2)[§]		3.91×10^{-4}	
		2845[§e]	<0.3[§]	2319.000	5$^-$				
5171.90	(4)	2432.0 *3*	56 *5*	2739.29	(4)$^-$				
		2853.06 *14*	100 *5*	2319.000	5$^-$				
5175.8	3,4$^+$	2989.5 *3*	100	2186.273	2$^+$				
5183.61	1,2$^+$	2997.5 *2*	85 *13*	2186.273	2$^+$				
		5183.2 *3*	100 *13*	0	0$^+$				
5222.97	(4$^+$)	2483.67 *19*	100	2739.29	(4)$^-$				
5232.3		3046.0 *3*	100	2186.273	2$^+$				
5247.52	9$^+$	1658.10[a] *4*	100[a]	3589.418	8$^+$	E2(+M1)[a]	+14 *14*	3.80×10^{-4} *17*	B(M1)(W.u.)>2.2×10^{-7}
5270.74		2531.44 *16*	100	2739.29	(4)$^-$				
5275.4	(2$^+$)	5275.2	100[&]	0	0$^+$	(E2)		1.59×10^{-3}	B(E2)(W.u.)=0.0072 *+12−15* Mult.: from ^{89}Y(p,γ).
5305.97	2$^+$	5305.8 *2*	100	0	0$^+$	E2			B(E2)(W.u.)=0.33 *+14−7* Mult.: Q from $\gamma(\theta)$ in (n,n′γ), M2 excluded by comparison to RUL.
5307.75	(3$^-$,4$^+$)	2560.2 *4*	13 *5*	2747.875	3$^-$				
		2988.9 *2*	20 *4*	2319.000	5$^-$				
		3121.3 *2*	100 *7*	2186.273	2$^+$				
5312.77	1,2$^+$	3551.4[e] *6*		1760.74	0$^+$				
		5312.6 *2*		0	0$^+$				
5317.7	3$^-$	2570.2 *4*	100 *12*	2747.875	3$^-$				
		3131.2 *4*	72 *12*	2186.273	2$^+$	[E1]			B(E1)(W.u.)=2.5×10^{-5} *11*
5359.22	3,4	2282.4 *2*	100	3076.925	4$^+$				
5379.8	(4$^+$)	3193.6 *3*	100	2186.273	2$^+$	[E2]			B(E2)(W.u.)=3.6 *+9−6*
5426.01	3$^-$	2118.1 *2*	100 *18*	3308.10	2$^+$	[E1]			B(E1)(W.u.)=3.3×10^{-4} *+13−10*
		3106.8 *2*	80 *14*	2319.000	5$^-$	E2			B(E2)(W.u.)=0.60 *+24−18* Mult.: Q from $\gamma(\theta)$ in (n,n′γ), M2 excluded by comparison to RUL.
		3239.7 *2*	28 *6*	2186.273	2$^+$	[E1]			B(E1)(W.u.)=2.6×10^{-5} *+11−9*

$^{90}_{40}Zr_{50}$-19

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[b]	Comments
5432.790	$7^+,8^+$	268[§e]	<0.6[§]	5164.484	$(8)^+$				
		792.05[§] *19*	1.5[§] *5*	4640.94	7,8				
		891[§e]	<8.3[§]	4541.37	6^+				
		1057.8[§] *1*	2.5[§] *8*	4375.07	7^-				
		1201[§e]	<2.7[§]	4232.220	(6^-)				
		1843.342[§] *22*	100.0[§] *24*	3589.418	8^+	M1,E2[§]		4.08×10^{-4} *14*	
		1984.54[§] *3*	99[§] *4*	3448.230	6^+				
		3114[§e]	<0.24[§]	2319.000	5^-				
5437.33	2^+	2690.08 *23*	100 *3*	2747.875	3^-	[E1]			B(E1)(W.u.)=4.5×10^{-4} *7*
		3676.6 *2*	34 *3*	1760.74	0^+	E2			B(E2)(W.u.)=0.30 *+6−4* Mult.: Q from $\gamma(\theta)$ in (n,n′γ), M2 excluded by comparison to RUL.
		5436.9 *2*	29.1 *18*	0	0^+	E2			B(E2)(W.u.)=0.037 *+7−5* Mult.: Q from $\gamma(\theta)$ in (n,n′γ), M2 excluded by comparison to RUL.
5457.70	(4^+)	2380.6 *3*	52 *17*	3076.925	4^+				
		2710.2 *2*	100 *17*	2747.875	3^-	[E1]			B(E1)(W.u.)=9.6×10^{-5} *12*
5504.75		3744.5 *5*	100 *5*	1760.74	0^+				
		5504.5 *2*	75 *5*	0	0^+				
5513.41	(3,4)	2436.5 *3*	53 *13*	3076.925	4^+				
		2765.8 *2*	100 *13*	2747.875	3^-				
5564.2		3377.9 *4*	100	2186.273	2^+				
5590.58	2^+	2842.9 *2*	35 *6*	2747.875	3^-	[E1]			B(E1)(W.u.)=1.68×10^{-4} *+36−31*
		3404.1 *2*	100 *5*	2186.273	2^+				
		5590.9 *3*	57 *3*	0	0^+	E2			B(E2)(W.u.)=0.081 *+13−11* Mult.: Q from $\gamma(\theta)$ in (n,n′γ), $\Delta\pi$=no from level scheme.
5601.8		3415.5 *4*	100	2186.273	2^+				
5607.6		2299.5 *3*	100	3308.10	2^+				
5644.02	10^+	2054.55[a] *5*	100[a]	3589.418	8^+	E2[a]		4.88×10^{-4}	B(E2)(W.u.)>0.023
5651.1		2911.8 *3*	100	2739.29	$(4)^-$				
5724.3		3538.0 *4*	100	2186.273	2^+				
5775.1		3588.8 *5*	100	2186.273	2^+				
5785.0		5784.8[#] *4*	100[#]	0	0^+				
5792.05	(9^+)	2202.603[a] *30*	100[a]	3589.418	8^+	(M1+E2)[a]	−0.07 *4*	5.03×10^{-4}	δ: from $\gamma(\theta)$ and γ(lin pol) in (^{18}O,4nγ).
5808		5807.7[#] *3*	100[#]	0	0^+				
5821.8		3635.5 *6*	100	2186.273	2^+				
5846.4		3660.1 *5*	100	2186.273	2^+				
5884.4		5884.2[#] *4*	100[#]	0	0^+				
6279.70	11^+	1032.19[a] *10*	100[a] *4*	5247.52	9^+	E2[a]		6.24×10^{-4}	

$^{90}_{40}Zr_{50}$-20

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[b]	Comments
6296	1^-	6295.6[#] *2*	100[#]	0	0^+	E1[#]			
6376.10	(10^-)	584.04[a] *8*	[a]	5792.05	(9^+)				
		1128.2[a] *7*	[a]	5247.52	9^+				
6389.8	1	6389.6[#] *3*	100[#]	0	0^+	D[#]			
6424.3	1^-	6424.1[#] *3*	100[#]	0	0^+	E1[#]			
6565.7	1	6565.4[#] *3*	100[#]	0	0^+	D[#]			
6640.1	(2^+)	6640.1	100[&]	0	0^+	(E2)			B(E2)(W.u.)=0.087 *+34−22* Mult.: From ^{89}Y(p,γ).
6669.2	1	6668.9[#] *7*	100[#]	0	0^+	D[#]			
6721.11	(10^-)	345.24[a] *20*	100[a] *8*	6376.10	(10^-)				
		441.42[ae] *13*	≤11.6[a]	6279.70	11^+				
		929.03[ae] *9*	≤23.3[a]	5792.05	(9^+)				
		1077.06[ae] *8*	≤23.3[a]	5644.02	10^+				
		1473.65[a] *20*	45[a] *5*	5247.52	9^+				
		1556.63[ae] *9*	≤17.4[a]	5164.484	$(8)^+$				
6761.4	1^-	6761.1[#] *2*	100[#]	0	0^+	E1[#]			
6769.51	(12^+)	489.81[a] *15*	100[a]	6279.70	11^+	(M1+E2)[a]	−0.26 *6*	0.00342 *6*	
6876	1^-	6876[#] *3*	100[#]	0	0^+	E1[#]			
6953.94	$(11)^-$	1309.83[a] *7*	100[a]	5644.02	10^+	E1(+M2)[a]	+0.02 *2*	2.90×10^{-4} *5*	B(E1)(W.u.)>5.3×10^{-6} δ: from $\gamma(\theta)$ in γ(lin pol) in (^{18}O,4nγ).
6960.4	1	6960.1[#] *7*	100[#]	0	0^+	D[#]			
7008.63	(11^-)	54.66[a] *5*	11.9[a] *17*	6953.94	$(11)^-$				
		287.55[a] *7*	100[a] *3*	6721.11	(10^-)	M1+E2[a]	−0.07 *5*	0.01235 *21*	δ: from $\gamma(\theta)$ in γ(lin pol) in (^{18}O,4nγ).
		1364.73[a] *20*	73[a] *3*	5644.02	10^+	(E1(+M2))[a]	−0.01 *2*	3.12×10^{-4}	δ: from $\gamma(\theta)$ in γ(lin pol) in (^{18}O,4nγ).
7025.59	(10^+)	1233.54[a] *10*	28[a] *4*	5792.05	(9^+)				
		1381.78[a] *30*	9.6[a] *10*	5644.02	10^+				
		1778.10[a] *7*	100[a] *10*	5247.52	9^+				
		1861.37[a] *30*	26.8[a] *13*	5164.484	$(8)^+$	(E2)[a]		4.26×10^{-4}	
7042.0	1	7041.7[#] *7*	100[#]	0	0^+	D[#]			
7085.6	(1)	7085.3[#] *10*	100[#]	0	0^+	(D)[#]			
7194.35	(11^+)	168.760[a] *4*	44.5[a] *15*	7025.59	(10^+)	M1+E2[a]		0.11 *6*	B(E2)(W.u.)>0.0017; B(M1)(W.u.)>4.5×10^{-8}
		818.23[a] *5*	100.0[a] *29*	6376.10	(10^-)	E1(+M2)[a]	−0.02 *4*	4.30×10^{-4} *10*	B(E1)(W.u.)>1.3×10^{-5} δ: from $\gamma(\theta)$ and γ(lin pol) in (^{18}O),4nγ).
		1402.27[a] *7*	<1.5[a]	5792.05	(9^+)				
		1550.27[a] *30*	5.1[a] *5*	5644.02	10^+	D			
7198.2	1	7197.9[#] *6*	100[#]	0	0^+	D[#]			
7223.89	$(12)^+$	29.57 *8*	18 *3*	7194.35	(11^+)	(M1)		6.74 *11*	B(M1)(W.u.)=0.90 *+19−16*
		215.27 *4*	47 *4*	7008.63	(11^-)	[E1]			B(E1)(W.u.)=9.3×10^{-5} *+24−16*

$^{90}_{40}Zr_{50}$-21

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[b]	Comments
7223.89	(12)+	269.93 *5*	100 *3*	6953.94	(11)−	E1(+M2)	−0.02 *3*	0.00651 *16*	B(E1)(W.u.)=1.00×10^{-4} +*22*−*16* δ: from $\gamma(\theta)$ and γ(lin pol) in (^{18}O),4nγ).
		1580.00 *30*	2.5 *3*	5644.02	10+	(E2)		3.70×10^{-4}	B(E2)(W.u.)=3.5×10^{-4} +*9*−*7*
7250	1−	7248.9[#] *3*	100[#]	0	0+	E1[#]			
7280.9		7280.6[#] *7*	100[#]	0	0+				
7361.0	1	7360.8[#] *6*	100[#]	0	0+	D[#]			
7387.6	1	7387.3[#] *4*	100[#]	0	0+	D[#]			
7424.5		7424.2[#] *10*	100[#]	0	0+				
7433.8	1	7433.5[#] *8*	100[#]	0	0+	D[#]			
7437.82	(13)+	213.93[a] *4*	100[a]	7223.89	(12)+	M1+E2[a]	−0.07 *3*	0.0264 *5*	B(E2)(W.u.)=9×10^{1} +*9*−*6*; B(M1)(W.u.)=0.75 +*16*−*11* δ: from $\gamma(\theta)$ and γ(lin pol) in (^{18}O),4nγ).
7468		7468[#] *2*	100[#]	0	0+				
7474.9	(1)	7474.6[#] *3*	100[#]	0	0+	(D)[#]			
7649.9	(2+)	7649.6	100	0	0+	(E2)			B(E2)(W.u.)=0.00164 *24* E_γ,I_γ,Mult.: from ^{89}Y(p,γ).
7685.8	1	7685.4[#] *4*	100[#]	0	0+	D[#]			
7702.9	1−	7702.5[#] *3*	100[#]	0	0+	E1[#]			
7723.1		7722.7[#] *9*	100[#]	0	0+				
7759.7	(1)	7759.3[#] *6*	100[#]	0	0+	(D)[#]			
7779.0	1	7778.6[#] *6*	100[#]	0	0+	D[#]			
7807.9	1	7807.5[#] *3*	100[#]	0	0+	D[#]			
7857.8	(1)	7857.4[#] *7*	100[#]	0	0+	(D)[#]			
7935.6	1	7935.2[#] *3*	100[#]	0	0+	D[#]			
7976.6	1	7976.2[#] *4*	100[#]	0	0+	D[#]			
8006.9	1	8006.5[#] *8*	100[#]	0	0+	D[#]			
8058.41	(14)+	620.58[a] *8*	100[a] *3*	7437.82	(13)+	M1+E2	−0.14 *5*	0.00209 *16*	B(E2)(W.u.)=17 +*24*−*11*; B(M1)(W.u.)=0.32 +*27*−*11* δ: from $\gamma(\theta)$ and γ(lin pol) in (^{18}O),4nγ).
		834.51[e] *8*	<1.35	7223.89	(12)+				
		1288.90[e] *21*	<1.35	6769.51	(12+)				
8067.4	(1)	8067.0[#] *5*	100[#]	0	0+	(D)[#]			
8110	1−	8109.6[#] *8*	100[#]	0	0+	E1[#]			
8131	(1−)	8131.5[#] *4*	100[#]	0	0+	(E1)[#]			
8144		8144[#] *2*	100[#]	0	0+	[#]			
8166.7	(1)	8166.3[#] *5*	100[#]	0	0+	(D)[#]			
8221.2	1	8220.8[#] *8*	100[#]	0	0+	D[#]			
8235.6	1	8235.2[#] *3*	100[#]	0	0+	D[#]			

$^{90}_{40}Zr_{50}$-22

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	α[b]	Comments
8250.7	1	8250.3[#] *5*	100[#]	0	0^+	D[#]		
8295.3	(1)	8294.9[#] *10*	100[#]	0	0^+	(D)[#]		
8313.0	1	8312.6[#] *7*	100[#]	0	0^+	D[#]		
8334.1	1	8333.7[#] *5*	100[#]	0	0^+	D[#]		
8357.5	1	8357.1[#] *18*	100[#]	0	0^+	D[#]		
8382.1	(1)	8381.7[#] *10*	100[#]	0	0^+	(D)[#]		
8403.7		8403.3[#] *11*	100[#]	0	0^+			
8413.5	1	8413.1[#] *4*	100[#]	0	0^+	D[#]		
8440.6	1	8440.2[#] *4*	100[#]	0	0^+	D[#]		
8467.7		8467.3[#] *15*	100[#]	0	0^+			
8501.2	1^-	8500.8[#] *4*	100[#]	0	0^+	E1[#]		
8518		8518[#] *3*	100[#]	0	0^+			
8544		8544[#] *4*	100[#]	0	0^+			
8553.5	1	8553.1[#] *12*	100[#]	0	0^+	D[#]		
8588.3	1	8587.9[#] *7*	100[#]	0	0^+	D[#]		
8598.2	1	8597.8[#] *10*	100[#]	0	0^+	D[#]		
8625.6	1	8625.2[#] *10*	100[#]	0	0^+	D[#]		
8664.1	1	8663.7[#] *5*	100[#]	0	0^+	D[#]		
8716.6	1^-	8716.1[#] *5*	100[#]	0	0^+	E1[#]		
8751.0	1	8750.5[#] *8*	100[#]	0	0^+	D[#]		
8760.4	1	8759.9[#] *5*	100[#]	0	0^+	D[#]		
8812.0	1	8811.5[#] *13*	100[#]	0	0^+	D[#]		
8833.2	1	8832.7[#] *8*	100[#]	0	0^+	D[#]		
8874.9	1	8874.4[#] *9*	100[#]	0	0^+	D[#]		
8903.0		8902.5[#] *8*	100[#]	0	0^+			
8927.4		8926.9[#] *4*	100[#]	0	0^+			
8958.13	$(15)^-$	899.71[a] *20*	100[a]	8058.41	$(14)^+$	E1[a]	3.71×10^{-4} *18*	B(E1)(W.u.)=9×10^{-4} *+9−4*
		1520.29[a] *22*	<1[a]	7437.82	$(13)^+$			
8978.4	(1)	8977.9[#] *9*	100[#]	0	0^+	(D)[#]		
8985		8985[#] *2*	100[#]	0	0^+			
9004.7	1	9004.2[#] *5*	100[#]	0	0^+	D[#]		
9014.0		9013.5[#] *8*	100[#]	0	0^+			
9034.0		9033.5[#] *8*	100[#]	0	0^+			
9043.6	1	9043.1[#] *4*	100[#]	0	0^+	D[#]		
9053.5		9053.0[#] *7*	100[#]	0	0^+			

$^{90}_{40}Zr_{50}$-23

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J_i^π	E_γ[†&]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	α[b]	Comments
9085.1	1	9084.6[#] *3*	100[#]	0	0^+	D[#]			
9111.1	1	9110.6[#] *6*	100[#]	0	0^+	D[#]			
9123.6		9123.1[#] *7*	100[#]	0	0^+				
9137.5		9137.0[#] *7*	100[#]	0	0^+				
9148.5	1^-	9148.0[#] *3*	100[#]	0	0^+	E1[#]			
9164.9		9164.4[#] *7*	100[#]	0	0^+				
9177.5		9177.0[#] *5*	100[#]	0	0^+				
9187		9186[#] *3*	100[#]	0	0^+				
9196.5	(1^-)	9196.0[#] *3*	100[#]	0	0^+	(E1)[#]			
9260.5	1	9260.0[#] *6*	100[#]	0	0^+	D[#]			
9292.8	1	9292.3[#] *5*	100[#]	0	0^+	D[#]			
9309.4	1	9308.9[#] *7*	100[#]	0	0^+	D[#]			
9333.4	1^-	9332.9[#] *6*	100[#]	0	0^+	E1[#]			
9373.2		9372.8[#] *7*	100[#]	0	0^+				
9392.4	1	9391.9[#] *8*	100[#]	0	0^+	D[#]			
9409.4		9408.9[#] *11*	100[#]	0	0^+				
9424.3		9423.8[#] *10*	100[#]	0	0^+				
9444.7	1	9444.2[#] *4*	100[#]	0	0^+	D[#]			
9465.1	1	9464.6[#] *5*	100[#]	0	0^+	D[#]			
9486.8	1	9486.3[#] *4*	100[#]	0	0^+	D[#]			
9510.5	(1)	9510.0[#] *13*	100[#]	0	0^+	(D)[#]			
9524.1	1	9523.6[#] *13*	100[#]	0	0^+	D[#]			
9539.2	1	9538.7[#] *5*	100[#]	0	0^+	D[#]			
9551.4	1	9550.9[#] *6*	100[#]	0	0^+	D[#]			
9563.0	1	9562.5[#] *6*	100[#]	0	0^+	D[#]			
9609.2		9608.6[#] *7*	100[#]	0	0^+				
9625.1		9624.5[#] *8*	100[#]	0	0^+				
9640.4	1	9639.8[#] *8*	100[#]	0	0^+	D[#]			
9666.0	(1)	9665.4[#] *8*	100[#]	0	0^+	(D)[#]			
9678.3	(1^-)	9677.7[#] *7*	100[#]	0	0^+	(E1)[#]			
9686.9	1	9686.3[#] *6*	100[#]	0	0^+	D[#]			
9707.00?	(16^-)	748.87[ae] *20*	100[a]	8958.13	$(15)^-$	(M1(+E2))[a]	−0.15 *15*	1.27×10^{-3} *2*	B(E2)(W.u.)=5 *+16−4*; B(M1)(W.u.)=0.105 *+39−26*
9733.2	1	9732.6[#] *5*	100[#]	0	0^+	D[#]			
9741.7		9741.1[#] *7*	100[#]	0	0^+				
9754.0	1	9753.4[#] *6*	100[#]	0	0^+	D[#]			

$^{90}_{40}Zr_{50}$-24

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[b]	Comments
9784.6		9784.0[#] *5*	100[#]	0	0^+				
9805.4		9804.8[#] *10*	100[#]	0	0^+				
9836.01	$(15)^+$	1777.6[a] *3*	100[a]	8058.41	$(14)^+$				
9843.4	1	9842.8[#] *6*	100[#]	0	0^+	D[#]			
9855.5	1	9854.9[#] *8*	100[#]	0	0^+	D[#]			
9872.4	1	9871.8[#] *4*	100[#]	0	0^+	D[#]			
9890.7	(1)	9890.1[#] *13*	100[#]	0	0^+	(D)[#]			
9901.9		9901.3[#] *13*	100[#]	0	0^+				
9932.1	1	9931.5[#] *12*	100[#]	0	0^+	D[#]			
9962.8	1	9962.2[#] *5*	100[#]	0	0^+	D[#]			
9984.1		9983.5[#] *11*	100[#]	0	0^+				
10004.2	1	10003.6[#] *10*	100[#]	0	0^+	D[#]			
10019.6	1	10019.0[#] *11*	100[#]	0	0^+	D[#]			
10031		10030[#] *2*	100[#]	0	0^+				
10042.9	(1^-)	10042.3[#] *4*	100[#]	0	0^+	(E1)[#]			
10083.8	1	10083.2[#] *6*	100[#]	0	0^+	D[#]			
10094.2	1	10093.6[#] *7*	100[#]	0	0^+	D[#]			
10104.9	(1)	10104.3[#] *12*	100[#]	0	0^+	(D)[#]			
10123.7	1	10123.1[#] *18*	100[#]	0	0^+	D[#]			
10125.84	$(16)^+$	289.83[a] *6*	57.2[a] *23*	9836.01	$(15)^+$	M1(+E2)[a]	−0.01 *6*	0.01205 *18*	B(M1)(W.u.)=0.54 *+25−14* δ: from $\gamma(\theta)$ and γ(lin pol) in (^{18}O,4nγ).
		1167.70[a] *20*	100[a] *4*	8958.13	$(15)^-$	E1(+M2)[a]	−0.02 *5*	2.42×10^{-4} *5*	B(E1)(W.u.)=2.2×10^{-4} *+11−6* δ: from $\gamma(\theta)$ and γ(lin pol) in (^{18}O,4nγ).
		2067.4[a] *3*	<5.1[a]	8058.41	$(14)^+$				
10146.8	1	10146.2[#] *9*	100[#]	0	0^+	D[#]			
10163.4	1	10162.9[#] *8*	100[#]	0	0^+	D[#]			
10193.0	1	10192.4[#] *5*	100[#]	0	0^+	D[#]			
10216.8	1	10216.2[#] *10*	100[#]	0	0^+	D[#]			
10233		10232[#] *4*	100[#]	0	0^+				
10241	(1)	10240[#] *2*	100[#]	0	0^+	(D)[#]			
10260.9		10260.3[#] *11*	100[#]	0	0^+				
10270.0		10269.4[#] *7*	100[#]	0	0^+				
10286.2	1	10285.6[#] *6*	100[#]	0	0^+	D[#]			
10298.3	(1)	10297.7[#] *10*	100[#]	0	0^+	D[#]			
10306.6	1	10306.0[#] *9*	100[#]	0	0^+	D[#]			

$^{90}_{40}Zr_{50}$-25

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	Comments
10315.1	1	10314.5[#] *4*	100[#]	0	0^+	D[#]	
10334.9	1	10334.3[#] *6*	100[#]	0	0^+	D[#]	
10361	(1)	10360[#] *2*	100[#]	0	0^+	(D)[#]	
10376.8	1	10376.2[#] *4*	100[#]	0	0^+	D[#]	
10402.5	1	10401.9[#] *9*	100[#]	0	0^+	D[#]	
10494.5	(1)	10493.8[#] *11*	100[#]	0	0^+	(D)[#]	
10507.9	1	10507.2[#] *8*	100[#]	0	0^+	D[#]	
10524.6	1	10523.9[#] *4*	100[#]	0	0^+	D[#]	
10595.0	1	10594.3[#] *7*	100[#]	0	0^+	D[#]	
10618.7	1	10618.0[#] *8*	100[#]	0	0^+	D[#]	
10638.5	1	10637.8[#] *9*	100[#]	0	0^+	D[#]	
10682.2	1	10681.5[#] *6*	100[#]	0	0^+	D[#]	
10713.2	(1)	10712.5[#] *12*	100[#]	0	0^+	(D)[#]	
10728.2	1	10727.5[#] *11*	100[#]	0	0^+	D[#]	
10764.9	(17^+)	639.0[ca] *8*	100[a] *23*	10125.84	$(16)^+$	(M1+E2)[a]	B(E2)(W.u.)>6.7×10^{-4}; B(M1)(W.u.)>2.7×10^{-7}
		928.9[a] *7*	<5.7[a]	9836.01	$(15)^+$		
		1806.7[a] *8*	<4.5[a]	8958.13	$(15)^-$		
10827.1	1	10826.4[#] *5*	100[#]	0	0^+	D[#]	
10914	(1)	10913[#] *2*	100[#]	0	0^+	(D)[#]	
10957	1	10956[#] *2*	100[#]	0	0^+	D[#]	
10987.0	1	10986.3[#] *10*	100[#]	0	0^+	D[#]	
11044		11043[#] *2*	100[#]	0	0^+		
11094.2		11093.5[#] *15*	100[#]	0	0^+		
11108.0		11107.3[#] *16*	100[#]	0	0^+		
11120.4	1	11119.7[#] *9*	100[#]	0	0^+	D[#]	
11129.2		11128.5[#] *17*	100[#]	0	0^+		
11140		11139[#] *2*	100[#]	0	0^+		
11232.4	1	11231.6[#] *7*	100[#]	0	0^+	D[#]	
11243.2	1	11242.4[#] *6*	100[#]	0	0^+	D[#]	
11337.7	1	11336.9[#] *6*	100[#]	0	0^+	D[#]	
11403.9	(18^+)	639.0[a] *8*	1.0×10^2[a] *3*	10764.9	(17^+)	(M1+E2)[a]	
		1278.1[ca] *10*	<3.9[a]	10125.84	$(16)^+$		
11417.5	(1)	11416.7[#] *7*	100[#]	0	0^+	(D)[#]	
11452.2	1	11451.4[#] *10*	100[#]	0	0^+	D[#]	
11479.7	1	11478.9[#] *8*	100[#]	0	0^+	D[#]	

$^{90}_{40}Zr_{50}$-26

$\gamma(^{90}Zr)$ (continued)

E_i(level)	J^π_i	E_γ[†&]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[b]	Comments
11501		11500[#] *3*	100[#]	0	0^+				
11510		11509[#] *7*	100[#]	0	0^+				
11531	1	11530[#] *2*	100[#]	0	0^+	D[#]			
11627.9		11627.1[#] *9*	100[#]	0	0^+				
11651.5	(1)	11650.7[#] *8*	100[#]	0	0^+	(D)[#]			
11777.4	1	11776.6[#] *10*	100[#]	0	0^+	D[#]			
11788	1	11787[#] *3*	100[#]	0	0^+	D[#]			
11963.3	(1)	11962.4[#] *18*	100[#]	0	0^+	(D)[#]			
11984	1	11983[#] *2*	100[#]	0	0^+	D[#]			
12020.6	1	12019.7[#] *8*	100[#]	0	0^+	D[#]			
12067.8	1	12066.9[#] *9*	100[#]	0	0^+	D[#]			
12110.7	(19^+)	706.8[a] *3*	100[a] *10*	11403.9	(18^+)	(M1(+E2))[a]	−0.3 *5*	0.00151 *8*	B(M1)(W.u.)=0.39 *+14−18* δ: from $\gamma(\theta)$ and γ(lin pol) in (^{18}O,4nγ).
		1345.9[a] *8*	<9.8[a]	10764.9	(17^+)				
12208.3	1	12207.4[#] *12*	100[#]	0	0^+	D[#]			
12219.6		8383[@] *6*	18	3842.34	2^+				
		8919[@] *6*	26	3308.10	2^+				
		9467[@] *6*	16	2747.875	3^-				
		10033[@] *6*	47	2186.273	2^+				
		10453[@] *6*	40	1760.74	0^+				
		12212[@] *6*	100	0	0^+				
12243.6	1	12242.7[#] *14*	100[#]	0	0^+	D[#]			
12496.3		12495.4[#] *18*	100[#]	0	0^+				
12880.3		12879.3[#] *10*	100[#]	0	0^+				
12964.7	(20^+)	854.00[a] *30*	1.0×10^2[a] *3*	12110.7	(19^+)				
		1560.8[a] *5*	<10.7[a]	11403.9	(18^+)				
13110.2	$(2)^-$	9270[@]		3842.34	2^+				
		9800[@]		3308.10	2^+				
		10360[@]		2747.875	3^-				
		10920[@]		2186.273	2^+				
		11350[@]		1760.74	0^+				
		13110[@]		0	0^+				

[†] From (n,n′γ), except where noted.
[‡] From $\gamma(\theta)$ in (n,n′γ) except where noted.
[§] From ^{90}Nb ε decay.

$^{90}_{40}Zr_{50}$-27

Adopted Levels, Gammas (continued)

$\gamma(^{90}Zr)$ (continued)

[&] From $^{89}Y(p,\gamma)$ reaction.
[@] From $^{89}Y(p,\gamma)$. From level energy difference for level 13110; not included in level energy fit.
[#] From $^{90}Zr(\gamma,\gamma')$.
[a] From $^{76}Ge(^{18}O,4n\gamma)$.
[b] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[c] Multiply placed.
[d] Multiply placed with undivided intensity.
[e] Placement of transition in the level scheme is uncertain.

$^{90}_{40}Zr_{50}$-28

^{90}Y β^- decay (64.00 h) 1976Gr16,1990Zh20

Parent: ^{90}Y: E=0; J$^\pi$=2$^-$; T$_{1/2}$=64.00 h *21*; Q(β^-)=2278.5 *16*; %β^- decay=100.0

1976Gr16: Y(n,γ), chemical separation. 4$\pi\beta$-counting, γ(t) with Ge(Li).

1990Zh20: ^{90}Sr source with ^{90}Y in equilibrium. Measured Iγ with HPGe detector in low-background setup.

For relative measurement of the longitudinal electron polarization, see 1971Jo17.

For studies of shape factors, see 1964Da16, 1966Ri01, 1971Na09, 1975Fl07, 1983Ha35, 2005Gr41.

For measurements of β^- using liquid scintillator detectors see 1993Gr09, 1993Gr18, 1994Gr21, 1994Gr30, 1995Gr04, 2005Gr41; using solid scintillator detectors, see 1993Va11, 1993Ya17, 1994Us01, 1994Sz09; detecting Cerenkov radiation, see 1994Br45,1995Ra27; using gas-flow proportional counters, see 1996Be48; using photomultipliers, see 1992Bo35; using ion-chambers, see 1996Wo08.

^{90}Zr Levels

E(level)†	J$^\pi$†	T$_{1/2}$
0	0$^+$	stable
1760.74 *14*	0$^+$	
2186.273 *14*	2$^+$	

† From the Adopted Levels.

β^- radiations

E(decay)	E(level)	Iβ^-†	Log *ft*	Comments
(92.2 *16*)	2186.273	1.4×10^{-6} *3*	11.04 *10*	Iβ^-: From measured intensity of 2186γ (1976Gr16).
(517.8 *16*)	1760.74	0.0115 *14*	9.64^{1u} *6*	Iβ^-: From measured I($\gamma^\pm$)/I(β^-)=0.000034 *4* (1961La07) and I(ce)/I($\gamma^\pm$)=2.38 *8* (1962Ne02).
(2278.5 *16*)	0	99.9885 *14*	9.2240^{1u} *23*	Measured β^- endpoint energies: 2265 keV *5* (1957Yu06); 2261 keV *3* (1958Jo33); 2271 keV *2* (1961Ni02); 2268 keV *2* (1964An12); 2273 keV *5* (1964La13); 2284 keV *5* (1964Da16); 2275 keV *5* (1966Ha15); 2280 keV *5* (1966Ri01); 2275 keV *3* (1993Gr17).

† Absolute intensity per 100 decays.

γ(^{90}Zr)

Probability of two-photon decay for 1760.7, 0$^+$ to 0$^+$ transition is 0.040% *5*, weighted av of 0.051% *25* (1973Na01), 0.0317% *77* (1973As04), 0.039% *12* (1989Mu12), and 0.052% *10* (1993Ba65). Others: 1961La07, 1970Ha27, 1970Va09.

Probability of one-photon E0 transition for 1760.7 relative to internal conversion is 5×10^{-7} *2* (1990Zh20). Probability of two-photon E0 transition relative to internal pair conversion is 7.4×10^{-4} *14* (1993Ba65).

E$_\gamma$†	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.†	I$_{(\gamma+ce)}$‡	Comments
1760.70 *20*	1760.74	0$^+$	0	0$^+$	E0	0.0115 *14*	ce(K)/(γ+ce)=0.89 *1*; ce(L)/(γ+ce)=0.11 *1* I$_{(\gamma+ce)}$: derived from Iβ^- to this level, see comment on Iβ^-. Probability of one-phonon E0 transition relative to internal conversion is 5×10^{-7} *2* (1990Zh20). internal pair production of 1760.7 E0 transition, branching ratio=0.00320 *15* pairs/100 decays (2020Pi01), 0.00326 *4* pairs/100 decays (2020Dr01), 0.003186 *47* pairs/100 decays (2007Se01).

Continued on next page (footnotes at end of table)

^{90}Y β^- decay (64.00 h) 1976Gr16,1990Zh20 (continued)

$\gamma(^{90}Zr)$ (continued)

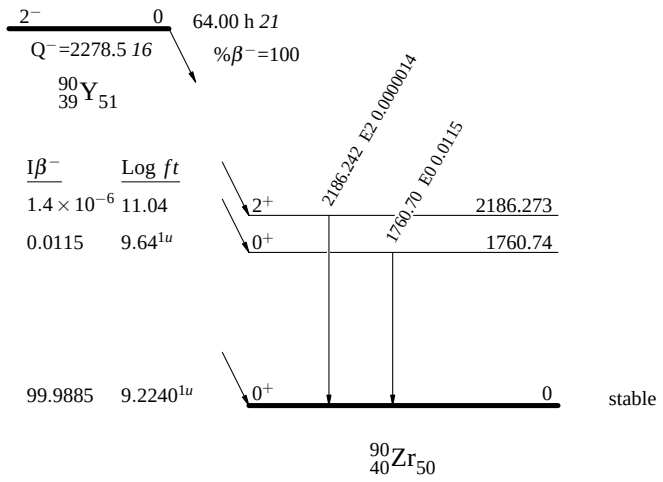
E_γ[†]	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[†]	α[§]	Comments
2186.242 *25*	1.4×10^{-6} *3*	2186.273	2^+	0	0^+	E2	5.36×10^{-4}	I_γ: From absolute counting (1976Gr16). Other: 1.12×10^{-6} *6* from measurement of activity in equilibrium with a ^{90}Sr source (1990Zh20). The method of normalization of 1990Zh20 is however not described.

[†] From the Adopted Gammas.
[‡] Absolute intensity per 100 decays.
[§] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

^{90}Y β^- decay (64.00 h) 1976Gr16,1990Zh20

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Y β^- decay (3.19 h) 1976Gr16

Parent: ^{90}Y: E=681.68 *4*; $J^\pi=7^+$; $T_{1/2}$=3.19 h *1*; Q(β^-)=2278.5 *16*; %β^- decay=0.00180 *20*

^{90}Y-%β^- decay: From measured I(2319γ)/I(480γ)=1.89×10^{-5} *18* (1976Gr16); in agreement with upper limit of 8×10^{-5} (1973Ra10). Value is recalculated by evaluator with adopted photon branching ratios.

1976Gr16: Y(n,γ), chemical separation. Measured γ(t) with Ge(Li).

Other: 1973Ra10.

^{90}Zr Levels

E(level)†	J^π	$T_{1/2}$†
0	0^+	stable
2319.000 *9*	5^-	809.2 ms *20*

† From the Adopted Levels.

β^- radiations

E(decay)	E(level)	Iβ^-†	Log *ft*
(641.2 *16*)	2319.000	0.0018 *2*	9.62^{1u} *5*

† Absolute intensity per 100 decays.

γ(^{90}Zr)

E_γ†	I_γ‡	E_i(level)	J^π_i	E_f	J^π_f	Mult.†	α§
2318.968 *10*	100	2319.000	5^-	0	0^+	E5	4.64×10^{-4}

† From the Adopted Gammas.

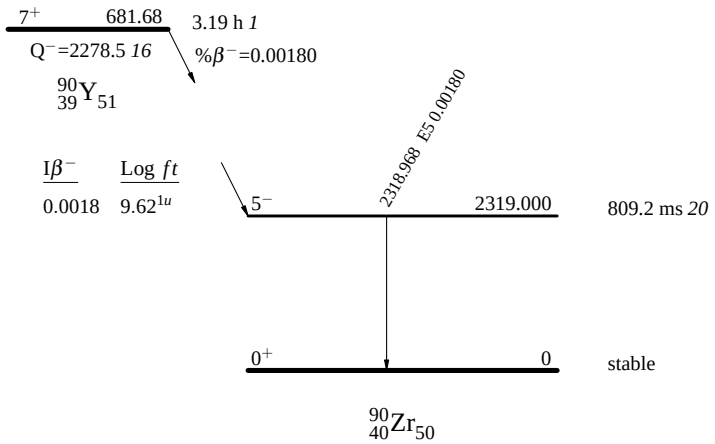
‡ For absolute intensity per 100 decays, multiply by 0.000018 *2*.

§ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

^{90}Y β^- decay (3.19 h) 1976Gr16

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Nb ε decay 1990Me15,1982Wa24

Parent: ^{90}Nb: E=0.0; $J^{\pi}=8^{+}$; $T_{1/2}$=14.60 h *5*; Q(ε)=6111.0 *30*; %ε+%β^{+} decay=100.0

1990Me15: Measured precision Eγ and Iγ with carefully calibrated Ge(Li) detector systems.

1982Wa24: Measured precision Eγ, γ(t), $\gamma\gamma$ and delayed $\gamma\gamma$ coin with Ge(Li)-NaI escape-suppression spectrometer and Ge(Li).

1968Pe01: Measured γ singles and ce(t) spectra with chemically separated sources.

1987Be12: $\gamma\gamma(\theta)$ with NaI-Ge(Li) detectors.

1964Lo02: Delayed $\beta\gamma$ coin with anthracene and NaI.

Others: 1954On06, 1955Ma31, 1957Sh32, 1958La12, 1959Bj39, 1960Ha06, 1966Pe10, 1970Tu04, 1971Za03, 1975Pa07, 1980Iw03, 2001Ba06.

Decay scheme is based on $\gamma\gamma$ coin and energy sums (1982Wa24).

Total energy release in the decay is 6040 keV *60* as computed by the code Radlist, compared to the Q value of 6111 *3*.

^{90}Zr Levels

E(level)†	J^{π}‡	$T_{1/2}$	Comments
0	0^{+}	stable	
1760.74 *15*	0^{+}		
2186.265 *19*	2^{+}		
2318.991 *19*	5^{-}	809.2 ms *20*	g=1.250 *26* (1987Ed02) g: From nuclear magnetic resonance on oriented nuclei.
2739.29 *5*	$(4)^{-}$		
2747.867 *21*	3^{-}		
3076.917 *21*	4^{+}		
3448.221 *21*	6^{+}		
3589.409 *22*	8^{+}	125 ns *6*	$T_{1/2}$: From delayed $\beta\gamma$ coin (1964Lo02).
4232.21 *3*	$6^{-},7^{-}$		
4319.02? *10*			
4375.06 *7*	7^{-}		
4541.36 *4*	6^{+}		
4640.94 *5*			
5059.97 *3*	7^{+}		
5164.48 *3*	$(8)^{+}$		
5247.52 *5*	9^{+}		
5432.78 *3*	$7^{+},8^{+},9^{+}$		
5589.46? *10*			

† From a least-squares fit to Eγ, by evaluators.

‡ From the Adopted Levels.

ε,β^{+} radiations

$\varepsilon+\beta^{+}$ branches are obtained from Iγ+ce imbalance at each level.

E(decay)	E(level)	Iβ^{+} †	Iε†	Log *ft*	I($\varepsilon+\beta^{+}$)†
(522‡ *3*)	5589.46?		0.07 *1*	7.35 *7*	0.07 *1*
(678 *3*)	5432.78		1.40 *3*	6.281 *11*	1.40 *3*
(863 *3*)	5247.52		0.335 *15*	7.116 *20*	0.335 *15*
(947 *3*)	5164.48		1.017 *24*	6.715 *11*	1.017 *24*
(1051 *3*)	5059.97		4.64 *9*	6.148 *9*	4.64 *9*
(1470 *3*)	4640.94	0.00466 *23*	0.214 *9*	7.779 *18*	0.219 *9*
(1736 *3*)	4375.06	0.010 *1*	0.088 *9*	8.31 *5*	0.098 *10*
(1792‡ *3*)	4319.02?	0.009 *1*	0.06 *1*	8.50 *7*	0.07 *1*
(1879 *3*)	4232.21	0.031 *4*	0.141 *20*	8.18 *6*	0.172 *24*

Continued on next page (footnotes at end of table)

^{90}Nb ε decay 1990Me15,1982Wa24 (continued)

ϵ,β^+ radiations (continued)

E(decay)	E(level)	Iβ^+ †	Iε †	Log *ft*	I($\varepsilon+\beta^+$) †
(2522 *3*)	3589.409	51 *2*	36 *1*	6.028 *16*	87 *3*
(2663 *3*)	3448.221	<4	<2	>7.3	<6

† Absolute intensity per 100 decays.
‡ Existence of this branch is questionable.

γ(^{90}Zr)

For adjusted Eγ and Iγ (based on energy sums and intensity balance) see 1982Wa24.
For a search for the 2319 to 1761 E5 transition with mini-orange detectors, see 1985HaZI.

E_γ[‡]	I_γ[‡&]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[§]	δ[§]	α[@]	Comments
132.716 *18*	50.4 *5*	2318.991	5⁻	2186.265	2⁺	E3(+M4)	<0.07	2.97 *11*	Mult.: α(K)exp=2.11 *15*; K/L=3.22 *16* (1968Pe01). Mult.: (132.7γ)(2186.3γ)(θ): A_2=+0.187 *38*, A_4=−0.063 *36* (1978Be12). δ: +0.06 *10* from γγ(θ); 0.00 *7* from ce measurements.
141.178 *15*	814 *8*	3589.409	8⁺	3448.221	6⁺	E2		0.316	Mult.: α(K)exp=0.268 *19*; K/L=6.25 *33* (1968Pe01). Mult.: (141.3γ)(1129.2γ)(θ): A_2=−0.070 *12*, A_4=−0.003 *10* (1978Be12). δ: −0.02 *+11−5* from γγ(θ); 0.05 *4* from ce measurements; both consistent with no M3 admixture.
222[a]	<0.08[†]	4541.36	6⁺	4319.02?					
268[a]	<0.05[†]	5432.78	7⁺,8⁺,9⁺	5164.48	(8)⁺				
309[a]	<0.11[†]	4541.36	6⁺	4232.21	6⁻,7⁻				
329.058 *16*	1.50 *5*	3076.917	4⁺	2747.867	3⁻				
337.50 *15*	0.3 *1*	3076.917	4⁺	2739.29	(4)⁻				
371.307 *8*	22.0 *8*	3448.221	6⁺	3076.917	4⁺	E2		0.01064	Mult.: α(K)exp=0.088 *6*.
409[a]	<0.11[†]	4640.94		4232.21	6⁻,7⁻				
420.28 *5*	0.33 *3*	2739.29	(4)⁻	2318.991	5⁻				
425.5 *2*	0.06 *1*	2186.265	2⁺	1760.74	0⁺	E2		0.00688	
429[a]	<0.06[†]	2747.867	3⁻	2318.991	5⁻				
518.60 *6*	8.4 *6*	5059.97	7⁺	4541.36	6⁺				α(K)exp=0.00195 *17*.
524[a]	<0.23[†]	5164.48	(8)⁺	4640.94					
561.604 *11*	1.46 *4*	2747.867	3⁻	2186.265	2⁺				
623[a]	<0.23[†]	5164.48	(8)⁺	4541.36	6⁺				
643[a]	<0.23[†]	4232.21	6⁻,7⁻	3589.409	8⁺				
757.95 *5*	0.49 *5*	3076.917	4⁺	2318.991	5⁻				
784[a]	<0.08[†]	4232.21	6⁻,7⁻	3448.221	6⁺				
792.05 *19*	0.13 *4*	5432.78	7⁺,8⁺,9⁺	4640.94					
827.74 *4*	13.5 *2*	5059.97	7⁺	4232.21	6⁻,7⁻	E1		4.19×10^{-4}	Mult.: α(K)exp=0.00033 *4*. Mult.: (827.7γ)(1913.2γ)(θ): A_2=+0.164 *40*, A_4=+0.062 *35* (1978Be12).
890.64 *5*	22.0 *5*	3076.917	4⁺	2186.265	2⁺	(E2)		8.82×10^{-4}	Mult.: α(K)exp=0.00076 *6*. Mult.: (890.6γ)(2186.3γ)(θ): A_2=+0.132 *51*, A_4=−0.023 *48* (1978Be12). δ: +0.05 *7* from γγ(θ); 0.0 *1* from ce measurements; both consistent with no M3 admixture.
891[a]	<0.70[†]	5432.78	7⁺,8⁺,9⁺	4541.36	6⁺				

$^{90}_{40}Zr_{50}$-36

γ(^{90}Zr) (continued)

E_γ[‡]	I_γ[‡&]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[§]	α[@]	$I_{(\gamma+ce)}$[&]	Comments
932[a]	<1.4[†]	5164.48	(8)$^+$	4232.21	6$^-$,7$^-$				
952[a]	<0.11[†]	4541.36	6$^+$	3589.409	8$^+$				
1051.53 *4*	2.6 *1*	4640.94		3589.409	8$^+$				
1057.8 *1*	0.21 *6*	5432.78	7$^+$,8$^+$,9$^+$	4375.06	7$^-$				
1093.14 *9*	1.2 *1*	4541.36	6$^+$	3448.221	6$^+$				
1129.224 *15*	1130 *5*	3448.221	6$^+$	2318.991	5$^-$	E1	2.41×10^{-4}		Mult.: α(K)exp=0.000197 *11*. Mult.: (141.3γ)(1129.2γ)(θ): A_2=−0.070 *12*, A_4=−0.003 *10* (1978Be12). δ: −0.02 *7* from γγ(θ); 0.000 *14* from ce measurements; both consistent with no M2 admixture.
1155[a]	<0.06[†]	4232.21	6$^-$,7$^-$	3076.917	4$^+$				
1192.7 *1*	0.20 *2*	4640.94		3448.221	6$^+$				
1201[a]	<0.23[†]	5432.78	7$^+$,8$^+$,9$^+$	4232.21	6$^-$,7$^-$				
1270.396 *18*	15.8 *3*	3589.409	8$^+$	2318.991	5$^-$	(E3)	7.63×10^{-4}		Mult.: α(K)exp=0.00068 *7*.
1464[a]	<0.28[†]	4541.36	6$^+$	3076.917	4$^+$				
1470.528 *24*	5.6 *2*	5059.97	7$^+$	3589.409	8$^+$				
1493[a]	<0.11[†]	4232.21	6$^-$,7$^-$	2739.29	(4)$^-$				
1575.035 *23*	6.3 *2*	5164.48	(8)$^+$	3589.409	8$^+$	M1,E2	3.64×10^{-4} *8*		Mult.: α(K)exp=0.00023 *6*.
1611.76 *3*	29.0 *8*	5059.97	7$^+$	3448.221	6$^+$	M1,E2	3.67×10^{-4} *9*		Mult.: α(K)exp=0.000240 *22*. Mult.: (1611.8γ)(1129.2γ)(θ): A_2=−0.088 *20*, A_4=+0.013 *18* (1978Be12). δ: +0.35 *7* or +2.4 *5* from γγ correlation.
1658.10 *4*	4.08 *18*	5247.52	9$^+$	3589.409	8$^+$				
1716.27 *3*	6.1 *2*	5164.48	(8)$^+$	3448.221	6$^+$	(E2)	3.91×10^{-4}		Mult.: α(K)exp=0.00021 *7*. Mult.: (1716.2γ)(1129.2γ)(θ): A_2=−0.011 *75*, A_4=+0.041 *60* (1978Be12).
1760.70 *20*		1760.74	0$^+$	0	0$^+$	E0		0.060 *10*	E_γ: Conversion electrons observed by 1968Pe01. $I_{(\gamma+ce)}$: From intensity balance, assuming no ε feeding. Mult.: α(K)exp > 4.8.
1843.342 *22*	8.4 *2*	5432.78	7$^+$,8$^+$,9$^+$	3589.409	8$^+$	M1,E2	4.08×10^{-4} *14*		Mult.: α(K)exp=0.000166 *23*.
1913.194 *25*	15.6 *2*	4232.21	6$^-$,7$^-$	2318.991	5$^-$	M1,E2	4.27×10^{-4} *16*		Mult.: α(K)exp=0.000144 *17*.
1984.54 *3*	8.3 *3*	5432.78	7$^+$,8$^+$,9$^+$	3448.221	6$^+$				(1984.5γ)(1129.2γ)(θ): A_2=−0.006 *54*, A_4=−0.036 *50* (1978Be12).
2000.2[#a] *3*	0.8[#] *1*	4319.02?		2318.991	5$^-$				
2000.2[#a] *3*	0.8[#] *1*	5589.46?		3589.409	8$^+$				
2056.10 *8*	1.4 *1*	4375.06	7$^-$	2318.991	5$^-$				
2186.242 *25*	219 *2*	2186.265	2$^+$	0	0$^+$	E2	5.36×10^{-4}		Mult.: α(K)exp=0.000123 *10*.
2222.34 *3*	7.6 *3*	4541.36	6$^+$	2318.991	5$^-$				α(K)exp=0.00010 *3*.

$^{90}_{40}Zr_{50}$-37

$\gamma(^{90}Zr)$ (continued)

E_γ[‡]	I_γ[‡&]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[§]	α[@]	Comments
2318.959 *25*	1000 *2*	2318.991	5^-	0	0^+	E5	4.64×10^{-4}	Mult.: α(K)exp=0.000385 *30* (1984HaZC).
[x]2321.9 *2*	9 *2*							
2322[a]	<0.10[†]	4640.94		2318.991	5^-			
2741.0 *3*	0.09 *3*	5059.97	7^+	2318.991	5^-	E3	5.86×10^{-4}	
2747.8 *3*	0.06 *2*	2747.867	3^-	0	0^+			
2845[a]	<0.02[†]	5164.48	$(8)^+$	2318.991	5^-			
3114[a]	<0.02[†]	5432.78	$7^+,8^+,9^+$	2318.991	5^-			

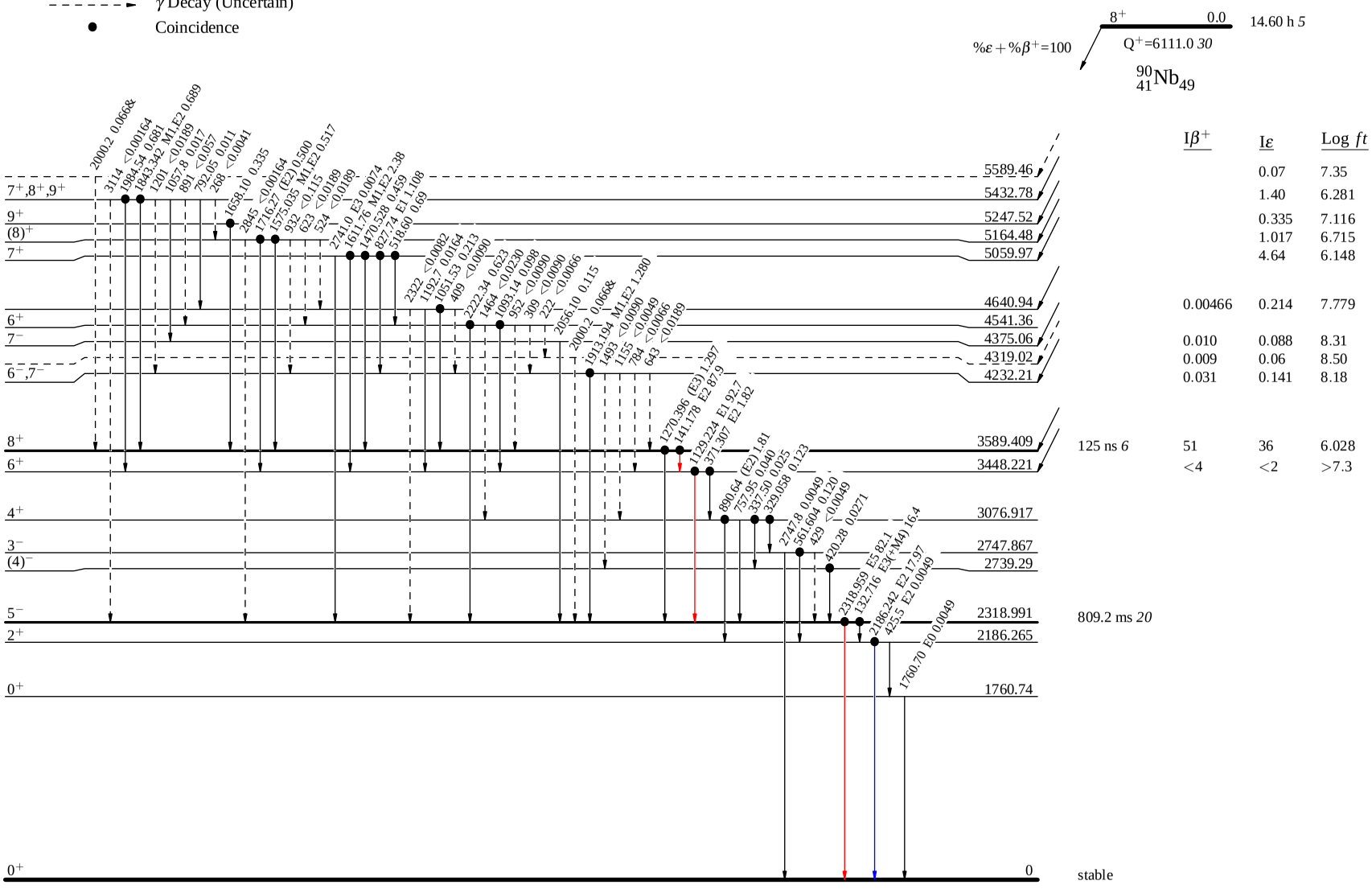
[†] Upper limits from 1982Wa24 renormalized to current normalization.
[‡] From 1990Me15, except as noted.
[§] From the Adopted Gammas. For cases where values originate from this dataset, supported evidence is included in the comments.
[&] For absolute intensity per 100 decays, multiply by 0.08203 *20*.
[@] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[#] Multiply placed with undivided intensity.
[a] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

$^{90}_{40}Zr_{50}$-38

^{90}Nb ε decay 1990Me15,1982Wa24

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
& Multiply placed: undivided intensity given



$^{90}_{40}Zr_{50}$

$^{90}_{40}Zr_{50}$-39

^{90}Zr IT decay (809.2 ms) 1990Me15

Parent: ^{90}Zr: E=2319.000 *9*; $J^{\pi}=5^{-}$; $T_{1/2}$=809.2 ms *20*; %IT decay=100.0

^{90}Zr Levels

E(level)†	J^{π}†	$T_{1/2}$†
0.0	0^{+}	stable
1760.74 *15*	0^{+}	61.3 ns *25*
2186.265 *19*	2^{+}	88 fs *3*
2319.000 *9*	5^{-}	809.2 ms *20*

† From the Adopted Levels.

$\gamma(^{90}Zr)$

Iγ normalization: From ΣI(γ+ce)(to g.s.)=100. A sum of Iγ=ce out of the 2319-keV level gives a normalization of 0.0836, with larger uncertainty due to possibility of M4 admixture in the 132.7γ.

E_γ †	I_γ †‡	E_i(level)	J^π_i	E_f	J^π_f	Mult. †	δ †	α §	$I_{(\gamma+ce)}$ ‡	Comments
132.716 *18*	50.4 *5*	2319.000	5^-	2186.265	2^+	E3(+M4)	<0.07	2.97 *11*		
425.5 *2*	0.06 *1*	2186.265	2^+	1760.74	0^+	E2		0.00688		
1760.70 *20*		1760.74	0^+	0.0	0^+	E0			0.060 *10*	$I_{(\gamma+ce)}$: from transition intensity balance.
2186.242 *25*	219 *2*	2186.265	2^+	0.0	0^+	E2		5.36×10^{-4}		
2318.959 *25*	1000 *2*	2319.000	5^-	0.0	0^+	E5		4.64×10^{-4}		

† From ^{90}Nb ε decay.

‡ For absolute intensity per 100 decays, multiply by 0.0820 *4*.

§ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

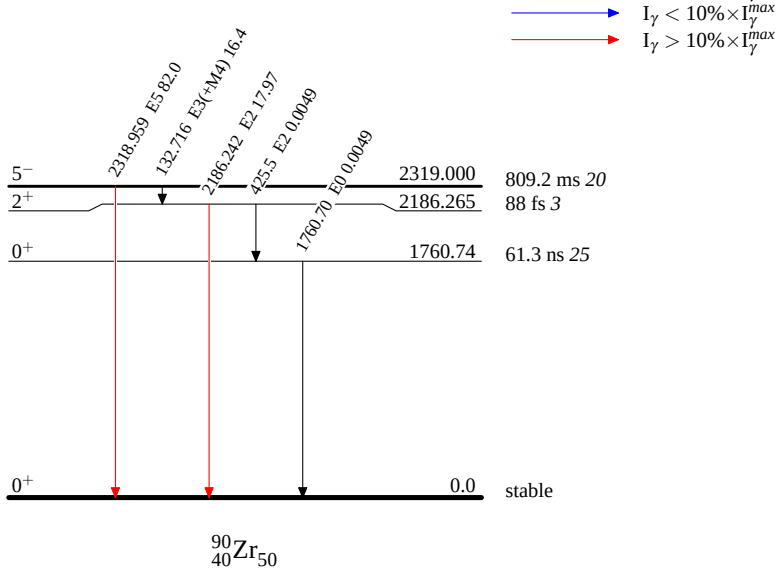
$^{90}_{40}Zr_{50}$-41

^{90}Zr IT decay (809.2 ms) 1990Me15

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays

%IT=100.0



$^{90}_{40}Zr_{50}$

^{76}Ge(^{18}O,4nγ) 1985Wa09

1985Wa09: E(^{18}O)=40-80 MeV. Measured excit, $\gamma\gamma$ coin, $\gamma(\theta)$, γ-ray linear polarizations, DSA and recoil distance. Ge detectors.

^{90}Zr Levels

E(level)†	J^{π}‡	$T_{1/2}$#	E(level)†	J^{π}‡	$T_{1/2}$#	E(level)†	J^{π}‡	$T_{1/2}$#
0	0^+		5644.04 *5*	10^+	<28 ps	7437.84 *8*	$(13)^+$	2.9 ps *5*
1760.69 *20*	0^+		5792.07 *3*	$9^{(+)}$		8058.42 *11*	$(14)^+$	0.28 ps *14*
2186.285 *8*	2^+		6279.69 *11*	$(11)^+$		8958.13 *23*	$(15)^-$	0.5 ps *3*
2319.002 *8*	5^-		6376.12 *9*	$10^{(-)}$	<28 ps	9707.0? *3*	(16^-)	0.49 ps *14*
2739.29 *5*	4^-		6721.11 *9*	(10^-)		9836.0 *3*	$(15)^+$	
2747.839 *24*	3^-		6769.50 *19*	(12^+)		10125.8 *3*	$(16)^+$	0.62 ps *21*
3076.899 *11*	4^+		6953.96 *7*	$(11)^-$	<28 ps	10764.97 *8*	(17^+)	0.14 ps *14*
3448.193 *10*	6^+		7008.63 *7*	$(11)^-$		11403.9 *11*	(18^+)	0.21 ps *11*
3589.446 *10*	8^+		7025.61 *7*	$(10)^+$		12110.8 *11*	(19^+)	0.14 ps *5*
5164.463 *18*	(8^+)		7194.36 *7*	$(11)^+$	<28 ps	12964.8 *12*	(20)	<0.35 ps
5247.498 *23*	9^+	<28 ps	7223.91 *7*	$(12)^+$	59 ps *10*			

† From a least-squares fit to Eγ, by evaluators.

‡ From 1985Wa09 based on$\gamma(\theta)$, linear polarization and RUL assuming J(initial)≥J(final) and using systematics for the alignment coefficients.

From DSA and RDM (1985Wa09).

γ(^{90}Zr)

E_γ	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[#]	Comments
29.57 *8*	14.5 *20*	7223.91	(12)$^+$	7194.36	(11)$^+$	(M1)		6.74 *11*	I_γ: From E. Warburton, priv. comm. Mult.: No polarization data available. Mult. is from intensity arguments (α for E1 and M1 are 3.7 and 6.8, respectively). Absence of E2 admixture is from RUL. Mult.: A_2=−0.016 *4* (1985Wa09).
54.66 *5*	2.15 *30*	7008.63	(11)$^-$	6953.96	(11)$^-$				I_γ: From E. Warburton, priv. comm. A_2=+0.076 *16* (1985Wa09).
132.717[&] *3*	16.5 *10*	2319.002	5$^-$	2186.285	2$^+$				A_2=+0.001 *1*, A_4=+0.001 *1* (1985Wa09).
[x]134.34 *3*	4.0 *7*								A_2=−0.003 *12* (1985Wa09).
141.252[&] *2*	260 *10*	3589.446	8$^+$	3448.193	6$^+$	E2		0.316	I_γ: Unresolved from impurity line. From intensity balance at the 3448 level, using α(exp)=0.32 for 141 γ. Mult.: A_2=+0.023 *3*, A_4=−0.007 *3*, Pol=+0.032 *3* (1985Wa09).
168.760 *4*	30.8 *10*	7194.36	(11)$^+$	7025.61	(10)$^+$	M1+E2		0.107 *59*	Mult.: A_2=−0.030 *2*, A_4=0.000 *2*, Pol=−0.022 *8* (1985Wa09).
213.93 *4*	177 *6*	7437.84	(13)$^+$	7223.91	(12)$^+$	M1+E2	−0.07 *3*	0.0264 *5*	Mult.,δ: A_2=−0.032 *2*, A_4=+0.002 *2*, Pol=−0.019 *4* (1985Wa09).
215.27 *4*	37.2 *30*	7223.91	(12)$^+$	7008.63	(11)$^-$				Mult.,δ: A_2=−0.037 *9* (1985Wa09).
269.93 *5*	78.5 *25*	7223.91	(12)$^+$	6953.96	(11)$^-$	E1(+M2)	−0.02 *3*	0.00651 *16*	Mult.,δ: A_2=−0.026 *1*, Pol=+0.036 *6* (1985Wa09).
287.55 *7*	18.0 *5*	7008.63	(11)$^-$	6721.11	(10$^-$)	M1+E2	−0.07 *5*	0.01235 *21*	Mult.,δ: A_2=−0.035 *2*, Pol=−0.035 *12* (1985Wa09).
289.83 *6*	22.3 *9*	10125.8	(16)$^+$	9836.0	(15)$^+$	M1(+E2)	−0.01 *6*	0.01205 *18*	Mult.,δ: A_2=−0.025 *3*, Pol=−0.030 *14* (1985Wa09).
329.059[@] *25*	≈0.58	3076.899	4$^+$	2747.839	3$^-$				
337.65[@] *20*	≈0.12	3076.899	4$^+$	2739.29	4$^-$				
345.24 *20*	8.6 *7*	6721.11	(10$^-$)	6376.12	10$^{(-)}$				A_2=+0.040 *3*, A_4=0.000 *3* (1985Wa09).
371.295[&] *7*	6.1 *5*	3448.193	6$^+$	3076.899	4$^+$	E2		0.01064	Mult.: A_2=+0.027 *5*, A_4=+0.004 *5* (1985Wa09).
420.29[@] *5*	≈0.12	2739.29	4$^-$	2319.002	5$^-$				
425.59[@] *20*	≈0.14	2186.285	2$^+$	1760.69	0$^+$				
[x]429.9 *8*	13.2 *10*					M1		0.00457	Mult.: A_2=−0.033 *4*, Pol=−0.025 *8* (1985Wa09).
441.42[§b] *13*	≤1[§]	6721.11	(10$^-$)	6279.69	(11)$^+$				
[x]484.75 *25*	24.2 *10*					M1		0.00344	Mult.: A_2=−0.017 *10*, Pol=−0.004 *7* (1985Wa09).
489.81 *15*	12.0 *5*	6769.50	(12$^+$)	6279.69	(11)$^+$	(M1+E2)	−0.26 *6*	0.00342 *6*	Mult.,δ: A_2=−0.062 *5*, A_4=+0.014 *5*, Pol=−0.005 *7* (1985Wa09).
[x]516.40 *25*	9.4 *10*					M1		0.00296	Mult.: A_2=−0.039 *6*, Pol=−0.018 *10* (1985Wa09).
561.55[@] *5*	≈0.55	2747.839	3$^-$	2186.285	2$^+$				
584.04[§] *8*	[§]	6376.12	10$^{(-)}$	5792.07	9$^{(+)}$				I_γ: 14 *+10−4*. Pol=−0.027 *10*.
620.58 *8*	148 *5*	8058.42	(14)$^+$	7437.84	(13)$^+$	M1+E2	−0.14 *5*	0.00194	Mult.,δ: A_2=−0.039 *4*, Pol=−0.015 *2* (1985Wa09).

$^{90}_{40}$Zr$_{50}$-44

γ(^{90}Zr) (continued)

E_γ	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[#]	Comments
639.0[a] *8*	44[a] *10*	10764.97	(17$^+$)	10125.8	(16)$^+$	(M1+E2)		0.00194 *14*	Mult.,δ: A_2=−0.046 *5*, Pol=−0.017 *7* (1985Wa09) for doublet.
639.0[a] *8*	38[a] *10*	11403.9	(18$^+$)	10764.97	(17$^+$)	(M1+E2)		0.00194 *14*	Mult.,δ: A_2=−0.046 *5*, Pol=−0.017 *7* (1985Wa09) for doublet.
706.8 *3*	20.5 *20*	12110.8	(19$^+$)	11403.9	(18$^+$)	(M1(+E2))	−0.3 *5*	0.00145 *5*	Mult.,δ: A_2=−0.080 *60*, Pol=+0.010 *12* (1985Wa09).
[x]713.05 *20*	13.6 *5*					M1		1.41×10^{-3}	Mult.: A_2=+0.012 *4*, A_4=+0.005 *4*, Pol=−0.022 *19* (1985Wa09).
748.87[b] *20*	16.0 *8*	9707.0?	(16$^-$)	8958.13	(15)$^-$	(M1(+E2))	−0.15 *15*	1.27×10^{-3} *2*	Mult.,δ: A_2=−0.056 *5*, Pol=−0.000 *20* (1985Wa09).
757.78[@] *20*	≈0.18	3076.899	4$^+$	2319.002	5$^-$				
818.23 *5*	69.2 *20*	7194.36	(11)$^+$	6376.12	10$^{(-)}$	E1(+M2)	−0.02 *4*	4.30×10^{-4} *10*	Mult.,δ: A_2=−0.026 *3*, A_4=0.0004, Pol=+0.031 *3* (1985Wa09).
834.51[§b] *8*	<2[§]	8058.42	(14)$^+$	7223.91	(12)$^+$				
854.0 *3*	14 *4*	12964.8	(20)	12110.8	(19$^+$)				Pol=+0.040 *20* (1985Wa09).
890.613[&] *10*	8.3 *5*	3076.899	4$^+$	2186.285	2$^+$	E2		8.82×10^{-4}	Mult.: A_2=+0.015 *4*, A_4=−0.002 *4* (1985Wa09).
899.71 *20*	92.7 *30*	8958.13	(15)$^-$	8058.42	(14)$^+$	E1(+M2)	−0.07 *7*	0.00036 *3*	Mult.,δ: A_2=−0.034 *2*, Pol=+0.043 *15* (1985Wa09).
928.9[§b] *7*	<2.5[§]	10764.97	(17$^+$)	9836.0	(15)$^+$				
929.03[§b] *9*	≤2[§]	6721.11	(10$^-$)	5792.07	9$^{(+)}$				
1032.19 *10*	22.0 *9*	6279.69	(11)$^+$	5247.498	9$^+$	E2		6.24×10^{-4}	Mult.: A_2=+0.030 *3*, A_4=−0.012 *3*, Pol=+0.061 *14* (1985Wa09).
1077.06[§b] *8*	≤2[§]	6721.11	(10$^-$)	5644.04	10$^+$				
1128.2 *7*	50 *6*	6376.12	10$^{(-)}$	5247.498	9$^+$				
1129.182[&] *10*	340 *12*	3448.193	6$^+$	2319.002	5$^-$	E1		2.41×10^{-4}	Mult.: A_2=−0.020 *1*, A_4=+0.001 *2*, Pol=+0.022 *3* (1985Wa09).
1167.70 *20*	39.0 *16*	10125.8	(16)$^+$	8958.13	(15)$^-$	E1(+M2)	−0.02 *5*	2.42×10^{-4} *5*	Mult.,δ: A_2=−0.028 *4*, Pol=+0.037 *4* (1985Wa09).
1233.54 *10*	5.5 *8*	7025.61	(10)$^+$	5792.07	9$^{(+)}$				A_2=−0.029 *4*, A_4=−0.001 *4* (1985Wa09).
1270.422[&] *15*	5.2 *4*	3589.446	8$^+$	2319.002	5$^-$				A_2=+0.044 *15*.
1278.1[§b] *10*	<1.5[§]	11403.9	(18$^+$)	10125.8	(16)$^+$				
1288.90[§b] *21*	<2[§]	8058.42	(14)$^+$	6769.50	(12$^+$)				
1309.83 *7*	79.6 *24*	6953.96	(11)$^-$	5644.04	10$^+$	E1(+M2)	+0.02 *2*	2.90×10^{-4} *5*	Mult.,δ: A_2=−0.0258 *6*, A_4=−0.0004 *6*, Pol=+0.032 *4* (1985Wa09).
1345.9[§b] *8*	<2[§]	12110.8	(19$^+$)	10764.97	(17$^+$)				
1364.73 *20*	13.2 *5*	7008.63	(11)$^-$	5644.04	10$^+$	(E1(+M2))	−0.01 *2*	3.12×10^{-4}	Mult.,δ: A_2=−0.024 *3*, A_4=0.004 *4*, Pol=+0.008 *10* (1985Wa09).
1381.8 *3*	1.90 *20*	7025.61	(10)$^+$	5644.04	10$^+$				A_2=+0.008 *20*, A_4=−0.019 *30* (1985Wa09).
1402.27[§b] *7*	<1[§]	7194.36	(11)$^+$	5792.07	9$^{(+)}$				
1473.65 *20*	3.9 *4*	6721.11	(10$^-$)	5247.498	9$^+$				A_2=−0.004 *6*, A_4=−0.004 *6* (1985Wa09).
1520.29[§b] *22*	<1[§]	8958.13	(15)$^-$	7437.84	(13)$^+$				

$^{90}_{40}$Zr$_{50}$-45

γ(^{90}Zr) (continued)

E_γ	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[#]	Comments
1550.3 *3*	3.50 *30*	7194.36	(11)$^+$	5644.04	10$^+$	D			A_2=−0.071 *7*, A_4=−0.004 *7* (1985Wa09).
1556.63[§b] *9*	≤1.5[§]	6721.11	(10$^-$)	5164.463	(8$^+$)				
1560.8[§b] *5*	<1.5[§]	12964.8	(20)	11403.9	(18$^+$)				
1575.009[&] *20*	3.0 *5*	5164.463	(8$^+$)	3589.446	8$^+$				
1580.0 *3*	2.00 *20*	7223.91	(12)$^+$	5644.04	10$^+$	(E2)		3.70×10^{-4}	Mult.: A_2=+0.048 *14*, A_4=−0.018 *18* (1985Wa09).
1658.035[&] *20*	95 *5*	5247.498	9$^+$	3589.446	8$^+$	E2(+M1)	+14 *14*	3.80×10^{-4} *17*	I_γ: Unresolved from impurity lines. Iγ is from intensity balance. Mult.,δ: A_2=+0.004 *4*, A_4=+0.030 *5*, Pol=+0.007 *5* (1985Wa09).
1716.248[&] *20*	4.0 *7*	5164.463	(8$^+$)	3448.193	6$^+$				
1777.6[§] *3*	≈22.3[§]	9836.0	(15)$^+$	8058.42	(14)$^+$				A_2=−0.022 *2*, A_4=+0.002 *2*, Pol=+0.033 *10* (1985Wa09).
1778.10[§] *7*	19.8[§] *20*	7025.61	(10)$^+$	5247.498	9$^+$				A_2=−0.022 *3*, A_4=+0.002 *2*, Pol=+0.033 *10* (1985Wa09).
1806.7[§b] *8*	<2[§]	10764.97	(17$^+$)	8958.13	(15)$^-$				
1861.4 *3*	5.30 *25*	7025.61	(10)$^+$	5164.463	(8$^+$)	(E2)		4.26×10^{-4}	Mult.: A_2=+0.028 *10*, A_4=−0.006 *12* (1985Wa09).
2054.55 *5*	130 *4*	5644.04	10$^+$	3589.446	8$^+$	E2		4.88×10^{-4}	Mult.: A_2=+0.0321 *5*, A_4=−0.0102 *5*, Pol=+0.044 *7* (1985Wa09).
2067.4[§b] *3*	<2[§]	10125.8	(16)$^+$	8058.42	(14)$^+$				
2186.254[&] *10*	69.6 *20*	2186.285	2$^+$	0	0$^+$	E2		5.36×10^{-4}	Mult.: A_2=+0.002 *2*, A_4=−0.003 *2* (1985Wa09).
2202.60 *3*	25.5 *10*	5792.07	9$^{(+)}$	3589.446	8$^+$	(M1+E2)	−0.07 *4*	5.03×10^{-4}	Mult.,δ: A_2=−0.034 *3*, A_4=−0.004 *3*, Pol=+0.004 *17* (1985Wa09).
2318.968[&] *10*	306 *8*	2319.002	5$^-$	0	0$^+$				
2747.6[@] *3*	≈0.03	2747.839	3$^-$	0	0$^+$				

[†] From γ-ray data at E(^{18}O)=60 MeV, except as noted.
[‡] From $\gamma(\theta)$; δ assumes given spin combinations.
[§] Eγ deduced from level energy difference, Iγ estimated.
[&] Eγ from ^{90}Nb ε decay (1982Wa24).
[@] Eγ from ^{90}Nb ε decay (1982Wa24), Iγ estimated.
[#] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[a] Multiply placed with intensity suitably divided.
[b] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

$^{90}_{40}$Zr$_{50}$-46

^{87}Sr(α,nγ) 1971Gl06

1971Gl06: E=10.3-13.5 MeV. Measured Eγ. Ge(Li) detector.

^{90}Zr Levels

E(level)	J^{π} †
0†	0^+
2186.3†	2^+
2319.0†	5^-
2738.9‡	$(4)^-$
2747.5‡	3^-
3076.9†	4^+
3305.0?‡	2^+
3448.2†	6^+
3589.4†	8^+

† From the Adopted Levels.
‡ As given by 1971Gl06.

γ(^{90}Zr)

E_γ	E_i(level)	J^π_i	E_f	J^π_f
132.8	2319.0	5^-	2186.3	2^+
141	3589.4	8^+	3448.2	6^+
420	2738.9	$(4)^-$	2319.0	5^-
561	2747.5	3^-	2186.3	2^+
891	3076.9	4^+	2186.3	2^+
1118†	3305.0?	2^+	2186.3	2^+
1128	3448.2	6^+	2319.0	5^-
2186.3	2186.3	2^+	0	0^+
2319.0	2319.0	5^-	0	0^+

† Placement of transition in the level scheme is uncertain.

^{88}Sr(^{3}He,n) 1974Da20,1976Fi09

1974Da20: E=16.86-25.49 MeV. Measured σ(E(n)), θ=0°, neutron time-of-flight, enriched target. DWBA analysis.
1976Fi09: E=25.4 MeV. Measured $\sigma(\theta)$ for g.s., neutron time-of-flight, θ=0°−40°, natural target. DWBA analysis.
No additional excited levels were observed by the (^{3}He,n) reaction up to 12.6 MeV and σ(1760)<<σ(g.s.) (1974Da20).

^{90}Zr Levels

E(level)†	L‡
0	0
1760	

† From 1974Da20.
‡ From 1976Fi09.

^{88}Sr(^{16}O,^{14}C),(^{12}C,^{10}Be) 1978Tu06

1978Tu06: E(^{16}O)=80 MeV, E(^{12}C)=60 MeV. Measured $\sigma(\theta)$, θ(c.m.)=10°−70°, semi, FWHM 150-200 keV, enriched target. DWBA and CCBA analyses.

Other: 1973Ch10.

^{90}Zr Levels

E(level)
0
2190†
2320†
2740‡
2750‡
3080
3310

† Unresolved doublet. Separate experiment shows at least 90% to be 2320 level.

‡ Unresolved doublet.

^{89}Y(p,γ) 1969Ir01,1979Sz06

1967Bl07: E=2.8-10 MeV. Measured σ(E), W(θ), scin.
1969Ir01: E=3930 keV. Measured σ(Eγ), semi.
1973Ha62: E=5.4-17.0 MeV. Measured σ(E,Eγ,θ), scin.
1974Ra04: E=4.82 MeV. Measured Eγ, Iγ, semi.
1979Sz06: E=2.2-3.4 MeV. Measured Eγ, Iγ, semi. Deduced gamma-ray strength function.
1987Sz02: E=3.7-11.5 MeV. Measured σ(E,Eγ), semi. Deduced spectroscopic factors.
1993Sa38: E=4 MeV. Measured Eγ, Iγ, γ(θ), levels half-life. Doppler-shift attenuation, Detector: NaI.
2013Ha03: E=2,3,4 and 4.8 MeV; 4$\pi\gamma$ summing technique using NaI(Tl) detector; measured Eγ, Iγ, Iγ(θ), angle integrated cross-section; deduced astrophysical S-factor and reaction rates; statistical model calculations; TALYS code.
2015Ne07: E=3.65 to 4.70 MeV. Measured σ(E), Eγ, Iγ.
The analog states are superimposed on the broad giant dipole resonance centered at E(level)≈16500 with a width Γ≈4000 (1973Ha62).
Other: 2014Ne18.

^{90}Zr Levels

E(level)[†]	J$^{\pi}$[e]	T$_{1/2}$[‡]	C^{2}S[d]	Comments
0	0$^+$			
1762[b] *3*	0$^+$		0.80	
2187[b] *3*	2$^+$	82 fs *+16−12*		
2320[&b]	5$^-$		1.16	
2740[&]	(4)$^-$		0.97	
2748 *3*	3$^-$			
3081 *3*	4$^+$			
3308 *3*	2$^+$	96 fs *+6−5*		
3842 *3*	2$^+$	14 fs *+6−4*		
4126 *3*	0$^+$			
4233 *3*				
4424 *3*	0$^+$			
4581 *3*	1$^+$	8.7 fs *+13−9*		
4681 *3*	2$^+$			
4992 *3*				
5095 *3*				
5108 *3*	3$^-$			
5187 *3*	0$^+$,1$^+$,2$^+$			
5275.2[a]	(2$^+$)	0.8 ps *+2−1*		
5308 *3*				
6640.1[a]	(2$^+$)	21 fs *+7−6*		
7649.6[a]	(2$^+$)	0.55 ps *+9−7*		
11936[c] *26*				
12220 *3*				
12482[c] *28*				
12779[c] *29*				
12977[c] *26*				
13110[@]				E(level): Probable analog of ^{90}Y g.s. E(p)(lab)=4810.
13310[@]				E(level): Probable analog of ^{90}Y(203). E(p)(lab)=5010.
14430[#]				E(level): Probable analog of ^{90}Y(1371). E(p)(lab)=6140.
15500[#]				E(level): E(p)(lab)=7220.
15700[#]				E(level): E(p)(lab)=7420.
15900[#]				E(level): E(p)(lab)=7620.
16290[#]				E(level): Probable analog of ^{90}Y(3145). E(p)(lab)=8020.
17300[#]				E(level): E(p)(lab)=9000.

Continued on next page (footnotes at end of table)

^{89}Y(p,γ) 1969Ir01,1979Sz06 (continued)

^{90}Zr Levels (continued)

E(level)[†]	Comments
19400[#]	E(level): Possible analog resonance. E(p)(lab)=11100.
20800[#]	E(level): Possible analog resonance. E(p)(lab)=12550.

[†] From 1979Sz06, except as noted.
[‡] From Doppler-shift attenuation method (1993Sa38).
[#] From 1973Ha62. For resonance parameters, see 1973Ha62. Calculated from E(p) by evaluators using S(p)=8353.1 keV *16* (2017Wa10).
[@] From 1967Bl07. Calculated from E(p) by evaluators using S(p)=8353.1 keV *16* (2017Wa10).
[&] From 1987Sz02.
[a] From 1993Sa38.
[b] 2013Ha03 confirmed population of this level from sum peaks and entry state at 11.317 MeV.
[c] From 2015Ne07.
[d] From comparison with statistical+direct-semidirect model, C^2S=1.31 for g.s. was used to determine the strength of the optical potential (1987Sz02).
[e] From the Adopted Levels.

γ(^{90}Zr)

E_i(level)	J^π_i	E_γ	I_γ[&]	E_f	J^π_f	Mult.	Comments
4581	1^+	4582.7[§]		0	0^+	(E2)[§]	Mult.: Assigned (E2) multi-polarity is not consistent with Jπ=1^+, as adopted for 4581 level.
5275.2	(2^+)	5275.2[§]		0	0^+	(E2)[§]	
6640.1	(2^+)	6640.1[§]		0	0^+	(E2)[§]	
7649.6	(2^+)	7649.6[§]		0	0^+	(E2)[§]	
12220		8383[†] *6*	18	3842	2^+		
		8919[†] *6*	26	3308	2^+		
		9467[†] *6*	16	2748	3^-		
		10033[†] *6*	47	2187	2^+		
		10453[†] *6*	40	1762	0^+		
		12212[†] *6*	100	0	0^+		
13110		9270[‡]		3842	2^+		
		9800[‡]		3308	2^+		
		10360[‡]		2748	3^-		
		10920[‡]		2187	2^+		
		11350[‡]		1762	0^+		
		13110[‡]		0	0^+		

[†] From 1969Ir01.
[‡] Approximate Eγ from level energy difference. Observed by 1974Ra04.
[§] From 1993Sa38.
[&] From 1969Ir01.

^{89}Y(p,n),(p,nγ) 1967Bl07,1968Jo01,1969Li17

1967Bl07: E=4.7-6.5 MeV. Measured σ(E), BF_3-counter, scin.
1968Jo01: E=3.6-5.8 MeV. Measured σ(E), 4π flat-response neutron detector.
1969Li17: E=5.4-7.8 MeV. Measured Σ(E,Eγ), semi.
Other: 1995Ka51.

^{90}Zr Levels

E(level)[†]	Comments
13108[‡] *4*	E(level): Probable analog of ^{90}Y(g.s). E(p)(lab)=4807 *4*.
13309[‡] *4*	E(level): Probable analog of ^{90}Y(203). Not observed in (p,n) to the first excited state in ^{89}Zr (1967Bl07). E(p)(lab)=5010 *4*.
13940	E(level): Possible analog of ^{90}Y(777). E(p)(lab)=5645.
14090	E(level): Possible analog of ^{90}Y(954). E(p)(lab)=5800.
14220	E(level): Possible analog of ^{90}Y(1048). E(p)(lab)=5930.
14270	E(level): Probable analog of ^{90}Y(1212). E(p)(lab)=5980.
14310	E(level): E(p)(lab)=6025.
14410	E(level): E(p)(lab)=6120.
14440	E(level): Probable analog of ^{90}Y(1371). For resonance parameters see 1969Li17. E(p)(lab)=6150.
15510[#]	E(level): Probable analog of ^{90}Y(2474). E(p)(lab)=7230.
15690[#]	E(level): Probable analog of ^{90}Y(2624). E(p)(lab)=7420.

[†] Calculated from E(p) using S(p)=8353.1 keV *16* (2017Wa10).
[‡] From 1968Jo01. For resonance parameters, see 1968Jo01, 1965Ma20. For angular distribution of neutrons, see 1966Ki08, 1965Ma20.
[#] From 1969Li17.

^{89}Y(p,p),(pol p,p) 1964Fo03,1969Mi18,1973Gr08

1964Fo03: ^{89}Y(p,n)(p,p), measured σ(E).
1969Mi18: E=7.04-7.61 MeV. Measured σ(E,θ), Si(Li), polarization(θ), carbon foil polarimeter and ΔE/E telescope.
1973Gr08: ^{89}Y(polarized p,p), E=4.7-5.1 MeV. Measured σ(θ), A(θ).
Others: 1969Li17, 1992Ch38.
Data are from 1964Fo03, except as noted.

^{90}Zr Levels

E(level)	J^π	L	Γ[†]	Comments
13120 *30*	$1^-,2^-,3^-$[&]	2	25.5[‡] *20*	E(level): Probable analog of ^{90}Y(g.s.).
13320 *30*	$1^-,2^-,3^-$[&]	2	27.7[‡] *20*	E(level): Probable analog of ^{90}Y(203).
14270 *30*				E(level): Probable analog of ^{90}Y(1212).
14400 *30*				E(level): Probable analog of ^{90}Y(1371).
15550 *30*	$2^-,(1^-)$[@]		60[#]	E(level): Proton configuration d3/2. Probable analog of ^{90}Y(2474).
15700 *30*	$1^-,(2^-)$[@]		60[#]	E(level): Proton configuration d3/2. Probable analog of ^{90}Y(2624).

[†] Γ in keV.
[‡] From 1973Gr08.
[#] From 1969Mi18.
[@] From 1969Mi18.
[&] From L.

^{89}Y(p,p′),(p,p′γ) 1967Bl07,1968Lo04

1964Jo13,1967Bl07: E=4.7-6.4 MeV. Measured yield of 909-keV isomeric transition, scintillator.
1968Lo04: E=5.5-10.9 MeV. Measured σ(E), W(θ), magnetic spectrograph.

^{90}Zr Levels

E(level)[†]	J^{π}[@]	Comments
13088[‡]		E(level): Probable analog of ^{90}Y(g.s.).
13314[‡]		E(level): Probable analog of ^{90}Y(203).
13917[‡]		E(level): Probable analog of ^{90}Y(777).
14095[‡]		E(level): Probable analog of ^{90}Y(954).
14332[‡]		
14748[#]	(3^-)	
14878[#]	(0^-)	
14928[#]	(1^-)	
15578[#]		
15948[#]	(2^-)	
16148[#]	(2^-)	
16258[#]	(1^-)	
16278[#]		

[†] E(level) has been calculated from E(p) using S(p)=8353.1 keV *16* (2017Wa10).
[‡] From 1967Bl07.
[#] From 1968Lo04.
[@] Tentative assignment from σ(θ) (1968Lo04).

^{89}Y(d,n) 1976Ad06

Jπ(^{89}Y)=1/2$^-$.
1976Ad06: E=11.5 MeV. Measured $\sigma(\theta)$, θ=10°−75° in steps of 5°. Liquid scintillator, time-of-flight, FWHM=80 keV. (1976Ad06).
For vector-analyzing power in ^{89}Y(pol d,n), see 1972Qu02.

^{90}Zr Levels

E(level)	L†	C^{2}S′†	Comments
0	1	1.09	
1763 *20*	1	0.43	
2321 *10*	4	6.37	
2735 *10*	4	4.37	
4228 *15*	1	0.09	L,C^{2}S′: L=1+4, C^{2}S′=0.08+0.10 for 2p3/2+1g9/2.
4430			
4540			
5090			
5640 *10*	2	0.71	C^{2}S′: 0.64 for 2d5/2.
5764 *15*	2	0.26	C^{2}S′: 0.24 for 2d5/2.
5868 *15*	2	0.13	C^{2}S′: 0.12 for 2d5/2.
6020 *20*	2	0.05	C^{2}S′: 0.04 for 2d5/2.
6198 *20*	2	0.14	C^{2}S′: 0.12 for 2d5/2.
6247 *15*	2	0.20	C^{2}S′: 0.17 for 2d5/2.
6670			
6820			
6870			
7005 *20*	0	0.04	
7116 *30*	0	0.04	
7258 *15*	0	0.04	
7480			
7600			
7776 *25*	2	0.10	C^{2}S′: 0.09 for 2d5/2.
7840			
8000			
13140	2		E(level): Suggested analog of ^{90}Y g.s.
13340	2		E(level): Suggested analog of ^{90}Y(203).

† From comparison of $\sigma(\theta)$ with DWBA calculations.

^{89}Y(^{3}He,d) 1969Vo03

Jπ(^{89}Y)=1/2$^-$.

1969Vo03: E=25 MeV. Measured σ(θ), ten angles between 10° and 55°. Magnetic spectrograph, nuclear emulsions. FWHM=30 keV.

For a discussion of anti-analog states, see 1969Vo03.

^{90}Zr Levels

E(level)	L†	C^{2}S†‡	E(level)	L†	C^{2}S†‡	E(level)	L†	C^{2}S†‡	E(level)	L†	C^{2}S†‡
0	1	1.31	5180 *15*	1	0.08,0.06	6370 *15*	@	@	7350 *15*	2	0.18
1760 *15*	1	0.52	5310 *15*	2	0.06	6400 *15*	@	@	7420 *15*		
2320 *15*	4	12.43	5420 *15*	2,1	0.05,0.04	6640 *15*	2	0.10	7480 *15*		
2730 *15*	4	9.99	5620 *15*	2	1.09	6670 *15*	&	&	7530 *15*	*a*	*a*
4230 *15*	1	0.22,0.18	5660 *15*	2	0.38	6710 *15*	&	&	7580 *15*	*a*	*a*
4500 *15*	1	0.08,0.06	5760 *15*	2	0.43	6760 *15*	2	0.08	7650 *15*	2	0.25
4560 *15*	1	0.14,0.11	5860 *15*	2	0.26	6810 *15*	2	0.16	7770 *15*	2	0.26
4650 *15*	1	0.04,0.04	6020 *15*	2	0.16	6880 *15*	0	0.12	7840 *15*	2	0.26
4780 *15*	1	0.06,0.04	6070 *15*	2	0.25	7000 *15*	0	0.14	7910 *15*	(2)	0.23
4980 *15*	2	0.04	6200 *15*	2	0.18	7110 *15*	0	0.16	8000 *15*		
5080 *15*	#	#	6250 *15*	2	0.33	7160 *15*	2	0.17	8050 *15*	(2)	0.19
5100 *15*	#	#	6320 *15*	2	0.12	7260 *15*	0	0.17	8120 *15*	(2)	0.37

† From comparison with DWBA calculations (1969Vo03).

‡ Values are given for both J=1/2 and J=3/2, respectively, for states of L=1.

L=2 and C^{2}S′=0.57 for 5080+5100 keV.

@ L=(2) and C^{2}S′=0.49 for 6370+6400 keV.

& L=0+2 and C^{2}S′=0.10+0.16 for 6670+6710 keV.

a L=2 and C^{2}S′=0.36 for 7530+7580 keV.

^{90}Zr(γ,γ') 2008Sc20,1984Be31,1974Me13

2008Sc20: E=7.9,9.0,13.2 MeV beam from ELBE accelerator at the research centre Dresden-Rosendorf. Measured Eγ, Iγ, angular distributions, scattering cross sections, width parameters using four HPGe detectors.

2013Ru01: E= 7 − 11 MeV 100% linearly polarized and monoenergetic beam from High Intensity γ ray Source (HIγS) facility. Measured Eγ, Iγ, angular distribution using four 60% HPGe detectors, two perpendicular to the beam and two in horizontal plane at θ=135°. Deduced giant M1 resonance strength.

1984Be31: Polarized bremsstrahlung with E<15 MeV. Measured σ(Eγ,θ), θ=0°, 90°, 180°, 270°, semi, enriched target.

1972Me04,1974Me13: Bremsstrahlung with E<5.6 MeV. Measured σ(Eγ,θ), θ=98° and 127°, semi, natural and enriched targets.

1976CaYX: Bremsstrahlung with E<9.5 MeV. Measured σ(Eγ,θ), θ=90° and 127°, semi, natural and enriched targets.

Others: 1969Ra09, 1974Ar15, 1982Be18.

^{90}Zr Levels

E(level)[†]	J$^\pi$[‡]	Γ_0^2/Γ (eV)[@]	I$_s$ (eVb)[b]	E(level)[†]	J$^\pi$[‡]	Γ_0^2/Γ (eV)[@]	I$_s$ (eVb)[b]
0.0	0$^+$			8006.9 *8*	1	0.20 eV *5*	36 *9*
2186.2 *1*	2$^+$	0.00489[&] eV *28*	19 *4*	8067.4 *5*	(1)	0.31 eV *7*	55 *13*
3308.0 *2*	2$^+$	0.0034[&] eV *7*	4.7 *19*	8110.0 *8*	1$^-$[#]	0.70 eV *14*	124 *24*
3842.0 *2*	2$^+$	0.024[&] eV *4*	26 *4*	8131.9 *4*	(1$^-$)[#]	0.88 eV *16*	154 *28*
3932.4 *6*			8.3 *32*	8144 *2*			115 *75*
4507.0 *8*			21 *10*	8166.7 *5*	(1)	0.57 eV *11*	98 *19*
4578.3 *3*		0.024[&] eV *4*	16 *4*	8221.2 *8*	1	0.33 eV *7*	57 *12*
5183.0 *5*			7.1 *24*	8235.6 *3*	1	1.5 eV *3*	254 *44*
5304.5 *3*		0.12[a] eV *5*	57 *8*	8250.7 *5*	1	0.50 eV *10*	85 *16*
5503.6 *3*		0.048[&] eV *17*	34 *6*	8295.3 *10*	(1)	0.24 eV *7*	40 *11*
5785.0 *4*		0.145 eV *22*	50 *8*	8313.0 *7*	1	0.42 eV *10*	70 *15*
5807.9 *3*		0.23 eV *3*	78 *10*	8334.1 *5*	1	0.54 eV *12*	90 *20*
5884.4 *4*		0.143 eV *23*	48 *8*	8357.5 *18*	1	0.10 eV *4*	16 *7*
6295.8 *2*	1$^-$[#]	2.55 eV *22*	740 *63*	8382.1 *10*	(1)	0.16 eV *3*	25 *6*
6389.8 *3*	1	0.29 eV *5*	82 *15*	8403.7 *11*		0.26 eV *4*	43 *7*
6424.3 *2*	1$^-$[#]	1.72 eV *15*	479 *43*	8413.5 *4*	1	1.30 eV *24*	212 *38*
6565.7 *3*	1	0.25 eV *3*	66 *9*	8440.6 *4*	1	1.38 eV *25*	224 *40*
6669.2 *7*	1	0.11 eV *3*	29 *8*	8467.7 *15*		0.19 eV *11*	31 *17*
6761.4 *2*	1$^-$[#]	2.55 eV *24*	644 *60*	8501.2 *4*	1$^-$[#]	2.2 eV *4*	346 *63*
6875.4 *2*	1$^-$[#]	0.81 eV *9*	198 *22*	8518 *3*		0.25 eV *10*	40 *16*
6960.4 *7*	1	0.18 eV *4*	44 *10*	8544 *4*		0.051 eV *19*	8 *3*
7042.0 *7*	1	0.11 eV *3*	25 *6*	8553.5 *12*	1	0.50 eV *5*	79 *8*
7085.6 *10*	(1)	0.13 eV *4*	30 *10*	8588.3 *7*	1	0.60 eV *13*	93 *21*
7198.2 *6*	1	0.20 eV *5*	45 *10*	8598.2 *10*	1	0.27 eV *8*	42 *12*
7249.2 *3*	1$^-$[#]	0.45 eV *8*	99 *17*	8625.6 *10*	1	0.24 eV *7*	37 *11*
7280.9 *7*				8664.1 *5*	1	0.39 eV *9*	59 *14*
7361.0 *6*	1	0.15 eV *3*	33 *7*	8716.6 *5*	1$^-$[#]	1.16 eV *22*	176 *33*
7387.6 *4*	1	0.36 eV *7*	75 *14*	8751.0 *8*	1	0.41 eV *10*	62 *15*
7424.5 *10*		0.069 eV *24*	14 *5*	8760.4 *5*	1	1.08 eV *20*	162 *31*
7433.8 *8*	1	0.09 eV *3*	19 *6*	8812.0 *13*	1	0.25 eV *9*	37 *13*
7468 *2*		0.061 eV *18*	12 *4*	8833.2 *8*	1	0.56 eV *13*	83 *20*
7474.9 *3*	(1)	0.62 eV *11*	127 *23*	8874.9 *9*	1	0.28 eV *8*	41 *11*
7685.8 *4*	1	0.36 eV *7*	70 *13*	8903.0 *8*		0.39 eV *4*	57 *6*
7702.9 *3*	1$^-$[#]	0.82 eV *14*	158 *28*	8927.4 *4*		0.88 eV *9*	127 *13*
7723.1 *9*		0.11 eV *3*	20 *6*	8978.4 *9*	(1)	0.62 eV *22*	88 *31*
7759.7 *6*	(1)	0.20 eV *5*	38 *9*	8985 *2*		0.32 eV *9*	45 *13*
7779.0 *6*	1	0.21 eV *5*	40 *9*	9004.7 *5*	1	0.24 eV *8*	34 *11*
7807.9 *3*	1	0.66 eV *12*	125 *23*	9014.0 *8*		0.17 eV *10*	24 *14*
7857.8 *7*	(1)	0.18 eV *5*	34 *9*	9034.0 *8*		0.25 eV *5*	35 *7*
7935.6 *3*	1	1.14 eV *20*	209 *36*	9043.6 *4*	1	0.50 eV *7*	71 *10*
7976.6 *4*	1	0.69 eV *12*	125 *23*	9053.5 *7*		0.27 eV *5*	38 *7*

Continued on next page (footnotes at end of table)

^{90}Zr(γ,γ') 2008Sc20,1984Be31,1974Me13 (continued)

^{90}Zr Levels (continued)

E(level)[†]	J^{π}[‡]	Γ_0^2/Γ (eV)[@]	I_s (eVb)[b]
9085.1 *3*	1	0.93 eV *11*	129 *15*
9111.1 *6*	1	1.02 eV *14*	141 *20*
9123.6 *7*		0.91 eV *13*	126 *17*
9137.5 *7*		1.34 eV *16*	185 *22*
9148.5 *3*	1^{-}[#]	5.10 eV *48*	703 *66*
9164.9 *7*		0.78 eV *10*	107 *14*
9177.5 *5*		1.18 eV *13*	162 *18*
9187 *3*		0.33 eV *10*	45 *13*
9196.5 *3*	(1^{-})[#]	1.85 eV *19*	252 *25*
9260.5 *6*	1	1.11 eV *14*	149 *19*
9292.8 *5*	1	1.62 eV *18*	216 *24*
9309.4 *7*	1	1.03 eV *14*	137 *18*
9333.4 *6*	1^{-}[#]	1.06 eV *15*	141 *19*
9373.2 *7*		0.84 eV *16*	111 *21*
9392.4 *8*	1	0.78 eV *15*	102 *19*
9409.4 *11*		0.54 eV *12*	71 *16*
9424.3 *10*		0.61 eV *13*	79 *17*
9444.7 *4*	1	1.71 eV *22*	221 *28*
9465.1 *5*	1	1.32 eV *19*	169 *25*
9486.8 *4*	1	1.77 eV *25*	226 *32*
9510.5 *13*	(1)	0.35 eV *12*	45 *16*
9524.1 *13*	1	0.35 eV *11*	44 *14*
9539.2 *5*	1	1.21 eV *18*	154 *22*
9551.4 *6*	1	1.27 eV *19*	160 *23*
9563.0 *6*	1	1.42 eV *22*	180 *28*
9609.2 *7*		0.57 eV *18*	72 *22*
9625.1 *8*		0.47 eV *13*	58 *16*
9640.4 *8*	1	0.46 eV *12*	56 *14*
9666.0 *8*	(1)	0.32 eV *7*	39 *9*
9678.3 *7*	(1^{-})[#]	0.55 eV *8*	67 *10*
9686.9 *6*	1	0.59 eV *9*	72 *11*
9733.2 *5*	1	0.45 eV *7*	55 *8*
9741.7 *7*		0.28 eV *5*	33 *6*
9754.0 *6*	1	0.41 eV *7*	50 *9*
9784.6 *5*		0.92 eV *12*	111 *15*
9805.4 *10*		0.34 eV *7*	41 *9*
9843.4 *6*	1	0.70 eV *13*	84 *15*
9855.5 *8*	1	0.49 eV *11*	58 *13*
9872.4 *4*	1	1.07 eV *21*	126 *24*
9890.7 *13*	(1)	0.7 eV *3*	81 *34*
9901.9 *13*		0.59 eV *24*	70 *28*
9932.1 *12*	1	1.1 eV *3*	123 *39*
9962.8 *5*	1	1.5 eV *3*	172 *37*
9984.1 *11*		0.6 eV *3*	69 *34*
10004.2 *10*	1	0.61 eV *14*	70 *16*
10019.6 *11*	1	0.82 eV *14*	94 *16*
10031 *2*		0.60 eV *14*	69 *16*
10042.9 *4*	(1^{-})[#]	2.76 eV *31*	316 *36*
10083.8 *6*	1	0.82 eV *12*	93 *13*
10094.2 *7*	1	0.73 eV *12*	83 *14*
10104.9 *12*	(1)	0.43 eV *12*	49 *13*
10123.7 *18*	1	1.22 eV *89*	14×10^{1} *10*
10146.8 *9*	1	0.41 eV *11*	46 *13*
10163.4 *8*	1	0.54 eV *15*	60 *16*
10193.0 *5*	1	1.51 eV *22*	168 *25*
10216.8 *10*	1	0.69 eV *16*	76 *18*
10233 *4*		0.43 eV *35*	47 *38*
10241 *2*	(1)	0.72 eV *3*	79 *34*
10260.9 *11*		0.21 eV *5*	23 *6*
10270.0 *7*		0.31 eV *8*	34 *9*
10286.2 *6*	1	0.39 eV *8*	42 *9*
10298.3 *10*	(1)	0.29 eV *7*	32 *8*
10306.6 *9*	1	0.43 eV *8*	46 *9*
10315.1 *4*	1	0.95 eV *13*	103 *14*
10334.9 *6*	1	0.47 eV *9*	51 *10*
10361 *2*	(1)	0.50 eV *13*	54 *14*
10376.8 *4*	1	2.24 eV *26*	240 *28*
10402.5 *9*	1	0.80 eV *15*	85 *16*
10494.5 *11*	(1)	0.41 eV *9*	43 *10*
10507.9 *8*	1	0.47 eV *10*	49 *10*
10524.6 *4*	1	1.38 eV *18*	143 *18*
10595.0 *7*	1	0.90 eV *14*	92 *14*
10618.7 *8*	1	0.65 eV *12*	67 *12*
10638.5 *9*	1	0.58 eV *12*	59 *12*
10682.2 *6*	1	0.42 eV *10*	42 *10*
10713.2 *12*	(1)	0.37 eV *20*	37 *20*
10728.2 *11*	1	1.0 eV *3*	102 *32*
10827.1 *5*	1	1.07 eV *17*	105 *16*
10914 *2*	(1)	1.17 eV *21*	113 *21*
10957 *2*	1	1.22 eV *20*	118 *19*
10987.0 *10*	1	1.69 eV *24*	161 *23*
11044 *2*		0.52 eV *18*	49 *17*
11094.2 *15*		0.74 eV *11*	70 *10*
11108.0 *16*		0.42 eV *8*	39 *8*
11120.4 *9*	1	0.99 eV *18*	92 *17*
11129.2 *17*		0.61 eV *20*	57 *18*
11140 *2*		0.61 eV *10*	57 *9*
11232.4 *7*	1	0.96 eV *15*	88 *13*
11243.2 *6*	1	1.01 eV *15*	92 *14*
11337.7 *6*	1	1.01 eV *17*	91 *15*
11417.5 *7*	(1)	1.2 eV *3*	108 *25*
11452.2 *10*	1	1.5 eV *3*	132 *28*
11479.7 *8*	1	2.2 eV *4*	191 *33*
11501 *3*		0.8 eV *4*	66 *37*
11510 *7*		0.38 eV *17*	33 *15*
11531 *2*	1	0.85 eV *35*	74 *30*
11627.9 *9*		0.52 eV *18*	44 *16*
11651.5 *8*	(1)	0.56 eV *19*	48 *16*
11777.4 *10*	1	1.5 eV *5*	124 *40*
11788 *3*	1	0.9 eV *4*	73 *36*
11963.3 *18*	(1)	0.85 eV *18*	68 *14*
11984 *2*	1	0.72 eV *17*	57 *13*
12020.6 *8*	1	1.94 eV *26*	155 *21*
12067.8 *9*	1	1.57 eV *24*	124 *19*
12208.3 *12*	1	0.93 eV *21*	72 *16*
12243.6 *14*	1	0.80 eV *19*	62 *15*
12496.3 *18*		1.18 eV *24*	87 *18*
12880.3 *10*		0.16 eV *5*	11 *3*

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^{90}Zr(γ,γ') 2008Sc20,1984Be31,1974Me13 (continued)

^{90}Zr Levels (continued)

† From 2008Sc20, except as noted. The energy was deduced by 2008Sc20 from the γ-ray energy measured at 127° to the beam by including a recoil and Doppler correction.
‡ As given by 2008Sc20, except where noted. Values for levels above 6 MeV are from measured $\gamma(\theta)$.
# From measured asymmetry with polarized photons (1984Be31).
@ From 2008Sc20, except where noted.
& From 1974Me13.
a From 1976CaYX.
b Integrated scattering cross section. The values were deduced from data at kinetic energies of 7.9, 9.0 and 13.2 MeV for different excitation energy ranges, viz., up to 6.875 MeV, between 6.960 and 8.832 MeV and above 8.832 MeV (2008Sc20).

γ(^{90}Zr)

Ratios Iγ(90°)/Iγ(127°) are from 2008Sc20. Expected values are 0.74 for elastic pure dipole (0-1-0 spin sequence) and 2.18 for elastic quadrupole (0-2-0 spin sequence).

E_γ†	E_i(level)	J^π_i	E_f	J^π_f	Mult.‡	Comments
2186.2 *1*	2186.2	2^+	0.0	0^+		
3307.9 *2*	3308.0	2^+	0.0	0^+		
3841.9 *2*	3842.0	2^+	0.0	0^+		
3932.3 *6*	3932.4		0.0	0^+		
4506.9 *8*	4507.0		0.0	0^+		
4578.2 *3*	4578.3		0.0	0^+		
5182.8 *5*	5183.0		0.0	0^+		
5304.3 *3*	5304.5		0.0	0^+		
5503.6 *3*	5503.6		0.0	0^+		
5784.8 *4*	5785.0		0.0	0^+		
5807.7 *3*	5807.9		0.0	0^+		
5884.2 *4*	5884.4		0.0	0^+		
6295.6 *2*	6295.8	1^-	0.0	0^+	E1§	Iγ(90°)/Iγ(127°)=0.75 *3*.
6389.6 *3*	6389.8	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.82 *8*.
6424.1 *2*	6424.3	1^-	0.0	0^+	E1§	Iγ(90°)/Iγ(127°)=0.74 *4*.
6565.4 *3*	6565.7	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.79 *15*.
6668.9 *7*	6669.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.64 *16*.
6761.1 *2*	6761.4	1^-	0.0	0^+	E1§	Iγ(90°)/Iγ(127°)=0.76 *3*.
6875.1 *2*	6875.4	1^-	0.0	0^+	E1§	Iγ(90°)/Iγ(127°)=0.73 *4*.
6960.1 *7*	6960.4	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.77 *11*.
7041.7 *7*	7042.0	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.74 *19*.
7085.3 *10*	7085.6	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.83 *21*.
7197.9 *6*	7198.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.49 *20*.
7248.9 *3*	7249.2	1^-	0.0	0^+	E1§	Iγ(90°)/Iγ(127°)=0.78 *7*.
7280.6 *7*	7280.9		0.0	0^+		
7360.8 *6*	7361.0	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.57 *17*.
7387.3 *4*	7387.6	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.68 *10*.
7424.2 *10*	7424.5		0.0	0^+		Iγ(90°)/Iγ(127°)=1.4 *6*.
7433.5 *8*	7433.8	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.52 *21*.
7468 *2*	7468		0.0	0^+		Iγ(90°)/Iγ(127°)=1.5 *5*.
7474.6 *3*	7474.9	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.96 *10*.
7685.4 *4*	7685.8	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.65 *10*.
7702.5 *3*	7702.9	1^-	0.0	0^+	E1§	Iγ(90°)/Iγ(127°)=0.83 *7*.
7722.7 *9*	7723.1		0.0	0^+		Iγ(90°)/Iγ(127°)=0.9 *3*.
7759.3 *6*	7759.7	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.82 *19*.

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^{90}Zr(γ,γ') 2008Sc20,1984Be31,1974Me13 (continued)

γ(^{90}Zr) (continued)

E_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	Comments
7778.6 *6*	7779.0	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.77 *17*.
7807.5 *3*	7807.9	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.75 *6*.
7857.4 *7*	7857.8	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.84 *25*.
7935.2 *3*	7935.6	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.81 *6*.
7976.2 *4*	7976.6	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.67 *7*.
8006.5 *8*	8006.9	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.71 *25*.
8067.0 *5*	8067.4	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=1.0 *3*.
8109.6 *8*	8110.0	1^-	0.0	0^+	E1[§]	Iγ(90°)/Iγ(127°)=0.71 *9*.
8131.5 *4*	8131.9	(1^-)	0.0	0^+	(E1)[§]	Iγ(90°)/Iγ(127°)=0.74 *9*.
8144 *2*	8144		0.0	0^+		
8166.3 *5*	8166.7	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.89 *14*.
8220.8 *8*	8221.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.80 *13*.
8235.2 *3*	8235.6	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.74 *4*.
8250.3 *5*	8250.7	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.68 *7*.
8294.9 *10*	8295.3	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.9 *3*.
8312.6 *7*	8313.0	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.73 *18*.
8333.7 *5*	8334.1	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.72 *18*.
8357.1 *18*	8357.5	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.32 *18*.
8381.7 *10*	8382.1	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=1.1 *4*.
8403.3 *11*	8403.7		0.0	0^+		
8413.1 *4*	8413.5	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.87 *9*.
8440.2 *4*	8440.6	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.87 *10*.
8467.3 *15*	8467.7		0.0	0^+		Iγ(90°)/Iγ(127°)=1.0 *5*.
8500.8 *4*	8501.2	1^-	0.0	0^+	E1[§]	Iγ(90°)/Iγ(127°)=0.81 *8*.
8518 *3*	8518		0.0	0^+		Iγ(90°)/Iγ(127°)=1.6 *6*.
8544 *4*	8544		0.0	0^+		
8553.1 *12*	8553.5	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.12 *6*.
8587.9 *7*	8588.3	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.58 *13*.
8597.8 *10*	8598.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.59 *22*.
8625.2 *10*	8625.6	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.7 *3*.
8663.7 *5*	8664.1	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.68 *16*.
8716.1 *5*	8716.6	1^-	0.0	0^+	E1[§]	Iγ(90°)/Iγ(127°)=0.75 *6*.
8750.5 *8*	8751.0	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.36 *14*.
8759.9 *5*	8760.4	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.58 *10*.
8811.5 *13*	8812.0	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.76 *24*.
8832.7 *8*	8833.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.67 *15*.
8874.4 *9*	8874.9	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.37 *13*.
8902.5 *8*	8903.0		0.0	0^+		
8926.9 *4*	8927.4		0.0	0^+		
8977.9 *9*	8978.4	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.8 *4*.
8985 *2*	8985		0.0	0^+		
9004.2 *5*	9004.7	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.45 *23*.
9013.5 *8*	9014.0		0.0	0^+		
9033.5 *8*	9034.0		0.0	0^+		
9043.1 *4*	9043.6	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.44 *6*.
9053.0 *7*	9053.5		0.0	0^+		
9084.6 *3*	9085.1	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.60 *9*.
9110.6 *6*	9111.1	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.64 *15*.
9123.1 *7*	9123.6		0.0	0^+		
9137.0 *7*	9137.5		0.0	0^+		
9148.0 *3*	9148.5	1^-	0.0	0^+	E1[§]	Iγ(90°)/Iγ(127°)=0.60 *4*.
9164.4 *7*	9164.9		0.0	0^+		
9177.0 *5*	9177.5		0.0	0^+		

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^{90}Zr(γ,γ') 2008Sc20,1984Be31,1974Me13 (continued)

γ(^{90}Zr) (continued)

E_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	Comments
9186 *3*	9187		0.0	0^+		
9196.0 *3*	9196.5	(1^-)	0.0	0^+	(E1)[§]	Iγ(90°)/Iγ(127°)=0.72 *7*.
9260.0 *6*	9260.5	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.67 *9*.
9292.3 *5*	9292.8	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.65 *7*.
9308.9 *7*	9309.4	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.71 *10*.
9332.9 *6*	9333.4	1^-	0.0	0^+	E1[§]	Iγ(90°)/Iγ(127°)=0.67 *10*.
9372.8 *7*	9373.2		0.0	0^+		
9391.9 *8*	9392.4	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.45 *13*.
9408.9 *11*	9409.4		0.0	0^+		
9423.8 *10*	9424.3		0.0	0^+		
9444.2 *4*	9444.7	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.65 *8*.
9464.6 *5*	9465.1	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.66 *11*.
9486.3 *4*	9486.8	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.75 *10*.
9510.0 *13*	9510.5	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.9 *4*.
9523.6 *13*	9524.1	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.47 *22*.
9538.7 *5*	9539.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.85 *13*.
9550.9 *6*	9551.4	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.47 *9*.
9562.5 *6*	9563.0	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.64 *17*.
9608.6 *7*	9609.2		0.0	0^+		
9624.5 *8*	9625.1		0.0	0^+		
9639.8 *8*	9640.4	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.6 *3*.
9665.4 *8*	9666.0	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.7 *3*.
9677.7 *7*	9678.3	(1^-)	0.0	0^+	(E1)[§]	Iγ(90°)/Iγ(127°)=0.67 *19*.
9686.3 *6*	9686.9	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.66 *17*.
9732.6 *5*	9733.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.5 *3*.
9741.1 *7*	9741.7		0.0	0^+		
9753.4 *6*	9754.0	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.5 *3*.
9784.0 *5*	9784.6		0.0	0^+		Iγ(90°)/Iγ(127°)=1.4 *3*.
9804.8 *10*	9805.4		0.0	0^+		Iγ(90°)/Iγ(127°)=1.6 *6*.
9842.8 *6*	9843.4	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.77 *16*.
9854.9 *8*	9855.5	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.55 *17*.
9871.8 *4*	9872.4	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.49 *12*.
9890.1 *13*	9890.7	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.7 *5*.
9901.3 *13*	9901.9		0.0	0^+		
9931.5 *12*	9932.1	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.43 *14*.
9962.2 *5*	9962.8	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.57 *14*.
9983.5 *11*	9984.1		0.0	0^+		
10003.6 *10*	10004.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.42 *19*.
10019.0 *11*	10019.6	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.65 *16*.
10030 *2*	10031		0.0	0^+		
10042.3 *4*	10042.9	(1^-)	0.0	0^+	(E1)[§]	Iγ(90°)/Iγ(127°)=0.70 *8*.
10083.2 *6*	10083.8	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.78 *13*.
10093.6 *7*	10094.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.74 *19*.
10104.3 *12*	10104.9	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.7 *3*.
10123.1 *18*	10123.7	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.5 *3*.
10146.2 *9*	10146.8	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.6 *3*.
10162.9 *8*	10163.4	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.50 *23*.
10192.4 *5*	10193.0	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.60 *12*.
10216.2 *10*	10216.8	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.57 *24*.
10232 *4*	10233		0.0	0^+		
10240 *2*	10241	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.9 *3*.
10260.3 *11*	10260.9		0.0	0^+		
10269.4 *7*	10270.0		0.0	0^+		

Continued on next page (footnotes at end of table)

^{90}Zr(γ,γ') 2008Sc20,1984Be31,1974Me13 (continued)

γ(^{90}Zr) (continued)

E_γ †	E_i(level)	J^π_i	E_f	J^π_f	Mult. ‡	Comments
10285.6 *6*	10286.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.64 *19*.
10297.7 *10*	10298.3	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.8 *3*.
10306.0 *9*	10306.6	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.71 *21*.
10314.5 *4*	10315.1	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.63 *12*.
10334.3 *6*	10334.9	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.68 *21*.
10360 *2*	10361	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.9 *3*.
10376.2 *4*	10376.8	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.46 *7*.
10401.9 *9*	10402.5	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.72 *14*.
10493.8 *11*	10494.5	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.7 *3*.
10507.2 *8*	10507.9	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.6 *3*.
10523.9 *4*	10524.6	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.72 *10*.
10594.3 *7*	10595.0	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.80 *19*.
10618.0 *8*	10618.7	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.74 *23*.
10637.8 *9*	10638.5	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.41 *20*.
10681.5 *6*	10682.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.54 *16*.
10712.5 *12*	10713.2	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.8 *4*.
10727.5 *11*	10728.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.67 *20*.
10826.4 *5*	10827.1	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.82 *15*.
10913 *2*	10914	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.79 *21*.
10956 *2*	10957	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.35 *8*.
10986.3 *10*	10987.0	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.66 *13*.
11043 *2*	11044		0.0	0^+		
11093.5 *15*	11094.2		0.0	0^+		
11107.3 *16*	11108.0		0.0	0^+		
11119.7 *9*	11120.4	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.60 *16*.
11128.5 *17*	11129.2		0.0	0^+		
11139 *2*	11140		0.0	0^+		
11231.6 *7*	11232.4	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.45 *14*.
11242.4 *6*	11243.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.58 *15*.
11336.9 *6*	11337.7	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.85 *13*.
11416.7 *7*	11417.5	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.8 *4*.
11451.4 *10*	11452.2	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.42 *12*.
11478.9 *8*	11479.7	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.58 *15*.
11500 *3*	11501		0.0	0^+		
11509 *7*	11510		0.0	0^+		
11530 *2*	11531	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.42 *25*.
11627.1 *9*	11627.9		0.0	0^+		
11650.7 *8*	11651.5	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=1.0 *3*.
11776.6 *10*	11777.4	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.46 *22*.
11787 *3*	11788	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.4 *3*.
11962.4 *18*	11963.3	(1)	0.0	0^+	(D)	Iγ(90°)/Iγ(127°)=0.8 *3*.
11983 *2*	11984	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.57 *18*.
12019.7 *8*	12020.6	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.67 *14*.
12066.9 *9*	12067.8	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.63 *17*.
12207.4 *12*	12208.3	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.40 *15*.
12242.7 *14*	12243.6	1	0.0	0^+	D	Iγ(90°)/Iγ(127°)=0.57 *19*.
12495.4 *18*	12496.3		0.0	0^+		
12879.3 *10*	12880.3		0.0	0^+		

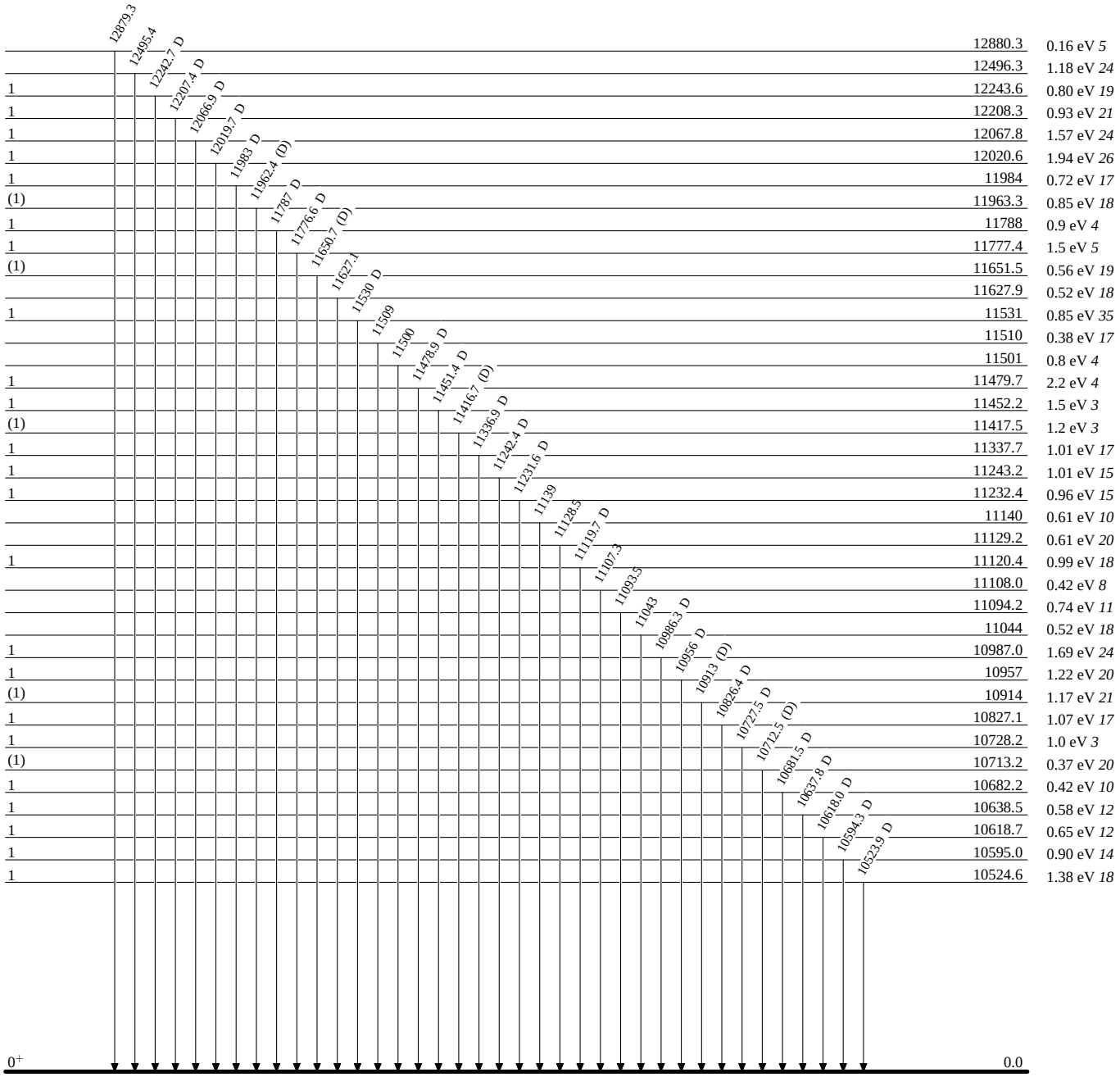
† Deduced by the evaluators from level energies given by 2008Sc20 and with recoil correction removed which varies from 1.0 keV at the highest of 12.9 MeV to 0.03 keV at 2.2 MeV excitation.

‡ From Iγ(90°)/Iγ(127°)ratios from 2008Sc20.

§ From measured asymmetry with polarized photons (1984Be31).

^{90}Zr(γ,γ′) 2008Sc20,1984Be31,1974Me13

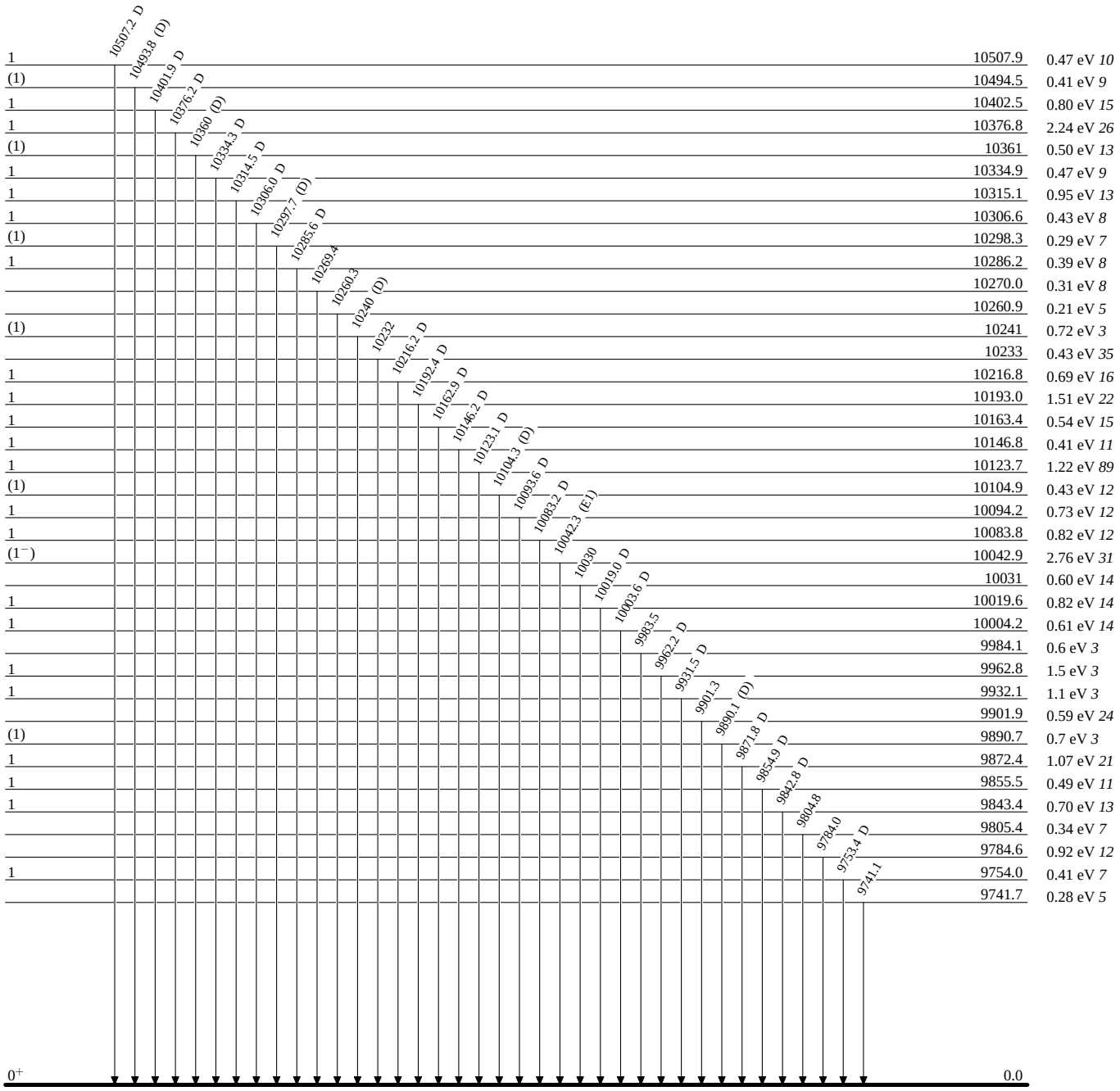
Level Scheme



$^{90}_{40}Zr_{50}$

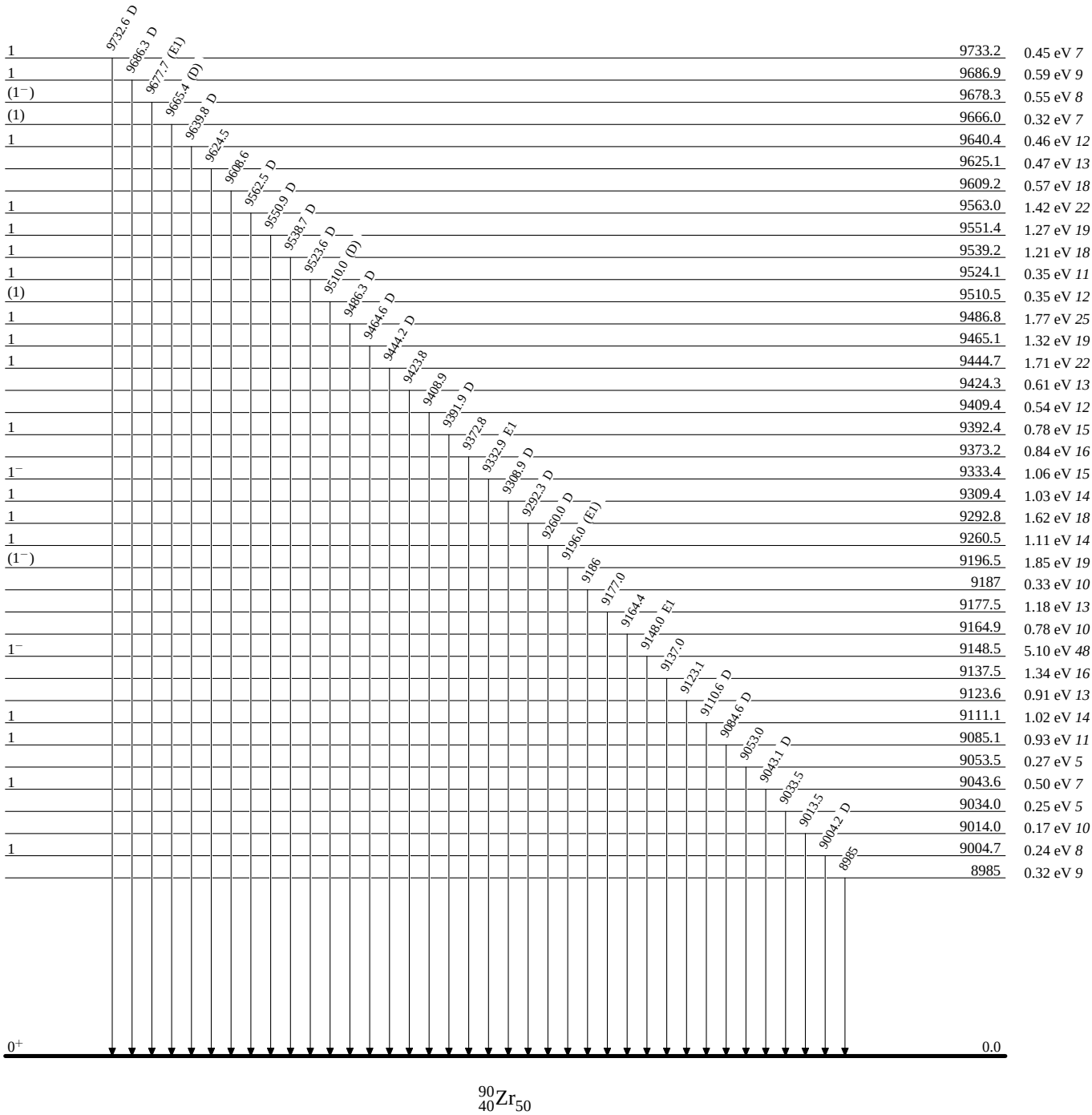
^{90}Zr(γ,γ′) 2008Sc20,1984Be31,1974Me13

Level Scheme (continued)



^{90}Zr(γ,γ′) 2008Sc20,1984Be31,1974Me13

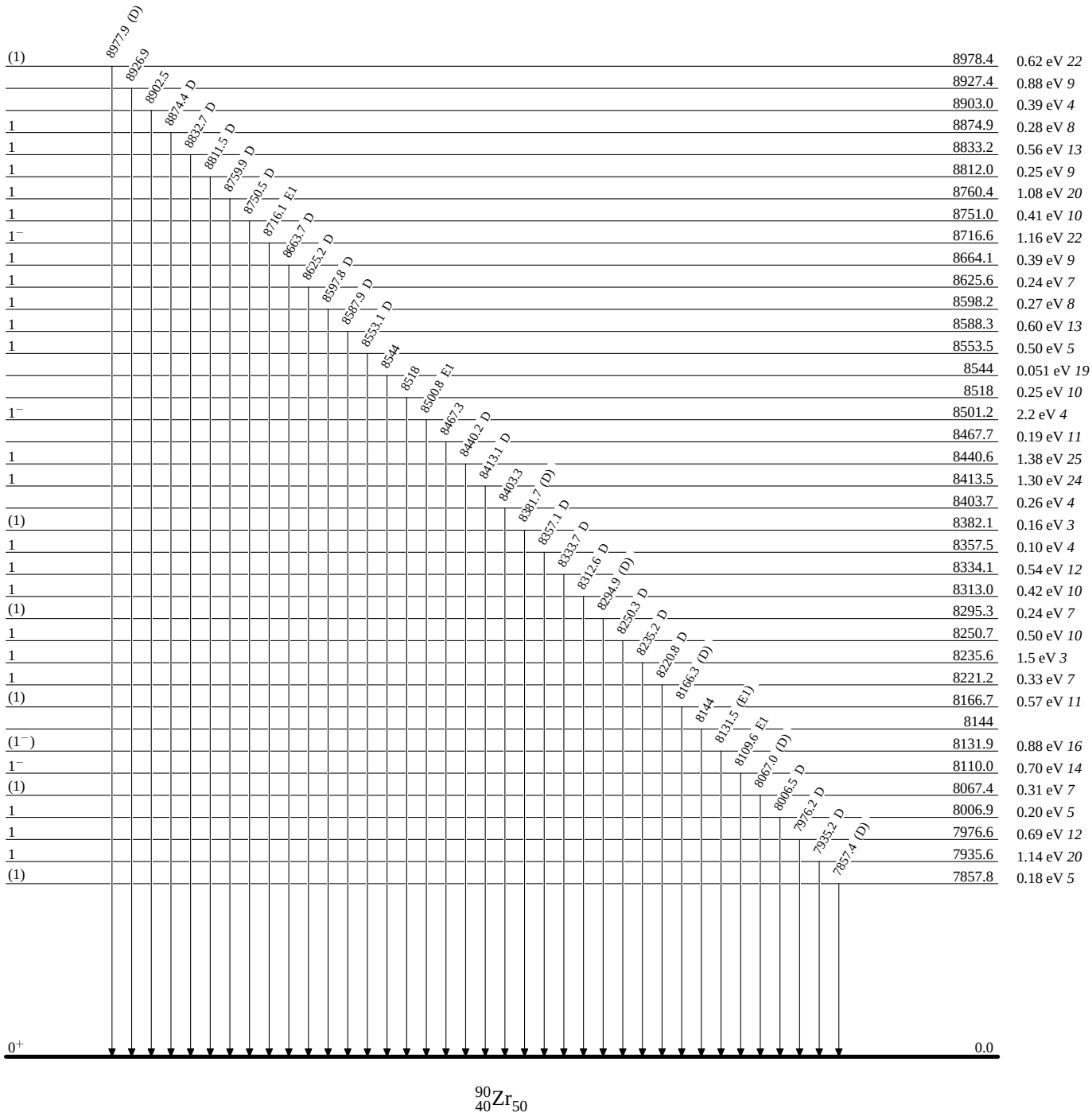
Level Scheme (continued)



$^{90}_{40}Zr_{50}$

^{90}Zr(γ,γ′) 2008Sc20,1984Be31,1974Me13

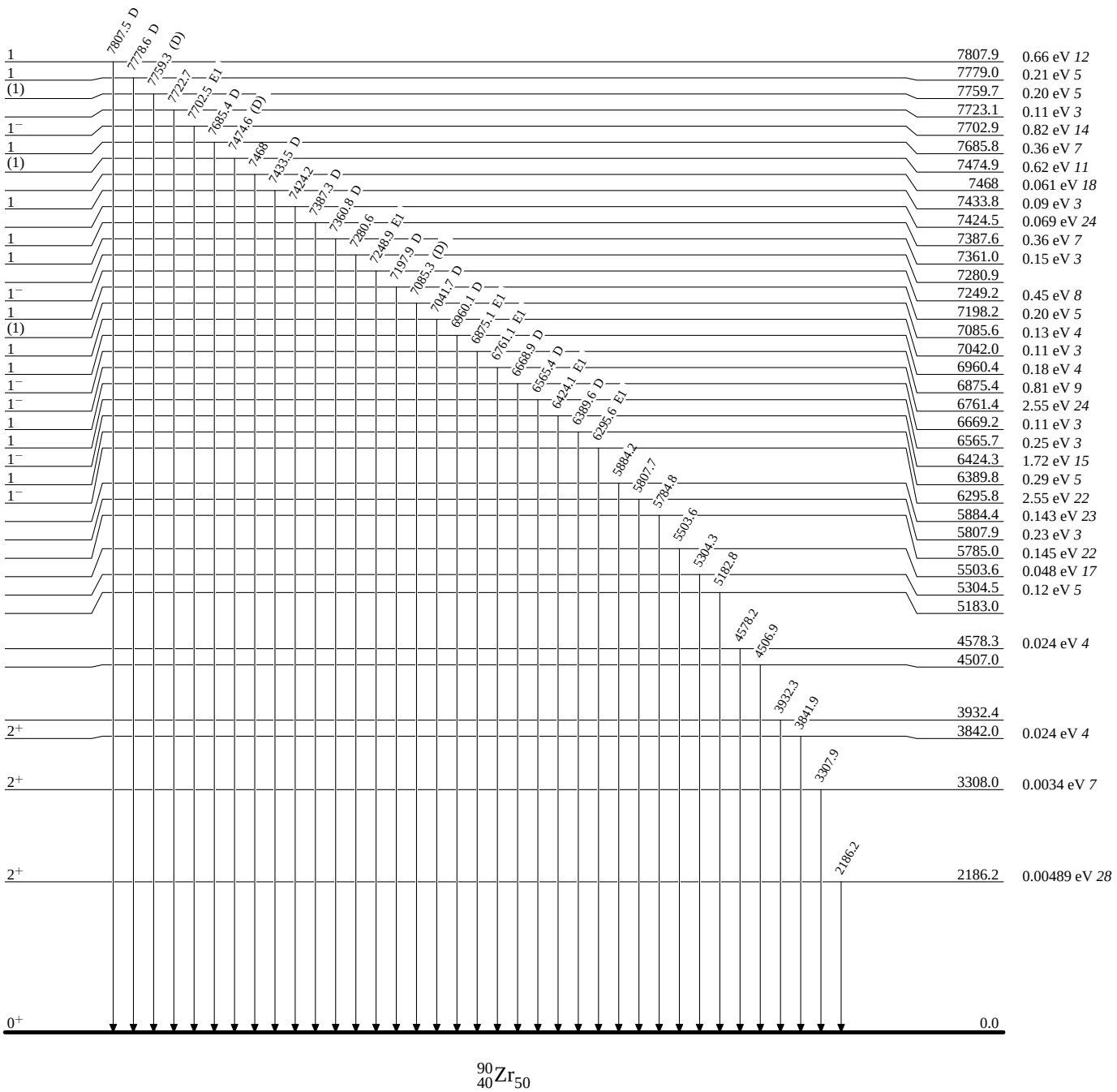
Level Scheme (continued)



$^{90}_{40}Zr_{50}$

^{90}Zr(γ,γ′) 2008Sc20,1984Be31,1974Me13

Level Scheme (continued)



$^{90}_{40}Zr_{50}$

^{90}Zr(γ,n) 1973As01

1973As01: Bremsstrahlung with endpoint energies of 20 and 24 MeV. Measured E(n), I(n), scin, enriched target.
Other: 1971Le28.

^{90}Zr Levels

E(level)
16200
17200
19400
20700
21800
23700

^{90}Zr(e,e′) 1975Si21,1980Me13,1984He02

1975Si21: E=53.75-112.2 MeV. Measured σ(E,θ), momentum transfer=0.29-1.07 fm^{-1}, FWHM≈0.15%, enriched target. DWBA analysis.

1980Me13: E=24-66 MeV. Measured σ(E,θ), momentum transfer=0.20-0.62 fm^{-1}, FWHM≈30 keV, enriched target. DWBA analysis.

1984He02: E=70-368 MeV. Measured σ(E,θ), momentum transfer=0.4-3.1 fm^{-1}, FWHM<40 keV, enriched target. DWBA analysis.

Others: 1983Sc01, 1982Sc08, 1982Fa11, 1974Si01, 1973Ph02, 1991Ta23, 1970Be07.

The radius of the g(9/2) proton orbit was determined from the density of the 3589, 8$^+$ level as R=5.04 fm *5* (1984He02).

Configuration assignments are from 1984He02.

For summed M1 and M2 strength in the region 8-10 MeV, see 1980Me13.

For deformation parameters, see 1975Si21.

^{90}Zr Levels

E(level)[†]	J$^\pi$[#]	Comments
0		
2180 *13*	2$^+$	B(E2)↑=0.0653 *21* (1984He02); Configuration=(π 1g$_{9/2}$)$^{+2}$ B(E2)↑: Other: 0.067 *6* (1975Si21).
2310 *11*	5$^-$	
2738 *15*	3$^-$	B(E3)↑=0.087 *10* (1975Si21)
3060 *15*	4$^+$	Configuration=(π 1g$_{9/2}$)$^{+2}$ B(E4)↑: Other: 0.0030 *9* (1975Si21).
3290 *25*	2$^+$	B(E2)↑=0.0078 *8* (1984He02); Configuration=(π 1g$_{9/2}$0$^+$)(CORE 2$^+$)
3456[‡]	6$^+$	Configuration=(π 1g$_{9/2}$)$^{+2}$
3589[‡]	8$^+$	Configuration=(π 1g$_{9/2}$)$^{+2}$
3835 *14*	2$^+$	B(E2)↑=0.0224 *13* (1984He02); Configuration=(π 1g$_{9/2}$2$^+$)(CORE 2$^+$)
3955 *23*	5$^-$	
4067 *22*	(4$^+$)	Configuration=(π 1g$_{9/2}$2$^+$)(CORE 2$^+$)
4223[‡] *2*	(2$^+$)	
4228[‡] *2*	(4$^-$)	
4231[‡] *2*	(6$^-$)	
4334[‡] *2*	4$^+$	Configuration=((ν 2d$_{5/2}$)(ν 1g$_{9/2}$)$^{-1}$)
4460[‡]	(5$^+$)	Configuration=((ν d$_{5/2}$)(ν 1g$_{9/2}$)$^{-1}$)
4471 *12*	4$^+$	
4542[‡]	6$^-$	Configuration=((π 1g$_{9/2}$)(π 2p$_{3/2}$)$^{-1}$)
4548[‡] *4*	6$^+$	Configuration=((ν 2d$_{5/2}$)(ν 1g$_{9/2}$)$^{-1}$)
4690[‡]	2$^+$	Configuration=(π 1g$_{9/2}$0$^+$)(CORE 2$^+$)
5061[‡]	7$^+$	Configuration=((ν 2d$_{5/2}$)(ν 1g$_{9/2}$)$^{-1}$)
5070[‡]	(2$^+$)	Configuration=(π 1g$_{9/2}$0$^+$)(CORE 2$^+$)
5620 *20*	3$^-$	B(E3)↑=0.0068 *10* (1975Si21)
5770 *32*	3$^-$	B(E3)↑=0.00145 *22* (1975Si21)
7774 *10*	(1$^+$,2$^-$)	
7806 *10*	(2$^-$)	
7868 *10*	(1$^+$,2$^-$)	
7907 *10*		
7996 *10*	(3$^-$)	
8032 *10*	2$^-$	
8113 *10*	1$^-$,(2$^-$)	
8142 *10*	1$^+$,(2$^-$)	
8233 *10*	1$^+$	
8291 *10*	2$^-$	
8316 *10*	(2$^-$)	
8366 *10*	(1$^+$)	
8400 *10*	(2$^-$)	

Continued on next page (footnotes at end of table)

^{90}Zr(e,e′) 1975Si21,1980Me13,1984He02 (continued)

^{90}Zr Levels (continued)

E(level)†	J^{π}#	E(level)†	J^{π}#	E(level)†	J^{π}#	E(level)†	J^{π}#
8442 *10*	2^-	8853 *10*	2^-	9101 *10*	2^-	9439 *10*	$1^+,(2^-)$
8494 *10*	$1^-,(2^-)$	8882 *10*	2^-	9127 *10*	2^-	9489 *10*	2^-
8542 *10*	2^-	8911 *10*	2^-	9150 *10*	$1^-,(2^-)$	9520 *10*	$(1^+,2^-)$
8602 *10*	(1^+)	8934 *10*	2^-	9265 *10*	2^-	9541 *10*	2^-
8627 *10*	2^-	8971 *10*	2^-	9294 *10*	2^-	9601 *10*	$(1^-,2^-)$
8701 *10*	(2^-)	9000 *10*	1^+	9327 *10*	2^-	9694 *10*	2^-
8809 *10*	(2^-)	9061 *10*	2^-	9371 *10*	1^+	9863 *10*	$(1^-,2^-)$

† Data are from 1975Si21 for levels up to 6 MeV and from 1980Me13 for levels above 6 MeV, except where noted. ΔE as stated by 1980Me13, is 3-10 keV for levels above 6 MeV.

‡ From 1984He02.

As given by the authors, derived from a combination of literature and DWBA analysis by 1975Si21,1984He02, and from DWBA analysis by 1980Me13.

^{90}Zr(e,e′p),(γ,p) 1973As01,1974Sh05

1974Sh05: E=14-30 MeV. Measured σ(E,E(p),θ), deduced Γ_γ, magnetic spectrometer, FWHM≈100 keV, enriched target.
1973As01: Bremsstrahlung with endpoint energy of 30.5 MeV. Measured E(p), I(p), semi, FWHM=60 keV, enriched target.
For Γ_γ of resonances, see 1974Sh05, 1983Do06.
Data are from 1973As01, except as noted.

^{90}Zr Levels

E(level)	Comments
14300	
16200	
17200	
19400†	
21000†	E(level): From 1974Sh05.

† Broad resonance corresponding to a coherent state (1974Sh05).

^{90}Zr(n,n′) 1975Gu20,1990Wa13

1975Gu20: E=1.8-4.0 MeV. Measured σ(E,θ), neutron time-of-flight, enriched target.

1990Wa13: E=8.0, 10.0, 24.0 MeV. Measured σ(E,θ), neutron time-of-flight, FWHM=135, 188 and 410 keV for the three energies respectively, enriched target.

Others: 1972Le05, 1977Ba38, 1978Ba60, 1980Fi08, 1988Wa27, 1993Ji01.

For discussion of isotopic decomposition of matrix elements, see 1988Wa27, 1990Wa13.

^{90}Zr Levels

E(level)†	L‡	β_LR‡
0		
1749 *15*		
2169 *15*	2	0.44 *3*
2306 *20*	5	0.42 *4*
2732 *20*	3	0.86 *5*
3068 *20*		
3300 *20*		

† From 1975Gu20.
‡ From 1990Wa13.

^{90}Zr(n,n′γ) 2003Ga23

2003Ga23: Neutrons from spallation reaction with the maximum energy of the "WHITE" neutron spectrum up to 800 MeV. For accelerator produced neutrons, E(n)≈5.5 and ≈9 MeV. Measured Eγ, Iγ, γγ, γ(θ), excitation functions, lifetimes by Doppler-shift attenuation method (DSAM) using the GEANIE detector array consisting of 11 planars and 15 HPGe detectors, nine of the HPGe detectors had BGO suppression shields.

2013Pe16: E(n) = 2.5 and 3.5 MeVn on natural Zr target; measured lifetimes of first and second 2^+ levels in ^{90}Zr by Doppler-shift attenuation method (DSAM); used ZR metal and oxide targets of natural isotopic abundance.

1971Gl11: E(n)=2.85-5.97 MeV, enriched target, semi. Measured Eγ, Iγ.

1963Sc14: Be(d,n) source, natural target, scin. Measured Eγ, Iγ, $T_{1/2}$.

Others: 1959Kl46, 1963Wa08, 1972Br53.

^{90}Zr Levels

E(level)†	J^{π}‡	$T_{1/2}$#	Comments
0.0	0^+		
1760.61 *9*	0^+	62 ns *4*	$T_{1/2}$: from 1959Kl46.
2186.21 *6*	2^+	86.6 fs *+49−42*	$T_{1/2}$: from DSAM (2013Pe13). Value is the average of half-lives obtained from the metal and oxide scattering samples.
2318.96 *6*	5^-	809.2 ms *20*	$T_{1/2}$: from 1972Br53. Other: 801 ms *5* (1963Wa08).
2739.27 *8*	4^-		
2747.60 *6*	3^-		
3076.79 *7*	4^+		
3308.10 *8*	2^+	67.9 fs *+42−35*	$T_{1/2}$: from DSAM (2013Pe16); measurement with metallic sample.
3448.14 *10*	6^+	>1.46 ps	
3589.29 *12*	8^+		
3842.27 *13*	2^+	24 fs *5*	
3958.59 *10*	5^-	33 fs *6*	
4058.07 *9*	4^+	0.12 ps *+6−4*	J^{π}: shape of excitation function consistent with J=4 (2003Ga23).
4124.49 *14*	0^+		
4225.35 *12*	4^-	20 fs *5*	
4229.05 *9*	2^+	27 fs *3*	
4231.93 *13*	(6^-)	45 fs *+37−19*	
4236.96 *10*	$(1,2^+)$	104 fs *21*	
4262.37 *8*	3^+	0.28 ps *+13−7*	J^{π}: shape of excitation function consistent with J=3 (2003Ga23).
4299.12 *11*	(5^-)	31 fs *6*	J^{π}: shape of excitation function consistent with J=4 or 5 (2003Ga23).
4331.93 *9*	4^+	37 fs *6*	
4348.10 *13*	(4^+)	29 fs *7*	$T_{1/2}$: likely contamination of the 2161.9γ from ^{209}Bi makes the lifetime derived from DSAM using this transition suspect (2003Ga23). J^{π}: shape of excitation function consistent with J=4 (2003Ga23).
4374.76 *14*	7^-		
4426.43 *13*	0^+	0.20 ps *+24−8*	
4454.71 *10*	(5^+)		J^{π}: shape of excitation function consistent with J=4 or 5 (2003Ga23).
4455.58 *10*	$2^{(-)}$	0.14 ps *+5−3*	J^{π}: shape of excitation function consistent with J=2 or 3 (2003Ga23).
4474.31 *14*	4^+	0.15 ps *+18−6*	
4494.79 *12*	3^-	42 fs *8*	
4533.52 *10*	3^-	69 fs *+35−28*	J^{π}: shape of excitation function consistent with J=3 (2003Ga23).
4537.70 *11*	$4^{(-)}$	0.13 ps *+7−5*	J^{π}: shape of excitation function consistent with J=4 (2003Ga23).
4541.37 *12*	6^+	59 fs *+17−12*	
4562.02 *14*	5	0.14 ps *+10−4*	J^{π}: shape of excitation function consistent with J=5 (2003Ga23).
4578.93 *13*	$1^{(+)}$	5.1 fs *20*	
4591.37 *10*	3^+	0.14 ps *+4−3*	J^{π}: shape of excitation function consistent with J=3 (2003Ga23).
4614.42 *13*	6^+		J^{π}: shape of excitation function consistent with J=6 (2003Ga23).
4640.58 *17*	7,8		
4646.7 *3*	$1,2^+$	5 fs *4*	
4681.26 *12*	2^+	31 fs *7*	
4701.10 *10*	2^+	46 fs *7*	

Continued on next page (footnotes at end of table)

^{90}Zr(n,n′γ) 2003Ga23 (continued)

^{90}Zr Levels (continued)

E(level)†	Jπ‡	$T_{1/2}$#	Comments
4774.29 *13*	(1,2)+		
4781.81 *20*	4,(3−)	14 fs *+22−13*	Jπ: shape of excitation function consistent with J=3 or 4 (2003Ga23).
4795.6 *3*	2+	7 fs *+6−3*	
4814.44 *11*	3−		
4818.02 *12*	3,4+	0.14 ps *+19−7*	Jπ: shape of excitation function consistent with J=3 or 4 (2003Ga23).
4824.21 *13*	2+	40 fs *+10−8*	
4840.27 *14*	5−	83 fs *+28−14*	Jπ: shape of excitation function consistent with J=5 (2003Ga23).
4867.47 *12*	5+	0.14 ps *+5−4*	Jπ: shape of excitation function consistent with J=5 (2003Ga23).
4932.6 *4*	1,2+	0.18 ps *+35−11*	$T_{1/2}$: positive part of the uncertainty is missing in Table II of 2003Ga23; estimated here from listed uncertainties for F(τ) value.
4941.89 *13*	4+	49 fs *10*	
4992.36 *12*	2−	0.21 ps *+13−6*	
5060.85 *17*	7+		
5068.6 *6*	1−	7 fs *+13−6*	
5084.03 *14*	2(−),3(−)	46 fs *+12−10*	Jπ: shape of excitation function consistent with J=2 or 3 (2003Ga23).
5090.30 *23*	(3−)		Jπ: shape of excitation function consistent with J=3 (2003Ga23).
5107.92 *21*	(3),4+	0.07 ps *+4−3*	
5112.6 *14*	3−		
5171.90 *16*	(4)	23 fs *+8−6*	Jπ: shape of excitation function consistent with J=4 (2003Ga23).
5175.8 *3*	3,4+	22 fs *+21−8*	Jπ: shape of excitation function consistent with J=3 or 4 (2003Ga23).
5183.61 *18*	1+,2+	6.9 fs *35*	
5222.97 *23*	4+		
5232.3 *3*	3,4+	34.0 fs *28*	
5270.74 *20*	3,4	17 fs *+53−16*	
5305.97 *20*	2+	17 fs *5*	
5307.75 *15*	3−,4+	0.07 ps *+8−2*	
5312.77 *20*	1,(2+)	59 fs *10*	
5317.7 *3*	3−	0.19 ps *+11−6*	
5359.22 *19*	3+,4	22.9 fs *28*	Jπ: shape of excitation function consistent with J=3 or 4 (2003Ga23).
5379.8 *3*	4+	20 fs *4*	
5426.01 *13*	3−	52 fs *+19−14*	
5437.33 *13*	2+	24.3 fs *35*	
5457.70 *18*	4+	115.9 fs *28*	
5504.75 *19*	1−	7.7 fs *7*	
5513.41 *16*	(3,4)	0.16 ps *+8−6*	
5564.2 *4*	2,3,4	7.6 fs *28*	
5590.58 *14*	2+	15.9 fs *21*	
5601.8 *4*	3,4+	24 fs *4*	
5607.6 *4*	3,4+	14 fs *+9−7*	
5651.1 *3*		45 fs *5*	
5724.3 *4*		22 fs *4*	
5775.1 *5*		24 fs *+21−6*	
5821.8 *6*			
5846.4 *5*		14 fs *+44−13*	

† From least-squares fit to Eγ′s; systematic uncertainty of 0.1 keV for each γ ray was added in quadrature in this procedure.
‡ As proposed by 2003Ga23 based on γ(θ), excitation functions and decay pattern.
# From DSAM measurements (2003Ga23), except where noted.

^{90}Zr(n,n′γ) 2003Ga23 (continued)

γ(^{90}Zr)

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[&]	δ[@]	Comments
1760.61	0^+	1760.70 *20*		0.0	0^+	E0		E_γ,Mult.: from the Adopted Levels.
2186.21	2^+	2186.224 *23*	100	0.0	0^+	Q		A_2=+0.20 *2*
2318.96	5^-	132.716 *18*		2186.21	2^+			α(K)exp=2.2 *3* (1963Sc14) Mult.: from α(K)exp.
		2318.96 *3*		0.0	0^+			
2739.27	4^-	420.321 *13*	100	2318.96	5^-	D		A_2=+0.05 *2*
2747.60	3^-	429.0 *3*	0.5 *1*	2318.96	5^-			
		561.3 *1*	93.8 *3*	2186.21	2^+	D		A_2=−0.06 *1*
		2747.47 *5*	5.7 *3*	0.0	0^+	O		A_2=+0.55 *8*
3076.79	4^+	329.125 *15*	6.0 *3*	2747.60	3^-	D		A_2=−0.05 *6*
		337.8 *2*	0.8 *1*	2739.27	4^-			
		757.80 *4*	2.5 *1*	2318.96	5^-			
		890.629 *14*	90.7 *3*	2186.21	2^+	Q		A_2=+0.40 *3*
3308.10	2^+	1121.990 *22*	30 *3*	2186.21	2^+	D+Q	+0.25	A_2=+0.31 *6* δ: other: +1.3.
		1547.5[§]	2.6 *7*	1760.61	0^+			
		3308.1 *2*	67 *3*	0.0	0^+	Q		A_2=+0.29 *3*
3448.14	6^+	1129.113 *17*	100	2318.96	5^-	D		A_2=+0.0 *1*
3589.29	8^+	141.178 *15*		3448.14	6^+			
		1270.16 *16*		2318.96	5^-			
3842.27	2^+	1656.05 *11*	14.5 *13*	2186.21	2^+	D+Q	+1.1	A_2=+0.43 *7* δ: other: +0.3.
		3842.2 *4*	85.5 *13*	0.0	0^+	Q		A_2=+0.38 *2*
3958.59	5^-	1219.33 *3*	35.0 *8*	2739.27	4^-	D+Q	+0.08	A_2=−0.16 *7*
		1639.60 *4*	65.0 *8*	2318.96	5^-	D+Q	+0.06	A_2=+0.48 *4*
4058.07	4^+	981.31 *7*	6.8 *13*	3076.79	4^+	D+Q	−0.11	A_2=+0.31 *23*
		1310.00 *18*	3.7 *12*	2747.60	3^-			
		1318.92 *19*	2.1 *11*	2739.27	4^-			
		1871.90 *3*	87 *3*	2186.21	2^+	Q		A_2=+0.46 *5*
4124.49	0^+	1938.26 *6*	100	2186.21	2^+			
4225.35	4^-	1478.02 *16*	15 *3*	2747.60	3^-			
		1485.75 *14*	67 *3*	2739.27	4^-	D+Q	+0.31	A_2=+0.54 *5*
		1906.50 *17*	18 *4*	2318.96	5^-	D+Q	−0.57	A_2=+0.43 *14*
4229.05	2^+	1481.40 *6*	34 *8*	2747.60	3^-			
		2042.73 *4*	52 *6*	2186.21	2^+	D+Q	+0.04	A_2=+0.30 *8* δ: other: +2.0.
		4229.3 *2*	14.5 *24*	0.0	0^+	Q		A_2=+0.47 *7*
4231.93	(6^-)	1912.94 *4*	100	2318.96	5^-	D+Q	+0.5	A_2=+0.50 *25*
4236.96	$(1,2^+)$	929.01 *18*	5.7 *2*	3308.10	2^+			
		2050.81 *9*	19.8 *35*	2186.21	2^+			
		2476.22 *4*	74.4 *35*	1760.61	0^+			
4262.37	3^+	954.2 *1*	6.9 *6*	3308.10	2^+	D+Q	+0.06	A_2=−0.20 *13*
		1185.56 *5*	14.1 *15*	3076.79	4^+	D+Q	−3.1	A_2=+0.11 *20* δ: other: −0.2.
		1514.8 *1*	14.8 *25*	2747.60	3^-			A_2=+0.38 *14*
		1523.07 *4*	29.4 *7*	2739.27	4^-			A_2=−0.01 *11*
		2076.20 *4*	34.7 *16*	2186.21	2^+	D+Q	+0.6	A_2=+0.44 *10*
4299.12	(5^-)	1559.91 *7*	33.5 *11*	2739.27	4^-	D+Q	+0.34	A_2=+0.30 *9*
		1980.06 *8*	66.5 *11*	2318.96	5^-	D+Q	+0.85	A_2=+0.40 *7*
4331.93	4^+	1255.18 *3*	38.2 *11*	3076.79	4^+	D+Q	+0.1	A_2=+0.48 *4*
		1584.25 *4*	51.3 *14*	2747.60	3^-			A_2=−0.08 *5*
		2012.9 *2*	10.5 *20*	2318.96	5^-			
4348.10	(4^+)	1608.8[§]		2739.27	4^-			placement from γγ coin.
		2161.87 *3*	100	2186.21	2^+			A_2=−0.12 *5*

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^{90}Zr(n,n′γ) 2003Ga23 (continued)

γ(^{90}Zr) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[&]	δ[@]	Comments
								A_2 likely has contamination from ^{209}Bi (2003Ga23).
4374.76	7⁻	2055.77 *7*	100	2318.96	5⁻	Q		A_2=+0.31 *19*
4426.43	0⁺	2240.20 *5*	100	2186.21	2⁺			A_2=0.00 *7*
4454.71	(5⁺)	1377.74 *12*	11.9 *22*	3076.79	4⁺			
		1715.73 *14*	13.8 *50*	2739.27	4⁻			
		2135.70 *5*	74.3 *51*	2318.96	5⁻			A_2=+0.53 *10*
4455.58	2⁽⁻⁾	1707.90 *5*	42.7 *25*	2747.60	3⁻	D+Q	+0.024	A_2=−0.10 *7*
		2269.40 *4*	57.3 *25*	2186.21	2⁺			A_2=+0.32 *9*
4474.31	4⁺	1726.68 *7*	71.3 *33*	2747.60	3⁻			
		1735.0[§]	28.7 *33*	2739.27	4⁻			
4494.79	3⁻	1747.2 *2*	4.7 *30*	2747.60	3⁻			
		1755.49 *4*	95.3 *30*	2739.27	4⁻	D+Q	−0.02	A_2=−0.08 *3* δ: other: −6.4.
4533.52	3⁻	1225.3[#] *2*	10.4 *13*	3308.10	2⁺			
		1456.78 *4*	58.9 *62*	3076.79	4⁺			A_2=+0.54 *11*
		1794.15 *6*	22.7 *23*	2739.27	4⁻	D+Q	+2.0	A_2=+0.12 *9* δ: other: −0.4.
		2347.3[§]	8.0 *22*	2186.21	2⁺			
4537.70	4⁽⁻⁾	1460.95 *6*	38.5 *35*	3076.79	4⁺			
		2218.65 *7*	61.5 *35*	2318.96	5⁻	D+Q	−0.36	A_2=+0.3 *3* δ: other: −1.8.
4541.37	6⁺	1092.97 *23*	7.5 *20*	3448.14	6⁺			
		2222.43 *4*	92.5 *20*	2318.96	5⁻			
4562.02	5	1822.74 *5*	100	2739.27	4⁻			
4578.93	1⁽⁺⁾	2818.33 *10*	54.5 *44*	1760.61	0⁺			
		4578.7 *2*	45.5 *44*	0.0	0⁺			A_2=−0.01 *7*
4591.37	3⁺	1843.70 *5*	73.2 *9*	2747.60	3⁻			A_2=+0.43 *6*
		2405.18 *7*	26.8 *9*	2186.21	2⁺	D+Q	−0.07	A_2=−0.38 *7*
4614.42	6⁺	1166.24 *12*	40 *4*	3448.14	6⁺			
		1537.64 *12*	30 *4*	3076.79	4⁺			
		2295.5[§]	30 *3*	2318.96	5⁻			
4640.58	7,8	1051.29 *4*	100	3589.29	8⁺			
4646.7	1,2⁺	2884.8 *13*	84.5 *24*	1760.61	0⁺			
		4646.6 *3*	15.5 *24*	0.0	0⁺			
4681.26	2⁺	1933.77 *8*	50 *5*	2747.60	3⁻			
		2495.1[§]	21 *3*	2186.21	2⁺			
		4680.8 *2*	29 *4*	0.0	0⁺	Q		A_2=+0.51 *7*
4701.10	2⁺	1953.26 *17*	39.6 *18*	2747.60	3⁻			
		2514.76 *13*	15.4 *11*	2186.21	2⁺			
		2940.60 *12*	37.6 *17*	1760.61	0⁺	Q		A_2=+0.51 *11*
		4701.2 *3*	7.4 *16*	0.0	0⁺	Q		A_2=+0.7 *4*
4774.29	(1,2)⁺	537.34 *5*	25.4 *24*	4236.96	(1,2⁺)			
		2587.96 *25*	74.6 *24*	2186.21	2⁺			
4781.81	4,(3⁻)	2462.81 *19*	100	2318.96	5⁻			
4795.6	2⁺	4795.5 *3*	100	0.0	0⁺	Q		A_2=+0.5 *3*
4814.44	3⁻	2066.95 *8*	76 *5*	2747.60	3⁻	D+Q	+0.34	A_2=+0.7 *3*
		2495.5[§]	12.0 *23*	2318.96	5⁻			
		2628.01 *10*	12.5 *24*	2186.21	2⁺			A_2=−0.02 *9*
4818.02	3,4⁺	975.75 *15*	14 *3*	3842.27	2⁺			
		2070.39 *7*	86 *3*	2747.60	3⁻			
4824.21	2⁺	1747.2 *2*	6 *4*	3076.79	4⁺			

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^{90}Zr(n,n′γ) 2003Ga23 (continued)

γ(^{90}Zr) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[&]	δ[@]	Comments
4824.21	2+	2638.07 *11*	80 *4*	2186.21	2+	D+Q	+0.11	A_2=+0.34 *6* δ: other: +1.7.
		4823.9 *5*	13.9 *25*	0.0	0+	Q		A_2=+0.75 *14*
4840.27	5−	1763.46 *6*	70 *4*	3076.79	4+			
		2092.7[§]	30 *4*	2747.60	3−			
4867.47	5+	1419.23 *10*	31 *3*	3448.14	6+	D+Q	−1.0	A_2=+0.58 *14*
		1790.73 *8*	59 *5*	3076.79	4+	D+Q	+0.8	A_2=+0.75 *16*
		2128.2[§]	10 *4*	2739.27	4−			
4932.6	1,2+	4932.5 *4*	100	0.0	0+			
4941.89	4+	1865.03 *8*	75.7 *24*	3076.79	4+			
		2623.0 *2*	24.3 *24*	2318.96	5−			
4992.36	2−	1150.3[§]	16.6 *17*	3842.27	2+			
		1684.35 *8*	55 *3*	3308.10	2+			A_2=+0.35 *7*
		2244.5 *3*	17.2 *17*	2747.60	3−			
		2252.9 *2*	10.8 *16*	2739.27	4−			
5060.85	7+	1612.69 *11*	100	3448.14	6+			
5068.6	1−	5068.4 *6*	100	0.0	0+			
5084.03	2(−),3(−)	2336.18 *10*	73 *5*	2747.60	3−			
		2345.7 *3*	27 *5*	2739.27	4−			
5090.30	(3−)	2904.03 *23*	100	2186.21	2+			
5107.92	(3),4+	2368.6[§]		2739.27	4−			
		2921.7 *2*	100	2186.21	2+			A_2=+0.51 *14*
5112.6	3−	2365.0 *10*	100	2747.60	3−	D+Q	−0.1	A_2=+0.25 *11* E_γ: from γγ coin spectra.
5171.90	(4)	2432.0 *3*	36 *3*	2739.27	4−			A_2=+0.6 *3*
		2853.06 *14*	64 *3*	2318.96	5−			
5175.8	3,4+	2989.5 *3*	100	2186.21	2+			
5183.61	1+,2+	2997.5 *2*	46 *7*	2186.21	2+			
		5183.2 *3*	54 *7*	0.0	0+			
5222.97	4+	2483.67 *19*	100	2739.27	4−			A_2=+0.41 *23*
5232.3	3,4+	3046.0 *3*	100	2186.21	2+			
5270.74	3,4	2531.44 *16*	100	2739.27	4−			
5305.97	2+	5305.8 *2*	100	0.0	0+	Q		A_2=+0.26 *19*
5307.75	3−,4+	2560.2 *4*	10 *4*	2747.60	3−			
		2988.9 *2*	15 *3*	2318.96	5−			
		3121.3 *2*	75 *5*	2186.21	2+			
5312.77	1,(2+)	3551.4[#] *6*		1760.61	0+			
		5312.6 *2*	100	0.0	0+			
5317.7	3−	2570.2 *4*	58 *7*	2747.60	3−			
		3131.2 *4*	42 *7*	2186.21	2+			
5359.22	3+,4	2282.4 *2*	100	3076.79	4+			A_2=+0.34 *13*
5379.8	4+	3193.6 *3*	100	2186.21	2+			
5426.01	3−	2118.1 *2*	48.2 *86*	3308.10	2+			
		3106.8 *2*	38.4 *66*	2318.96	5−	Q		A_2=+0.7 *4*
		3239.7 *2*	13.3 *28*	2186.21	2+			
5437.33	2+	2690.08 *23*	61.8 *20*	2747.60	3−			A_2=−0.14 *14*
		3676.6 *2*	21.0 *17*	1760.61	0+	Q		A_2=+0.48 *23*
		5436.9 *2*	18.0 *11*	0.0	0+	Q		A_2=+0.47 *19*
5457.70	4+	2380.6 *3*	34 *11*	3076.79	4+			
		2710.2 *2*	66 *11*	2747.60	3−			A_2=−0.43 *12*
5504.75	1−	3744.5 *5*	57 *3*	1760.61	0+			
		5504.5 *2*	43 *3*	0.0	0+			
5513.41	(3,4)	2436.5 *3*	34 *8*	3076.79	4+			A_2=−0.21 *16*

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^{90}Zr(n,n′γ) 2003Ga23 (continued)

γ(^{90}Zr) (continued)

E_i(level)	J^π_i	E_γ †	I_γ ‡	E_f	J^π_f	Mult. &	Comments
5513.41	(3,4)	2765.8 *2*	64 *8*	2747.60	3^-		
5564.2	2,3,4	3377.9 *4*	100	2186.21	2^+		
5590.58	2^+	2842.9 *2*	18.1 *30*	2747.60	3^-		
		3404.1 *2*	52.3 *24*	2186.21	2^+		
		5590.9 *3*	29.7 *17*	0.0	0^+	Q	A_2=+0.55 *14*
5601.8	$3,4^+$	3415.5 *4*	100	2186.21	2^+		A_2=+0.5 *3*
5607.6	$3,4^+$	2299.5 *3*	100	3308.10	2^+		
5651.1		2911.8 *3*	100	2739.27	4^-		A_2=+0.25 *18*
5724.3		3538.0 *4*	100	2186.21	2^+		A_2=−0.22 *15*
5775.1		3588.8 *5*	100	2186.21	2^+		
5821.8		3635.5 *6*	100	2186.21	2^+		
5846.4		3660.1 *5*	100	2186.21	2^+		

† From 2003Ga23, except where noted.
‡ From 2003Ga23, except where noted. Values are relative branching from each level.
§ From level energy difference. 2003Ga23 state that peak in singles spectrum was either component of unresolved doublet or heavily influenced by background.
& From γ(θ) in 2003Ga23, except where noted.
@ From γ(θ) in 2003Ga23. The value with smaller χ^2 is listed in the data field while the value with larger χ^2 is given in the comments.
# Placement of transition in the level scheme is uncertain.

^{90}Zr(p,p′) 1983Va03,1981Fu01

1983Va03: E=25.05 MeV. Measured $\sigma(\theta$,E(p′)), magnetic spectrograph, FWHM=12-16 keV, θ=9° to 107°, enriched target.
1981Fu01: E=65 MeV. Measured $\sigma(\theta$,E(p′)), magnetic spectrograph, FWHM=15 keV, θ=10°−63°, enriched target.
For other measurements of deformation parameters, see 1990Wa13, 1981Fu01, 1973Hi04, 1968Di05, 1967Ma14.
Data are from 1983Va03 for levels below 6250 keV, from 1981Fu01 for levels above 6250 keV, except as noted.
E=12.7 MeV, FWHM=40 keV (1968Di05).
E=14.7 MeV (1967Ma14).
E=24 MeV (1974Ce03).
E=40: MeV, FWHM=20 keV (1973Hi04).
E=61.2 MeV, FWHM ≈ 45 keV (1972Wh03,1981Sc04).
E=65 MeV, FWHM=15 keV (1981Fu10).
E=65 MeV, FWHM=15 keV (1989Fu07).
E=800 MeV, FWHM=170-230 keV (1979Di01).
E=800 MeV, FWHM=70-100 keV (1982Ga02,1983Ga09).
Experiments using polarized protons:
E=20 MeV (1979Pl01,1984Pl06,1988Pl04,1989Pl09).
E=20.3 MeV, FWHM=100-150 keV (1969Gl05).
E=30 MeV, FWHM=80-100 keV (1977De03).
E=40 MeV, FWHM=60-80 keV (1979De11).
E=57.5 MeV, FWHM=150-250 keV (1979Ma06).
E=160 MeV, FWHM=80 keV (1980Sc21).
E=185 MeV, FWHM=280-320 keV (1971Ha63).
E=400 MeV, FWHM=120-300 keV (1989Le04,1989Le06).
E=500 MeV (1987Ba22).
E=800 MeV, FWHM=120 keV (1983Ba06).
E=16 MeV (1994PlZZ, 1994PlZY).

^{90}Zr Levels

E(level)[†]	L[†‡]	β_LR[†]	Comments
0			
1756 *4*	0		
2185 *4*	2	0.45	
2319 *4*	5	0.45	
2751 *4*	3	1.02	
3078 *4*	4	0.27	
3311 *5*	2	0.28	
3455 *5*	6	0.20	
3596 *5*	8	0.14	
3846 *5*	2	0.32	
3962 *5*	5	0.38	
4062 *5*	4	0.16	
4128 *5*	0		
4233 *5*	(2,5)		E(level): unresolved doublet (1983Va03). L: L=5 from 1968Di05. 1983Va03 report L=2, βR=0.23, but state that L=2 alone cannot reproduce the $\sigma(\theta)$.
4305 *6*			
4338[@] *6*	4	0.36	E(level): suggested to be the 4^+ member of the configuration=$((\nu\ 1g_{9/2})^{-1}(\nu\ d_{5/2}))$ multiplet (1981Fu10).
4380 *6*	7	0.45	
4427 *6*			
4462[@] *6*			E(level): suggested to be the 5^+ member of the configuration=$((\nu\ 1g_{9/2})^{-1}(\nu\ d_{5/2}))$ multiplet (1981Fu10).
4480 *6*			
4500 *6*	(3)	0.21	

Continued on next page (footnotes at end of table)

^{90}Zr(p,p′) 1983Va03,1981Fu01 (continued)

^{90}Zr Levels (continued)

E(level)[†]	L[†‡]	β_LR[†]	Comments
4547[@] *6*	(2,6)		E(level): unresolved doublet (1983Va03). L: L=2 from 1968Di05. 1983Va03 report L=6, βR=0.39. E(level): the 6^+ state is suggested to belong to the configuration=((ν $1g_{9/2}$)$^{-1}$(ν $d_{5/2}$)) multiplet (1981Fu10).
4598[@] *6*			E(level): suggested to be the 3^+ member of the configuration=((ν $1g_{9/2}$)$^{-1}$(ν $d_{5/2}$)) multiplet (1981Fu10).
4653 *6*			
4689 *6*	2	0.18	
4710 *6*	2	0.12	
4783 *6*			
4828 *6*	2	0.10	
4849 *6*			
4875 *6*			
4946 *6*			
4997 *6*	(2)		L: from 1968Di05.
5065[@] *6*			E(level): suggested to be the 7^+ member of the configuration=((ν $1g_{9/2}$)$^{-1}$(ν $d_{5/2}$)) multiplet (1981Fu10).
5089 *6*			
5118 *6*	3	0.29	
5176 *6*			
5215 *6*	4	0.19	
5315 *6*	(4,5)		
5381 *6*	4	0.27	
5433 *6*	2	0.10	
5462 *6*	4	0.27	
5512 *6*	0,1		L: from 1974Ce03. Comparison of strength in (p,p′) and (α,α′) suggests natural parity.
5582 *6*			
5631 *7*	3	0.33	
5666 *7*	3	0.27	
5703 *7*			
5753 *7*			
5781 *7*	3	0.23	
5829 *7*			
5891 *7*	1		
5939 *7*	3	0.27	
5977 *7*	4	0.22	
6006 *7*	4	0.18	
6058 *7*	(4)		
6078 *7*			
6106 *7*			
6128 *7*			
6167 *7*	4	0.14	
6209 *7*	1		
6229 *7*			
6245 *7*			
6290	(3)		
6308[#] *7*	(4)		E(level): unresolved doublet (1983Va03).
6397[#] *7*	(3)		
6425[#] *7*	1		L: from 1983Va03.
6479	(3)		
6496[#] *7*			
6517	(4)		
6547[#] *7*			

Continued on next page (footnotes at end of table)

^{90}Zr(p,p′) 1983Va03,1981Fu01 (continued)

^{90}Zr Levels (continued)

E(level)[†]	L[†‡]	Comments
6574[#] *7*		E(level): unresolved doublet (1983Va03).
6636[#] *7*		
6666	(4)	
6694	(4)	
6709	(3)	
6742	(3)	
6794[#] *7*		
6813	(4)	
6853	(4)	
6867	(3)	
6895	(4)	
6924[#] *8*		
6974	(3)	
7002	(3)	
7047	(3)	
7060	(4)	
7089	(3)	
7120	(3)	
7136[#] *8*		
7151	(4)	
7165[#] *8*		
7200	(3)	
7235	(3)	
7263	(3)	
7275	(4)	
7343[#] *8*		
7378[#] *8*		
7402	(3)	
7423	(3)	
7461	(3)	
7523	(4)	
7614	(3)	
7633	(3)	
7722	(3)	
7750	(3)	
7767	(4)	
7796	(4)	
7877	(4)	
7902	(3)	
7926	(4)	
7984	(4)	
8123	(3)	
8168	(3)	
8276	(3)	
8412	(3)	
8430	(3)	
8515	(3)	
8539	(3)	

[†] From 1983Va03 for levels below 6250 keV and from 1981Fu01 for levels above 6250 keV, except where noted. Energies of 1981Fu01 are systematically high and have been lowered by 15 keV by the evaluators. 1981Fu01 report an uncertainty of 5 keV.
[‡] Most of the parentheses on L values have been added by the evaluators.
[#] From 1983Va03.
[@] Configuration assignment from comparison of $\sigma(\theta)$(exp) with distorted wave calculations (1981Fu10).

^{90}Zr(p,p′γ) 1971Ra08,1974Ce03

1971Ra08: E=3.0-7.2 MeV. Measured Eγ, Iγ, semi, enriched target.
1974Ce03: E=24 MeV. Measured σ(E(p′),θ), semi, p-γ coin, Eγ, scin.
Others: 1962Ne02, 1970Am01, 1972Bu18, 1972Pi13, 1974Ch52, 1984Sc37, 2015Ot02.
Data are from 1971Ra08, except as noted.

^{90}Zr Levels

E(level)	J^{π} †	$T_{1/2}$	Comments
0	0^+		
1762 *2*	0^+	61.3 ns *25*	E(level): From 1962Ne02. $T_{1/2}$: From 1972Bu18.
2186.3 *3*	2^+		
2318.7 *3*	5^-		
2738.8 *5*	$(4)^-$		E(level): For cross section limit on excitation of this level in (p,p′), see 1974Ch52.
2748.0 *4*	3^-		
3077.3 *4*	4^+		
3308.8 *6*	2^+		
3845.0 *10*	2^+		
4237.9 *13*	(2^+)		
5510‡ *15*	$1^+,1^-,2^+$‡		
5890‡ *15*	1^-‡		
6420‡ *15*	$1^+,1^-,2^+$‡		

† From Adopted Levels, except as noted.
‡ From 1974Ce03. Jπ based on observed $\Gamma_{\gamma 0}/\Gamma_{\gamma}$ and γ(θ).

γ(^{90}Zr)

For measured conversion electron spectrum, see 1972Pi13.
Probability of two-photon decay for 1762, 0^+ to 0^+, transition is 0.018% *2*, with a ratio <2E1>/<2M1>of 1.9 *0.7* (1984Sc37).

E_{γ}	I_{γ} †	E_i(level)	J^{π}_i	E_f	J^{π}_f	Comments
236.5§		3308.8	2^+	3077.3	4^+	E_{γ}: From 1972Pi13.
420.1 *3*		2738.8	$(4)^-$	2318.7	5^-	
561.7 *3*		2748.0	3^-	2186.3	2^+	
891.0 *3*		3077.3	4^+	2186.3	2^+	
1122.0 *8*	26 *12*	3308.8	2^+	2186.3	2^+	
1762		1762	0^+	0	0^+	α: I(ce)/I(γ)=2.38 *8*, K/LM=7.06 *8* (1962Ne02). E_{γ}: For excitation function of K-electrons for E(p)=6.0-8.6 MeV, see 1970Co01.
2186.3 *3*		2186.3	2^+	0	0^+	
2318.7 *3*		2318.7	5^-	0	0^+	
2477.7 *12*		4237.9	(2^+)	1762	0^+	
2747.5 *10*		2748.0	3^-	0	0^+	I_{γ}: a few percent (1971Ra08).
3309.1 *8*	74 *12*	3308.8	2^+	0	0^+	
3844.9 *10*		3845.0	2^+	0	0^+	
4237.0 *15*		4237.9	(2^+)	0	0^+	
5510‡		5510	$1^+,1^-,2^+$	0	0^+	
5890‡		5890	1^-	0	0^+	

† Percent photon branching from each level (1970Am01).
‡ From 1974Ce03.
§ Placement of transition in the level scheme is uncertain.

^{90}Zr(d,d′) 1973Ba28

1973Ba28: E(d)=15 MeV. Measured $\sigma(\theta)$ with magnetic spectrograph, θ=20°−110°. FWHM=35 keV.
1992Se02: E(d)=16.0 MeV, polarized deuterons. Measured $\sigma(\theta)$ and vector-analyzing power with semi telescope.
Data are from 1973Ba28, except as noted. Others: 1982Cl03, 1975Ba41, 1996Ka10.

^{90}Zr Levels

E(level)†	L‡	βR‡	Comments
0			
1750	0	0.10	
2180	2	0.39	βR: 1975Ba41 obtain βR=0.24 in poor agreement with 1973Ba28 and 1992Se02.
2300	5	0.24	
2750	3	0.71	βR: 1975Ba41 obtain βR=0.49 in poor agreement with 1973Ba28 and 1992Se02.
3090	(4)	0.18	
3290	2	0.23	
3440	(6)	0.09	
3820	2	0.27	
3940	5	0.16	
4220	2	0.20	
4350	(4)	0.23	

† From 1973Ba28.
‡ From comparison with DWBA calculations (1973Ba28), except where noted. L=4 and 6 give poor fits to the data, and are considered tentative.

^{90}Zr(t,t′) 1968Fl06,1994So26

1968Fl06: E=20 MeV. Measured $\sigma(\theta)$, θ(lab)=18°−78° in steps of 3°. ΔE-E telescope. FWHM=60 keV.
1994So26: E=20 MeV. Measured deformation parameters β_2 and β_3.

^{90}Zr Levels

E(level)[†]	L[‡]	β_L[‡#]	Comments
0			
1750 *15*			
2180 *15*	2	0.070	β_L: other: β_2=0.09 (1994So26).
2300 *15*	5	0.039	
2750 *15*	3	0.12	β_L: other: β_3=0.16 (1994So26).
3090 *15*	4	0.027	
3290 *15*	2	0.040	β_L: other: β_2=0.03 (1994So26).
3440 *15*	6	0.016	
3580 *15*	(1)		
3820 *15*	2	0.047	β_L: other: β_2=0.03 (1994So26).
3990 *15*	5	0.027	
4040 *15*	(2,5)	0.022	
4220 *15*	(2)	0.037	
4330 *15*	4		
4370 *15*			
4450 *15*	3		
4530 *15*	5		
4610 *15*			
4670 *15*	(2)		
4810 *15*	(1)		
5110 *15*	(3,4,5)		
5220 *15*	(1,3)		
5380 *15*	4		
5460 *15*	4		
5650 *15*	3		
5780 *25*			
5960 *25*			
6070 *25*			
6300 *25*			
6430 *25*			
6560 *25*			

[†] From 1968Fl06.
[‡] From comparison with DWBA calculations (1968Fl06).
[#] From 1968Fl06.

^{90}Zr(^{3}He,^{3}He′) 1967Gi05

1967Gi05: E(^{3}He)=43.7 MeV. Measured $\sigma(\theta)$ with semi, θ=14°−123°. FWHM=200 keV.
Other: 1993Fa09, 1993Be07, 1981Ya02.

^{90}Zr Levels

E(level)†	L‡	βR‡
0		
2180	2	0.52
2710	3	0.78
3270	(2)	
3840	2	0.33
4350		
5630		

† From 1967Gi05.
‡ From comparison with DWBA calculations (1967Gi05).

^{90}Zr(^{3}He,dp) 1979Fi02

1979Fi02: E=30.2 MeV. Measured σ(E(d),E(p)), dp coin. Enriched target (97.7%). Si ΔE-E telescope.

^{90}Zr Levels

E(level)
0
2180
2750

^{90}Zr(α,α') 1986La18

1986La18: Eα=35.4 MeV. Magnetic spectrograph, FWHM=35-50 keV. Measured $\sigma(\theta)$, θ=10°−50°.
1987Ry01: Eα=35.4 MeV. Magnetic spectrograph, FWHM=40-70 keV. Measured $\sigma(\theta)$, θ=10°−50°.
1968Ma30: Eα=31 MeV. Si detectors, FWHM=80 keV. Measured $\sigma(\theta)$, θ=16°−70°.
1995Lu05: Eα=34.5 MeV. Magnetic spectrometer. Measured $\sigma(\theta)$, θ=8° −46.5°. Determined B(E2)↑ and B(E3)↑.
2018Gu05: E(α)=385 MeV beam was from the ring cyclotron facility of the Research Center for Nuclear Physics (RCNP). Target was self-supporting foil of 97.7% enriched ^{90}Zr with a thickness within 4.0 to 5.4 mg/cm^2. Inelastically scattered particles were momentum-analyzed with the high-resolution magnetic spectrometer Grand Raiden and detected with a focal-plane detector system consisting of two position-sensitive multi-wire drift chambers (MWDCs) and two plastic scintillators. Measured σ(E$_\alpha$,θ). Deduced energies, widths, percentages of energy weighted sum rule (EWSR) of the isoscalar giant monopole (ISGMR), dipole (ISGDR) and quadrupole (ISGQR) from DWBA analysis.
Others: 1966Bi05, 1973Bi12, 1974Ce03, 1975Gi10, 1978ToZU, 1989Ku29, 1990Bu25, 2001Cl01, 2004Yo05, 2004Lu04, 2013Yo07, 2015Kr08, 2016Gu13.
Data are from 1986La18, except as noted. There is good agreement between the results of 1968Ma30 and 1986La18.
For studies of projectile excitation in (α,α'), see 1979Ka03.
For discussion of isospin decomposition of matrix elements, see 1987Ry01, 1990Bu25.

^{90}Zr Levels

Parameters of strength distributions of the giant resonances are deduced from DWBA analysis of measured differential cross sections (2018Gu05).

E(level)†	L‡	βR‡	Comments
0			
2194	2	0.42	B(E2)↑=0.063 *5* (1995Lu01).
2327	5	0.34	
2754	3	0.77	B(E3)↑=0.051 to 0.091 (1995Lu01).
3082	4	0.21	
3319	2	0.19	
3463	6	0.12	
3839	2	0.25	
3957	5	0.25	
4056	4	0.14	
4121	0		
4229	2	0.14	
4305	4	0.08	
4334	4	0.25	
4374	7	0.19	
4491	3	0.13	
4542	6	0.14	
4685	2	0.14	
4821			
4941	4	0.07	
5060	(7)		
5114	3	0.20	
5215	4	0.15	
5317			
5382	4	0.20	
5464	4	0.18	
5512	1		
5582	(3)		
5630	3	0.27	
5671	3	0.22	
5778	3	0.18	
5891	1		
5951	3	0.19	

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^{90}Zr(α,α') 1986La18 (continued)

^{90}Zr Levels (continued)

E(level)†	J^π	Γ	L‡	Comments
13.99×10^3 *7*	2$^+$	7.44 MeV *+30−28*	2	%EWSR=108 *5* (ISGQR). E(level),J^π,Γ: from 2018Gu05.
16.76×10^3 *12*	0$^+$	4.96 MeV *+31−32*	0	%EWSR=75 *9* (ISGMR). E(level),J^π,Γ: from 2018Gu05. E(level): other: 16550 *50* (2016Gu13). Γ: other: 4.2 MeV *3* (2016Gu13).
27.8×10^3 *9*	1$^-$	11.3 MeV *+24−27*	1	E(level): from 27.8×10^3 *+10−8* in 2018Gu05. %EWSR=69 *12* (ISGDR). E(level),J^π,Γ: from 2018Gu05.

† From 1986La18 with general statement that uncertainty is 10-15 keV, except where noted.
‡ From comparison with DWBA calculations (1986La18), except where noted.

^{90}Zr(^{17}O,^{17}O′),(^{17}O,^{17}O′γ) 1993Li24,2010Kr01,2015Cr02

1993Li24: (^{17}O,^{17}O′), E=1435 MeV. Measured scattered ^{17}O ions at various angles. Determined B(E2)↑ and B(E3)↑. Detector: ion chamber, plastic scintillator. Other: 1995Be12, 1992VaZW.

1993Ho03, 1992Ho02: (^{6}Li,^{6}Li′), E=70 MeV. Measured scattered ^{6}Li ions at various angles from θ=4° to 45°. Detector: magnetic spectrometer, FWHM≈225 keV. Determined B(E2)↑. Target: 97.67% enriched ^{90}Zr.

2010Kr01: (^{6}Li,^{6}Li′), E=240 MeV. 90% enriched 5.0 mg/cm^2 ^{90}Zr target; measured scattered ^{6}Li ions at various angles from θ(c.m.) = 4° to 43°. Multipole-Dipole-Multipole (MDM) spectrometer at TAMU. Determined B(E2)↑, B(E3)↑. Double folding model analysis using density dependent M3Y NN effective interaction and with phenomenological Woods-Saxon potential.

2015Cr02: E(^{17}O)=340 MeV beam from the Tandem-ALPI accelerator complex of the Legnaro National Laboratories of INFN at Legnaro, Italy. Self-supporting target with thickness of 2 mg/cm^2. Measured Eγ, Iγ, $\gamma(\theta)$ using the AGATA demonstrator consisting of three triple clusters of HPGe detectors and E(recoil), recoil-γ coincidences using two ΔE-E silicon telescopes (FWHM ≈ 0.3% at 340 MeV). Differential cross sections compared to the results of DWBA calculations using both the standard collective form factor and a form factor obtained by folding microscopically calculated transition densities. Comparison of data to (γ,γ') and (p,p′) data in the energy region of 6 to 11 MeV.

^{90}Zr Levels

E(level)	J$^\pi$ †	Comments
0.0	0$^+$	
1760.7	0$^+$	
2186.3	2$^+$ ‡	B(E2)↑=0.066 *6* (^{6}Li,^{6}Li′) (1993Ho03); B(E2)↑=0.043 *9*, (^{17}O,^{17}O′) (1993Li24), B(E2)↑=0.059 *+2−6* (^{6}Li,^{6}Li′) (2010Kr01).
2319.0	5$^-$	
2739.3	(4)$^-$ #	
2747.9	3$^-$ ‡	B(E3)↑=0.027 *5*, (^{17}O,^{17}O′)(1993Li24) ;B(E2)↑=0.086 *+2 −9* (^{6}Li,^{6}Li′)(2010Kr01).
3076.9	4$^+$	
3308.8	2$^+$ ‡	
3448.2	6$^+$	
3842.2	2$^+$	E(level): cross section best reproduced by a calculation which considers only the Coulomb excitation contribution.
4223	(2$^+$) #	
4681	2$^+$	E(level): excitation cross section measurements suggest that other sizable decay branches (apart from the observed 839γ and 4681γ) might exist from this level.
6424	1$^-$	E(level): cross section not well reproduced by DWBA calculation using standard deformed potential model, better agreement obtained when nuclear contribution is calculated from a microscopic form factor. E(level): dominant isoscalar component, exhausts 2.17% of the isoscalar dipole energy weighted sum rule strength.

† From the Adopted Levels.

‡ DWBA calculations with standard deformed potential model consistent with Jπ from Adopted Levels.

Listed without parentheses in level-scheme Fig. 4 of 2015Cr02.

γ(^{90}Zr)

Yield ratio is determined from Y_R=Y(125°−150°)/Y(100°−125°) where Y(θ) is the yield at angle θ. The average for the known E2 ground state transitions from the 2186-, 3309-, and 3842-keV levels is Y_R=1.05 *5* (read by evaluators from Fig. 3 of 2015Cr02). For the 6.5 to 8 MeV energy interval, Y_R=1.39 *7*, and for the 6.5 to 10 MeV energy interval, Y_R=1.36 *6* (both read by evaluators from Figure 3 of 2015Cr02), suggesting dominant E1 character for transitions in this energy range, although the presence of M1 and E2 transitions cannot be excluded.

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^{90}Zr(^{17}O,^{17}O′),(^{17}O,^{17}O′γ) 1993Li24,2010Kr01,2015Cr02 (continued)

γ(^{90}Zr) (continued)

E_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.‡	Comments
420	2739.3	(4)$^-$	2319.0	5$^-$		
425	2186.3	2$^+$	1760.7	0$^+$		E_γ: listed as 562 keV in Figure 4 of 2015Cr02, which evaluators consider to be a typo. Figure 1 and text of 2015Cr02 describe a 425γ depopulating the 2186.3-keV level. A 562γ depopulates 2748, 3$^-$ level.
562	2747.9	3$^-$	2186.3	2$^+$		
839§	4681	2$^+$	3842.2	2$^+$		E_γ: observed in spectrum with condition on the energy of the scattered ^{17}O particles which corresponds to excitation energies in ^{90}Zr between 4.2 MeV and 5.2 MeV, however, absent in same spectrum gated on ^{90}Zr energies between 3.0 MeV and 4.0 MeV.
891	3076.9	4$^+$	2186.3	2$^+$		
1122	3308.8	2$^+$	2186.3	2$^+$		
1129	3448.2	6$^+$	2319.0	5$^-$		E_γ: a 562γ is shown in Figure 4 of 2015Cr02 as depopulating the 3448-keV level and populating the 2739-keV level, which evaluators considers to be a typo. Figure 1 and text of 2015Cr02 describe a 1129γ depopulating the 3448-keV level.
2186†	2186.3	2$^+$	0.0	0$^+$	E2	Mult.: Y_R=1.02 *2*, read by evaluators from Figure 3 of 2015Cr02.
2748†	2747.9	3$^-$	0.0	0$^+$		
3309†	3308.8	2$^+$	0.0	0$^+$	E2	Mult.: Y_R=1.1 *1*, read by evaluators from Figure 3 of 2015Cr02.
3842†	3842.2	2$^+$	0.0	0$^+$	E2	Mult.: Y_R=1.13 *8*, read by evaluators from Figure 3 of 2015Cr02.
4223	4223	(2$^+$)	0.0	0$^+$		
4681† *8*	4681	2$^+$	0.0	0$^+$		
6424†	6424	1$^-$	0.0	0$^+$	E1	Mult.: dipole from observation in spectra with condition on angle between emitted γ ray and recoil direction which enhances dipole transitions. Mult.: Y_R=1.43 *17*, read by evaluator from Figure 3 of 2015Cr02.

† Confirmed ground state transitions through their observation in spectra obtained by requiring the γ-ray energy to be equal to the excitation energy in ^{90}Zr, within the energy resolution of the charged-particle telescopes.

‡ From yield ratio,Y_R (2015Cr02).

§ Placement of transition in the level scheme is uncertain.

^{91}Zr(p,d) 1968Ba31

Jπ(^{91}Zr)=5/2$^+$.
1968Ba31: E=31 MeV. Measured $\sigma(\theta)$. Magnetic spectrograph, nuclear emulsions. FWHM=18 keV.
For discussion of strength distribution of L=1, L=3 and L=4 levels, see 1987DuZW.
Other: 1971Ma58.

^{90}Zr Levels

E(level)†	L‡	C^{2}S‡#	E(level)†	L‡	C^{2}S‡#	E(level)†	L‡	C^{2}S‡#	E(level)†	L‡	C^{2}S‡#
0	2	0.98	3840 *5*			4578 *5*	4	0.96	5420 *10*	1	0.47,0.51
2184 *5*	2	0.04	4030 *5*			4650 *5*			5500 *10*	1	0.18,0.19
2744 *5*			4220 *5*	4	0.26	4810 *10*	1	0.37,0.34	5560 *10*	1	0.20,0.22
3069 *5*			4320 *5*	4	1.27	4980 *10*	1	0.42,0.38	5640 *10*	1	0.41,0.44
3296 *5*			4443 *5*	4	1.85	5050 *10*	4	2.05	5950 *10*	1	0.58,0.62
3557 *5*			4528 *5*	4	2.20	5100 *10*	1	0.41,0.37			

† From 1968Ba31.
‡ From comparison with DWBA calculations (1968Ba31).
# Values are given for both J=1/2 and J=3/2, respectively, for states of L=1.

^{91}Zr(d,t) 1963Co10

Jπ(^{91}Zr)=5/2$^+$.
1963Co10: E=15 MeV. Measured σ, magnetic spectrograph, FWHM 75-100 keV, θ=47°, enriched target.
Others: 1960Vl04, 1965Ja07.

^{90}Zr Levels

E(level)
0
1750
2210
2770

^{91}Zr(^{3}He,α) 1973Fa05

Jπ(^{91}Zr)=5/2$^+$.

1973Fa05: E=24 MeV. Measured $\sigma(\theta)$, θ=10°, 20°, 35°, 45°, 55°. Position sensitive proportional detectors, magnetic spectrograph. FWHM=40 keV.

1977Ga17: E=39 MeV. Measured $\sigma(\theta)$, θ=5°−40° in steps of 5°. Position sensitive detectors, magnetic spectrograph. FWHM=30-35 keV.

Other: 1968Ru02.

Data are from 1973Fa05, except as noted.

^{90}Zr Levels

E(level)	L[†]	C^{2}S[†&]	Comments
0	2[@]	0.94[@]	
2186[‡]	[4]	0.05	
3077[‡]	[4]	0.05	
3309[‡]	[4]	0.10	
3843[‡]	[4]	0.03	
4334 *10*	(4)	1.54	E(level): Suggested to be the 4$^+$ member of the configuration=((ν 1g$_{9/2}$)$^{-1}$(ν d$_{5/2}$)) multiplet.
4457 *10*	(4)	1.80	E(level): Suggested to be the 5$^+$ member of the configuration=((ν 1g$_{9/2}$)$^{-1}$(ν d$_{5/2}$)) multiplet.
4542 *10*	(4)	2.11	E(level): Suggested to be the 6$^+$ member of the configuration=((ν 1g$_{9/2}$)$^{-1}$(ν d$_{5/2}$)) multiplet.
4594 *10*	(4)	1.03	E(level): Suggested to be the 3$^+$ member of the configuration=((ν 1g$_{9/2}$)$^{-1}$(ν d$_{5/2}$)) multiplet.
4694 *10*	(4)	0.34	E(level): Suggested to be the 2$^+$ member of the configuration=((ν 1g$_{9/2}$)$^{-1}$(ν d$_{5/2}$)) multiplet.
5061 *10*	(4)	2.66	E(level): Suggested to be the 7$^+$ member of the configuration=((ν 1g$_{9/2}$)$^{-1}$(ν d$_{5/2}$)) multiplet.
5350 *20*	(3,4)	0.25[#]	
5690 *20*	(3,4)	0.26[#]	
5810 *20*	(3,4)	0.29[#]	
6300 *20*	(3,4)	0.88[#]	

[†] From comparison of $\sigma(\theta)$ with DWBA calculations (1973Fa05), except where noted. The L values should be regarded as tentative. Brackets have been added by the evaluators.

[‡] From the Adopted Levels.

[#] Assuming L=4 (1973Fa05).

[@] From 1977Ga17.

[&] Relative strength only, except for g.s.

^{92}Zr(p,t) 1971Ba43

1971Ba43: E=38 MeV, magnetic spectrograph, θ(c.m.)=5°−49°, FWHM≈ 25 keV, enriched target, DWBA analysis.
For analyzing power of the g.s. transition, see 1985Ya02, 1982Ao01.
For bump of two-hole states at around 8 MeV excitation energy, see 1982Na06.
Other: 1972Ba75.

^{90}Zr Levels

E(level)	L	E(level)	L	E(level)	L	E(level)	L
0	0	4125 *5*	0	4683 *5*	2	5441 *5*	0
1761 *5*	0	4232 *5*	2	4817 *5*	3	5507 *5*	(3,4)
2186 *5*	2	4335 *5*	4	5068 *5*	(1)	5592 *5*	2
2319 *5*		4427 *5*	0	5110 *5*	3	5938 *5*	(1)
2748 *5*		4543 *5*	6	5314 *5*	3		

^{92}Zr(α,^{6}He) 1979TaZL

1979TaZL: E=64 MeV. Measured $\sigma(\theta)$, θ=4.5°−30°, magnetic spectrograph and ΔE counters.

^{90}Zr Levels

E(level)	E(level)	E(level)	E(level)
0	3310	4340	5110
2190	3840	4540	5440
2320	4130	4680	
2748	4230	4820	

^{92}Mo(^{14}C,^{16}O) 1982Ma30

1982Ma30: E=71 MeV. Measured $\sigma(\theta)$, θ(c.m.)≈11°−46°, magnetic spectrograph, FWHM 100-200 keV, enriched target, DWBA analysis.

^{90}Zr Levels

E(level)
0
1761
2186
2748

^{93}Nb(p,α) 1974Ve08

Jπ(^{93}Nb)=9/2$^+$.
1974Ve08: E=15.2 MeV. Measured σ(Eα,θ), θ=10°−160°, semi; θ=10°, 30°, magnetic spectrograph, FWHM=11 keV.
Other: 1995Ol01.
For shell and odd-even effects on alpha-particle energy spectra from the (p,α) reaction on nuclei around neutron number 50, see 1987Ku01.

^{90}Zr Levels

E(level)	L‡	S†	Comments
0	4	1.0	
1760	(4)	0.022	
2180	4	0.177	
2320	1	1.0	
2740	1	1.4	L,S: Doublet.
3070	4	0.35	
3290	4	0.14	
3450	4	0.43	
3590	4	0.56	
3840		@	
3955 *10*	1	0.68	
4015? *10*		@	
4120? *10*		@	
4225 *10*	1		
4280 *10*	1		
4330 *10*			
4370 *10*	3		
4420? *10*		@	
4450? *10*		@	
4470 *10*	#		
4490 *10*	#		
4540 *10*	1		
5100	3		

† Normalized to 1 for the ground state (1974Ve08).
‡ From comparison with DWBA calculations (1974Ve08).
# L=(3) for the levels at 4470 and 4490 keV.
@ Weak.

^{94}Mo(d,^{6}Li) 1984Va31

1979Sa12,1983Va18,1984Va31: E=45 MeV. Measured $\sigma(\theta)$, θ=6°−26°, magnetic spectrograph, FWHM≈70-100 keV, enriched target, DWBA analysis.

Others: 1979Sa12, 1984Um04.

For α spectroscopic strengths, see 1984Um04 (1984Va31).

^{90}Zr Levels

E(level)†	L†	E(level)†	L†	E(level)†	L†	E(level)†	L†
0	0	3310 *15*	2	4330 *15*	(4)	5430 *15*	(4)
1770 *15*	0	3450 *15*	6	4410 *15*	0	5560 *15*	(2)
2190 *15*	2	3590 *15*	(4)	4540 *15*	(6)	5650 *15*	(3)
2330 *15*	5	3850 *15*	(2)	4680 *15*	(2)	5950 *15*	(4)
2750 *15*	3	3960 *15*	5	4810 *15*	(3)	6750 *15*	(3)
3080 *15*	4	4110 *15*	0	5340 *15*	(3)		

† From 1984Va31.

^{208}Pb(^{90}Zr,^{90}Zr′γ) 2015Va12

2015Va12: E(^{90}Zr)=560 MeV. Measured Eγ, Iγ, γγ, recoil-γ using CLARA array consisting of 24 Compton-suppressed Clover detectors. Projectile-like products detected with the PRISMA magnetic spectrometer at lab angles of 56° and 61°.
Ohter: 2005Ga44.

^{90}Zr Levels

E(level)†	J^π†	E(level)†	J^π†	E(level)†	J^π†
0.0	0^+	2747.9	3^-	3589.4	8^+
2186.3	2^+	3076.9	4^+	3842.3	2^+
2319.0	5^-	3308.2	2^+	4058.1	4^+
2739.3	$(4)^-$	3448.2	6^+	4374.8	7^-
				5644.0	10^+

† From Figure 3 in 2015Va12.

γ(^{90}Zr)

E_γ	E_i(level)	J^π_i	E_f	J^π_f	E_γ	E_i(level)	J^π_i	E_f	J^π_f
329.1	3076.9	4^+	2747.9	3^-	1871.9	4058.1	4^+	2186.3	2^+
420.3	2739.3	$(4)^-$	2319.0	5^-	2054.6	5644.0	10^+	3589.4	8^+
561.6	2747.9	3^-	2186.3	2^+	2055.8	4374.8	7^-	2319.0	5^-
890.6	3076.9	4^+	2186.3	2^+	2186.3	2186.3	2^+	0.0	0^+
1122.0	3308.2	2^+	2186.3	2^+	3308.1	3308.2	2^+	0.0	0^+
1129.2	3448.2	6^+	2319.0	5^-	3842.2	3842.3	2^+	0.0	0^+

Coulomb excitation 1965Ga05

1965Ga05: E(^{14}N)=44 MeV. Measured ^{14}N′-γ coin, semi-scin.

^{90}Zr Levels

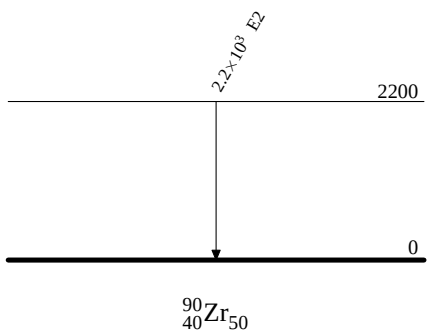
E(level)	Comments
0	
2.2×10^3	B(E2)↑=0.042 *15*

γ(^{90}Zr)

E_γ	E_i(level)	E_f	Mult.
2.2×10^3	2.2×10^3	0	E2

Coulomb excitation 1965Ga05

Level Scheme



Adopted Levels, Gammas

Q(β^-)=−2489 *3*; S(n)=10108 *24*; S(p)=5075 *5*; Q(α)=−5803 *15* 2017Wa10
S(2n)=22630 *60*, S(2P)=12940 *4* (2017Wa10).

^{90}Nb Levels

For influence of the chemical and physical environment on $T_{1/2}$(125), see 1965Co12, 1969Ol01, 1970Ol04, 1971Sm07, 1977Do07, 1978Me03.

For activities not definitely assigned to ^{90}Mo, see 1965Mc03 (80 μs), 1967Iv04 (20.1 ms), 1975DeYP (53 ms, 10 ms), 1977DeZT and 1977DeXV (85 ms *6*). No trace of a 50-100 ms component in the decay of the 382 level was found in a search with a mini-orange spectrometer (1982Hu01).

Cross Reference (XREF) Flags

A	^{90}Mo ε decay	E	^{90}Zr(p,n)	I	^{76}Ge(^{19}F,5nγ)
B	^{90}Zr(p,nγ)	F	^{89}Y(α,3nγ),^{90}Zr(^{3}He,p2nγ)	J	^{9}Be(^{124}Xe,Xγ)
C	^{90}Zr(^{3}He,t)	G	^{90}Zr(^{12}C,^{12}B)		
D	^{92}Mo(d,α)	H	^{63}Cu(^{31}P,3pnγ)		

E(level)†	J$^\pi$	$T_{1/2}$	XREF	Comments
0	8$^+$‡	14.60 h *5*	ABCD FGHIJ	%ε+%β^+=100 Q=+0.01 *4*; μ=+4.957 *5* J$^\pi$: J from atomic and molecular beam measurements (1975Ru06,1978Ru04); π from μ comparison with shell model predictions. $T_{1/2}$: from β(t) with chemically separated source (1968Pe01). Others in good agreement: 1954On06, 1957Sh32. μ: from weighted average of +4.961 *4* (from NMR on oriented nuclei, 1981Ha24) and +4.952 *4* (from colinear laser spectroscopy (CLS), 2009Ch25); for a latest compilation see 2014StZZ. Q: from colinear laser spectroscopy (CLS) (2009Ch25,2016St14). Other: +0.046 *7* (from multiple adiabatic passage NMR on Oriented Nuclei (MAPON), 1998Se01). Δ<r^2>(^{91g}Nb,^{90g}Nb)=+0.011 fm^2 *1* (2009Ch25).
122.370 *22*	6$^+$‡	63 μs *2*	ABC F H	%IT=100 μ=+3.720 *24* $T_{1/2}$: from γ(t) (1978Ba18). Others: 61 μs *4* (1971Ho27), 73 μs (1967Iv04). μ: from time differential perturbed angular distribution (TDPAD); corrected for Knight shift and diamagnetism (1978Ha52, 2014STZZ). J$^\pi$: E2 122.4γ to 8$^+$, member of ((π1g$_{9/2}$)(ν1g$_{9/2}$)$_1$) multiplet.
124.67 *25*	4$^-$#	18.91 s *6*	AB D F	%IT=100 Q=−0.26 *4*; μ=−0.018 *9* J$^\pi$: from L(d,α)=3. $T_{1/2}$: weighted average of 18.97 s *4* (2011Ki45), 18.82 s *9* (1969Ge03), 18.84 s *9* (1971Sm07), and 18.76 s *10* (1974Co33), γ(t) and ce(t) for the 122-keV transition. Decay of level 124.67 has not been observed. Other: 1978Me03 (18.87 s *2*, statistical uncertainty only). μ: From colinear laser spectroscopy (CLS) (2009Ch25, 2014StZZ). Q: From colinear laser spectroscopy (CLS) (2009Ch25, 2016St14). Δ<r^2>(^{91g}Nb,^{90m}Nb)=+0.042 fm^2 *2* (2009Ch25).
171.10 *10*	7$^+$‡	<1 μs	BCD F	J$^\pi$: from L(d,α)=6. $T_{1/2}$: From $\gamma\gamma$(t) in ^{89}Y(α,3nγ).
285.30 *10*	5$^+$‡		ABCD F H	J$^\pi$: M1+E2 162.9γ to 6$^+$.
328.00 *10*	4$^{(+)}$‡		ABC F H	J$^\pi$: M1 42.7 γ to 5$^+$.
362.4 *3*	5$^-$#		BC F	J$^\pi$: from D 237.7γ to 4$^-$.
382.01 *25*	1$^+$‡	6.19 ms *8*	AB D	%IT=100

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{90}Nb Levels (continued)

E(level)[†]	J^π	$T_{1/2}$	XREF	Comments
				$T_{1/2}$: From γ(t) with Ge(Li) (1974Ha50). Others: 6.3 ms *2* (1974Co33 ce(t)), 6.3 ms *2* (1977DeXV), 6.44 ms (1967Iv04). J^π: from log *ft*=5.3 in ε decay from 0^+ parent, E3 257.3γ to 4^-.
651.19 *19*	$4^{(+)}$[‡]		ABCD F H	J^π: M1+E2 323.2γ to 2^+.
812.90 *10*	$(9)^+$[‡]		CD F HIJ	J^π: M1 812.9γ to 8^+.
822.6 *6*			AB	
827.4 *3*			AB	
847.7 *4*			BCD F	
854.32 *21*	2^-		ABCD F H	J^π: E1 203.1γ to 3^+, 472.2γ to 1^+.
958 *7*	(3,4,5)		CDE G	E(level),J^π: from (^{3}He,t). Jπ assignment is tentative.
1128.2 *4*			B D	
1195.2 *9*			B D	
1231 *10*			D	E(level): from (d,α).
1255 *10*			D	E(level): from (d,a).
1279.7 *11*			BC	
1286 *10*	(3,4,5)		CD	E(level),J^π: from (^{3}He,t). Jπ assignment is tentative.
1344.1 *4*	1^+		AB D H	J^π: 489.8γ to 2^-, feeding from 0^+ parent in ε decay.
1362.7 *6*	(3^+)		BCD	J^π: from γ's to 1^+, 4^+ and 4^-.
1372.1 *4*			B	
1414.2 *11*			BCD	
1433.3 *8*			B	
1498 *7*	$2^-,3^-,4^-$		CD	J^π: From L=3 transfer in ^{92}Mo(d,α) reaction (1974Co37). E(level): from (d,α).
1558 *7*	$4^-,5^-,6^-$		CD	J^π: From L=5 transfer in ^{92}Mo(d,α) reaction (1974Co37). E(level): from (d,α).
1630.7 *11*			B	
1646.7 *11*			BCD	
1692 *7*			CD	E(level): from (^{3}He,t).
1769.1 *4*	1^+		ABCD H	J^π: M1+E2 1387.4γ to 1^+, log *ft*=5.2 from 0^+ parent.
1804 *10*			D	J^π: from (d,α).
1809.11 *20*	(9^-)		F HIJ	J^π: D 996.2γ to $(9)^+$.
1815.7 *11*			BC	
1835.7 *9*			B D	
1844.8 *6*	(1^+)		AB H	J^π: D 990.2γ to 2^-.
1873 *10*			CD F H	E(level): from (d,α).
1880.21 *20*	(11^-)	463 ns *13*	F HIJ	μ=+8.78 *3* $T_{1/2}$: weighted average of 477 ns *10* from (^{31}P,3pnγ), 440 ns *20* from (α,3nγ) and 415 ns *67* from (^{124}Xe,Xγ). μ: from time differential perturbed angular distribution (TDPAD); corrected for Knight shift and diamagnetism (1978Ha52, 2014STZZ). J^π: (E2) 71.1γ to (9^-).
1971.7 *11*	(3,4,5)		BCD	J^π: from 1847γ to 4^-.
1985.61 *23*	(10^+)		F H	J^π: D 1172.7γ to $(9)^+$.
1990.4 *8*			BC	
2000 *7*			B D	E(level): from (^{3}He,t).
2037 *10*			C	E(level): from (^{3}He,t).
2063.32 *24*	(10^+)		I	J^π: Q 2063.3γ to 8^+.
2082 *10*			C	E(level): from (^{3}He,t).
2104 *10*			C	E(level): from (^{3}He,t).
2125.6 *7*	1^+		ABC H	J^π: M1 1271.3γ to 2^-.
2168 *7*	(3,4,5)		CD	J^π: Tentative assignement from(^{3}He,t).
2180.6 *5*	(12^-)		H	J^π: M1 300.4γ to (11^-).
2309.0 *7*	3^+		A GH	J^π: E1 1454.6γ to 2^-.

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Adopted Levels, Gammas (continued)

^{90}Nb Levels (continued)

E(level)[†]	J^π	XREF	Comments
2344 *7*		CD H	E(level): from (^{3}He,t).
2370 *15*		CD	E(level): from (^{3}He,t).
2430 *15*		C	E(level): from (^{3}He,t).
2479 *15*		D	E(level): from (^{3}He,t).
2487.3 *3*	(12$^-$)	F HI	J^π: M1 607.1γ to (11$^-$).
2530 *15*		C	E(level): from (^{3}He,t).
2560 *15*		C	E(level): from (^{3}He,t).
2580 *15*		C	E(level): from (^{3}He,t).
2650 *15*		C	E(level): from (^{3}He,t).
2680 *15*		C	E(level): from (^{3}He,t).
2690.0 *3*	(11$^+$)	I	J^π: Q 1876.6γ to (9$^+$).
2710 *15*		C	E(level): from (^{3}He,t).
2730 *15*		C G	E(level): from (^{3}He,t).
2780 *15*		C	E(level): from (^{3}He,t).
2793.2 *6*		H	
2813.6 *5*	(13$^-$)	H	J^π: 633.2γ to (12$^-$), 933.3γ to (11$^-$).
2818.8 *4*	(12$^+$)	I	J^π: Q 7555γ to (10$^+$).
2850 *15*		C	E(level): from (^{3}He,t).
2880 *15*		C	E(level): from (^{3}He,t).
2950 *15*		C	E(level): from (^{3}He,t).
2980 *15*		C E	E(level): from (^{3}He,t).
3020 *15*		C H	E(level): from (^{3}He,t).
3071.8 *6*	(13$^-$)	F H	J^π: D 584.5γ to (12$^-$).
3074.7 *6*	(13$^-$)	I	J^π: D 587.1γ to (12$^-$).
3160 *15*		C	E(level): from (^{3}He,t).
3314.8 *5*	(13$^+$)	I	J^π: D 496.0γ to (12$^+$).
3497.0 *5*	(13$^+$)	I	J^π: D 678.2γ to (12$^+$).
3654.3 *5*	13$^-$	H	J^π: E2 1773.9γ to 11$^-$.
3672.2 *7*	(14$^-$)	I	J^π: D 597.5γ to (13$^-$).
3975.7 *6*	(14$^+$)	I	J^π: D 660.9γ to (13$^+$).
4068.0 *6*	(15$^+$)	I	J^π: (Q) 571.0γ to (13$^+$).
4330.6 *6*	14$^{(-)}$	H	J^π: D 676.4γ to 13$^-$.
4422.1 *7*	(15$^+$)	I	J^π: D 446.4γ to (14$^+$).
5037 *6*	0$^+$[‡]	C	E(level),J^π: from (^{3}He,t).
5051.2 *6*		H	
5557.8 *5*	15$^{(-)}$	H	J^π: Q 1903.4γ to 13$^-$.
5576.5 *8*	(15$^-$)	I	J^π: D 1904.3γ to (14$^-$).
5762.6 *7*	(17$^+$)	I	J^π: Q 1694.6γ to (15$^+$).
6147.1 *8*	(18$^+$)	I	J^π: D 384.5γ to (17$^+$).
6155.5 *6*	16$^{(-)}$	H	J^π: M1 597.7γ to 15$^{(-)}$.
6229.9 *6*		H	
6684.6 *8*		I	
6742.3 *6*	17$^{(+)}$	H	J^π: E1 586.8γ to 16$^{(-)}$.
7024.2 *7*	18$^{(+)}$	H	J^π: M1 281.9γ to 17$^{(+)}$.
7351.0 *8*	(17$^-$)	I	J^π: Q 1774.4γ to (15$^-$).
7768.1 *7*	19$^{(+)}$	H	J^π: E2 1025.7γ to 17$^{(+)}$.
8094.8 *9*	(18$^-$)	I	J^π: D 743.8γ to (17$^-$).
8376.3 *9*		I	

[†] From least-squares fit to Eγ, by evaluators.
[‡] Probable configuration=((π 1g$_{9/2}$)(ν 1g$_{9/2}$)).
[#] Probable configuration=((π 2p$_{1/2}$)(ν 1g$_{9/2}$)).

$\gamma(^{90}Nb)$

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	δ	α[#]	Comments
122.370	6^+	122.370[‡] *22*	100[‡]	0	8^+	E2		0.557	B(E2)(W.u.)=0.00878 *28* Mult.,δ: from ce measurements in ^{90}Mo ε decay.
124.67	4^-	(2.3 *4*)		122.370	6^+	[M2,E3]		$3.\times10^9$ *9*	E_γ: from level energy difference.
171.10	7^+	171.1[@] *1*	100[@]	0	8^+	D			Mult.: from (α,3nγ).
285.30	5^+	162.93[‡] *9*	100[‡]	122.370	6^+	M1+E2	0.24 *17*	0.067 *13*	Mult.,δ: from ce measurements in ^{90}Mo ε decay.
328.00	$4^{(+)}$	42.70[‡] *4*	100[‡]	285.30	5^+	M1+(E2)	<0.18	2.9 *4*	Mult.,δ: from ce measurements in ^{90}Mo ε decay.
362.4	5^-	237.7[@] *1*	100[@]	124.67	4^-	D			Mult.: from (α,3nγ).
382.01	1^+	257.34[‡] *4*	100[‡] *3*	124.67	4^-	E3(+M4)	<0.12	0.182 *12*	B(E3)(W.u.)=4.60 *+13−16* Mult.,δ: from ce measurements in ^{90}Mo ε decay.
651.19	$4^{(+)}$	323.20[‡] *18*	100[‡]	328.00	$4^{(+)}$	M1+E2	0.6 *3*	0.0122 *15*	Mult.,δ: from ce measurements in ^{90}Mo ε decay.
812.90	$(9)^+$	812.9[@] *1*	100[@]	0	8^+	M1		1.16×10^{-3}	Mult.: from $\gamma\gamma(\theta)$ and γ(lin pol) in ^{63}Cu(^{31}P,3pnγ).
822.6		440.5[‡] *6*	100[‡]	382.01	1^+				
827.4		445.37[‡] *21*	100[‡]	382.01	1^+				
847.7		485.4[§] *3*		362.4	5^-				
		722[§] *1*		124.67	4^-				
854.32	2^-	203.13[‡] *10*	100[‡] *9*	651.19	$4^{(+)}$	E1		0.01535	Mult.: from $\gamma\gamma(\theta)$ and γ(lin pol) in ^{63}Cu(^{31}P,3pnγ). Inconsistent with ce measurements in ^{90}Mo ε decay which give M1+E2 with δ<0.36.
		472.2[‡] *3*	22[‡] *3*	382.01	1^+			1.59×10^{-3}	
1128.2		477.1[§] *3*		651.19	$4^{(+)}$				
		1003[§] *1*		124.67	4^-				
1195.2		1071[§] *1*	100	124.67	4^-				
1279.7		1155[§] *1*	100[§]	124.67	4^-				
1344.1	1^+	489.8[§] *4*	100[§]	854.32	2^-			1.46×10^{-3}	
1362.7	(3^+)	711[§] *1*		651.19	$4^{(+)}$				
		981[§] *1*		382.01	1^+				
		1035[§] *1*		328.00	$4^{(+)}$				
		1238[§] *1*		124.67	4^-				
1372.1		517.7[§] *3*		854.32	2^-				
		1248[§] *1*		124.67	4^-				
1414.2		763[§] *1*	100[§]	651.19	$4^{(+)}$				
1433.3		1105[§] *1*		328.00	$4^{(+)}$				
		1309[§] *1*		124.67	4^-				
1630.7		1506[§] *1*	100[§]	124.67	4^-				
1646.7		1522[§] *1*	100[§]	124.67	4^-				

$^{90}_{41}Nb_{49}$-4

$\gamma(^{90}Nb)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	α[#]	Comments
1769.1	1^+	425.1[‡] *3*	6.5[‡] *14*	1344.1	1^+			
		941.5[‡] *4*	100[‡] *12*	827.4				
		946.4[‡] *8*	12[‡] *4*	822.6				
		1387.4[‡] *5*	33[‡] *4*	382.01	1^+	M1+E2	4.06×10^{-4} *7*	Mult.: from ^{90}Mo ε decay.
1809.11	(9^-)	996.2 *2*	100	812.90	$(9)^+$	D	3.11×10^{-4}	
1815.7		1691[§] *1*	100[§]	124.67	4^-			
1835.7		641[§] *1*	[§]	1195.2				
		1184[§] *1*	[§]	651.19	$4^{(+)}$			
1844.8	(1^+)	990.2[‡] *6*	100[‡] *10*	854.32	2^-	D	3.15×10^{-4}	Mult.: from DCO ratio data of (^{31}P,3pnγ).
		1463.5[‡] *9*	69[‡] *23*	382.01	1^+			
1880.21	(11^-)	71.1[@] *2*	6.7[@] *19*	1809.11	(9^-)	(E2)	3.97 *7*	B(E2)(W.u.)=1.41 *+29−33*
		1067.3[@] *2*	100[@] *4*	812.90	$(9)^+$	(M2)	1.48×10^{-3}	B(M2)(W.u.)=0.00181 *+15−13*
1971.7	(3,4,5)	1847[§] *1*	100[§]	124.67	4^-			
1985.61	(10^+)	1172.7[@] *2*	100	812.90	$(9)^+$	D	5.28×10^{-4}	Mult.: from (α,3nγ).
1990.4		1340[§] *1*		651.19	$4^{(+)}$			
		1865[§] *1*		124.67	4^-			
2063.32	(10^+)	1249.9 *3*	16 *7*	812.90	$(9)^+$	D	4.72×10^{-4}	
		2063.3 *3*	100 *14*	0	8^+	Q	5.02×10^{-4}	
2125.6	1^+	1271.3[‡] *6*	100[‡]	854.32	2^-	M1	2.86×10^{-4}	Mult.: from $\gamma\gamma(\theta)$ and γ(lin pol) in ^{63}Cu(^{31}P,3pnγ).
2180.6	(12^-)	300.4[‡]	100[‡]	1880.21	(11^-)	M1	0.01218	Mult.: from $\gamma\gamma(\theta)$ and γ(lin pol) in ^{63}Cu(^{31}P,3pnγ).
2309.0	3^+	1454.6[‡] *7*	100[‡] *30*	854.32	2^-	E1	3.66×10^{-4}	Mult.: from $\gamma\gamma(\theta)$ and γ(lin pol) in ^{63}Cu(^{31}P,3pnγ).
		1481.6[‡] *14*	13[‡] *13*	827.4				
2487.3	(12^-)	607.1[@] *2*	100[@]	1880.21	(11^-)	M1	0.00223	Mult.: from $\gamma\gamma(\theta)$ and γ(lin pol) in ^{63}Cu(^{31}P,3pnγ).
2690.0	(11^+)	626.7 *3*	53 *21*	2063.32	(10^+)	Q	0.00234	
		1876.6 *3*	1.0×10^2 *3*	812.90	$(9)^+$	Q	4.44×10^{-4}	
2793.2		807.7[&a]	100[&]	1985.61	(10^+)			
2813.6	(13^-)	633.2[&]	91[&] *18*	2180.6	(12^-)		0.00203	
		933.3[&]	100[&] *18*	1880.21	(11^-)		8.46×10^{-4}	
2818.8	(12^+)	755.5 *3*	100	2063.32	(10^+)	Q	1.42×10^{-3}	
3071.8	(13^-)	584.5[@] *5*	100[@]	2487.3	(12^-)	D	0.00244	Mult.: from $\gamma\gamma(\theta)$ in ^{63}Cu(^{31}P,3pnγ).
3074.7	(13^-)	587.1 *3*	100	2487.3	(12^-)	D	0.00241	
3314.8	(13^+)	496.0 *3*	100	2818.8	(12^+)	D	0.00358	
3497.0	(13^+)	678.2 *3*	100	2818.8	(12^+)	D	1.73×10^{-3}	
3654.3	13^-	1773.9[&]	100[&]	1880.21	(11^-)	E2	4.18×10^{-4}	Mult.: from $\gamma\gamma(\theta)$ and γ(lin pol) in ^{63}Cu(^{31}P,3pnγ).
3672.2	(14^-)	597.5 *3*	100	3074.7	(13^-)	D	0.00232	
3975.7	(14^+)	660.9 *3*	100	3314.8	(13^+)	D	0.00184	

$^{90}_{41}Nb_{49}$-5

$\gamma(^{90}Nb)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	α[#]	Comments
4068.0	(15^+)	571.0 *3*	100	3497.0	(13^+)	(Q)	0.00303	
4330.6	$14^{(-)}$	676.4[&]	100[&]	3654.3	13^-	D		Mult.: from $\gamma\gamma(\theta)$ in $^{63}Cu(^{31}P,3pn\gamma)$.
4422.1	(15^+)	446.4 *3*	100	3975.7	(14^+)	D	0.00460	
5051.2		720.6[&a]	100[&]	4330.6	$14^{(-)}$			
5557.8	$15^{(-)}$	1903.4[&]	100[&] *18*	3654.3	13^-	Q	4.52×10^{-4}	Mult.: from $\gamma\gamma(\theta)$ in $^{63}Cu(^{31}P,3pn\gamma)$.
		2744.2[&]	47[&] *9*	2813.6	(13^-)	Q	7.61×10^{-4}	Mult.: from $\gamma\gamma(\theta)$ in $^{63}Cu(^{31}P,3pn\gamma)$.
5576.5	(15^-)	1904.3 *3*	100	3672.2	(14^-)	D	4.27×10^{-4}	
5762.6	(17^+)	1694.6 *3*	100	4068.0	(15^+)	Q	4.03×10^{-4}	
6147.1	(18^+)	384.5 *3*	100	5762.6	(17^+)	D	0.00661	
6155.5	$16^{(-)}$	597.7[&]		5557.8	$15^{(-)}$	M1	0.00232	Mult.: from $\gamma\gamma(\theta)$ and γ(lin pol) in $^{63}Cu(^{31}P,3pn\gamma)$.
		1824.9[&]		4330.6	$14^{(-)}$			
6229.9		672.1[&a]	100[&]	5557.8	$15^{(-)}$			
6684.6		537.5[a] *3*	100	6147.1	(18^+)			
6742.3	$17^{(+)}$	586.8[&]	100[&]	6155.5	$16^{(-)}$	E1	9.50×10^{-4}	Mult.: from $\gamma\gamma(\theta)$ and γ(lin pol) in $^{63}Cu(^{31}P,3pn\gamma)$.
7024.2	$18^{(+)}$	281.9[&]	100[&]	6742.3	$17^{(+)}$	M1	0.01429	Mult.: from $\gamma\gamma(\theta)$ and γ(lin pol) in $^{63}Cu(^{31}P,3pn\gamma)$.
7351.0	(17^-)	1774.4 *3*	100	5576.5	(15^-)	Q	4.19×10^{-4}	
7768.1	$19^{(+)}$	744.0[&]	100[&] *18*	7024.2	$18^{(+)}$	M1	1.41×10^{-3}	Mult.: from $\gamma\gamma(\theta)$ and γ(lin pol) in $^{63}Cu(^{31}P,3pn\gamma)$.
		1025.7[&]	48[&] *9*	6742.3	$17^{(+)}$	E2	6.80×10^{-4}	Mult.: from $\gamma\gamma(\theta)$ and γ(lin pol) in $^{63}Cu(^{31}P,3pn\gamma)$.
8094.8	(18^-)	743.8 *3*	100	7351.0	(17^-)	D	1.41×10^{-3}	
8376.3		281.5 *3*	100	8094.8	(18^-)			

[†] From $^{76}Ge(^{19}F,5n\gamma)$, except where noted.
[‡] From ^{90}Mo ε decay.
[§] From $^{90}Zr(p,n\gamma)$.
[&] From $^{63}Cu(^{31}P,3pn\gamma)$,
[@] From $^{89}Y(\alpha,3n\gamma)$,$^{90}Zr(^3He,p2n\gamma)$.
[#] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[a] Placement of transition in the level scheme is uncertain.

$^{90}_{41}Nb_{49}$-6

^{90}Mo ε decay 1968Co05,1966Pe10

Parent: ^{90}Mo: E=0.0; $J^{\pi}=0^{+}$; $T_{1/2}$=5.56 h *9*; Q(ε)=2489 *3*; %ε+%β^{+} decay=100.0
1968Co05: ^{93}Nb(p,4n), E=50-55 MeV, chemical separation. Measured: γ singles and $\gamma\gamma$ coin with Ge(Li) and NaI.
1966Pe10: measured: ce(t) and β^{+} spectra.
Others: 1955Ma31, 1965Co14, 1965Gr29, 1981KaZI, 1984Bu36.

^{90}Nb Levels

The decay scheme has been established from $\gamma\gamma$ coin data (1968Co05) and excit in ^{90}Zr(p,nγ) (1972Yo03).

E(level)	J^{π} †	$T_{1/2}$ †	E(level)	J^{π} †	$T_{1/2}$ †	E(level)	J^{π} †
0	8^{+}	14.60 h *5*	382.0 *4*	1^{+}	6.19 ms *8*	1344.1 *5*	1^{+}
122.370 *22*	6^{+}	63 μs *2*	651.20 *21*	3^{+}		1769.1 *5*	1^{+}
124.7 *4*	4^{-}	18.81 s *6*	822.6 *6*			1844.8 *6*	1^{+}
285.30 *10*	5^{+}		827.4 *4*			2125.6 *7*	1^{+}
328.00 *10*	$4^{(+)}$		854.32 *23*	2^{-}		2309.0 *7*	1^{+}

† From Adopted Levels.

ε,β^{+} radiations

ε branches are obtained from I(γ+ce) imbalance at each level.

E(decay)	E(level)	Iβ^{+} †	Iε†	Log *ft*	I($\varepsilon+\beta^{+}$)†
(180 *3*)	2309.0		2.1 *6*	4.51 *13*	2.1 *6*
(363 *3*)	2125.6		4.1 *5*	4.87 *6*	4.1 *5*
(644 *3*)	1844.8		1.69 *24*	5.77 *7*	1.69 *24*
(720 *3*)	1769.1		8.0 *8*	5.20 *5*	8.0 *8*
(1145 *3*)	1344.1		0.73 *11*	6.65 *7*	0.73 *11*
(2107 *3*)	382.0	25 *2*	56 *3*	5.30 *3*	81 *5*

† Absolute intensity per 100 decays.

γ(^{90}Nb)

Iγ normalization: Calculated from total γ+ce feeding to g.s. assuming no ε feeding to g.s. (0^+ to 8^+ transition).
α(K)exp values given in comments are calculated from Iγ (1968Co05) and Ice (1966Pe10) assuming α(K)(122.4γ)=0.47 for an E2 transition.

E_γ[†]	I_γ[‡&]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[§]	δ	α[@]	$I_{(\gamma+ce)}$[&]	Comments
(2.3 *4*)		124.7	4^-	122.370	6^+	[M2+E3]		3.3×10^9 *89*	8.2 *8*	ce(M)/(γ+ce)=0.9 *11*; ce(N)/(γ+ce)=0.10 *35*; ce(O)/(γ+ce)=4.E−6 *13* E_γ: From level-energy differences. For an attempt to measure the conversion electron energy see 1988GeZV. $I_{(\gamma+ce)}$: From intensity balance of 124.7 level.
42.70 *4*	2.8 *3*	328.00	$4^{(+)}$	285.30	5^+	M1+(E2)	<0.18	2.9 *4*		Mult.: α(K)exp=2.3 *8*, K/L=9.5 *40* (1966Pe10). δ: From α(K)exp/α(L)exp.
122.370 *22*	83 *3*	122.370	6^+	0	8^+	E2		0.557		Mult.: K/L=6.03 *18* (1966Pe10).
162.93 *9*	7.7 *7*	285.30	5^+	122.370	6^+	M1+E2	0.24 *17*	0.067 *13*		Mult.: a(K)exp=0.059 *6*.
203.13 *10*	8.2 *7*	854.32	2^-	651.20	3^+			0.036 *4*		Mult.: a(K)exp=0.034 *4*. Mult.: M1+E2 with δ<0.36 is inconsistent with adopted Δπ.
257.34 *4*	100 *3*	382.0	1^+	124.7	4^-	E3(+M4)	<0.12	0.182 *12*		Mult.: a(K)exp=0.150 *11*, K/L=5.51 *16* (1966Pe10). δ: From α(K)exp and α(K)exp/α(L)exp.
323.20 *18*	8.1 *7*	651.20	3^+	328.00	$4^{(+)}$	M1+E2	0.6 *3*	0.0122 *15*		Mult.: a(K)exp=0.0106 *12*. δ: From α(K)exp.
[x]421.0 *3*	0.32 *10*									a(K)exp=0.0038 *14*.
425.1 *5*	0.46 *10*	1769.1	1^+	1344.1	1^+					
440.5[‡] *6*	1.2 *3*	822.6		382.0	1^+					
445.37 *21*	7.7 *8*	827.4		382.0	1^+					Mult.: a(K)exp=0.0050 *7*.
472.2 *3*	1.83 *19*	854.32	2^-	382.0	1^+					Mult.: a(K)exp=0.0029 *4*.
489.8 *4*	0.94 *13*	1344.1	1^+	854.32	2^-					Mult.: a(K)exp=0.0038 *7*.
[x]517.7[‡] *7*	0.20 *13*									
941.5 *4*	7.1 *8*	1769.1	1^+	827.4						Mult.: a(K)exp=0.00071 *10*.
946.4[‡] *8*	0.9 *3*	1769.1	1^+	822.6						
[x]987.3[‡] *10*	0.18 *7*									
990.2 *6*	1.31 *13*	1844.8	1^+	854.32	2^-					Mult.: a(K)exp=0.00070 *12*.
1271.3 *6*	5.3 *5*	2125.6	1^+	854.32	2^-					Mult.: a(K)exp=0.00050 *6*.
1387.4 *5*	2.4 *3*	1769.1	1^+	382.0	1^+	M1+E2		4.06×10^{-4} *7*		Mult.: a(K)exp=0.00044 *6*.
[x]1446[‡] *2*	0.06 *3*									
1454.6 *7*	2.4 *7*	2309.0	1^+	854.32	2^-					Mult.: a(K)exp=0.00036 *12*.
1463.5 *9*	0.9 *3*	1844.8	1^+	382.0	1^+					Mult.: a(K)exp=0.00048 *22*.
1481.6 *14*	0.3 *3*	2309.0	1^+	827.4						

$^{90}_{41}$Nb$_{49}$-8

γ(^{90}Nb) (continued)

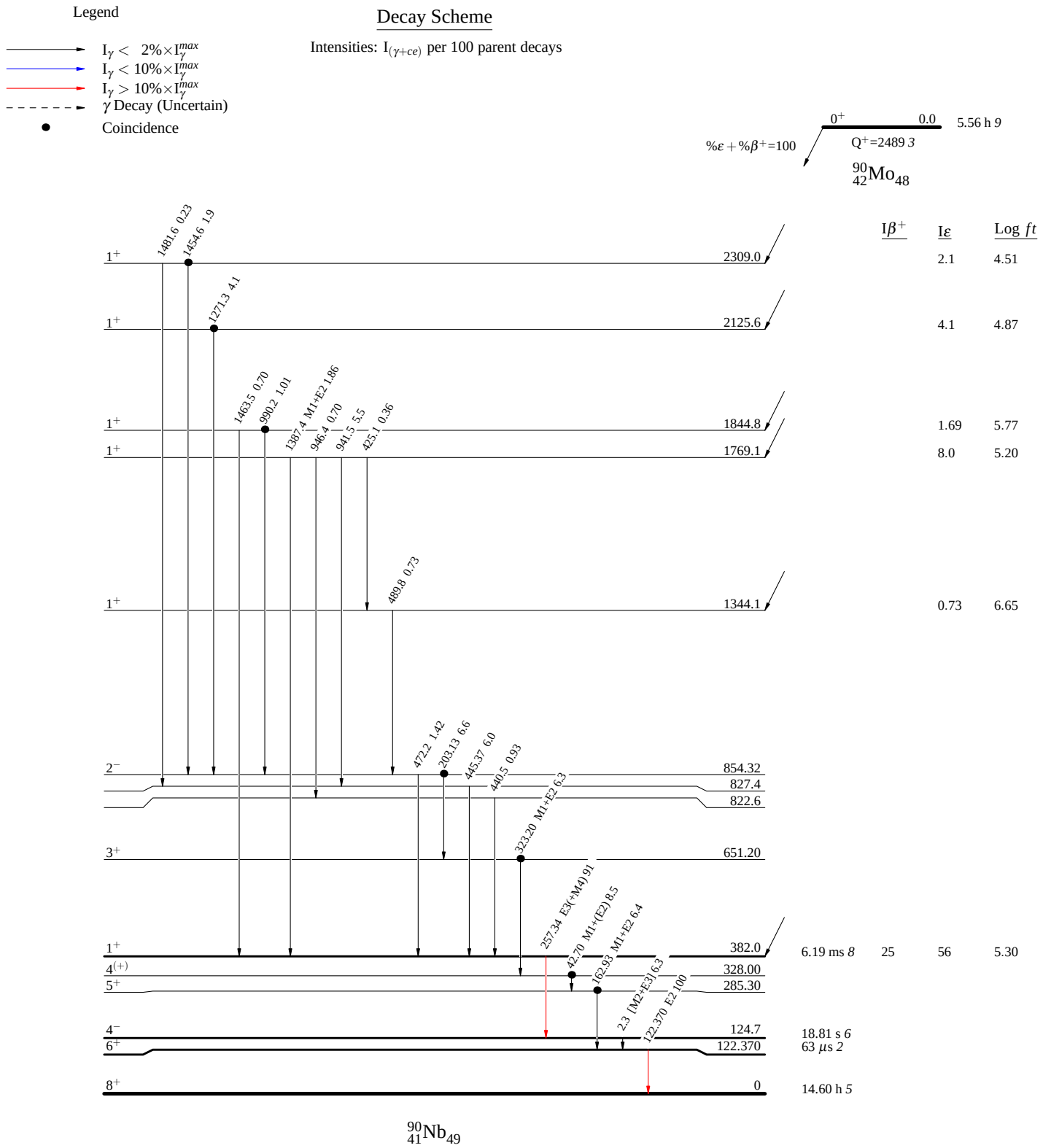
† From 1966Pe10 (from ce spectra), except as noted.
‡ From 1968Co05.
§ From conversion coefficient data above and adopted Jπ's. E3/M2 and MR=0.10 for the other multipolarities. E3/M2 and MR=0.10 for the other multipolarities.
& For absolute intensity per 100 decays, multiply by 0.774 *29*.
@ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
x γ ray not placed in level scheme.

$^{90}_{41}$Nb$_{49}$-9

^{90}Mo ε decay 1968Co05,1966Pe10

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{9}Be(^{124}Xe,Xγ) 2017Pa35

2017Pa35: ^{90}Nb produced in fragmentation of a ^{124}Xe beam at E=345 MeV/nucleon incident on a 740 mg/cm^2 thick ^{9}Be target at the RIKEN-RIBF facility. The identification of the nuclide of interest was made through the BigRIPS separator and the ZeroDegree spectrometer by determining the atomic number and the mass-to-charge ratio of the ion using the tof-Bρ-ΔE method. The secondary beam was stopped in the double-sided silicon strip detector of the WAS3ABi spectrometer. Measured Eγ, Iγ and $T_{1/2}$ using the EURICA array consisting of 84 HP Ge detectors.

^{90}Nb Levels

E(level)†	J^{π}‡	$T_{1/2}$	Comments
0	8^+		
813	9^+		
1809	9^-		
1880	11^-	415 ns *67*	E(level): Isomeric ratio R=16% *3* (2017Pa35). $T_{1/2}$: From γ(t) in 2017Pa35; gating γ-ray transitions were not specified by the authors.

† Rounded values from the Adopted Levels.
‡ From the Adopted Levels.

γ(^{90}Nb)

E_γ†	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.	α‡	$I_{(\gamma+ce)}$	Comments
71	5.4 *14*	1880	11^-	1809	9^-	[E2]	3.97 *7*	27 *7*	I_γ: from reported I(γ+ce) in 2017Pa35 and α .
813		813	9^+	0	8^+				
996		1809	9^-	813	9^+				
1067	73 *7*	1880	11^-	813	9^+	[M2]	1.48×10^{-3}	73 *7*	I_γ: from reported I(γ+ce) in 2017Pa35 and α.

† Rounded values from the Adopted Gammas.
‡ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

^{63}Cu(^{31}P,3pnγ) 2005Ch65

Results of two experiments are reported:

1. E(^{31}P)=120 and 125 MeV incident on a AP 1.2 mg/cm^2 enriched ^{63}Cu target on a 10 mg/cm^2 gold backing. Measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma(\theta)$(DCO) using Indian National Gamma Array (INGA), consisting of eight Compton-suppressed Clover HPGe detectors and a 14-element NaI(Tl) multiplicity filter.
2. E(^{31}P)= 120 MeV. Measured Eγ, Iγ, $\gamma\gamma$, γ-(recoil) coin, γ(t) using eight Compton-suppressed Clover HPGe detectors and the Heavy-ion reaction analyzer (HIRA). A 23% HPGe detector was placed at the focal plane for γ(recoil) coincidences.

^{90}Nb Levels

E(level)†	J$^\pi$‡	T$_{1/2}$	Comments
0.0	8$^+$		
122.6	6$^+$		
285.6	5$^+$		
328.1	4$^+$		
651.4	3$^+$		
813.4	9$^+$		
854.7	2$^-$		
1345.3			
1770.3			
1809.5	9$^-$		
1845.1	3$^{(+)}$		
1880.3	11$^-$	0.47 μs *1*	T$_{1/2}$: from γ(t) (2005Ch65).
1985.5	10$^+$		
2126.0	3$^-$		
2180.6	(12$^-$)		
2309.4	3$^+$		
2487.3	(12$^-$)		
2793.2			
2813.6	(13$^-$)		
3071.6	(13$^-$)		
3654.3	13$^-$		
4330.6	14		
5051.2			
5557.8	15$^{(-)}$		
6155.5	16$^{(-)}$		
6229.9			
6742.3	17$^{(+)}$		
7024.2	18$^{(+)}$		
7768.1	19$^{(+)}$		

† From least-squares fit to Eγ's, by evaluators.
‡ From 2005Ch65 with assignments based on mutipolarity of γ rays deduced from DCO and polarization data.

γ(^{90}Nb)

DCO values corresponds to angles 90°, 250° and 285° along one axis and 150°, 210° and 325° along the other axis. DCO of ≈1 is expected for same multipolarity as for the gated γ, ≈2 if different.

POL is polarization asymmetry parameter, positive for electric and negative for magnetic multipole character.

E$_\gamma$	I$_\gamma$	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.‡	Comments
42.5†	2 *1*	328.1	4$^+$	285.6	5$^+$		
70.8	1.7 *3*	1880.3	11$^-$	1809.5	9$^-$	Q	DCO=1.35 *23* (gate: 996γ, ΔJ=0, quadrupole).

Continued on next page (footnotes at end of table)

^{63}Cu(^{31}P,3pnγ) 2005Ch65 (continued)

γ(^{90}Nb) (continued)

E_γ	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.‡	Comments
122.6†	51 *3*	122.6	6^+	0.0	8^+		
163.0	68 *3*	285.6	5^+	122.6	6^+	D	DCO=0.87 *10* (gate: 323γ, ΔJ=1, dipole).
203.3	22.3 *25*	854.7	2^-	651.4	3^+	E1	DCO=0.97 *10* (gate: 163γ, ΔJ=1, dipole). POL=+0.08 *2*.
281.9	5.1 *9*	7024.2	$18^{(+)}$	6742.3	$17^{(+)}$	M1	DCO=1.24 *13* (gate: 598γ, ΔJ=1, dipole). POL=−0.08 *4*.
300.4	5.0 *9*	2180.6	(12^-)	1880.3	11^-		
323.3	22.4 *14*	651.4	3^+	328.1	4^+	M1	DCO=1.17 *11* (gate: 163γ, ΔJ=1, dipole). POL=−0.04 *2*.
425.0		1770.3		1345.3			
490.6		1345.3		854.7	2^-		
584.3	6.0 *11*	3071.6	(13^-)	2487.3	(12^-)	D	DCO=1.19 *14* (gate: 607γ, ΔJ=1, dipole).
586.8	6.5 *12*	6742.3	$17^{(+)}$	6155.5	$16^{(-)}$	E1	DCO=1.09 *20* (gate: 598γ, ΔJ=1, dipole). POL=+0.24 *3*.
597.7	11.9 *21*	6155.5	$16^{(-)}$	5557.8	$15^{(-)}$	M1	DCO=2.08 *20* (gate: 1774γ, ΔJ=2, quadrupole). POL=−0.13 *2*.
607.0	12 *2*	2487.3	(12^-)	1880.3	11^-	M1	DCO=1.04 *12* (gate: 813γ, ΔJ=1, dipole). POL=−0.06 *3*.
633.2	2.0 *4*	2813.6	(13^-)	2180.6	(12^-)		
672.1&	§	6229.9		5557.8	$15^{(-)}$		
676.4	4.1 *7*	4330.6	14	3654.3	13^-	D	DCO=2.00 *21* (gate: 1774γ, ΔJ=2, quadrupole.
720.6&	§	5051.2		4330.6	14		
744.0	4.4 *8*	7768.1	$19^{(+)}$	7024.2	$18^{(+)}$	M1	DCO=2.0 *5* (gate: 1774γ, ΔJ=2, quadrupole). POL=−0.08 *2*.
807.7&	§	2793.2		1985.5	10^+		
813.4	45 *9*	813.4	9^+	0.0	8^+	M1	DCO=2.02 *24* (gate: 1067γ, ΔJ=2, quadrupole). POL=−0.02 *3*.
933.3	2.2 *4*	2813.6	(13^-)	1880.3	11^-		
990.4	2.3 *2*	1845.1	$3^{(+)}$	854.7	2^-	D	DCO=1.38 *20* (gate: 203γ, ΔJ=1, dipole).
996.2	16 *3*	1809.5	9^-	813.4	9^+	(M2)	DCO=0.46 *5* (gate: 813γ, ΔJ=1, dipole). POL=−0.11 *4*.
1025.7&	2.1 *4*	7768.1	$19^{(+)}$	6742.3	$17^{(+)}$	(E2)	DCO=1.2 *6* (gate: 1774γ, ΔJ=2, quadrupole). POL=−0.08 *4*. Mult.: Pol is inconsistent with E2 assignment.
1066.8	28 *5*	1880.3	11^-	813.4	9^+	M2	DCO=0.46 *8* (gate: 813γ, ΔJ=1, dipole). POL=−0.06 *3*.
1172.1	1.9 *4*	1985.5	10^+	813.4	9^+		
1271.3	10.9 *8*	2126.0	3^-	854.7	2^-	M1	DCO=1.1 *4* (gate: 203γ, ΔJ=1, dipole). POL=−0.07 *3*.
1454.7	4.2 *3*	2309.4	3^+	854.7	2^-	E1	DCO=0.96 *14* (gate: 323γ, ΔJ=1, dipole). POL=+0.17 *3*.
1773.9	18 *3*	3654.3	13^-	1880.3	11^-	E2	DCO=0.45 *9* (gate: 587γ, ΔJ=1, dipole). POL=+0.12 *5*.
1824.9	§	6155.5	$16^{(-)}$	4330.6	14		
1903.4	6.8 *12*	5557.8	$15^{(-)}$	3654.3	13^-	Q	DCO=0.55 *15* (gate: 598γ, ΔJ=1, dipole).
2744.2	3.2 *6*	5557.8	$15^{(-)}$	2813.6	(13^-)	Q	

† Not observed by 2005Ch65; value taken from ^{89}Y(α,3nγ),^{90}Zr(^{3}He,p2nγ) dataset (1981Fi02).
‡ Deduced from DCO ratio and polarization information in 2005Ch65.
§ Weak γ ray.
& Placement of transition in the level scheme is uncertain.

^{76}Ge(^{19}F,5nγ) 2005Cu07

E=80 MeV. Measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma(\theta)$ (DCO) using an array of 14 Compton-suppressed HPGe detectors.

^{90}Nb Levels

E(level)[†]	J$^\pi$	E(level)[†]	J$^\pi$	E(level)[†]	J$^\pi$	E(level)[†]	J$^\pi$
0[‡]	8$^+$	2690.0 *3*	(11$^+$)	3975.7[‡] *6*	(14$^+$)	6684.6[@] *8*	
813.41 *24*	9$^+$	2818.8[‡] *4*	(12$^+$)	4068.0[@] *6*	(15$^+$)	7351.0[#] *8*	(17$^-$)
1809.7 *4*	9$^-$	3074.7[#] *6*	(13$^-$)	4422.1[‡] *7*	(15$^+$)	8094.8[#] *9*	(18$^-$)
1880.9[#] *4*	11$^-$	3314.8[‡] *5*	(13$^+$)	5576.5[#] *8*	(15$^-$)	8376.3[#] *9*	
2063.32[‡] *24*	(10$^+$)	3497.0[@] *5*	(13$^+$)	5762.6[@] *7*	(17$^+$)		
2487.6[#] *5*	12$^-$	3672.2[#] *7*	(14$^-$)	6147.1[@] *8*	(18$^+$)		

[†] From least-squares fit to Eγ, by evaluators.
[‡] Seq.(A): γ sequence based on g.s..
[#] Seq.(B): γ sequence based on 11$^-$.
[@] Seq.(C): γ sequence based on (13$^+$).

γ(^{90}Nb)

DCO ratios extracted from the spectrum gated on ΔJ=2, Q transitions; angles are 90° and 48°. DCO ratio of 1.2 is expected for ΔJ=2, quadrupole transitions and 0.5 for ΔJ=1, dipole transitions.
Multipolarity deduced from measured DCO ratio and is corroborated with the known multipolarity of prompt γ rays in ^{90,91}Zr.

E$_\gamma$	I$_\gamma$	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.	Comments
281.5[†] *3*		8376.3		8094.8	(18$^-$)		E$_\gamma$: from figure 2 of 2005Cu07.
384.5 *3*	5.3 *23*	6147.1	(18$^+$)	5762.6	(17$^+$)	D	DCO=0.35 *25*
446.4 *3*	13 *4*	4422.1	(15$^+$)	3975.7	(14$^+$)	D	DCO=0.6 *5*
496.0 *3*	61 *8*	3314.8	(13$^+$)	2818.8	(12$^+$)	D	DCO=0.57 *21*
537.5[†] *3*		6684.6		6147.1	(18$^+$)		
571.0 *3*	15 *4*	4068.0	(15$^+$)	3497.0	(13$^+$)	(Q)	DCO=0.8 *5*
587.1 *3*	5.0 *25*	3074.7	(13$^-$)	2487.6	12$^-$	D	DCO=0.35 *29*
597.5 *3*	9 *3*	3672.2	(14$^-$)	3074.7	(13$^-$)	D	DCO=0.66 *35*
606.7 *3*	8 *3*	2487.6	12$^-$	1880.9	11$^-$	D	DCO=0.7 *4*
626.7 *3*	6.3 *25*	2690.0	(11$^+$)	2063.32	(10$^+$)	Q	DCO=1.3 *6*
660.9 *3*	38 *8*	3975.7	(14$^+$)	3314.8	(13$^+$)	D	DCO=0.43 *20*
678.2 *3*	4.5 *21*	3497.0	(13$^+$)	2818.8	(12$^+$)	D	DCO=0.22 *36*
743.8 *3*	2.1 *14*	8094.8	(18$^-$)	7351.0	(17$^-$)	D	DCO=0.7 *4*
755.5 *3*	65 *8*	2818.8	(12$^+$)	2063.32	(10$^+$)	Q	DCO=1.4 *5*
813.4 *3*	100 *10*	813.41	9$^+$	0	8$^+$	D	DCO=0.50 *9*
996.3 *3*	27 *5*	1809.7	9$^-$	813.41	9$^+$	D	DCO=0.9 *7*
1067.5 *3*	52 *7*	1880.9	11$^-$	813.41	9$^+$	Q	DCO=1.5 *4*
1249.9 *3*	9 *4*	2063.32	(10$^+$)	813.41	9$^+$	D	DCO=0.8 *4*
1694.6 *3*	7.0 *26*	5762.6	(17$^+$)	4068.0	(15$^+$)	Q	DCO=2.2 *14*
1774.4 *3*	6.6 *26*	7351.0	(17$^-$)	5576.5	(15$^-$)	Q	DCO=1.7 *6*
1876.6 *3*	12 *4*	2690.0	(11$^+$)	813.41	9$^+$	Q	DCO=2.0 *16*
1904.3 *3*	3.3 *18*	5576.5	(15$^-$)	3672.2	(14$^-$)	D	DCO=0.5 *3*
2063.3 *3*	56 *8*	2063.32	(10$^+$)	0	8$^+$	Q	DCO=1.6 *3*

[†] Placement of transition in the level scheme is uncertain.

^{89}Y(α,3nγ),^{90}Zr(^{3}He,p2nγ) 1981Fi02

1981Fi02: E(α)=35 MeV. E(^{3}He)=33-43 MeV. Measured $\gamma(\theta)$, nγ, $\gamma\gamma$ and delayed $\gamma\gamma$ coin, excitation function (1981Fi02).

^{90}Nb Levels

E(level)†	J$^\pi$‡	T$_{1/2}$	Comments
0	8$^+$		
122.6 *1*	6$^+$		
124.9 *5*	4$^-$	18.81 s *6*	T$_{1/2}$: from the Adopted Levels.
171.1 *1*	7$^+$	<1 μs	T$_{1/2}$: from absence of delayed γ (1981Fi02).
285.5 *2*	5$^+$		
328.0 *6*	4$^+$		
362.6 *5*	5$^-$		
651.0 *6*	3$^+$		
812.9 *1*	9$^+$		
854.0 *12*	2$^+$		
1809.1 *2*	9$^-$		
1880.2 *2*	11$^-$	0.44 μs *2*	T$_{1/2}$: from delayed $\gamma\gamma$ coin (1981Fi02).
1985.6 *3*	10$^+$		
2487.3 *3*	(12$^-$)		
3071.8 *6*			

† From a least-squares fit to Eγ, by evaluators.
‡ As given by 1981Fi02 from $\gamma(\theta)$, lifetimes and previous work.

γ(^{90}Nb)

E$_\gamma$	I$_\gamma$†	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.‡	Comments
(2.3 *4*)		124.9	4$^-$	122.6	6$^+$		E$_\gamma$: from the Adopted Levels.
42.5 *5*	0.7 *4*	328.0	4$^+$	285.5	5$^+$	D	I$_\gamma$: from authors' I(γ+ce)=2 *1* and α value. Mult.: A$_2$=−0.05 *2*, A$_4$=−0.02 *3* (1981Fi02).
71.1 *2*	1.8 *5*	1880.2	11$^-$	1809.1	9$^-$	Q	Mult.: A$_2$=+0.25 *2*, A$_4$=−0.03 *2* (1981Fi02). I$_\gamma$: from authors' I(γ+ce)=10 *3* and α value.
122.6 *1*	51 *3*	122.6	6$^+$	0	8$^+$		
162.9 *1*	20 *1*	285.5	5$^+$	122.6	6$^+$	D	Mult.: A$_2$=−0.08 *1*, A$_4$=+0.00 *1* (1981Fi02).
171.1 *1*	22 *1*	171.1	7$^+$	0	8$^+$	D	Mult.: A$_2$=−0.12 *1*, A$_4$=+0.03 *2* (1981Fi02).
203.0 *10*	1.2 *8*	854.0	2$^+$	651.0	3$^+$		A$_2$=−0.01 *7*, A$_4$=−0.1 *1* (1981Fi02).
237.7 *1*	22 *1*	362.6	5$^-$	124.9	4$^-$	D	Mult.: A$_2$=−0.26 *2*, A$_4$=+0.03 *2* (1981Fi02).
323.0 *2*	6.6 *4*	651.0	3$^+$	328.0	4$^+$		A$_2$=+0.03 *3*, A$_4$=+0.01 *4* (1981Fi02).
584.5 *5*	≈3	3071.8		2487.3	(12$^-$)		
607.1 *2*	12 *2*	2487.3	(12$^-$)	1880.2	11$^-$	D	Mult.: A$_2$=−0.71 *7*, A$_4$=+0.2 *2* (1981Fi02).
812.9 *1*	100	812.9	9$^+$	0	8$^+$	D	Mult.: A$_2$=−0.47 *1*, A$_4$=+0.03 *1* (1981Fi02).
996.2 *2*	21 *1*	1809.1	9$^-$	812.9	9$^+$		A$_2$=+0.29 *6*, A$_4$=−0.12 *7* (1981Fi02).
1067.3 *2*	27 *1*	1880.2	11$^-$	812.9	9$^+$	Q	Mult.: A$_2$=+0.33 *3*, A$_4$=−0.08 *5* (1981Fi02).
1172.7 *2*	9 *1*	1985.6	10$^+$	812.9	9$^+$	D	Mult.: A$_2$=−0.23 *7*, A$_4$=−0.1 *1* (1981Fi02).

† Deduced from $\gamma(\theta)$ data following (α,3nγ) reaction at 35 MeV.
‡ From $\gamma(\theta)$ measurements in 1981Fi02.

^{90}Zr(p,n) 1980Ba16,1988Bo43

1988Bo43: E(p)=22.5 MeV. Measured $\sigma(\theta)$ with neutron time-of-flight, distorted wave analysis.
1996Gr07: E(p)=26 MeV. Measured neutron time-of-flight.
1980Ba16: E(p)=120 MeV. Measured $\sigma(\theta)$ with neutron time-of-flight, FWHM=660 keV. L values are from comparison with distorted wave calculations.
For polarization transfer in the (p,n)-reaction, see 1987Sa14, 1987Ta22.
For studies of the IAS of ^{90}Zr(g.s.), see 1971Be46 (E(p)=23 MeV), 1973Jo05 (E(p)=22, 30, 40 MeV), 1975Do08 (E(p)=25, 35, 45 MeV), 1976Go23 (E(pol p)=22.8 MeV).

^{90}Nb Levels

E(level)†	L†	Comments
350		E(level): From 1988Bo43.
1.0×10^3 *2*		
2.13×10^3 *20*	0	E(level): from 1996Gr07.
3.0×10^3 *3*	0	
5.1×10^3 *2*	0	E(level): IAS of ^{90}Zr(g.s.).
8.7×10^3 *3*	0	
13.4×10^3 *4*	(1)	
17.9×10^3 *6*	1	

† From 1980Ba16, except where noted.

^{90}Zr(p,nγ) 1972Yo03

1972Yo03: E(p)=6.90-9.50 MeV. Measured excit with Ge(Li) at 90°.

^{90}Nb Levels

E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡
0.0	8$^+$	822.6		1372.0 *12*	(2$^-$)	≈1907?	
122.4	6$^+$	827.5	(2)$^+$	1414 *1*		1972 *1*	
124.8 *5*	4$^-$	847.8 *7*		1433 *1*		1991 *1*	
171.2 *3*	7$^+$	854.3	2$^+$	1631 *1*		≈2007?	
285.3	5$^+$	1128.3 *3*		1647 *1*		2125.6	(1)$^+$
328.0 *3*	4$^+$	1196 *1*		1769.0	(1)$^+$	≈2160?	
362.4 *6*	5$^-$	1280 *1*		1816 *1*			
382.1	1$^+$	1344.1	(1)$^+$	1836 *1*			
651.2	3$^+$	1363 *1*		1844.5	(1)$^+$		

† From 1972Yo03.
‡ As proposed by 1972Yo03.

γ(^{90}Nb)

For measured ce spectrum, see 1972Pi13.

E$_\gamma$	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Comments
(2.4)	124.8	4$^-$	122.4	6$^+$	
42.7 *3*	328.0	4$^+$	285.3	5$^+$	
122.37† *22*	122.4	6$^+$	0.0	8$^+$	
162.93† *9*	285.3	5$^+$	122.4	6$^+$	
171.2 *3*	171.2	7$^+$	0.0	8$^+$	
203.13† *10*	854.3	2$^+$	651.2	3$^+$	
237.6 *3*	362.4	5$^-$	124.8	4$^-$	
257.34† *4*	382.1	1$^+$	124.8	4$^-$	
323.20† *18*	651.2	3$^+$	328.0	4$^+$	
440.5† *6*	822.6		382.1	1$^+$	
445.37† *21*	827.5	(2)$^+$	382.1	1$^+$	
472.2† *3*	854.3	2$^+$	382.1	1$^+$	
477.1 *3*	1128.3		651.2	3$^+$	
485.4 *3*	847.8		362.4	5$^-$	
489.8† *4*	1344.1	(1)$^+$	854.3	2$^+$	
517.7† *7*	1372.0	(2$^-$)	854.3	2$^+$	
641 *1*	1836		1196		
711 *1*	1363		651.2	3$^+$	
722 *1*	847.8		124.8	4$^-$	
763 *1*	1414		651.2	3$^+$	
941.5† *4*	1769.0	(1)$^+$	827.5	(2)$^+$	
946.4† *8*	1769.0	(1)$^+$	822.6		
981 *1*	1363		382.1	1$^+$	E$_\gamma$: Authors′ value of 891 in their Table I is a misprint.
990.2† *6*	1844.5	(1)$^+$	854.3	2$^+$	
1003 *1*	1128.3		124.8	4$^-$	
1035 *1*	1363		328.0	4$^+$	
1053‡ *1*	≈1907?		854.3	2$^+$	
1071 *1*	1196		124.8	4$^-$	

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^{90}Zr(p,nγ) 1972Yo03 (continued)

γ(^{90}Nb) (continued)

E_γ	E_i(level)	J^π_i	E_f	J^π_f	E_γ	E_i(level)	J^π_i	E_f	J^π_f
1105 *1*	1433		328.0	4^+	1463.5† *9*	1844.5	$(1)^+$	382.1	1^+
1155 *1*	1280		124.8	4^-	1506 *1*	1631		124.8	4^-
1184 *1*	1836		651.2	3^+	1522 *1*	1647		124.8	4^-
1238 *1*	1363		124.8	4^-	1625‡ *1*	≈2007?		382.1	1^+
1248 *1*	1372.0	(2^-)	124.8	4^-	1691 *1*	1816		124.8	4^-
1271.3† *6*	2125.6	$(1)^+$	854.3	2^+	1778‡ *1*	≈2160?		382.1	1^+
1309 *1*	1433		124.8	4^-	1847 *1*	1972		124.8	4^-
1340 *1*	1991		651.2	3^+	1865 *1*	1991		124.8	4^-
1387.4† *5*	1769.0	$(1)^+$	382.1	1^+					

† From ^{90}Mo ε decay. Values are mostly from 1966Pe10, as quoted by 1968Co05.
‡ Placement of transition in the level scheme is uncertain.

^{90}Zr(^{3}He,t) 1982Fi09

1982Fi09: E(^{3}He)=43.4 MeV. Measured $\sigma(\theta)$ with magnetic spectrograph, FWHM≈40 keV.
1991Ja04: E(^{3}He)=200 MeV. Measured $\sigma(\theta)$ with magnetic spectrograph, observed IAS of ^{90}Zr(g.s.), 382 and 2126, 1^+ states.
2012Th12: E(^{3}He)=420 MeV. Target=0.99 mg/cm^2 self-supporting ^{96}Zr foil enriched to 57.7%. which contained 9.2% ^{90}Zr.

Measured triton spectra, $\sigma(\theta)$ using Grand Raiden spectrometer at the Osaka University RCNP facility. FWHM ≈ 32 keV.
Others: 1969Be46, 1969Ha47, 1981FuZV, 1989Va09.
For studies of IAS of ^{90}Zr(g.s.), see 1971Fa03, 1972Fa06, 1972Fa12, 1972Hi08, 1981FuZV, 1989Va09.

^{90}Nb Levels

E(level)[‡]	J^{π}[†]	L[&]	B(GT)	Comments
0	8^+			
123[#]	$6^+,4^-$			
171	7^+			
285	5^+			
328	4^+			
362[#]	$5^-,(1^+)$			
651	3^+			
813	9^+			
854	2^+			
959 *10*	(3,4,5)			
1286 *10*	(3,4,5)			
1364 *10*	(1,2)			
1424 *10*	(1,2)			
1503 *10*	(4,5,6)			
1563 *10*	(7,8)			
1658 *10*	(3,4,5)			
1692 *10*				
1792[#] *10*				
1827 *10*				
1862 *10*				
1973 *10*	(3,4,5)			
1998 *10*				
2037 *10*				
2082 *10*				
2104 *10*				
2136 *10*	1^+	0+2	1.56 *3*	dσ/dΩ=9.95 mb/sr *21* (2012Th12). E(level): value is 10 keV above 2125.6 keV given in Adopted Levels. The peak appears at 8408 keV in ^{90}Nb excitation spectrum (2012Th12).
2165 *10*	(3,4,5)			
2340 *15*				
2370 *15*				
2430 *15*				
2530 *15*				
2560 *15*				
2580 *15*				
2650 *15*				
2680 *15*				
2710 *15*				
2730 *15*				
2780 *15*				
2850 *15*				
2880 *15*				
2950 *15*				
2980 *15*				
3020 *15*				
3160 *15*				

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^{90}Zr(^{3}He,t) 1982Fi09 (continued)

^{90}Nb Levels (continued)

E(level)[‡]	J$^{\pi}$[†]	L[&]	Comments
5037[@] *6*	0^{+}	0	E(level): 5072 *25* (1991Ja04). E(level): IAS. The peak appears at 11309 keV in ^{90}Nb excitation spectrum (2012Th12).

[†] Tentative Jπ's from comparison with DWBA calculations and from comparison with $\sigma(\theta)$ for levels with known Jπ (1982Fi09).
[‡] From 1982Fi09, unless stated. Energies below 900 and 2126 are from 1972Yo03 as quoted by 1982Fi09.
[#] Unresolved doublet.
[@] IAS of ^{90}Zr(g.s.) (1981FuZV).
[&] From 1982Fi09, unless stated.

^{90}Zr(^{12}C,^{12}B) 1991An12

E(^{12}C)=70 MeV. Measured $\sigma(\theta)$ at angles <2.5° in 0.32° bins. FWHM≈800 keV. Compared $\sigma(\theta)$ of 2.3 MeV peak with distorted wave calculations.

^{90}Nb Levels

E(level)	J^π	L	Comments
0			
≈1000			
≈2300	1^+	0	L: rather poor fit to data assuming configuration=((π $1g_{9/2}$)(ν $1g_{9/2}$)$^{-1}$) or configuration=((π $1g_{7/2}$)(ν $1g_{9/2}$)$^{-1}$).
≈2730			
≈3400			

^{92}Mo(d,α) 1974Co37

1974Co37: E(d)=17 MeV. Measured $\sigma(\theta)$ with magnetic spectrograph, FWHM=25-30 keV.

^{90}Nb Levels

E(level)†	L‡	E(level)†	L‡	E(level)†	L‡	E(level)†	L‡
0.0		958 *10*	(5)	1415 *10*		1873 *10*	
129 *10*	3	1131 *10*		1492 *10*	3	1974 *10*	
176 *10*	6	1194 *10*		1552 *10*	5	2002 *10*	
286 *10*	4	1231 *10*		1647 *10*	3	2130 *10*	0+2
381 *10*	0+2	1255 *10*		1691 *10*		2172 *10*	
655 *10*	2+4	1289 *10*		1776 *10*	0+2	2311 *10*	
819 *10*	8	1350 *10*	0+2	1804 *10*		2349 *10*	
848 *10*	2	1370 *10*		1842 *10*		2479 *10*	

† Uncertainties are 5-10 keV (1974Co37).
‡ From comparison with DWBA calculations (1974Co37).

Adopted Levels, Gammas

Q(β^-)=−9448.0 *40*; S(n)=13229.0 *50*; S(p)=6836 *24*; Q(α)=−4628 *5* 2017Wa10
S(2n)=23629 *5*; S(2p)=11122 *6*.

^{90}Mo Levels

Cross Reference (XREF) Flags

A	^{90}Tc ε decay (8.7 s)	F	^{92}Mo(p,t)
B	^{90}Tc ε decay (50.7 s)	G	^{90}Zr(^{3}He,3nγ)
C	^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ)	H	^{9}Be(^{124}Xe,Xγ)
D	^{66}Zn(^{28}Si,2p2nγ)	I	^{59}Co(^{35}Cl,2p2nγ)
E	^{58}Ni(^{40}Ca,α4pγ)		

E(level)[#]	J$^\pi$	T$_{1/2}$[@]	XREF	Comments
0.0[†]	0$^+$	5.56 h *9*	ABCDEFGHI	%ε+%β^+=100 T$_{1/2}$: weighted average of 5.67 h *5* (1966Pe10), 5.60 h *15* (1965Gr29), 5.32 h *7* (1969Ol01), and 5.7 h *2* (1953Di08).
948.02[†] *9*	2$^+$		ABCDEFGHI	J$^\pi$: from L(p,t)=2.
1896.53 *13*	2$^+$		C FG	J$^\pi$: from L(p,t)=2.
1979 *5*	0$^+$		F	J$^\pi$: from L(p,t)=0.
2002.12[†] *11*	4$^+$		BCDEFGHI	J$^\pi$: from L(p,t)=4.
2432.63 *17*	3$^-$		C FG	J$^\pi$: from L(p,t)=3.
2450 *5*	0$^+$		F	J$^\pi$: from L(p,t)=0.
2534.1 *7*	(2$^+$)		FG	XREF: F(2528). J$^\pi$: D(+Q) 1586.2γ to 2$^+$, possible 2534γ to 0$^+$.
2548.82 *12*	5$^-$	16 ps *3*	BCDEFGH	μ=5.5 *14* J$^\pi$: from L(p,t)=5. μ: From IMPAD (ion-implantation perturbed angular distribution) (1994We09,2014StZZ).
2613 *5*	2$^+$		F	J$^\pi$: from L(p,t)=2.
2706 *5*			F	
2811.69[†] *12*	6$^+$		BCDE GHI	J$^\pi$: E2 809.6γ to 4$^+$, assignment to ground state sequence.
2859.21[‡] *13*	5$^-$		BC FG	J$^\pi$: from L(p,t)=5.
2874.81[†] *15*	8$^+$	1.14 μs *5*	CDEFGHI	Q=0.61 *3*; μ=−1.391 *14* J$^\pi$: systematics of half-lives for Jπ=8$^+$ member of g.s. rotational band in ^{88}Zr and ^{86}Sr. L(p,t)=(6) is in disagreement. 63γ to 6$^+$. T$_{1/2}$: weighted average of 1.14 μs *5* (1978Ha52), 1.05 μs *10* (1971Is04) and 1.15 μs *5* (2017Pa35), 1.14 μs *5* (2019Ha26, and 1.17 μs *+11−7* (2004Ch35). μ: from TDPAD (time-differential perturbed angular distribution) (1978Ha52, 2014StZZ). Q: from TDPAD (time-differential perturbed angular distribution) (1985Ra09, 2016St14).
2901.23 *19*	(4$^-$)		C FG	J$^\pi$: 468.6γ to 3$^-$.
2946.89 *14*	(6$^+$)		BC G	J$^\pi$: 944.8γ to 4$^+$, 135.2γ to 6$^+$.
3037.6 *10*			B	
3074 *7*	3$^-$		F	J$^\pi$: from L(p,t)=3.
3106.20 *16*	8$^+$	4.9 ps *13*	CDE G I	J$^\pi$: 231γ M1+E2 ΔJ=0 transition to 8$^+$.
3147.9 *10*	2$^+$		FG	J$^\pi$: from L(p,t)=2.
3150.0 *5*			B	E(level): possible ε+β^+ feeding from Jπ=8$^+$ suggests that this level is different from the 3148 level.
3185 *7*			F	
3293.86 *22*			BC FG	J$^\pi$: feeding from 8$^+$ parent in ^{90}Tc ε decay would suggest J=7,8,9. However, 1291.4γ to 4$^+$ and 482.3γ to 6$^+$ suggests J=4$^+$,5,6$^+$.
3355 *7*			F	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{90}Mo Levels (continued)

E(level)[#]	J^π	$T_{1/2}$[@]	XREF	Comments
3367.38[‡] *13*	7^-	<0.69 ps	CDE G	J^π: E2 818.6γ to 5^-, assignment to negative parity sequence.
3446.22 *19*	(7^-)		C G	J^π: (E2) 897.4γ to 5^-.
3494 *7*			F	
3514 *7*			F	
3539.8 *8*			B	
3659.73 *16*	(7^-)		C G	J^π: (E2) 800.5γ to 5^-.
3683 *7*			F	
3736 *7*			F	
3834 *7*			F	
3936 *7*			F	
4078.91[†] *16*	10^+	14.6 ps *28*	CDE G I	J^π: E2 972.7γ to 8^+, assignment to ground state sequence.
4094.8 *5*			B	
4175.4 *8*			B	
4192.52 *15*	10^+	<3.5 ps	CDE G I	J^π: E2 1317.7γ to 8^+.
4297.75[‡] *15*	9^-	9.7 ps *21*	CDE G	J^π: E2 930.3γ to 7^-.
4357.5 *10*			B	
4555.86[†] *15*	12^+	526 ps *3*	CDE G I	μ=6.0 *7* μ: from g-factor=0.50 *6*, by IMPAD (ion-implantation perturbed angular distribution) (1994We09,2014StZZ). J^π: E2 476.95γ to 10^+.
4594.25 *25*	(9,10)		C G	J^π: D(+Q) 296.5γ to 9^-.
4789.37 *18*	10		C G	J^π: D+Q 491.7γ to 9^-.
4842.02[‡] *15*	11^-	39 ps *2*	CDE G	μ=+4.6 *14* μ: from g-factor=0.42 *13*, by IMPAD (ion-implantation perturbed angular distribution) (1994We09,2014StZZ). $T_{1/2}$: other: < 0.7 ps from (^{28}Si,2p2nγ). J^π: E2 544.2γ to 9^-.
4895.14 *18*	(11)		C G	J^π: 105.8γ to (10).
5377.24 *17*	(13^+)	1.8 ps *3*	CDE G I	J^π: D+Q 821.4γ to 12^+. $T_{1/2}$: weighted average of 1.0 ps *3* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) and 1.94 ps *13* from ^{59}Co(^{35}Cl,2p2nγ).
5499.42 *16*	(12)		C	J^π: D 657.4γ to 11^-.
5621.6 *3*	(14^+)		D	J^π: D 244.2γ to (13^+).
5625.02[†] *17*	14^+	0.76 ps *7*	CDE I	$T_{1/2}$: from ^{59}Co(^{35}Cl,2p2nγ), uncertainty increased by evaluators. Others: 2.7 ps *1* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) and 4.8 ps *14* from (^{28}Si,2p2nγ). J^π: E2 1069.1γ to 12^+.
5699.65[‡] *16*	13^-	1.4 ps *4*	CDE	J^π: E2 857.7γ to 11^-. $T_{1/2}$: other: < 0.7 ps in (^{28}Si,2p2nγ).
5863.75 *16*	(13)		C	J^π: 364.4γ to (12).
5903.74 *18*	14^+	1.5 ps *3*	C E I	J^π: M1+E2 526.5γ to 13^+. $T_{1/2}$: weighted average of 1.7 ps *4* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) and 1.39 ps *28* from ^{59}Co(^{35}Cl,2p2nγ).
6064.89 *19*	(13)		C	J^π: 565.5γ to (12).
6148.16 *18*	15^+	0.721 ps *49*	CDE I	$T_{1/2}$: from ^{59}Co(^{35}Cl,2p2nγ). Others: <0.3 ps from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) and <1.4 ps in (^{28}Si,2p2nγ). J^π: M1+E2 244.5γ to 14^+.
6475.91 *16*	14^-	1.5 ps *10*	C E	J^π: M1+E2 776.2γ to 13^-.
6643.13[‡] *16*	15^-	1.3 ps *1*	CDE	J^π: E2 943.3γ to 13^-. $T_{1/2}$: other: < 0.7 ps in (^{28}Si,2p2nγ).
6746.10[†] *18*	16^+	2.0 ps *3*	CDE I	J^π: M1+E2 598.0γ to 15^+. $T_{1/2}$: weighted average of 3.6 ps *7* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) and

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{90}Mo Levels (continued)

E(level)[#]	J^π	$T_{1/2}$[@]	XREF	Comments
				1.91 ps *14* from ^{59}Co(^{35}Cl,2p2nγ).
7027.0? *4*	17		D	J^π: D+Q 280.9γ to 16^+.
7170.98 *19*	(16^+)		C	J^π: 1545.9γ to 14^+.
7385.59 *19*	16^-	6.6 ps *15*	C E	J^π: M1+E2 742.5γ to 15^-.
7515.01[‡] *19*	17^-	7.4 ps *3*	CDE	$T_{1/2}$: Other: 5.5 ps *7* from (^{28}Si,2p2nγ). J^π: E2 872.0γ to 15^-.
7629.61 *21*	(16)		C	J^π: (D+Q) 1481.4γ to 15^+.
7682.4? *4*	(18)		D	J^π: (D+Q) 167.4γ to 17^-.
8066.77 *19*	17^+	0.60 ps *4*	C E	J^π: E2 1918.6γ to 15^+.
8123.55[‡] *20*	(18^-)		C E	J^π: D+Q 608.5γ to 17^-; assignment to negative parity sequence.
8281.85 *22*	(17^+)		C	J^π: 2133.7γ to 15^+.
8525.30[†] *19*	18^+	0.16 ps *2*	C E	J^π: E2 1779.2γ to 16^+.
8616.84 *20*	(17^+)		C	J^π: 1870.7γ to 16^+, 2468.6γ to 15^+.
8678.44[‡] *23*	(19^-)		C E	J^π: D 554.9γ to (18^-), assignment to negative-parity sequence.
9079.18 *20*	(18^-)		C	J^π: 1564.1γ to 17^-, 1693.6γ to 16^-.
9136.60 *19*	(18^+)		C E	J^π: (E2) 2390.5γ to 16^+.
9319.01 *20*	(19^-)		C E	J^π: (E2) 1803.97γ to 17^-.
9443.90 *20*	(19^+)		C E	J^π: D+Q 918.6γ to 18^+, 1377.0γ to 17^+.
9739.38 *19*	(19^+)		C E	J^π: (E2) 1672.5γ to 17^+.
9787.96[†] *21*	(20^+)		C E	J^π: (E2) 1262.7γ to 18^+.
9995.04 *21*	(20^-)		C E	J^π: D+Q 676.0γ to (19^-), 1871.6γ to (18^-).
10235.14 *20*	20^+	0.21 ps *6*	C E	J^π: E2 1709.9γ to 18^+.
10477.36 *21*	(20^+)		C E	J^π: 738.0γ to (19^+), 1952.0γ to 18^+.
10537.91 *25*	(21)		C E	J^π: D 542.9γ to (20^-).
10855.61 *20*	21^+	0.90 ps *14*	C E	J^π: M1+E2 620.5γ to 20^+.
11135.76[†] *21*	22^+	<0.07 ps	C	J^π: M1+E2 280.2γ to 21^+.
11269.3 *7*	(21)		E	J^π: 2590γ to (19).
11577.07 *23*	(22^+)		C E	J^π: E2 1789.1γ to (20^+).
11735.5 *5*			E	
12016.61 *23*	23^+	<1.2 ps	C E	J^π: E2 1161.0γ to 21^+.
12257.7 *10*			E	
12383.6 *3*	(23)		C E	J^π: (E2) 1845.7γ to (21).
14279.8 *10*			E	
14412.1 *10*			E	
14486.6 *10*			E	

[†] Seq.(A): Ground state sequence.
[‡] Seq.(B): Negative-parity sequence.
[#] From a least-squares fit to Eγ, by evaluators.
[@] From recoil distance Doppler-shift and Doppler-shift attenuation methods in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), except where noted.

$\gamma(^{90}Mo)$

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[a]	Comments
948.02	2^+	948.01 *9*	100	0.0	0^+	E2		8.74×10^{-4}	Mult.: Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
1896.53	2^+	948.50 *10*		948.02	2^+	[M1+E2]		8.87×10^{-4} *19*	
		1896.8		0.0	0^+	[E2]		4.64×10^{-4}	E_γ: from (^{3}He,3nγ).
2002.12	4^+	1054.10 *7*	100	948.02	2^+	E2		6.86×10^{-4}	
2432.63	3^-	536.10 *10*	57 *5*	1896.53	2^+				I_γ: from (^{3}He,3nγ).
		1484.7	100 *16*	948.02	2^+	E1+M2	−0.12 *8*	3.97×10^{-4} *11*	E_γ,I_γ: from (^{3}He,3nγ). Mult.,δ: D+Q from $\gamma\gamma(\theta)$ in (^{3}He,3nγ), $\Delta\pi$=yes from level scheme.
2534.1	(2^+)	1586.2	100	948.02	2^+	D(+Q)	−0.13 *22*		E_γ,I_γ,Mult.,δ: from (^{3}He,3nγ).
		2534	≤5.6	0.0	0^+				E_γ,I_γ: from (^{3}He,3nγ).
2548.82	5^-	546.69 *4*	100	2002.12	4^+	E1		1.20×10^{-3}	B(E1)(W.u.)=1.29×10^{-4} *+30−20* Mult.: D from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=yes from level scheme.
2811.69	6^+	262.84 *17*	4.9 *3*	2548.82	5^-	E1		0.00790	Mult.: D from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=yes from level scheme. I_γ: weighted average of 3.8 *12* from ^{90}Tc ε decay (50.7 s), 5.0 *3* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), 12.5 *5* from ^{66}Zn(^{28}Si,2p2nγ), 8.9 *16* (^{40}Ca,α4pγ), and 4.6 *4* from (^{3}He,3nγ).
		809.57 *6*	100 *3*	2002.12	4^+	E2		1.28×10^{-3}	
2859.21	5^-	310.39 *6*	100 *11*	2548.82	5^-				I_γ: from (^{3}He,3nγ).
		857.10 *12*	≈30	2002.12	4^+				I_γ: from (^{3}He,3nγ). Other <125 in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ).
2874.81	8^+	63.15 *9*	100	2811.69	6^+	[E2]		6.30	B(E2)(W.u.)=2.84 *13*
2901.23	(4^-)	468.60 *10*	100	2432.63	3^-				
2946.89	(6^+)	135.18 *8*	≈50	2811.69	6^+				I_γ: from (^{3}He,3nγ). Other 80 *50* in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), 14.2 *22* in ^{90}Tc ε decay (50.7 s).
		944.80 *14*	100 *12*	2002.12	4^+				I_γ: from (^{3}He,3nγ).
3037.6		1035.5[§] *10*	100[§]	2002.12	4^+				
3106.20	8^+	231.43 *8*	100	2874.81	8^+	M1+E2	−0.04 *+10−40*	0.026 *6*	B(M1)(W.u.)=0.35 *+9−12*
3147.9	2^+	715.3	100	2432.63	3^-				E_γ: from (^{3}He,3nγ).
3150.0		1147.9[§] *5*	100[§]	2002.12	4^+				
3293.86		482.26 *20*	100 *7*	2811.69	6^+				E_γ: weighted average of 481.7 *3* (^{90}Tc ε Decay (50.7 s)), 482.40 *15* (^{58}Ni(^{3}Ar,4pγ),(^{35}Cl,3pγ)), 482.4 *10* (^{90}Zr(^{3}He,3nγ)).
		1291.4 *5*	54 *5*	2002.12	4^+				E_γ,I_γ: from ^{90}Tc ε decay (50.7 s).
3367.38	7^-	508.20 *15*	≤13	2859.21	5^-	[E2]		0.00452	
		555.65 *9*	30.8 *21*	2811.69	6^+	E1		1.15×10^{-3}	I_γ: other: 15.5 *19* in (^{3}He,3nγ).

$^{90}_{42}Mo_{48}$-4

$\gamma(^{90}Mo)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[a]	Comments
									Mult.: D from R(DCO) in $^{58}Ni(^{36}Ar,4p\gamma),(^{35}Cl,3p\gamma)$, $\Delta\pi$=yes from level scheme.
3367.38	7^-	818.56 *10*	100 *7*	2548.82	5^-	E2		1.24×10^{-3}	Mult.: Q from R(DCO) in $^{58}Ni(^{36}Ar,4p\gamma),(^{35}Cl,3p\gamma)$, M2 excluded by comparison to RUL.
3446.22	(7^-)	897.40 *15*	100	2548.82	5^-	(E2)[&]		9.95×10^{-4}	
3539.8		592.9[§] *8*	100[§]	2946.89	(6^+)				
3659.73	(7^-)	292.30 *24*	100 *8*	3367.38	7^-				
		800.52 *15*	60 *4*	2859.21	5^-	(E2)[&]		1.31×10^{-3}	
4078.91	10^+	972.73 *8*	100	3106.20	8^+	E2		8.23×10^{-4}	B(E2)(W.u.)=1.86 *+45−29* Mult.: Q from R(DCO) in $^{58}Ni(^{36}Ar,4p\gamma),(^{35}Cl,3p\gamma)$, M2 excluded by comparison to RUL.
4094.8		801.2[§] *5*	100[§] *15*	3293.86					
		2091.7[§] *9*	68[§] *15*	2002.12	4^+				
4175.4		1363.7[§] *8*	100[§]	2811.69	6^+				
4192.52	10^+	113.64 *8*	1.8 *3*	4078.91	10^+				I_γ: others: 5.7 *6* in $(^{40}Ca,\alpha4p\gamma)$, ≈ 70 in $(^3He,3n\gamma)$.
		1086.37 *12*	1.36 *21*	3106.20	8^+	[E2]		6.41×10^{-4}	
		1317.68 *7*	100 *14*	2874.81	8^+	E2		4.54×10^{-4}	Mult.: Q from R(DCO) in $^{58}Ni(^{36}Ar,4p\gamma),(^{35}Cl,3p\gamma)$, M2 excluded by comparison to RUL.
4297.75	9^-	638.00 *15*	3.12 *23*	3659.73	(7^-)	(E2)		0.00237	B(E2)(W.u.)=0.70 *+21−14* Mult.: Q from R(DCO) in $^{58}Ni(^{36}Ar,4p\gamma),(^{35}Cl,3p\gamma)$, M2 excluded by comparison to RUL.
		930.34 *9*	100 *7*	3367.38	7^-	E2		9.13×10^{-4}	B(E2)(W.u.)=3.4 *+10−6* Mult.: Q from R(DCO) in $^{58}Ni(^{36}Ar,4p\gamma),(^{35}Cl,3p\gamma)$, M2 excluded by comparison to RUL.
4357.5		2355.3[§] *10*	100[§]	2002.12	4^+				
4555.86	12^+	363.33[§] *4*	58 *4*	4192.52	10^+	E2		0.01282	B(E2)(W.u.)=2.57 *12* Mult.: Q from R(DCO) in $^{58}Ni(^{36}Ar,4p\gamma),(^{35}Cl,3p\gamma)$, M2 excluded by comparison to RUL. I_γ: weighted average of 54 *8* from $^{58}Ni(^{36}Ar,4p\gamma),(^{35}Cl,3p\gamma)$, 64.3 *11* from $^{66}Zn(^{28}Si,2p2n\gamma)$, 53.6 *9* $(^{40}Ca,\alpha4p\gamma)$. Other: 7.0 *7* from $(^3He,3n\gamma)$.
		476.95[§] *10*	100 *1*	4078.91	10^+	E2		0.00546	B(E2)(W.u.)=1.142 *30* Mult.: Q from R(DCO) in $^{58}Ni(^{36}Ar,4p\gamma),(^{35}Cl,3p\gamma)$, M2 excluded by comparison to RUL.
4594.25	(9,10)	296.50 *20*	100	4297.75	9^-	D(+Q)	−0.2 *+4−3*	0.0143 *18*	
4789.37	10	491.66 *14*	100	4297.75	9^-	D+Q		0.0045 *5*	
4842.02	11^-	544.22 *9*	100 *2*	4297.75	9^-	E2		0.00370	B(E2)(W.u.)=8.7 *7* Mult.: Q from R(DCO) in $^{58}Ni(^{36}Ar,4p\gamma),(^{35}Cl,3p\gamma)$, M2 excluded by comparison to RUL.

$^{90}_{42}Mo_{48}$-5

$\gamma(^{90}Mo)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[a]	Comments
4842.02	11^-	649.64 *16*	47 *10*	4192.52	10^+	E1		8.07×10^{-4}	B(E1)(W.u.)=1.00×10^{-5} *+15−17* I_γ: weighted average of 63.9 *22* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), 34.3 *19* (^{40}Ca,α4pγ), and 46 *6* from (^{3}He,3nγ). Mult.: D from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=yes from level scheme.
4895.14	(11)	105.78 *9*	100	4789.37	10				
5377.24	(13^+)	821.37 *9*	100	4555.86	12^+	M1+E2	0.09 *4*	1.24×10^{-3}	B(M1)(W.u.)=0.0219 *+44−32*; B(E2)(W.u.)=0.28 *+33−19* Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
5499.42	(12)	604.33 *15*	52 *7*	4895.14	(11)	(D+Q)		0.00266 *16*	
		657.41 *5*	100 *26*	4842.02	11^-	D			
5621.6	(14^+)	244.2 *3*	13.1 *2*	5377.24	(13^+)	D			
5625.02	14^+	247.75 *8*	100 *2*	5377.24	(13^+)	M1(+E2)	0.04 *5*	0.0220 *4*	B(M1)(W.u.)=1.07 *10* Mult.: D(+Q) from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
		1069.12 *21*	77 *2*	4555.86	12^+	E2		6.64×10^{-4}	B(E2)(W.u.)=9.6 *+10−8* Mult.: Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), M2 excluded by comparison to RUL. I_γ: from (^{40}Ca,α4pγ). Other: 95 *14* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ).
5699.65	13^-	857.52 *15*	100 *3*	4842.02	11^-	E2		1.11×10^{-3}	B(E2)(W.u.)=23 *+9−5* Mult.: Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), M2 excluded by comparison to RUL.
		1143.78 *10*	55 *2*	4555.86	12^+	E1		2.73×10^{-4}	B(E1)(W.u.)=5.7×10^{-5} *+22−13* I_γ: weighted average of 54 *8* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), 52 *4* from (^{28}Si,2p2nγ) and 57 *3* from (^{40}Ca,α4pγ). Mult.: D from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=yes from level scheme.
5863.75	(13)	364.36 *8*	100	5499.42	(12)				
5903.74	14^+	526.53 *8*	100	5377.24	(13^+)	M1+E2	0.13 *5*	0.00343	B(M1)(W.u.)=0.099 *+25−17*; B(E2)(W.u.)=6 *+6−4* Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), E1+M2 excluded by comparison to RUL.
6064.89	(13)	365.20 *20*	100 *25*	5699.65	13^-				
		565.50 *30*	28.8 *25*	5499.42	(12)				
6148.16	15^+	244.46 *8*	58 *9*	5903.74	14^+	M1+E2	0.12 *3*	0.0231	B(M1)(W.u.)=0.46 *6*; B(E2)(W.u.)=1.2×10^{2} *+7−5* Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), E1+M2 excluded by comparison to RUL. I_γ: weighted average of 44 *3* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) and 64 *2* from (^{40}Ca,α4pγ).
		523.11 *10*	100 *2*	5625.02	14^+	M1+E2	0.11 *3*	0.00348	B(M1)(W.u.)=0.081 *7*; B(E2)(W.u.)=3.8 *+24−18*

$^{90}_{42}Mo_{48}$-6

$\gamma(^{90}Mo)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[a]	Comments
									Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), E1+M2 excluded by comparison to RUL.
6148.16	15^+	526.4 *3*	100 *2*	5621.6	(14^+)	(M1+E2)	0.11 *3*	0.00343	B(M1)(W.u.)=0.080 *6*; B(E2)(W.u.)=3.7 *+22−18* I_γ: weighted average of 100 *15* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) and 100 *2* from (^{40}Ca,α4pγ). Other: 39 *3* from (^{28}Si,2p2nγ). Mult.: (D+Q) from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), E1+M2 excluded by comparison to RUL.
6475.91	14^-	411.00 *13*	14 *3*	6064.89	(13)	D			
		612.10 *8*	4.3 *3*	5863.75	(13)				
		776.24 *6*	100 *12*	5699.65	13^-	M1+E2	3.1 *+10−7*	1.42×10^{-3}	B(M1)(W.u.)=0.0025 *+35−13*; B(E2)(W.u.)=43 *+47−19* Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), E1+M2 excluded by comparison to RUL.
6643.13	15^-	167.11 *9*	38 *2*	6475.91	14^-	M1+E2		0.125 *64*	I_γ: weighted average of 39 *5* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) and 37 *2* from (^{40}Ca,α4pγ). Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
		779.43 *6*	7 *3*	5863.75	(13)	E2		1.40×10^{-3}	B(E2)(W.u.)=2.1 *9* Mult.: Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), M2 excluded by comparison to RUL.
		943.5 *2*	100 *3*	5699.65	13^-	E2		8.84×10^{-4}	B(E2)(W.u.)=11.8 *12* Mult.: Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), M2 excluded by comparison to RUL.
		1018.10 *12*	58 *11*	5625.02	14^+	E1		3.20×10^{-4}	B(E1)(W.u.)=6.9×10^{-5} *11* Mult.: D from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=yes from level scheme. I_γ: weighted average of 42 *6* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), 41 *4* from (^{28}Si,2p2nγ) and 72 *3* from (^{40}Ca,α4pγ).
6746.10	16^+	598.00 *10*	100	6148.16	15^+	M1+E2	3.4 *5*	0.00281	B(M1)(W.u.)=0.0041 *+17−10*; B(E2)(W.u.)=142 *+24−20* Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), E1+M2 excluded by comparison to RUL.
7027.0?	17	280.9[#] *3*	100[#]	6746.10	16^+	(D+Q)			
7170.98	(16^+)	1267.15 *17*	40 *8*	5903.74	14^+				
		1545.92 *18*	100 *16*	5625.02	14^+				
7385.59	16^-	742.46 *14*	100	6643.13	15^-	M1+E2	3.1 *8*	1.59×10^{-3}	B(M1)(W.u.)=8×10^{-4} *+7−3*; B(E2)(W.u.)=14.3 *+41−31* Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), E1+M2 excluded by comparison to RUL.
7515.01	17^-	129.41 *7*	16.3 *10*	7385.59	16^-	M1(+E2)	0.14 *14*	0.130 *19*	B(M1)(W.u.)=0.142 *+9−14* Mult.: D(+Q) from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ),

$^{90}_{42}Mo_{48}$-7

$\gamma(^{90}Mo)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[‡]	α[a]	Comments
								$\Delta\pi$=no from level scheme. I_γ: from (^{40}Ca,α4pγ). Other: 15 *4* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ).
7515.01	17$^-$	768.89 *10*	36.0 *15*	6746.10	16$^+$	E1	5.61×10^{-4}	B(E1)(W.u.)=2.33×10^{-5} *13* Mult.: D from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=yes from level scheme. I_γ: weighted average of 33.1 *23* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), 38 *3* from (^{28}Si,2p2nγ) and 36.8 *15* from (^{40}Ca,α4pγ).
		872.0 *3*	100 *2*	6643.13	15$^-$	E2	1.07×10^{-3}	B(E2)(W.u.)=4.10 *18* Mult.: Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), M2 excluded by comparison to RUL.
7629.61	(16)	458.70 *20*	≈100	7170.98	(16$^+$)			
		1481.40 *15*	35 *5*	6148.16	15$^+$	(D+Q)		
7682.4?	(18)	167.4[#] *3*	100[#]	7515.01	17$^-$	(D+Q)		
8066.77	17$^+$	437.20 *31*	12 *2*	7629.61	(16)			
		895.73 *8*	8.6 *13*	7170.98	(16$^+$)			
		1320.75 *11*	31 *11*	6746.10	16$^+$			I_γ: weighted average of 24 *3* from ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) and 49 *5* from (^{40}Ca,α4pγ).
		1918.60 *20*	100 *4*	6148.16	15$^+$	E2	4.70×10^{-4}	B(E2)(W.u.)=1.00 *+11−9* Mult.: Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), M2 excluded by comparison to RUL.
8123.55	(18$^-$)	608.54 *9*	100	7515.01	17$^-$	D+Q	0.00261 *15*	
8281.85	(17$^+$)	2133.70 *20*	100	6148.16	15$^+$			
8525.30	18$^+$	458.59 *9*	100 *17*	8066.77	17$^+$	M1+E2	0.0055 *7*	Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
		1779.20 *17*	16.7 *22*	6746.10	16$^+$	E2	4.35×10^{-4}	B(E2)(W.u.)=1.18 *+31−22* Mult.: Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), M2 excluded by comparison to RUL. I_γ: other: 48 *4* from (^{40}Ca,α4pγ).
8616.84	(17$^+$)	335.00 *15*	100 *16*	8281.85	(17$^+$)			
		1446.0 *3*	40 *6*	7170.98	(16$^+$)			
		1870.70 *15*	100 *16*	6746.10	16$^+$			
		2468.55 *19*	48 *6*	6148.16	15$^+$			
8678.44	(19$^-$)	554.90 *20*	100	8123.55	(18$^-$)	D		
9079.18	(18$^-$)	1564.10 *20*	<63	7515.01	17$^-$			
		1693.60 *10*	100 *25*	7385.59	16$^-$			
9136.60	(18$^+$)	519.70 *30*	100 *15*	8616.84	(17$^+$)	(M1+E2)	0.0039 *4*	Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
		2390.46 *7*	35 *8*	6746.10	16$^+$	(E2)[&]	6.32×10^{-4}	
9319.01	(19$^-$)	239.83 *9*	15 *4*	9079.18	(18$^-$)			
		640.60 *20*	11 *2*	8678.44	(19$^-$)			

$^{90}_{42}Mo_{48}$-8

$\gamma(^{90}Mo)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[a]	Comments
9319.01	(19⁻)	1195.45 *10*	13 *4*	8123.55	(18⁻)	(M1+E2)		5.41×10^{-4} *16*	Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
		1803.97 *11*	100 *24*	7515.01	17⁻	(E2)[&]		4.41×10^{-4}	
9443.90	(19⁺)	918.59 *7*	100 *15*	8525.30	18⁺	(M1+E2)		9.53×10^{-4} *19*	Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
		1377.00 *20*	2.4 *9*	8066.77	17⁺				
9739.38	(19⁺)	602.77 *10*	100 *4*	9136.60	(18⁺)	(M1+E2)		0.00263 *15*	Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
		1214.10 *10*	23 *3*	8525.30	18⁺				
		1672.52 *14*	25 *3*	8066.77	17⁺	(E2)[&]		4.17×10^{-4}	
9787.96	(20⁺)	344.00 *12*	100 *15*	9443.90	(19⁺)	(M1+E2)		0.012 *3*	Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
		1262.70 *10*	42 *6*	8525.30	18⁺	(E2)[&]		4.82×10^{-4}	
9995.04	(20⁻)	676.03 *9*	100 *23*	9319.01	(19⁻)	(M1+E2)		0.00197 *7*	Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
		1871.6 *5*	19 *6*	8123.55	(18⁻)				
10235.14	20⁺	495.71 *11*	100 *14*	9739.38	(19⁺)	M1(+E2)	0.14 *23*	0.00396 *11*	B(M1)(W.u.)=0.43 *+15−13*; B(E2)(W.u.)=4×10^{1} *+26−3* Mult.: D(+Q) from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
		1709.86 *11*	96 *13*	8525.30	18⁺	E2		4.23×10^{-4}	B(E2)(W.u.)=3.8 *+15−9* Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), M2 excluded by comparison to RUL.
10477.36	(20⁺)	738.00 *20*	70 *30*	9739.38	(19⁺)				
		1952.00 *20*	100 *13*	8525.30	18⁺				
10537.91	(21)	542.9 *2*	≤109	9995.04	(20⁻)	D			
		1859.45 *15*	100 *22*	8678.44	(19⁻)				
10855.61	21⁺	378.25 *8*	6.9 *13*	10477.36	(20⁺)				
		620.47 *4*	100 *14*	10235.14	20⁺	M1+E2	0.16 *9*	0.00234	B(M1)(W.u.)=0.093 *+16−14*; B(E2)(W.u.)=7 *+10−5* Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), E1+M2 excluded from comparison to RUL.
11135.76	22⁺	280.15 *3*	100	10855.61	21⁺	M1+E2	0.12 *+8−6*	0.0162 *5*	Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), E1+M2 excluded from comparison to RUL.

$^{90}_{42}Mo_{48}$-9

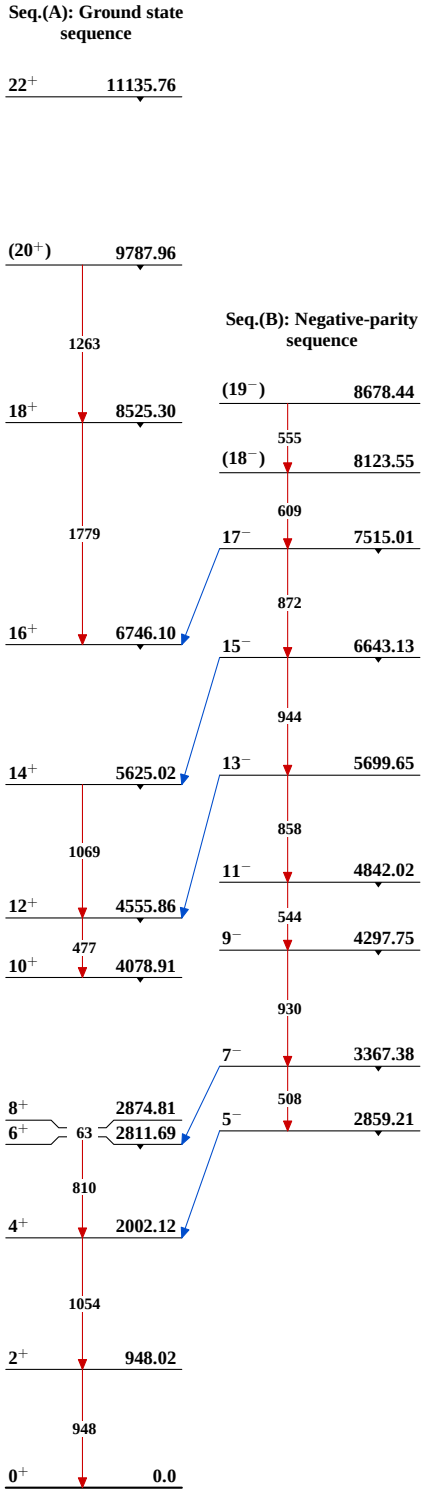
$\gamma(^{90}Mo)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[‡]	α[a]	Comments
11269.3	(21)	2590.0[@] *10*	100[@]	8678.44	(19$^-$)			
11577.07	(22$^+$)	1789.12 *20*	100	9787.96	(20$^+$)	E2	4.37×10^{-4}	Mult.: Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), M2 excluded from comparison to RUL.
11735.5		879.9[@] *5*	100[@]	10855.61	21$^+$	[@]		
12016.61	23$^+$	439.54 *8*	2.9 *3*	11577.07	(22$^+$)			I_γ: other: 16 *3* in (^{40}Ca,α4pγ).
		880.80 *19*	100 *14*	11135.76	22$^+$	M1+E2	1.05×10^{-3} *2*	Mult.: D+Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), $\Delta\pi$=no from level scheme.
		1161.00 *20*	13 *3*	10855.61	21$^+$	E2	5.58×10^{-4}	Mult.: Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), M2 excluded from comparison to RUL.
12257.7		1719.8[@] *10*	100[@]	10537.91	(21)	[@]		
12383.6	(23)	1113.5[@] *10*	49[@] *7*	11269.3	(21)	[@]		
		1845.68 *10*	100	10537.91	(21)	(E2)[&]	4.50×10^{-4}	
14279.8		2263.2[@] *10*	100[@]	12016.61	23$^+$	[@]		
14412.1		2028.5[@] *10*	100[@]	12383.6	(23)	[@]		
14486.6		2470.0[@] *10*	100[@]	12016.61	23$^+$	[@]		

[†] From ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), except where noted.
[‡] From $\gamma(\theta)$ and DCO ratios in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl, 3pγ), except where noted.
[§] From ^{90}Tc ε decay (50.7 s).
[&] Stretched Q from R(DCO) in ^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ), assumed E2.
[@] From ^{58}Ni(^{40}Ca,α4pγ).
[#] From ^{66}Zn(^{28}Si,2p2nγ).
[a] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

$^{90}_{42}Mo_{48}$-10

Adopted Levels, Gammas



$^{90}_{42}Mo_{48}$

^{90}Tc ε decay (50.7 s) 1981Ox01

Parent: ^{90}Tc: E=0.0; $J^{\pi}=8^{+}$; $T_{1/2}$=50.7 s *63*; Q(ε)=9448 *4*; %ε+%β^{+} decay=100.0
^{90}Tc-J^{π},$T_{1/2}$: From the Adopted Levels.
1981Ox01: Produced by ^{92}Mo(p,3n) reaction at E(p)=43 MeV; measured γ(t) with Ge(Li) and Ge detectors, $\gamma\gamma$ and $\beta\gamma$ coincidences with Ge(Li) and magnetic spectrometer. The decay scheme is established from $\gamma\gamma$ coincidence data.
Other: 1974Ia01.

^{90}Mo Levels

E(level)	J^{π}	$T_{1/2}$	E(level)	J^{π}	E(level)
0	0^{+}	5.56 h *9*	2859.7 *9*	5^{-}	3539.9 *10*
948.1 *2*	2^{+}		2947.0 *5*	(6^{+})	4094.8 *7*
2002.4 *4*	4^{+}		3037.9 *11*		4175.9 *9*
2549.4 *7*	5^{-}		3150.3 *7*		4357.7 *11*
2812.2 *5*	6^{+}		3293.8 *5*		

ε,β^{+} radiations

$\varepsilon+\beta^{+}$ branches are obtained from I(γ+ce) imbalance at each level.

E(decay)	E(level)	Iβ^{+} †	Iε †	Log *ft*	I($\varepsilon+\beta^{+}$) †	Comments
(5090 *4*)	4357.7	0.7 *3*	0.03 *1*	6.82 *20*	0.7 *3*	
(5272 *4*)	4175.9	3.5 *5*	0.12 *2*	6.20 *8*	3.6 *5*	
(5353 *4*)	4094.8	4.5 *6*	0.15 *2*	6.12 *8*	4.7 *6*	
(5908 *4*)	3539.9	1.2 *4*	0.028 *9*	6.95 *16*	1.2 *4*	
(6154 *4*)	3293.8	17.7 *12*	0.363 *24*	5.87 *7*	18.1 *12*	
(6298 *4*)	3150.3	1.7 *3*	0.032 *6*	6.95 *10*	1.7 *3*	
(6410 *4*)	3037.9	1.1 *4*	0.019 *7*	7.18 *17*	1.1 *4*	
(6501 *4*)	2947.0	39.9 *22*	0.67 *4*	5.65 *6*	40.6 *22*	Log *ft*: value is too small for a ΔJ=2 transition suggesting the decay scheme is incomplete.
(6588 *4*)	2859.7	2.6 *6*	0.041 *10*	6.87 *12*	2.6 *6*	Log *ft*: value is too small for a ΔJ=3 transition suggesting the decay scheme is incomplete.
(6636 *4*)	2812.2	13.0 *21*	0.20 *3*	6.18 *9*	13.2 *21*	Log *ft*: value is too small for a ΔJ=2 transition suggesting the decay scheme is incomplete.
(6899 *4*)	2549.4	5.3 *10*	0.073 *14*	6.66 *10*	5.4 *10*	Log *ft*: value is too small for a ΔJ=3 transition suggesting the decay scheme is incomplete.
(7446 *4*)	2002.4	<7	<0.07	>6.7	<7	

† Absolute intensity per 100 decays.

γ(^{90}Mo)

Iγ normalization: From the assumption of no ε feeding to the g.s. (ΔJ=8).

E_{γ}	I_{γ} ‡	E_i(level)	J^{π}_i	E_f	J^{π}_f	Mult. †
134.6 *5*	5.2 *8*	2947.0	(6^{+})	2812.2	6^{+}	
^{x}231.2 *8*	2.68 *4*					
262.5 *8*	1.3 *4*	2812.2	6^{+}	2549.4	5^{-}	E1
310.3 *6*	2.6 *6*	2859.7	5^{-}	2549.4	5^{-}	
481.7 *3*	13.6 *9*	3293.8		2812.2	6^{+}	
^{x}543.4 *5*	4.2 *4*					
546.8 *8*	9.3 *6*	2549.4	5^{-}	2002.4	4^{+}	E1

Continued on next page (footnotes at end of table)

^{90}Tc ε decay (50.7 s) 1981Ox01 (continued)

$\gamma(^{90}Mo)$ (continued)

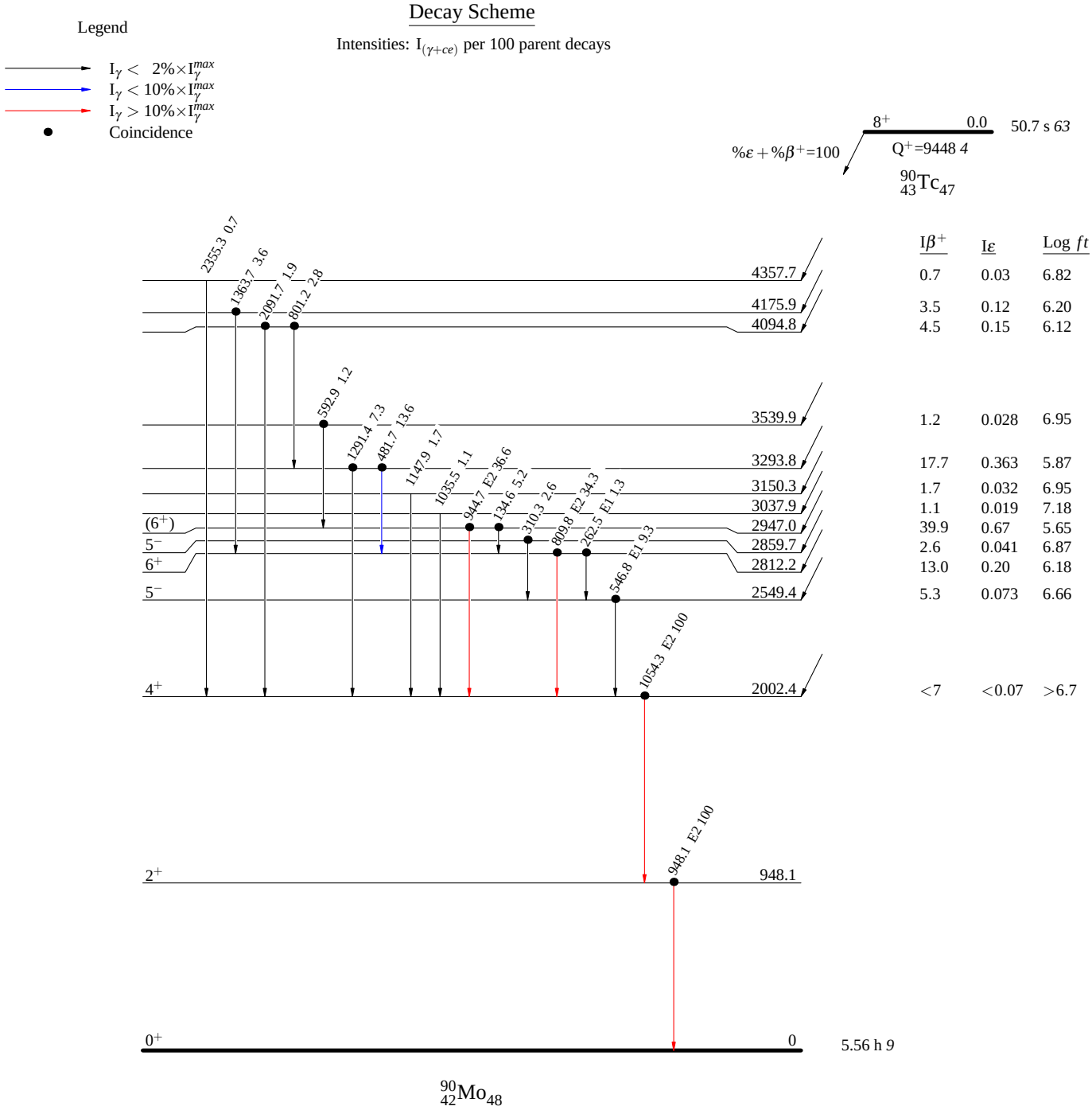
E_γ	I_γ ‡	E_i(level)	J^π_i	E_f	J^π_f	Mult. †
592.9 *8*	1.2 *4*	3539.9		2947.0	(6^+)	
801.2 *5*	2.8 *4*	4094.8		3293.8		
809.8 *3*	34.3 *15*	2812.2	6^+	2002.4	4^+	E2
944.7 *4*	36.6 *20*	2947.0	(6^+)	2002.4	4^+	E2
948.1 *2*	100	948.1	2^+	0	0^+	E2
^{x}983.5 *5*	5.4 *5*					
1035.5 *10*	1.1 *4*	3037.9		2002.4	4^+	
1054.3 *3*	100 *6*	2002.4	4^+	948.1	2^+	E2
1147.9 *5*	1.7 *3*	3150.3		2002.4	4^+	
1291.4 *5*	7.3 *6*	3293.8		2002.4	4^+	
1363.7 *8*	3.6 *5*	4175.9		2812.2	6^+	
2091.7 *9*	1.9 *4*	4094.8		2002.4	4^+	
2355.3 *10*	0.7 *3*	4357.7		2002.4	4^+	

† From the Adopted Gammas.
‡ Absolute intensity per 100 decays.
^{x} γ ray not placed in level scheme.

^{90}Tc ε decay (50.7 s) 1981Ox01

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{90}Tc ε decay (8.7 s) 1981Ox01

Parent: ^{90}Tc: E=144.1 *17*; $J^{\pi}=1^{+}$; $T_{1/2}$=8.7 s *2*; Q(ε)=9448 *4*; %ε+%β^{+} decay=100.0

1981Ox01: Produced by ^{92}Mo(p,3n) reaction at E(p)=43 MeV; measured γ(t) with Ge(Li) and Ge detectors, $\gamma\gamma$ and $\beta\gamma$ coincidences with Ge(Li) and magnetic spectrometer. The decay scheme is established from $\gamma\gamma$-coin data.

Other: 1974Ia01.

With a Q value of 9.4 MeV and the highest observed level at 0.9 MeV, this decay scheme is likely incomplete and ε+β^{+} feedings and log *ft* values should be taken as lower and upper limits respectively.

^{90}Mo Levels

E(level)	J^{π}	$T_{1/2}$	Comments
0.0	0^{+}	5.56 h *9*	$T_{1/2}$: from the Adopted Levels.
948.1 *2*	2^{+}		

ε,β^{+} radiations

ε+β^{+} branches are obtained from I(γ+ce) imbalance at each level.

E(decay)	E(level)	Iβ^{+} †	Iε †	Log *ft*	I($\varepsilon+\beta^{+}$) †
(8644 *4*)	948.1	78 *10*	0.50 *6*	5.3 *1*	78 *10*
(9592 *4*)	0.0	22 *10*	0.10 *5*	6.05 *20*	22 *10*

† Absolute intensity per 100 decays.

γ(^{90}Mo)

Iγ normalization: From measurement of $\gamma(\pm)$ for the gs band, and theoretical ε/β^{+} values. The contribution to $\gamma(\pm)$ from other sources were eliminated by following $\gamma(\pm)$(t) (1981Ox01).

E_{γ}	I_{γ} †	E_i(level)	J^{π}_i	E_f	J^{π}_f	Mult.	α ‡
948.1 *2*	78 *10*	948.1	2^{+}	0.0	0^{+}	E2	8.74×10^{-4}

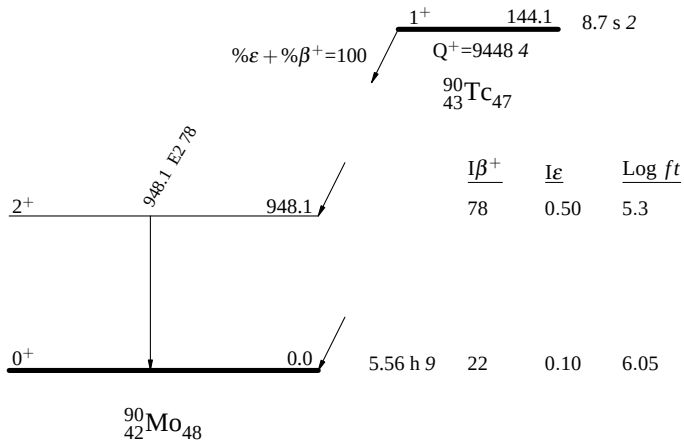
† Absolute intensity per 100 decays.

‡ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

^{90}Tc ε decay (8.7 s) 1981Ox01

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{9}Be(^{124}Xe,Xγ) 2017Pa35

2017Pa35: E(^{124}Xe)=345 MeV/nucleon incident on a 740 mg/cm^2 thick ^{9}Be target at the RIKEN-RIBF facility. Fragments identified using the BigRIPS separator and the ZeroDegree spectrometer by determining the atomic number and the mass-to-charge ratio of the ion using the tof-Bρ-ΔE method. Secondary beam was stopped in the double-sided silicon strip detector of the WAS3ABi spectrometer. Measured: Eγ, Iγ, implant-γ(t) using the EURICA array consisting of 84 HP Ge detectors.

2019Ha26: E(^{124}Xe)=345 MeV/nucleon incident on a thick ^{9}Be target at the RIKEN-RIBF facility. Fragments identified using the BigRIPS separator and the ZeroDegree spectrometer by determining the atomic number and the mass-to-charge ratio of the ion using the tof-Bρ-ΔE method. Secondary beam was stopped in the double-sided silicon strip detector of the WAS3ABi spectrometer. Measured: Eγ, Iγ, implant-γ(t) using the EURICA array consisting of 84 HP Ge detectors.

^{90}Mo Levels

E(level)†	J$^\pi$†	T$_{1/2}$	Comments
0.0	0$^+$		
948.0	2$^+$		
2002.1	4$^+$		
2548.8	5$^-$		
2811.7	6$^+$		
2874.8	8$^+$	1.15 μs *5*	E(level): isomeric ratio R=61% *3* (2017Pa35). T$_{1/2}$: from implant-γ(t) in 2017Pa35, but the gating γ-ray transitions were not specified by the authors. Also 1.14 μs *5* from implant-γ(t) in 2019Ha26.

† From the Adopted Levels. Level energies are rounded values.

γ(^{90}Mo)

E$_\gamma$†	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Comments
63.2	2874.8	8$^+$	2811.7	6$^+$	E$_\gamma$: other: 63 keV reported in 2017Pa35.
262.8	2811.7	6$^+$	2548.8	5$^-$	
546.7	2548.8	5$^-$	2002.1	4$^+$	
809.6	2811.7	6$^+$	2002.1	4$^+$	
948.0	948.0	2$^+$	0.0	0$^+$	
1054.1	2002.1	4$^+$	948.0	2$^+$	

† Rounded values from the Adopted Gammas.

^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) 1992Ka27

1992Ka27: 99.98% enriched ^{58}Ni + ^{36}Ar reaction at E=149 MeV; OSIRIS array of 12 Compton-suppressed HPGe detectors; measured Eγ, Iγ, $\gamma\gamma(\theta)$, DCO ratios; deduced γ-ray multi-polarities.

Other measurements:

1993Ka24: general treatment of DCO ratio analysis applied to a few transitions in ^{90}Mo.

1994Ka20: 99.8% enriched ^{58}Ni(^{36}Ar,4p) reaction at E=140 MeV; measured Eγ, Iγ, $\gamma\gamma(\theta)$, DCO ratios; measured $T_{1/2}$ of excited levels using the recoil-distance Doppler-shift method (RDDS) and differential decay curve method (DDCM). OSIRIS array of 12 Compton-suppressed HPGe detectors.

^{58}Ni(^{36}Ar,4p), E=149 MeV. Measured $T_{1/2}$ of excited levels using the Doppler-shift attenuation method (DSA) (1992Ka27,1994Ka20).

^{58}Ni(^{35}Cl,3p), E=120 MeV. Measured $\gamma(\theta)$. Deduced δ using the Rose and Brink phase convention (1994Ka20).

2013Zh10: ^{58}Ni(^{36}Ar,4pγ) reaction. Measured $\gamma(\theta)$ and γ(lin pol) for 478γ and 1054γ.

Level scheme and DCO ratios (given in comments) are from 1992Ka27.

^{90}Mo Levels

E(level)[†]	J^π	$T_{1/2}$[‡]	E(level)[†]	J^π	$T_{1/2}$[‡]	E(level)[†]	J^π	$T_{1/2}$[‡]
0.0[#]	0^+		4594.16 *25*	(9^-)		8123.44[&] *20*	18^-	
947.97[#] *9*	2^+		4789.28 *19*	10^-		8281.76 *22*	(17^+)	
1896.48 *14*	2^+		4841.91[&] *16*	11^-	39 ps *2*	8525.18[#] *19*	18^+	0.16 ps *2*
2002.06[#] *12*	4^+		4895.04 *19*	(11^-)		8616.74 *20*	(17^+)	
2432.58 *17*	3^-		5377.13 *17*	13^+	1.0 ps *3*	8678.33[&] *23*	19^-	
2548.75 *12*	5^-	16 ps *3*	5499.32 *16*	(12^-)		9079.08 *20*	(18^-)	
2811.63[#] *13*	6^+		5624.89[#] *17*	14^+	2.7 ps *1*	9136.48 *19*	18^+	
2859.14[&] *13*	5^-		5699.57[&] *16*	13^-	1.4 ps *4*	9318.91 *20*	19^-	
2874.73[#] *15*	8^+		5863.65 *17*	13^-		9443.78 *20*	19^+	
2901.18 *20*	(4^-)		5903.64 *18*	14^+	1.7 ps *4*	9739.26 *20*	19^+	
2946.82 *14*	(6^+)		6064.79 *19*	(13^-)		9787.84[#] *21*	20^+	
3106.11[@] *16*	8^+	4.9 ps *13*	6148.07 *18*	15^+	<0.3 ps	9994.95 *22*	20^-	
3294.03 *20*	(7^+)		6475.82 *17*	14^-	1.5 ps *10*	10235.02 *20*	(20^+)	0.21 ps *6*
3367.31[&] *14*	7^-	<0.69 ps	6643.03[&] *17*	15^-	1.3 ps *1*	10477.23 *21*	(20^+)	
3446.16 *20*	(7^-)		6746.00[#] *18*	16^+	3.6 ps *7*	10537.81 *25*	21^-	
3659.66 *16*	(7^-)		7170.88 *19*	(16^+)		10855.48 *21*	21^+	0.90 ps *14*
4078.82[#] *16*	10^+	14.6 ps *28*	7385.49 *19*	16^-	6.6 ps *15*	11135.63[#] *21*	22^+	<0.07 ps
4192.43[@] *15*	10^+	<3.5 ps	7514.91[&] *19*	17^-	7.4 ps *3*	11576.94 *24*	(22^+)	
4297.67[&] *15*	9^-	9.7 ps *21*	7629.51 *21*	(16^+)		12016.47 *23*	23^+	<1.2 ps
4555.77[#] *16*	12^+	526 ps *3*	8066.65 *19*	17^+	0.60 ps *4*	12383.5 *3*	(23^-)	

[†] Deduced by evaluators from a least-squares fit to γ-ray energies.

[‡] Average of recoil distance Doppler-shift, Doppler-shift attenuation, and differential decay curve methods (1994Ka20).

[#] Seq.(A): Ground state sequence.

[@] Seq.(B): Positive-parity sequence.

[&] Seq.(C): Negative-parity sequence.

^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) 1992Ka27 (continued)

γ(^{90}Mo)

DCO ratios in comments are from 1992Ka27. They are defined as Iγ(γ1 at 162° gated by γ2 at 65°,115°)/Iγ(γ1 at 65°,115° gated by γ2 at 162°). Expected values are 1.0 for stretched quadrupole and 0.5 for stretched dipole transitions.

E_γ[†]	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[§]	δ[§]	Comments
63.15 *9*	7.8 *6*	2874.73	8^+	2811.63	6^+			
105.78 *9*	0.48 *8*	4895.04	(11^-)	4789.28	10^-			
113.64 *8*	0.51 *9*	4192.43	10^+	4078.82	10^+			
129.41 *7*	3.8 *10*	7514.91	17^-	7385.49	16^-	D+Q[&]	0.14 *14*	Mult.: R(DCO)=0.24.
135.18 *8*	1.6 *10*	2946.82	(6^+)	2811.63	6^+			
167.11 *9*	7.7 *9*	6643.03	15^-	6475.82	14^-	D+Q		Mult.: R(DCO)=0.30 *8*.
231.43 *8*	33 *5*	3106.11	8^+	2874.73	8^+	D+Q[&]	−0.04 *+10−40*	Mult.: R(DCO)=0.71 *7*.
239.83 *9*	1.3 *3*	9318.91	19^-	9079.08	(18^-)			
244.46 *8*	11.4 *8*	6148.07	15^+	5903.64	14^+	D+Q[&]	0.12 *3*	Mult.: R(DCO)=0.38 *7*.
247.75 *8*	21 *3*	5624.89	14^+	5377.13	13^+	D+Q[&]	0.04 *5*	Mult.: R(DCO)=0.36 *7*.
262.84 *17*	3.1 *2*	2811.63	6^+	2548.75	5^-	D		Mult.: R(DCO)=0.43 *7*. Deviation from a expected value of 0.6 is due to the timing effect.
280.15 *3*	9.8 *14*	11135.63	22^+	10855.48	21^+	D+Q	0.12 *+8−6*	Mult.: R(DCO)=0.40 *8*.
292.30 *24*	1.3 *1*	3659.66	(7^-)	3367.31	7^-			R(DCO)≈0.7.
296.50 *20*	0.62 *5*	4594.16	(9^-)	4297.67	9^-	D+Q	−0.2 *+4−3*	Mult.: R(DCO)≈0.8.
310.39 *6*	1.6 *1*	2859.14	5^-	2548.75	5^-	[&]		R(DCO)=0.79 *13*.
335.00 *15*	1.9 *3*	8616.74	(17^+)	8281.76	(17^+)			
344.00 *12*	3.3 *5*	9787.84	20^+	9443.78	19^+	D+Q		Mult.: R(DCO)=0.46 *6*.
363.33 *4*	17.4 *25*	4555.77	12^+	4192.43	10^+	Q		Mult.: R(DCO)=0.95 *9*.
364.36 *8*	2.7 *10*	5863.65	13^-	5499.32	(12^-)			
365.20 *20*	0.8[‡] *2*	6064.79	(13^-)	5699.57	13^-			
378.25 *8*	1.1 *2*	10855.48	21^+	10477.23	(20^+)			
411.00 *13*	1.0 *2*	6475.82	14^-	6064.79	(13^-)	D		Mult.: R(DCO)≈0.5.
437.20 *31*	1.8 *3*	8066.65	17^+	7629.51	(16^+)			
439.54 *8*	0.23 *2*	12016.47	23^+	11576.94	(22^+)			
458.59 *9*	18 *3*	8525.18	18^+	8066.65	17^+	D+Q		Mult.: R(DCO)=0.69 *6*.
458.70 *20*	≈1.3[‡]	7629.51	(16^+)	7170.88	(16^+)			
468.60 *10*	0.57 *5*	2901.18	(4^-)	2432.58	3^-			
476.95 *10*	32 *5*	4555.77	12^+	4078.82	10^+	E2		Mult.: R(DCO)=1.01 *6*. Mult.: A_2=+0.32 *8*, A_4=−0.10 *1*, Pol=+0.51 *9* (2013Zh10).
482.40 *15*	2.3 *2*	3294.03	(7^+)	2811.63	6^+	D		Mult.: R(DCO)=0.70 *9*.
491.66 *14*	3.3 *2*	4789.28	10^-	4297.67	9^-	D+Q		Mult.: R(DCO)=0.49 *8*.
495.71 *11*	9.8 *14*	10235.02	(20^+)	9739.26	19^+	D+Q	0.14 *23*	Mult.: R(DCO)=0.70 *6*.
508.20 *15*	≤2.6[‡]	3367.31	7^-	2859.14	5^-			
519.7 *3*	4.8 *7*	9136.48	18^+	8616.74	(17^+)	D+Q		Mult.: R(DCO)=0.62 *7*.
523.18 *10*	26 *4*	6148.07	15^+	5624.89	14^+	D+Q	0.11 *3*	Mult.: R(DCO)=0.51 *6*.
526.53 *8*	11.3 *20*	5903.64	14^+	5377.13	13^+	D+Q	0.13 *5*	Mult.: R(DCO)=0.45 *6*.
536.10 *10*	1.4 *1*	2432.58	3^-	1896.48	2^+			
542.9 *2*	≤3.5[‡]	10537.81	21^-	9994.95	20^-	D		Mult.: R(DCO)=0.59 *6*.
544.22 *9*	18.0 *13*	4841.91	11^-	4297.67	9^-	Q		Mult.: R(DCO)=1.01 *6*.
546.69 *4*	32.4 *23*	2548.75	5^-	2002.06	4^+	D		Mult.: R(DCO)=0.60 *6*.
554.90 *20*	≈6[‡]	8678.33	19^-	8123.44	18^-	D		Mult.: R(DCO)=0.56 *7*.
555.65 *9*	6.0 *4*	3367.31	7^-	2811.63	6^+	D		Mult.: R(DCO)=0.62 *7*.
565.5 *3*	0.23 *2*	6064.79	(13^-)	5499.32	(12^-)			R(DCO)≈0.4.
598.00 *10*	19 *3*	6746.00	16^+	6148.07	15^+	D+Q	3.4 *5*	Mult.: R(DCO)=0.59 *6*.
602.77 *10*	6.5[‡]	9739.26	19^+	9136.48	18^+	D+Q		Mult.: R(DCO)=0.61 *6*.

Continued on next page (footnotes at end of table)

^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) 1992Ka27 (continued)

γ(^{90}Mo) (continued)

E_γ[†]	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[§]	δ[§]	Comments
604.33 *15*	1.4 *2*	5499.32	(12$^-$)	4895.04	(11$^-$)	(D+Q)		Mult.: R(DCO)=0.45 *4*.
608.54 *9*	11.4 *16*	8123.44	18$^-$	7514.91	17$^-$	D+Q		Mult.: R(DCO)=0.49 *7*.
612.10 *8*	0.32 *2*	6475.82	14$^-$	5863.65	13$^-$			R(DCO)≈0.3.
620.47 *4*	16.0 *22*	10855.48	21$^+$	10235.02	(20$^+$)	D+Q	0.16 *9*	Mult.: R(DCO)=0.38 *11*.
638.00 *15*	0.69 *5*	4297.67	9$^-$	3659.66	(7$^-$)	(Q)		Mult.: R(DCO)≈1.2.
640.60 *20*	0.9 *2*	9318.91	19$^-$	8678.33	19$^-$			
649.64 *16*	11.5 *4*	4841.91	11$^-$	4192.43	10$^+$	D		Mult.: R(DCO)=0.66 *8*.
657.41 *5*	2.7 *7*	5499.32	(12$^-$)	4841.91	11$^-$	D		Mult.: R(DCO)≈0.5.
676.03 *9*	3.1 *7*	9994.95	20$^-$	9318.91	19$^-$	D+Q		Mult.: R(DCO)=0.56 *8*.
738.00 *20*	0.5 *2*	10477.23	(20$^+$)	9739.26	19$^+$			
742.46 *14*	5.8 *15*	7385.49	16$^-$	6643.03	15$^-$	D+Q	3.1 *8*	Mult.: R(DCO)=0.69 *7* too large because of contamination from 2$^+$ to 0$^+$ transition in ^{88}Mo.
768.89 *10*	8.6 *6*	7514.91	17$^-$	6746.00	16$^+$	D		Mult.: R(DCO)=0.60 *7*.
776.24 *6*	7.4 *9*	6475.82	14$^-$	5699.57	13$^-$	D+Q	3.1 *+10−7*	Mult.: R(DCO)=0.51 *8*.
779.43 *6*	1.4 *5*	6643.03	15$^-$	5863.65	13$^-$	Q		Mult.: R(DCO)=0.97 *23*.
800.52 *15*	0.78 *5*	3659.66	(7$^-$)	2859.14	5$^-$	(Q)		Mult.: R(DCO)≈1.0.
809.57 *6*	62 *4*	2811.63	6$^+$	2002.06	4$^+$	Q		Mult.: R(DCO)=0.99 *6*.
818.56 *10*	19.5 *14*	3367.31	7$^-$	2548.75	5$^-$	Q		Mult.: R(DCO)=0.99 *6*.
821.37 *9*	31 *5*	5377.13	13$^+$	4555.77	12$^+$	D+Q	0.09 *4*	Mult.: R(DCO)=0.49 *6*.
857.10 *12*	≤2[‡]	2859.14	5$^-$	2002.06	4$^+$			E_γ: From level energy difference. R(DCO)=0.92 *6*, for the 857-keV doublet.
857.65 *11*	20 *5*	5699.57	13$^-$	4841.91	11$^-$	Q		Mult.: R(DCO)=0.88 *3* for doublet.
872.0 *3*	26 *6*	7514.91	17$^-$	6643.03	15$^-$	Q		Mult.: R(DCO)=1.03 *6*.
880.80 *19*	7.9 *11*	12016.47	23$^+$	11135.63	22$^+$	D+Q		Mult.: R(DCO)=0.56 *7*.
895.73 *8*	1.3 *2*	8066.65	17$^+$	7170.88	(16$^+$)			
897.40 *15*	3.2 *2*	3446.16	(7$^-$)	2548.75	5$^-$	(Q)		Mult.: R(DCO)≈0.8.
918.59 *7*	4.6 *7*	9443.78	19$^+$	8525.18	18$^+$	D+Q		Mult.: R(DCO)=0.60 *7*.
930.34 *9*	22.1 *16*	4297.67	9$^-$	3367.31	7$^-$	Q		Mult.: R(DCO)=1.00 *6*.
943.50 *20*	19.6 *5*	6643.03	15$^-$	5699.57	13$^-$	Q		Mult.: R(DCO)=0.97 *7*.
944.80 *14*	≤2[‡]	2946.82	(6$^+$)	2002.06	4$^+$			
948.01 *9*	108 *8*	947.97	2$^+$	0.0	0$^+$	Q		Mult.: R(DCO)=1.00 *6*.
948.50 *10*	1.5 *1*	1896.48	2$^+$	947.97	2$^+$			
972.73 *8*	32 *5*	4078.82	10$^+$	3106.11	8$^+$	Q		Mult.: R(DCO)=0.99 *9*.
1018.10 *12*	8.2 *12*	6643.03	15$^-$	5624.89	14$^+$	D		Mult.: R(DCO)=0.65 *7*.
1054.10 *7*	100.0	2002.06	4$^+$	947.97	2$^+$	E2		Mult.: R(DCO)=1.00 *6*. Mult.: A_2=+0.32 *3*, A_4=−0.02 *1*, Pol=+0.57 *6* (2013Zh10).
1069.12 *12*	20 *3*	5624.89	14$^+$	4555.77	12$^+$	Q		Mult.: R(DCO)=0.91 *7*.
1086.37 *12*	0.38 *6*	4192.43	10$^+$	3106.11	8$^+$			
1143.78 *10*	10.7 *15*	5699.57	13$^-$	4555.77	12$^+$	D		Mult.: R(DCO)=0.66 *8*.
1161.00 *20*	1.0 *2*	12016.47	23$^+$	10855.48	21$^+$	Q		Mult.: R(DCO)=1.10 *20*.
1195.45 *10*	1.1 *3*	9318.91	19$^-$	8123.44	18$^-$	D+Q		Mult.: R(DCO)=0.51 *9*.
1214.10 *10*	1.5 *2*	9739.26	19$^+$	8525.18	18$^+$			
1262.70 *10*	1.4 *2*	9787.84	20$^+$	8525.18	18$^+$	Q		Mult.: R(DCO)=1.00 *10*.
1267.15 *17*	1.0 *2*	7170.88	(16$^+$)	5903.64	14$^+$			
1317.68 *7*	28 *4*	4192.43	10$^+$	2874.73	8$^+$	Q		Mult.: R(DCO)=1.00 *8*.
1320.75 *11*	3.6 *5*	8066.65	17$^+$	6746.00	16$^+$			
1377.00 *20*	0.11 *4*	9443.78	19$^+$	8066.65	17$^+$			
1446.0 *3*	0.76 *11*	8616.74	(17$^+$)	7170.88	(16$^+$)			
1481.40 *15*	0.45 *6*	7629.51	(16$^+$)	6148.07	15$^+$	(D+Q)		Mult.: From R(DCO)=0.59 *14*.
1545.92 *18*	2.5 *4*	7170.88	(16$^+$)	5624.89	14$^+$			
1564.10 *20*	<0.5[‡]	9079.08	(18$^-$)	7514.91	17$^-$			

Continued on next page (footnotes at end of table)

^{58}Ni(^{36}Ar,4pγ),(^{35}Cl,3pγ) 1992Ka27 (continued)

γ(^{90}Mo) (continued)

E_γ †	I_γ †	E_i(level)	J^π_i	E_f	J^π_f	Mult. §	Comments
1672.52 *14*	1.6 *2*	9739.26	19^+	8066.65	17^+	Q	Mult.: R(DCO)=0.94 *8*.
1693.60 *10*	0.8 *2*	9079.08	(18^-)	7385.49	16^-		
1709.86 *11*	9.4 *13*	10235.02	(20^+)	8525.18	18^+	Q	Mult.: R(DCO)=1.18 *10*.
1779.20 *17*	3.0 *4*	8525.18	18^+	6746.00	16^+	Q	Mult.: R(DCO)=1.05 *11*.
1789.12 *20*	0.8 *1*	11576.94	(22^+)	9787.84	20^+	Q	Mult.: R(DCO)=1.04 *30*.
1803.97 *11*	8.5 *20*	9318.91	19^-	7514.91	17^-	Q	Mult.: R(DCO)=0.91 *8*.
1845.68 *10*	2.7 *5*	12383.5	(23^-)	10537.81	21^-	Q	Mult.: R(DCO)=0.87 *12*.
1859.45 *15*	3.2 *7*	10537.81	21^-	8678.33	19^-		
1870.70 *15*	1.9 *3*	8616.74	(17^+)	6746.00	16^+		
1871.6 *5*	0.6 *2*	9994.95	20^-	8123.44	18^-		
1918.60 *20*	15.2 *21*	8066.65	17^+	6148.07	15^+	Q	Mult.: R(DCO)=0.95 *6*.
1952.00 *20*	0.76 *10*	10477.23	(20^+)	8525.18	18^+		
2133.70 *20*	0.50 *7*	8281.76	(17^+)	6148.07	15^+		
2390.46 *7*	1.7 *4*	9136.48	18^+	6746.00	16^+	Q	Mult.: R(DCO)=1.00 *10*.
2468.55 *19*	0.91 *12*	8616.74	(17^+)	6148.07	15^+		

† From 1992Ka27, except where noted.
‡ From transition intensity balance.
§ From $\gamma(\theta)$ in ^{58}Ni(^{35}Cl,3pγ) and DCO ratios in ^{58}Ni(^{36}Ar,4pγ) (1992Ka27).
& DCO ratio underestimated due to different detector timing characteristics.

^{58}Ni(^{40}Ca,α4pγ) 1992Ar15

1992Ar15: 99.7% enriched ^{58}Ni(^{40}Ca,α4pγ) reaction, E=180, 187 MeV. Measured Eγ, Iγ, $\gamma\gamma$ coin, $\gamma\gamma(\theta)$. NORDBALL array, consisting of 15 Compton-suppressed HPGe detectors, a forward wall of 11 liquid scintillator neutron detectors and a 4π silicon-ball consisting of 21 detectors for protons and alphas.

^{90}Mo Levels

E(level)[‡]	J$^{\pi}$[†]	T$_{1/2}$	Comments
0.0[#]	0$^+$		
947.71[#] *20*	2$^+$		
2001.7[#] *3*	4$^+$		
2548.3[&] *3*	5$^-$		
2810.9[#] *3*	6$^+$		
2874.0[#] *8*	8$^+$		
3105.2[@] *8*	8$^+$		
3366.9[&] *4*	7$^-$		
4077.7[#] *8*	(10$^+$)		
4191.3[@] *8*	(10$^+$)		
4297.2[&] *4*	(9$^-$)		
4554.4[#] *8*	(12$^+$)	0.4 ns *1*	T$_{1/2}$: Doppler-shift method.
4840.7[&] *8*	(11$^-$)		
5375.5 *8*	(13$^+$)		
5623.2[#] *8*	(14$^+$)		
5698.0[&] *8*	(13$^-$)		
5901.8 *8*	(14$^+$)		
6146.0 *8*	(15$^+$)		
6473.8 *11*	(14$^-$)		
6641.0[&] *8*	(15$^-$)		
6743.8[#] *8*	(16$^+$)		
7383.1 *11*	(16$^-$)		
7512.6[&] *8*	(17$^-$)		
8064.8 *9*	(17$^+$)		
8120.4[&] *9*	(18$^-$)		
8523.0[#] *10*	(18$^+$)		
8674.3[&] *11*	(19$^-$)		
9134.0 *11*	(18$^+$)		
9316.5 *11*	(19$^-$)		
9441.1 *13*	(19$^+$)		
9737.2 *10*	(19$^+$)		
9784.5[#] *15*	(20$^+$)		
9991.5 *11*	(20$^-$)		
10232.5 *11*	(20$^+$)		
10475.0 *12*	(20$^+$)		
10532.8 *12*	(21$^-$)		
10852.4 *12*	(21$^+$)		
11264.6 *14*	(21$^-$)		
11573.8 *15*	(22$^+$)		
11732.4 *12*	(22$^+$)		
12012.2 *13*	(23$^+$)		
12252.6 *16*	(22$^-$)		
12378.4 *14*	(23$^-$)		
12488.8? *16*			
14275.5 *17*	(24$^+$,25$^+$)		

Continued on next page (footnotes at end of table)

^{58}Ni(^{40}Ca,α4pγ) 1992Ar15 (continued)

^{90}Mo Levels (continued)

E(level)[‡]	J$^{\pi}$[†]
14406.9 *17*	(25$^-$)
14482.3 *17*	(25$^+$)

[†] Assignments were mostly based on γ-ray anisotropies determined by $\gamma\gamma(\theta)$ measurements.
[‡] Deduced from a least-squares fit to Eγ, by evaluators.
[#] Seq.(A): Ground state sequence.
[@] Seq.(B): Positive-parity sequence.
[&] Seq.(C): Negative-parity sequence.

γ(^{90}Mo)

γ-ray anisotropies R=2 Iγ(143°)/[Iγ(79°) + Iγ(101°)] provided some information on γ-ray multipolarities. From systematics of transitions with known multipolarity, R≈1.7 for Q transitions, R≈0.9 for D transitions.

E$_\gamma$[†]	I$_\gamma$	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Anisotropy[&]	Comments
62.9 *10*		2874.0	8$^+$	2810.9	6$^+$		E$_\gamma$: From Adopted Gammas. Not measured in this experiment.
113.9 *10*	29 *3*	4191.3	(10$^+$)	4077.7	(10$^+$)	1.85 *36*	
129.6 *10*	65 *4*	7512.6	(17$^-$)	7383.1	(16$^-$)	0.82 *9*	
167.2 *10*	89 *4*	6641.0	(15$^-$)	6473.8	(14$^-$)	0.80 *7*	
231.2 *2*	1000 *10*	3105.2	8$^+$	2874.0	8$^+$	1.66 *3*	
244.1 *2*	286 *9*	6146.0	(15$^+$)	5901.8	(14$^+$)	0.75 *3*	
247.5 *2*	455 *7*	5623.2	(14$^+$)	5375.5	(13$^+$)	0.85 *3*	
262.5 *10*	17[‡] *3*	2810.9	6$^+$	2548.3	5$^-$	1.12 *25*	
279.6 *10*	98 *5*	12012.2	(23$^+$)	11732.4	(22$^+$)	0.84 *9*	See Adopted Levels, Gammas for adopted placement from 11136 level (1992Ka27).
343.2 *10*	73 *4*	9784.5	(20$^+$)	9441.1	(19$^+$)	0.92 *12*	
363.1 *2*	488 *8*	4554.4	(12$^+$)	4191.3	(10$^+$)	1.65 *5*	
377.3 *10*	14 *3*	10852.4	(21$^+$)	10475.0	(20$^+$)	0.74 *25*	
438.3 *10*	16 *3*	12012.2	(23$^+$)	11573.8	(22$^+$)	0.91 *36*	
458.0 *5*	153 *5*	8523.0	(18$^+$)	8064.8	(17$^+$)	0.79 *6*	
476.7 *2*	910 *11*	4554.4	(12$^+$)	4077.7	(10$^+$)	1.72 *4*	
495.3 *5*	108 *4*	10232.5	(20$^+$)	9737.2	(19$^+$)	0.70 *6*	
522.8 *2*	449 *8*	6146.0	(15$^+$)	5623.2	(14$^+$)	0.73 *3*	
526.2 *2*	261 *6*	5901.8	(14$^+$)	5375.5	(13$^+$)	0.72 *4*	
541.7[§] *10*		10532.8	(21$^-$)	9991.5	(20$^-$)		
543.6[§] *10*	268 *6*	4840.7	(11$^-$)	4297.2	(9$^-$)	1.37 *6*	Iγ is for 543.6 + 541.7 doublet.
546.6 *2*	223 *6*	2548.3	5$^-$	2001.7	4$^+$	0.93 *5*	
554.3 *10*	92 *4*	8674.3	(19$^-$)	8120.4	(18$^-$)	0.83 *10*	
597.8 *2*	380 *7*	6743.8	(16$^+$)	6146.0	(15$^+$)	0.80 *4*	
603.4 *5*	119 *5*	9737.2	(19$^+$)	9134.0	(18$^+$)	0.79 *4*	
607.8 *2*	160 *6*	8120.4	(18$^-$)	7512.6	(17$^-$)	0.75 *6*	
620.0 *5*	125 *5*	10852.4	(21$^+$)	10232.5	(20$^+$)	0.78 *6*	
649.5 *10*	92 *5*	4840.7	(11$^-$)	4191.3	(10$^+$)	0.93 *9*	
675.2 *10*	83 *5*	9991.5	(20$^-$)	9316.5	(19$^-$)	0.82 *11*	
742.1 *10*	75 *4*	7383.1	(16$^-$)	6641.0	(15$^-$)	0.63 *7*	
768.6 *5*	147 *6*	7512.6	(17$^-$)	6743.8	(16$^+$)	0.80 *6*	
775.9 *10*	84 *5*	6473.8	(14$^-$)	5698.0	(13$^-$)	0.66 *7*	
809.2 *2*	192[‡] *6*	2810.9	6$^+$	2001.7	4$^+$	1.31 *7*	
818.6 *2*	223 *8*	3366.9	7$^-$	2548.3	5$^-$	1.33 *8*	

Continued on next page (footnotes at end of table)

^{58}Ni(^{40}Ca,α4pγ) 1992Ar15 (continued)

γ(^{90}Mo) (continued)

E_γ[†]	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Anisotropy[&]	Comments
820.9 *2*	738 *12*	5375.5	(13$^+$)	4554.4	(12$^+$)	0.85 *3*	
857.3 *2*	246 *7*	5698.0	(13$^-$)	4840.7	(11$^-$)	1.86 *9*	
871.6 *2*	399 *8*	7512.6	(17$^-$)	6641.0	(15$^-$)	1.69 *7*	
879.9 *5*	96 *4*	11732.4	(22$^+$)	10852.4	(21$^+$)	0.80 *10*	See Adopted Levels, Gammas for adopted placement from 12016 level (1992Ka27).
918.0 *10*	47 *4*	9441.1	(19$^+$)	8523.0	(18$^+$)	0.99 *16*	
930.3 *2*	248 *7*	4297.2	(9$^-$)	3366.9	7$^-$	1.65 *8*	
943.1 *2*	238 *7*	6641.0	(15$^-$)	5698.0	(13$^-$)	1.81 *9*	
947.7 *2*	427[‡] *9*	947.71	2$^+$	0.0	0$^+$	1.48 *6*	
972.5 *2*	985 *14*	4077.7	(10$^+$)	3105.2	8$^+$	1.65 *4*	
1017.7 *5*	172 *6*	6641.0	(15$^-$)	5623.2	(14$^+$)	0.86 *5*	
1054.0 *2*	448[‡] *10*	2001.7	4$^+$	947.71	2$^+$	1.36 *5*	
1068.9 *2*	350 *8*	5623.2	(14$^+$)	4554.4	(12$^+$)	1.72 *8*	
1113.5 *10*	22 *3*	12378.4	(23$^-$)	11264.6	(21$^-$)	1.52 *31*	See Adopted Levels, Gammas for adopted placement from 12383.5 level (1992Ka27).
1143.8 *5*	139 *7*	5698.0	(13$^-$)	4554.4	(12$^+$)	0.91 *8*	
1160.2 *10*	14 *4*	12012.2	(23$^+$)	10852.4	(21$^+$)	1.49 *44*	
1196.3 *10*	14 *3*	9316.5	(19$^-$)	8120.4	(18$^-$)	0.30 *3*	
1213.6 *10*	16 *3*	9737.2	(19$^+$)	8523.0	(18$^+$)	0.92 *40*	
1317.4[§] *2*	510 *11*	4191.3	(10$^+$)	2874.0	8$^+$	1.64 *6*	Iγ is for 1317.4 + 1318.0 doublet.
1318.0[§@] *10*		9991.5	(20$^-$)	8674.3	(19$^-$)		
1320.9 *10*	71 *7*	8064.8	(17$^+$)	6743.8	(16$^+$)	0.73 *12*	
1672.4 *10*	28 *5*	9737.2	(19$^+$)	8064.8	(17$^+$)	1.83 *41*	
1719.8 *10*	4 *3*	12252.6	(22$^-$)	10532.8	(21$^-$)	0.50 *23*	
1779.0 *10*	73 *6*	8523.0	(18$^+$)	6743.8	(16$^+$)	1.58 *21*	
1789.1 *10*	9 *4*	11573.8	(22$^+$)	9784.5	(20$^+$)	1.50 *65*	
1804.0 *10*	87 *6*	9316.5	(19$^-$)	7512.6	(17$^-$)	1.40 *16*	
1845.8 *10*	45 *4*	12378.4	(23$^-$)	10532.8	(21$^-$)	1.67 *32*	See Adopted Levels, Gammas for adopted placement from 12383.5 level (1992Ka27).
1858.2 *10*	11 *3*	10532.8	(21$^-$)	8674.3	(19$^-$)	1.83 *84*	
1870.5 *10*	12 *4*	9991.5	(20$^-$)	8120.4	(18$^-$)	1.16 *52*	
1918.7 *5*	145 *6*	8064.8	(17$^+$)	6146.0	(15$^+$)	1.42 *11*	
1951.9 *10*	12 *3*	10475.0	(20$^+$)	8523.0	(18$^+$)	2.02 *68*	
1956.0[@] *10*	11 *4*	12488.8?		10532.8	(21$^-$)		
2028.5 *10*	14 *5*	14406.9	(25$^-$)	12378.4	(23$^-$)	1.67 *64*	
2263.2 *10*	5 *2*	14275.5	(24$^+$,25$^+$)	12012.2	(23$^+$)		
2391.1 *10*	13 *3*	9134.0	(18$^+$)	6743.8	(16$^+$)	2.31 *73*	
2470.0 *10*	16 *3*	14482.3	(25$^+$)	12012.2	(23$^+$)	2.70 *83*	
2590.0 *10*	6 *2*	11264.6	(21$^-$)	8674.3	(19$^-$)	1.79 *99*	

[†] Uncertainties vary from 0.2 to 1.0 keV, depending on the energy and the intensity of the transition. The evaluator has adopted the values given here for individual γ rays.

[‡] The measured intensity is lower because the γ of the gate is considerably shorter than 1 μs, the half-life of the 2875 level.

[§] Doublet.

[&] Anisotropy=2 Iγ(143°)/[Iγ(79°) + Iγ(101°)].

[@] Placement of transition in the level scheme is uncertain.

^{59}Co(^{35}Cl,2p2nγ) 2001Wu01

2001Wu01: E(^{35}Cl)=116 MeV. Measured Eγ, Iγ, $\gamma\gamma$ using ten Compton-suppressed HPGe detectors. Deduced $T_{1/2}$ using the Doppler Shift attenuation method.

^{90}Mo Levels

E(level)†	J^π†	E(level)†	J^π†	$T_{1/2}$‡	E(level)†	J^π†	$T_{1/2}$‡
0.0	0^+	3106	8^+		5625	14^+	0.762 ps *7*
948	2^+	4079	10^+		5904	14^+	1.39 ps *28*
2002	4^+	4193	10^+		6148	15^+	0.721 ps *49*
2812	6^+	4556	12^+		6746	16^+	1.91 ps *14*
2875	8^+	5377	13^+	1.94 ps *13*			

† From Figure 1 of 2001Wu01.
‡ From DSAM in 2001Wu01.

γ(^{90}Mo)

E_i(level)	J^π_i	E_γ	E_f	J^π_f	E_i(level)	J^π_i	E_γ	I_γ†	E_f	J^π_f
948	2^+	948	0.0	0^+	4556	12^+	477		4079	10^+
2002	4^+	1054	948	2^+	5377	13^+	821	100	4556	12^+
2812	6^+	810	2002	4^+	5625	14^+	248	39	5377	13^+
2875	8^+	63	2812	6^+			1069	61	4556	12^+
3106	8^+	231	2875	8^+	5904	14^+	527	100	5377	13^+
4079	10^+	973	3106	8^+	6148	15^+	245	29	5904	14^+
4193	10^+	1318	2875	8^+			523	571	5625	14^+
4556	12^+	363	4193	10^+	6746	16^+	598	100	6148	15^+

† Relative photon branching from each level.

^{66}Zn(^{28}Si,2p2nγ) 1992Si03,1994Da15

1992Si03: ^{66}Zn(^{28}Si,2p2nγ) reaction; E=90-120 MeV. Measured Eγ, Iγ, $\gamma\gamma$ coin, $\gamma\gamma(\theta)$, $\gamma(\theta)$ at 15°, 30°, 44°, 60° and 90°. An array of 5 Compton-suppressed HPGe spectrometers.

1994Da15: ^{66}Zn(^{28}Si,2p2nγ) reaction; E=115 MeV. Measured excited level $T_{1/2}$ using the recoil-distance method.

^{90}Mo Levels

^{90}Mo seems to be a transitional nucleus which exhibits both single-particle nature (even-parity states) and the features of the collective vibration (odd-parity states).

E(level)	J^{π}‡	E(level)	J^{π}‡	$T_{1/2}$†	E(level)	J^{π}‡	$T_{1/2}$†
0.0#	0^+	4079.7# *8*	10^+		5701.3& *8*	13^-	<0.7 ps
948.2# *3*	2^+	4193.4@ *8*	10^+		6149.6 *8*	15^+	<1.4 ps
2002.6# *5*	4^+	4300.3& *7*	9^-		6644.6& *8*	15^-	<0.7 ps
2549.6& *5*	5^-	4556.8# *8*	12^+		6747.9# *8*	16^+	
2812.6# *5*	6^+	4844.3& *7*	11^-	<0.7 ps	7028.8? *9*	17^+	
2875.4# *8*	8^+	5378.6 *8*	13^+		7516.6& *8*	17^-	5.5 ps *7*
3106.8@ *8*	8^+	5623.0 *8*	(14^+)		7684.0? *9*	18^-	
3368.6& *6*	7^-	5626.5# *8*	14^+	4.8 ps *14*			

† Recoil-distance method (1994Da15).
‡ Based on $\gamma(\theta)$ and $\gamma\gamma(\theta)$ (1992Si03).
# Seq.(A): Ground state sequence.
@ Seq.(B): Positive-parity sequence.
& Seq.(C): Negative-parity sequence.

γ(^{90}Mo)

Evaluators changed order of the 544-819-930 cascade based on the level scheme given by 1992Ka27 in ^{58}Ni(^{36}Ar,4pγ).

E_γ†	I_γ†	E_i(level)	J^{π}_i	E_f	J^{π}_f	Mult.‡	Comments
62.7	60.8 *9*	2875.4	8^+	2812.6	6^+		
167.4 *3*	7.3 *3*	7684.0?	18^-	7516.6	17^-	(D+Q)	A_2=−0.17 *2*, A_4=−0.01 *1*.
231.3 *3*	49.5 *6*	3106.8	8^+	2875.4	8^+	D+Q	A_2=+0.35 *1*, A_4=−0.02 *1*.
244.2 *3*	13.1 *2*	5623.0	(14^+)	5378.6	13^+	D	A_2=−0.42 *2*, A_4=+0.15 *1*.
247.7 *3*	13.5 *2*	5626.5	14^+	5378.6	13^+	(D+Q)	A_2=−0.07 *2*, A_4=+0.09 *1*.
263.3 *3*	9.5 *4*	2812.6	6^+	2549.6	5^-		
280.9 *3*	2.2 *1*	7028.8?	17^+	6747.9	16^+	(D+Q)	A_2=−0.51 *3*, A_4=+0.11 *1*.
363.4 *3*	24.3 *4*	4556.8	12^+	4193.4	10^+	Q	A_2=+0.30 *2*, A_4=−0.33 *1*.
477.1 *3*	37.8 *5*	4556.8	12^+	4079.7	10^+	Q	A_2=+0.33 *1*, A_4=−0.18 *1*.
523.2 *3*	8.7 *5*	6149.6	15^+	5626.5	14^+	(D+Q)	A_2=−0.62 *3*, A_4=+0.12 *1*.
526.4 *3*	3.4 *3*	6149.6	15^+	5623.0	(14^+)	(D+Q)	A_2=−0.77 *5*, A_4=+0.30 *2*.
544.0 *3*	14.7 *4*	4844.3	11^-	4300.3	9^-	Q	A_2=+0.02 *3*, A_4=−0.12 *1*. E_γ: placed by 1992Si03 from a 4026 (9^-) level.
547.3 *3*	28.1 *6*	2549.6	5^-	2002.6	4^+	(D)	A_2=−0.27 *2*, A_4=−0.09 *1*.
598.2 *3*	16.5 *6*	6747.9	16^+	6149.6	15^+	(D+Q)	A_2=−0.20 *3*, A_4=+0.04 *1*.
768.6 *3*	5.5 *4*	7516.6	17^-	6747.9	16^+	(D)	A_2=−0.45 *5*, A_4=−0.04 *2*.
809.7 *3*	76.3 *11*	2812.6	6^+	2002.6	4^+	Q	A_2=+0.24 *3*, A_4=−0.08 *1*.
819.0 *3*	9.7 *4*	3368.6	7^-	2549.6	5^-	Q	A_2=+0.41 *4*, A_4=−0.16 *2*. E_γ: placed by 1992Si03 from a 4845 (11^-) level.
821.4 *3*	17.4 *5*	5378.6	13^+	4556.8	12^+	(D+Q)	A_2=−0.08 *2*, A_4=−0.11 *1*.

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^{66}Zn(^{28}Si,2p2nγ) 1992Si03,1994Da15 (continued)

γ(^{90}Mo) (continued)

E_γ †	I_γ †	E_i(level)	J^π_i	E_f	J^π_f	Mult. ‡	Comments
857.0 *3*	10.2 *6*	5701.3	13^-	4844.3	11^-	Q	A_2=+0.22 *5*, A_4=−0.16 *2*.
872.1 *3*	14.6 *5*	7516.6	17^-	6644.6	15^-	Q	A_2=+0.43 *4*, A_4=−0.22 *2*.
931.7 *3*	30.0 *8*	4300.3	9^-	3368.6	7^-	Q	A_2=+0.23 *3*, A_4=−0.21 *1*. E_γ: placed by 1992Si03 from a 3482 (7^-) level.
943.4 *3*	13.4 *4*	6644.6	15^-	5701.3	13^-	Q	A_2=+0.17 *4*, A_4=−0.07 *1*.
948.2 *3*	100.0 *14*	948.2	2^+	0.0	0^+	Q	A_2=+0.23 *3*, A_4=−0.08 *1*.
972.9 *3*	44.3 *9*	4079.7	10^+	3106.8	8^+	Q	A_2=+0.36 *3*, A_4=−0.15 *1*.
1018.0 *3*	5.5 *6*	6644.6	15^-	5626.5	14^+	(D)	A_2=+0.09 *3*, A_4=+0.19 *2*.
1054.4 *3*	97.9 *14*	2002.6	4^+	948.2	2^+	Q	A_2=+0.30 *3*, A_4=−0.07 *1*.
1070.0 *3*	47.1 *2*	5626.5	14^+	4556.8	12^+	Q	A_2=+0.30 *2*, A_4=−0.13 *1*.
1144.5 *3*	5.3 *4*	5701.3	13^-	4556.8	12^+	(D)	A_2=−0.17 *11*, A_4=+0.29 *5*.
1318.0 *3*	26.9 *8*	4193.4	10^+	2875.4	8^+	Q	A_2=+0.24 *4*, A_4=−0.08 *2*.

† From 1992Si03.
‡ From $\gamma(\theta)$ and $\gamma\gamma(\theta)$ (1992Si03).

^{90}Zr(^{3}He,3nγ) 1982De34,2009Be49

1982De34: ^{90}Zr(^{3}He,3nγ), E(^{3}He)=33-43 MeV. Measured $\gamma(\theta)$, excit, $\gamma\gamma$ and nγ coin. Shell-model analysis.
2009Be49: ^{90}Zr(^{3}He,3nγ), E(^{3}He)=27 MeV. Measured $\gamma\gamma$ coin, $\gamma(\theta)$; deduced mixing ratio; HORUS spectrometer at Univ of Cologne. IBM-2 calculation.
1971Is04: ^{93}Nb(p,4nγ), E(p)=53 MeV; measured γ(t) with Ge(Li).
Other: 1977BeXM.

^{90}Mo Levels

E(level)†	J$^{\pi}$‡	T$_{1/2}$	Comments
0	0$^+$		
948.2 *8*	2$^+$		
1896.7 *8*	2$^+$		
2002.6 *17*	4$^+$		
2433.1 *10*	3$^-$		
2534.2 *8*	(2$^+$)		J$^{\pi}$: from $\gamma\gamma(\theta)$ (2009Be49).
2549.5 *18*	5$^-$		
2812.3 *18*	6$^+$		
2859.9 *20*	5$^-$		
2875.2 *21*	8$^+$	1.05 μs *10*	T$_{1/2}$: From γ(t) (1971Is04).
2902.0 *14*	(4$^-$)		
2947.7 *20*	(6$^+$)		
3106.8 *22*	8$^+$		
3148.4 *14*			
3294.5 *19*			
3368.0 *20*	7$^-$		
3447.2 *24*	(5$^-$)		
3660.2 *22*	(7$^-$)		
4079.9 *23*	(10$^+$)		
4193.1 *22*	(10$^+$)		
4298.1 *23*	(9$^-$)		
4557.0 *23*	(12$^+$)		
4595.2 *25*	(9$^-$)		
4788.2 *25*	(11$^-$)		
4842.5 *23*	(11$^-$)		
4894 *3*	(13$^-$)		
5378 *3*	(12$^+$)		

† From a least-squares fit to Eγ, by evaluators, assuming ΔEγ=1 keV when not specified.
‡ Suggested by 1982De34 from $\gamma(\theta)$, excitation function and tendency to populate yrast states, except where noted.

γ(^{90}Mo)

E$_{\gamma}$†	I$_{\gamma}$‡	E$_i$(level)	J$^{\pi}_i$	E$_f$	J$^{\pi}_f$	I$_{(\gamma+ce)}$	Comments
62.9 *10*	≈7.7	2875.2	8$^+$	2812.3	6$^+$	≈57	I$_{\gamma}$: Calculated from I(γ+ce)=57 given by 1982De34 corrected for conversion.
105.9 *10*	≈40	4894	(13$^-$)	4788.2	(11$^-$)	≈79	I$_{\gamma}$: Calculated from I(γ+ce)=79 given by 1982De34 corrected for conversion.
113.3 *10*	≈58§	4193.1	(10$^+$)	4079.9	(10$^+$)		
135.3 *10*	≈23§	2947.7	(6$^+$)	2812.3	6$^+$		
231.6 *10*	123 *13*	3106.8	8$^+$	2875.2	8$^+$		
262.9 *10*	21 *2*	2812.3	6$^+$	2549.5	5$^-$		
292.2 *10*	12 *2*	3660.2	(7$^-$)	3368.0	7$^-$		
297.1 *10*	11 *2*	4595.2	(9$^-$)	4298.1	(9$^-$)		

Continued on next page (footnotes at end of table)

^{90}Zr(^{3}He,3nγ) 1982De34,2009Be49 (continued)

γ(^{90}Mo) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	δ	Comments
310.3 *10*	46 *5*	2859.9	5^-	2549.5	5^-			
364.0 *10*	21 *2*	4557.0	(12^+)	4193.1	(10^+)			
468.9 *10*	≤27[§]	2902.0	(4^-)	2433.1	3^-			
477.0 *10*	302 *31*	4557.0	(12^+)	4079.9	(10^+)			
482.4 *10*	≈19[§]	3294.5		2812.3	6^+			
490.1 *10*	≈37[§]	4788.2	(11^-)	4298.1	(9^-)			
536.6 *10*	21 *2*	2433.1	3^-	1896.7	2^+			E_γ: other: 536.1 (2009Be49).
544.4 *10*	52 *6*	4842.5	(11^-)	4298.1	(9^-)			
547.0 *10*	252 *25*	2549.5	5^-	2002.6	4^+			
555.7 *10*	25 *3*	3368.0	7^-	2812.3	6^+			
649.4 *10*	24 *3*	4842.5	(11^-)	4193.1	(10^+)			
715.3		3148.4		2433.1	3^-			E_γ: observed only by 2009Be49.
809.9 *15*	456 *46*	2812.3	6^+	2002.6	4^+			
818.5 *15*	<161[&]	3368.0	7^-	2549.5	5^-			
821.1 *15*	<161[&]	5378	(12^+)	4557.0	(12^+)			
857.3 *15*	≈13[§]	2859.9	5^-	2002.6	4^+			
897.7 *15*	≈10[§]	3447.2	(5^-)	2549.5	5^-			
930.1 *15*	79 *8*	4298.1	(9^-)	3368.0	7^-			
945.2 *15*	43 *5*	2947.7	(6^+)	2002.6	4^+			
948.3 *15*	1000	948.2	2^+	0	0^+			
948.5	≤50[§]	1896.7	2^+	948.2	2^+			E_γ: from 2009Be49. Other: 951.2 *10* (1982De34). Evaluators adopt value from 2009Be49, as they also observe ground state transition which supports a level at 1897 keV, rather than at 1899.5-keV as proposed by 1982De34.
973.0 *15*	68 *7*	4079.9	(10^+)	3106.8	8^+			
1054.4 *15*	844 *85*	2002.6	4^+	948.2	2^+			
1291.6		3294.5		2002.6	4^+			
1317.9 *15*	83 *9*	4193.1	(10^+)	2875.2	8^+			
1484.7	37 *6*	2433.1	3^-	948.2	2^+	D+Q	−0.12 *8*	E_γ: observed only by 2009Be49. I_γ: calculated from $I\gamma(536.6\gamma)/I\gamma(1484.7\gamma)$=0.57 *8* from 2009Be49 and $I\gamma(536.1\gamma)$=21 *2* from 1982De34.
1586.2		2534.2	(2^+)	948.2	2^+	D(+Q)	−0.13 *22*	E_γ: observed only by 2009Be49.
1896.8	≤50	1896.7	2^+	0	0^+			E_γ: observed only by 2009Be49. I_γ: calculated from $I\gamma(1896.6\gamma)/I\gamma(948.5\gamma)$=0.059 *9* from 2009Be49 and $I\gamma(948.5\gamma)$<50 from 1982De34.
2534		2534.2	(2^+)	0	0^+			E_γ: transition not observed in 2009Be49, upper limit on intensity of $I\gamma(2534\gamma)/I\gamma(1586.2\gamma)$ < 0.056.

[†] From 1982De34, except where noted.
[‡] From $\gamma(\theta)$ measurement at 33 MeV (1982De34), except where noted.
[§] From coincidence measurement at 90° (1982De34).
[&] Unresolved doublet, composite intensity 146 *15* (1982De34).

^{92}Mo(p,t) 1976Ka08

1976Ka08: E(p)=28.0 MeV; measured $\sigma(\theta)$ from 5° to 60° in steps of 5°; enriched targets (98.45%), magnetic spectrograph, FWHM=11-15 keV; L values are from comparison with DWBA calculations. The agreement with previous work is good.
1972Yo05: E(p)=38.6 MeV; measured $\sigma(\theta)$ with semiconductor telescope; FWHM=45 keV.
1971Mo08: E(p)=40 MeV; measured $\sigma(\theta)$ with semiconductor telescope; FWHM≈90 keV.
Others: 1971Ta16, 1972Ba75.

^{90}Mo Levels

E(level)†	L†	E(level)†	L†	E(level)†	L†	E(level)†
0	0	2528 *5*	(2)	3074 *7*	3	3683 *7*
947 *5*	2	2545 *5*	5	3148 *5*	2	3736 *7*
1896 *5*	2‡	2613 *5*	2	3185 *7*		3834 *7*
1979 *5*	0	2706 *7*		3298 *7*		3936 *7*
2002 *5*	4	2855 *7*	5	3355 *7*		
2429 *5*	3	2871 *7*	(6)	3494 *7*		
2450 *5*	0	2903 *7*		3514 *7*		

† From 1976Ka08.
‡ 1972Yo05 assign L=0, but their fit to DWBA is rather poor.

Adopted Levels, Gammas

Q(β^-)=−5841 *4*; S(n)=11401 *4*; S(p)=2999 *4*; Q(α)=−4016 *6* 2017Wa10
S(2n)=25190 *150*; S(2p)=9130 *60*; Q(εp)= 2612 (syst) *24* (2017Wa10).

^{90}Tc Levels

Cross Reference (XREF) Flags

A	^{90}Ru ε decay
B	(HI,xnγ)
C	Ni(^{40}Ca,X)

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]	XREF	Comments
0	(8$^+$)	49.2 s *4*	BC	T$_{1/2}$: from 809.8γ(t) (1981Ox01). Other: 50.7 s *63* (2012Ka12, based on analysis of data in 2008We10). E(level): TOF spectra in Ni(^{40}Ca,X) reaction give population fractions of 89 % *5* and 11 % *5* for the ground state and isomer, respectively (2012Ka12). As high-spin levels are more favorably produced in these reactions, the ground state is assigned as the Jπ=(8$^+$) level. J$^\pi$: from systematics of Jπ=8$^+$ states in neighboring odd-odd ^{92}Tc(N=43), ^{90}Nb(N=49) and ^{88}Nb(N=47) nuclei and supported by shell-model calculations (1993Ru03).
103.70 *22*	(6$^+$)		B	J$^\pi$: shell-model calculations predict a Jπ=6$^+$ state at 106 keV (1993Ru03); in ^{90}Nb a 6$^+$ isomeric level lies at 123 keV with T$_{1/2}$ = 60 μs, which could explain the non-observation of a depopulating 104-keV transition.
144.1 *17*	1$^+$	8.7 s *2*	A C	%ε+%β^+=100 E(level): from Penning-trap mass measurement (2012Ka12): mass excess=−70724.7 keV *11* for ^{90}Tc g.s. and −70580.6 keV *13* for ^{90}Tc isomer (2012Ka12). T$_{1/2}$: from two component fit to 944.7γ+948.1γ(t) (1981Ox01). Other: 7.9 s *2* (1974Ia01). J$^\pi$: theoretical prediction is 2$^+$ but 1$^+$ is suggested from log *ft* value to 0$^+$ and 2$^+$ states in ^{90}Mo. If g.s. feeding is not properly determined then 2$^+$ is possible (2012Ka11).
152.52[&] *20*	(4$^-$)		B	J$^\pi$: 187.8γ from (5$^-$).
298.7 *1*			A	
340.33[&] *18*	(5$^-$)		B	J$^\pi$: E2 683.5γ from (7$^-$).
494.09[a] *8*	(9$^+$)		B	J$^\pi$: (M1+E2) 494.1γ to (8$^+$).
636.9			A	
993.72[a] *8*	(10$^+$)	1.4 ps *5*	B	J$^\pi$: E2 993.7γ to (8$^+$).
1023.83[&] *15*	(7$^-$)		B	J$^\pi$: E2 608.1γ from (9$^-$).
1485.90[a] *10*	(11$^+$)	<5 ps	B	J$^\pi$: (M1+E2) 492.1γ to (10$^+$).
1613.85 *10*			B	
1631.93[&] *12*	(9$^-$)		B	J$^\pi$: E2 363.3γ from (11$^-$).
1698.77 *13*			B	
1938.56[a] *10*	(12$^+$)	2.8 ps *5*	B	J$^\pi$: E2 944.9γ to (10$^+$).
1995.09[&] *9*	(11$^-$)	33 ps *4*	B	J$^\pi$: D 1001.4γ to (10$^+$), (M1+E2) 191.6γ from (11$^-$).
2186.48 *11*	(11$^-$)	13 ps *2*	B	J$^\pi$: E2 554.4γ to (9$^-$).
2247.95 *18*			B	
2537.40[a] *11*	(13$^+$)	<0.7 ps	B	J$^\pi$: 1051.5γ to (11$^+$), D+Q 598.9γ to (12$^+$).
2557.88[&] *11*	(12$^-$)	<0.7 ps	B	J$^\pi$: (M1+E2) 562.8γ to (11$^-$).
2600.48 *11*	(12$^-$)	5.3[@] ps *8*	B	J$^\pi$: (D+Q) 605.2γ to (11$^-$); assignment to negative-parity sequence.
2775.61[&] *10*	(13$^-$)	2.7 ps *3*	B	J$^\pi$: E2 780.6γ to (11$^-$).
2946.74 *12*			B	
2982.00 *12*			B	
3167.77[a] *11*	(14$^+$)	1.0 ps *3*	B	J$^\pi$: E2 1229.0γ to (12$^+$).

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Adopted Levels, Gammas (continued)

^{90}Tc Levels (continued)

E(level)[†]	J^{π}[‡]	$T_{1/2}$[#]	XREF	Comments
3201.19 *14*			B	
3383.26[a] *13*	(15$^+$)	1.8 ps *4*	B	J^{π}: E2 845.8γ to (13$^+$).
3405.73 *15*			B	
3488.64[&] *12*	(14$^-$)	<1.4 ps	B	J^{π}: (E2) 930.6γ to (12$^-$).
3593.08 *13*	(15$^+$)	1.2 ps *4*	B	J^{π}: E2 919.1γ from (17$^+$).
3672.91[&] *12*	(15$^-$)	1.1 ps *3*	B	J^{π}: E2 897.4γ to (13$^-$).
4486.41[a] *15*	(16$^+$)		B	J^{π}: 1103γ to (15$^+$); assignment to positive parity sequence.
4512.12[a] *14*	(17$^+$)	1.5 ps *3*	B	J^{π}: E2 1128.8γ to (15$^+$).
4637.12[&] *16*	(17$^-$)	1.6 ps *2*	B	J^{π}: E2 964.2γ to (15$^-$).
4864.66 *17*	(17$^+$)		B	J^{π}: 378.1γ to (16$^+$), 1481.9γ to (15$^+$).
5599.18[a] *17*	(18$^+$)		B	J^{π}: 1087.1γ to (17$^+$); assignment to positive parity sequence.
5651.25[a] *17*	(19$^+$)	2.4 ps *1*	B	J^{π}: E2 1139.1γ to (17$^+$).
5705.92[&] *19*	(19$^-$)	1.3 ps *2*	B	J^{π}: E2 1068.8γ to (17$^-$).
5808.21 *21*			B	
6338.54 *24*			B	
6455.27[a] *21*	(20$^+$)	<0.7[@] ps	B	J^{π}: (D+Q) 803.9γ to (19$^+$); assignment to positive parity sequence.
6884.81[a] *23*	(21$^+$)		B	J^{π}: (D+Q) 429.6γ to (20$^+$); assignment to positive parity sequence.
6993.93[&] *21*	(21$^-$)	0.8[@] ps *2*	B	J^{π}: E2 1288.0γ to (19$^-$).
7373.4 *3*			B	
7439.6[&] *4*	(22$^-$)		B	J^{π}: 445.7γ to (21$^-$); assignment to negative parity sequence.
7678.8 *3*			B	
8394.4[&] *4*	(23$^-$)		B	J^{π}: 954.8γ to (22$^-$); assignment to negative parity sequence.
8756.5[a] *3*	(22$^+$)		B	J^{π}: 1872.2γ to (21$^+$), 2300.8γ to (20$^+$).
9342.1 *3*			B	
9804.2 *3*			B	
11246.4 *4*			B	

[†] Deduced by evaluators from a least-squares fit to Eγ, except where noted.
[‡] Spin and parity assignments for excited states are based on γ-ray multipolarities and on the assumption that γ-ray deexcitation takes place through yrast states. Spin and parities of the (8$^+$) and (6$^+$) levels are based on shell-model calculations which use a configuration space of only the 2p1/2 and 1g9/2 orbitals for protons and neutrons (1993Ru03).
[#] From recoil-distance Doppler-shift method in (HI,xnγ), except where noted. (1994Ru13).
[@] Effective half-life from (HI,xnγ), not corrected for feeding.
[&] Band(A): Negative-parity sequence.
[a] Band(B): Positive-parity sequence.

γ(^{90}Tc)

E_i(level)	J^{π}_i	E_{γ}[†]	I_{γ}[†]	E_f	J^{π}_f	Mult.[‡]	δ[‡]	α[§]	Comments
152.52	(4$^-$)	48.8 *1*	100	103.70	(6$^+$)				E_{γ},I_{γ}: from ^{90}Ru ε decay.
298.7		154.6 *1*	100	144.1	1$^+$				
340.33	(5$^-$)	187.8 *1*	100 *12*	152.52	(4$^-$)	(M1+E2)	0.23 *+7−6*	0.054 *3*	Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); non-zero value of δ suggests M1+E2 character.
		236.8 *3*	10 *6*	103.70	(6$^+$)				
494.09	(9$^+$)	494.1 *1*	100	0	(8$^+$)	(M1+E2)	0.20 *+6−5*	0.00440	Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); non-zero value of δ suggests M1+E2 character.
636.9		492.8 *1*	100	144.1	1$^+$				E_{γ},I_{γ}: from ^{90}Ru ε decay.

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Adopted Levels, Gammas (continued)

$\gamma(^{90}Tc)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[§]	Comments
993.72	(10+)	499.7 *1*	5.5 *3*	494.09	(9+)	M1+E2	0.3 *2*	0.00432 *12*	B(M1)(W.u.)= 0.0060 *+31−19*; B(E2)(W.u.)=2.3 *+40−18* Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=no from level scheme.
		993.7 *1*	100 *3*	0	(8+)	E2		8.39×10^{-4}	B(E2)(W.u.)=16 *+9−4*
1023.83	(7−)	683.5 *1*	100	340.33	(5−)	E2		0.00210	
1485.90	(11+)	492.1 *1*	100 *4*	993.72	(10+)	(M1+E2)	0.15 *4*	0.00443	B(M1)(W.u.)>0.031; B(E2)(W.u.)>1.7 Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); non-zero value of δ suggests M1+E2 character.
		991.5 *2*	10.1 *22*	494.09	(9+)	[E2]			B(E2)(W.u.)>0.35
1613.85		620.2 *4*	21 *6*	993.72	(10+)				
		1119.8 *1*	100 *6*	494.09	(9+)				
1631.93	(9−)	608.1 *1*	100 *9*	1023.83	(7−)	E2		0.00288	
		1137.8 *3*	45 *11*	494.09	(9+)				
1698.77		1204.4 *4*	100	494.09	(9+)				
1938.56	(12+)	452.6 *1*	5.8 *4*	1485.90	(11+)	M1+E2		0.0061 *7*	B(M1)(W.u.)<0.0062; B(E2)(W.u.)<32 Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=no from level scheme.
		944.9 *1*	100 *3*	993.72	(10+)	E2		9.42×10^{-4}	B(E2)(W.u.)=10.6 *+23−16*
1995.09	(11−)	296.3 *1*	1.7 *7*	1698.77					
		363.3 *1*	6.1 *14*	1631.93	(9−)	[E2]		0.01355	B(E2)(W.u.)=5.1 *+14−12*
		381.3 *1*	5.0 *10*	1613.85					
		509.1 *1*	22.9 *21*	1485.90	(11+)	(E1)		1.51×10^{-3}	B(E1)(W.u.)= 1.30×10^{-5} *+21−18* Mult.: D from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=yes from level scheme.
		1001.4 *1*	100 *3*	993.72	(10+)	(E1)		3.53×10^{-4}	B(E1)(W.u.)= 7.5×10^{-6} *+10−8* Mult.: D from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=yes from level scheme.
2186.48	(11−)	191.6 *1*	100 *6*	1995.09	(11−)	(M1+E2)	0.20 *+30−10*	0.050 *12*	B(M1)(W.u.)=0.124 *+20−27* Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=no from level scheme.
		554.4 *1*	67.3 *20*	1631.93	(9−)	E2		0.00373	B(E2)(W.u.)=12.5 *+24−18*
		1192.8 *5*	14 *6*	993.72	(10+)	[E1]			B(E1)(W.u.)=1.1×10^{-6} *5*
2247.95		309.5 *2*	100	1938.56	(12+)				
2537.40	(13+)	598.9 *1*	100 *3*	1938.56	(12+)	(M1+E2)	0.07 *+10−8*	0.00278	B(M1)(W.u.)>0.12 Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ);

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Adopted Levels, Gammas (continued)

$\gamma(^{90}Tc)$ (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[‡]	α[§]	Comments
									$\Delta\pi$=no from level scheme.
2537.40	(13+)	1051.5 *1*	15.9 *11*	1485.90	(11+)	[E2]			B(E2)(W.u.)>3.3
2557.88	(12−)	371.4 *1*	8.1 *7*	2186.48	(11−)				
		562.8 *1*	100 *3*	1995.09	(11−)	(M1+E2)	0.08 *3*	0.00321	B(M1)(W.u.)>0.16; B(E2)(W.u.)>1.4 Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); non-zero value of δ suggests M1+E2 character.
2600.48	(12−)	413.9 *1*	60 *5*	2186.48	(11−)	D+Q			
		605.2 *1*	100 *5*	1995.09	(11−)	D+Q			
2775.61	(13−)	175.0 *1*	17.4 *19*	2600.48	(12−)	(M1+E2)		0.114 *54*	B(M1)(W.u.)<0.18; B(E2)(W.u.)<6472 Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=no from level scheme.
		217.7 *1*	100 *4*	2557.88	(12−)	(M1+E2)	0.06 *3*	0.0341 *6*	B(M1)(W.u.)=0.42 *5*; B(E2)(W.u.)=35 *+44−25* Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=no from level scheme.
		589.3 *1*	7.4 *12*	2186.48	(11−)	[E2]			B(E2)(W.u.)=5.0 *10*
		780.6 *1*	39.9 *16*	1995.09	(11−)	E2		1.49×10^{-3}	B(E2)(W.u.)=6.5 *+9−7*
		837.1 *1*	15.9 *8*	1938.56	(12+)	[E1]		5.03×10^{-4}	B(E1)(W.u.)= 1.82×10^{-5} *+24−21*
2946.74		409.4 *1*	74 *5*	2537.40	(13+)				
		698.9 *2*	37 *11*	2247.95					
		1008.5 *2*	100 *21*	1938.56	(12+)				
2982.00		381.3 *1*	25 *5*	2600.48	(12−)				
		424.2 *1*	100 *9*	2557.88	(12−)				
3167.77	(14+)	221.2 *1*	9.4 *7*	2946.74		(M1+E2)		0.053 *21*	B(M1)(W.u.)<0.26; B(E2)(W.u.)<5634 Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=no from level scheme.
		630.4 *1*	9 *1*	2537.40	(13+)	(M1+E2)		0.00254 *9*	B(M1)(W.u.)<0.011; B(E2)(W.u.)<29 Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=no from level scheme.
		1229.0 *1*	100 *4*	1938.56	(12+)	E2		5.38×10^{-4}	B(E2)(W.u.)=7.1 *+30−17*
3201.19		600.9 *2*	100	2600.48	(12−)				
3383.26	(15+)	215.5 *1*	100 *4*	3167.77	(14+)	(M1+E2)	≤0.06	0.0349	B(M1)(W.u.)=0.81 *+26−17*; B(E2)(W.u.)<88 Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=no from level scheme.
		845.8 *1*	47.8 *20*	2537.40	(13+)	E2		1.23×10^{-3}	B(E2)(W.u.)=9.6 *+27−18*
3405.73		238.1 *2*	26 *11*	3167.77	(14+)				
		868.4 *2*	100 *21*	2537.40	(13+)				
3488.64	(14−)	287.5 *1*	21.8 *23*	3201.19					
		506.5 *1*	49 *6*	2982.00					
		713.1 *1*	100 *3*	2775.61	(13−)	(M1+E2)	0.14 *+9−6*	0.00186	B(M1)(W.u.)>0.019; B(E2)(W.u.)>0.27

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

$\gamma(^{90}Tc)$ (continued)

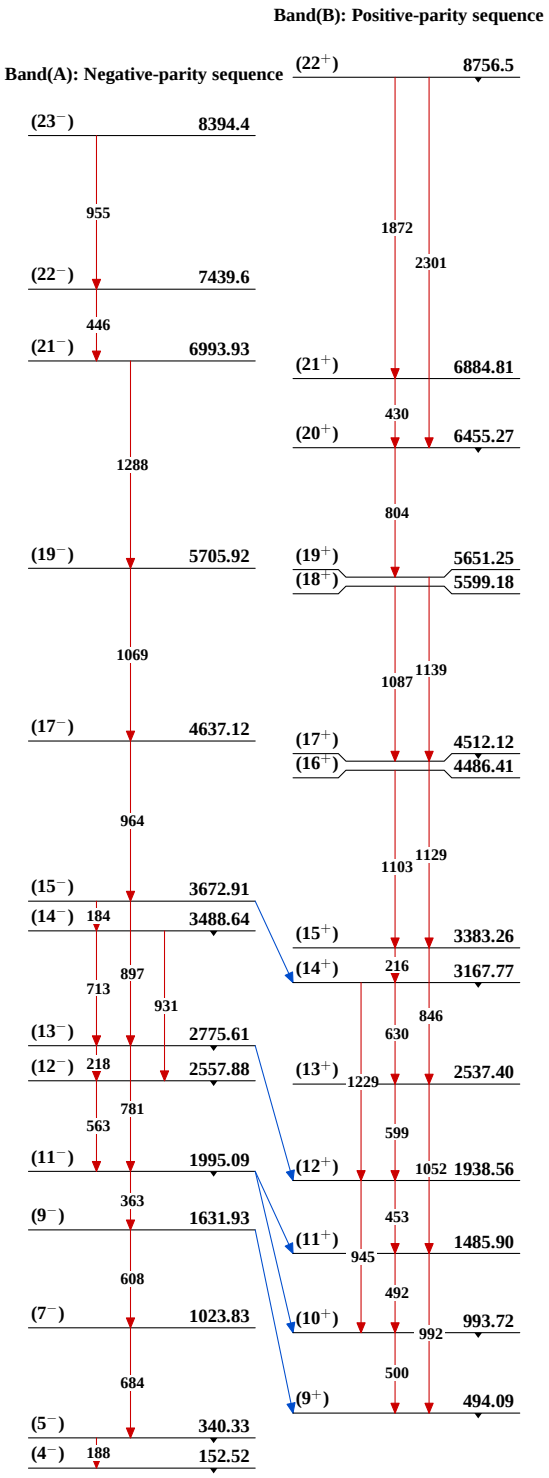
E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f	Mult.‡	α§	Comments
								Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=no from level scheme.
3488.64	(14⁻)	930.6 *2*	33.3 *23*	2557.88	(12⁻)	(E2)	9.76×10^{-4}	B(E2)(W.u.)>3.5
3593.08	(15⁺)	187.4 *1*	41 *4*	3405.73				
		210.1 *4*	11 *5*	3383.26	(15⁺)			
		425.3 *1*	100 *4*	3167.77	(14⁺)	(M1+E2)		B(M1)(W.u.)<0.25; B(E2)(W.u.)<1503 Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=no from level scheme.
3672.91	(15⁻)	184.2 *1*	43.5 *17*	3488.64	(14⁻)	(M1+E2)	0.096 *44*	B(M1)(W.u.)<1.4; B(E2)(W.u.)<42741 Mult.: D+Q from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (HI,xnγ); $\Delta\pi$=no from level scheme.
		505.0 *2*	5.0 *10*	3167.77	(14⁺)	[E1]		B(E1)(W.u.)=7.8×10^{-5} *+34−22*
		897.4 *1*	100 *4*	2775.61	(13⁻)	E2	1.06×10^{-3}	B(E2)(W.u.)=24 *+9−5*
4486.41	(16⁺)	1103.0 *1*	100	3383.26	(15⁺)			
4512.12	(17⁺)	919.1 *1*	32.1 *13*	3593.08	(15⁺)	E2	1.01×10^{-3}	B(E2)(W.u.)=5.8 *+15−10*
		1128.8 *1*	100 *3*	3383.26	(15⁺)	E2	6.33×10^{-4}	B(E2)(W.u.)=6.5 *+17−11*
4637.12	(17⁻)	964.2 *1*	100	3672.91	(15⁻)	E2	8.99×10^{-4}	B(E2)(W.u.)=17.7 *+26−20*
4864.66	(17⁺)	378.1 *1*	43 *9*	4486.41	(16⁺)			
		1481.9 *2*	100 *9*	3383.26	(15⁺)			
5599.18	(18⁺)	1087.1 *1*	100	4512.12	(17⁺)			
5651.25	(19⁺)	1139.1 *1*	100	4512.12	(17⁺)	E2	6.21×10^{-4}	B(E2)(W.u.)=5.13 *21*
5705.92	(19⁻)	1068.8 *1*	100	4637.12	(17⁻)	E2	7.12×10^{-4}	B(E2)(W.u.)=13.0 *+24−17*
5808.21		209.2 *2*	100	5599.18	(18⁺)			
6338.54		1473.8 *2*	100	4864.66	(17⁺)			
6455.27	(20⁺)	647.1 *1*	12.3 *14*	5808.21				
		803.9 *2*	100 *4*	5651.25	(19⁺)	(D+Q)		
6884.81	(21⁺)	429.6 *1*	100	6455.27	(20⁺)	(D+Q)		
6993.93	(21⁻)	1288.0 *1*	100	5705.92	(19⁻)	E2	5.00×10^{-4}	B(E2)(W.u.)=8.3 *+28−17*
7373.4		1722.2 *5*	100	5651.25	(19⁺)			
7439.6	(22⁻)	445.7 *3*	100	6993.93	(21⁻)			
7678.8		305.4 *2*	53 *13*	7373.4				
		1340.2 *2*	100 *7*	6338.54				
8394.4	(23⁻)	954.8 *2*	100	7439.6	(22⁻)			
8756.5	(22⁺)	1077.8 *5*	42 *17*	7678.8				
		1872.2 *3*	100 *25*	6884.81	(21⁺)			
		2300.8 *3*	83 *17*	6455.27	(20⁺)			
9342.1		585.7 *2*	100 *12*	8756.5	(22⁺)	(D+Q)		
		1663.0 *4*	30 *6*	7678.8				
9804.2		462.1 *1*	100	9342.1		(D+Q)		
11246.4		1442.2 *2*	100	9804.2		(E2)		

† From (HI,xnγ), except where noted.

‡ From $\gamma(\theta)$ in ^{58}Ni(^{35}Cl,2pnγ) and DCO ratios in ^{58}Ni(^{36}Ar,3pnγ), both from (HI,xnγ) dataset.

§ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

Adopted Levels, Gammas



$^{90}_{43}Tc_{47}$

^{90}Ru ε decay 2004De40

Parent: ^{90}Ru: E=0.0; $J^{\pi}=0^+$; $T_{1/2}$=11.7 s *9*; Q(ε)=5841 *4*; %ε+%β^+ decay=100.0

2004De40: ^{90}Ru isotope produced in the ^{58}Ni(^{36}Ar^{10+}, 2n2p) reaction with E=150 MeV. Nuclei recoiling out of the target were stopped and neutralised by 500 mbar of purified Ar gas inside a cell. Reaction products were ionized selectively, according to Z, using two dye lasers tuned to the resonant atomic transitions of the particular element. Laser-ionized nuclei were guided to the LISOL mass separator by a sextupole ion guide. Measured Eγ, Iγ, $\gamma\gamma$, $\beta\gamma$ (coin), Iβ, isotopic $T_{1/2}$ with two HPGe detectors arranged in a compact configuration around β-sensitive plastic ΔE detectors.

1991Zh29, 1994Zh26: Enriched ^{58}Ni(^{35}Cl,2np) E(^{35}Cl)=112-132 MeV; Si(Li), Compton-suppressed HPGe and neutron detectors; Wheel transportation system; Measured σ(E(^{58}Ni), Eγ) and γ(t); Identification of ^{90}Ru decay based on comparison of σ(E(^{58}Ni)) with cascade calculations; 37 γ-rays identified in coincidence with Tc Kα x ray by 1994Zh26 but not placed in a decay scheme.

^{90}Tc Levels

E(level)†	J^{π}‡	$T_{1/2}$	Comments
144.1 *17*	(1$^+$)	8.7 s *2*	E(level),$T_{1/2}$: from the Adopted Levels.
298.7 *17*			
636.9 *17*			

† From Eγ, except where noted.
‡ From Adopted Levels.

ε,β^+ radiations

E(decay)	E(level)	Iβ^+ ‡	Iε‡	Log *ft*†	I($\varepsilon+\beta^+$)‡	Comments
(5204 *4*)	636.9	9 *2*	0.3 *1*	5.19 *11*	9 *2*	
(5542 *4*)	298.7	41 *5*	1.2 *1*	4.67 *7*	42 *5*	
(5697 *4*)	144.1	48 *11*	1.3 *3*	4.67 *11*	49 *11*	I($\varepsilon+\beta^+$): isomer feeding was determined by 2004De20 from measurement of 511-keV annihilation intensity. 2004De20 do not provide value for Iγ(511γ).

† Values should be regarded as lower limits, as there is a large difference between the allowed energy for decay (5.8 MeV) and the highest observed excited level (0.6 MeV).
‡ Absolute intensity per 100 decays.

γ(^{90}Tc)

Iγ normalization: from ΣIγ(to 144-keV isomer)=51 *11*, based on 144-keV isomer I(ε+β^+) feeding of 49 *11* from 2004De20 derived from a measurement of 511-keV annihilation intensity.

2004De40 confirm only two γ rays out of 37 γ rays reported by 1994Zh26.

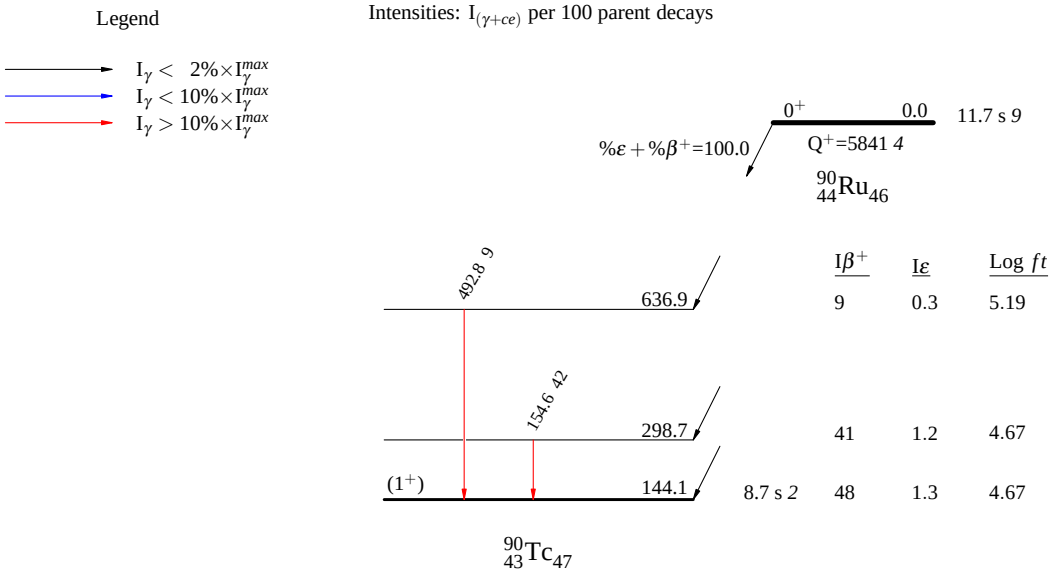
E_{γ}†	I_{γ}†‡	E_i(level)	E_f	J^{π}_f	Comments
154.6 *1*	100	298.7	144.1	(1$^+$)	E_{γ}: strong γ-ray identified in coincidence with Tc Kα x ray but not placed in a decay scheme by 1994Zh26.
492.8 *1*	21 *4*	636.9	144.1	(1$^+$)	E_{γ}: strong γ-ray identified in coincidence with Tc Kα x ray but not placed in a decay scheme by 1994Zh26.

† From 2004De20.
‡ For absolute intensity per 100 decays, multiply by 0.42 *9*.

^{90}Ru ε decay 2004De40

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



Ni(^{40}Ca,X) 2012Ka12

Determination of the energy of the low-spin isomeric state.

2012Ka12: ^{90}Tc isotope was produced through the Ni(^{40}Ca,X) at E=210 MeV using HIGISOL facility via JYFLTRAP mass measurement. Measured isomer excitation energy from difference in mass excess. Deduced $T_{1/2}$ of high-spin ground state analyzing data from 2008We10.

^{90}Tc Levels

E(level)	J^π	$T_{1/2}$	Comments
0	(8^+)	50.7 s *63*	$T_{1/2}$,J^π: from 2012Ka12 based on analysis of β(t) data from 2008We10.
144.1 *17*	(1^+)	8.7 s *2*	$T_{1/2}$: from the Adopted Levels. E(level): from Penning-trap mass measurement (2012Ka12): mass excess=−70724.7 keV *11* for ^{90}Tc g.s. and −70580.6 keV *13* for ^{90}Tc isomer (2012Ka12). Fit to TOF spectra yields fractions of lower-mass and and higher mass state as 89 % *5* and 11 % *5*, respectively (2012Ka12). As the high-spin state is more favorably produced in the reaction utilized in 2012Ka12, the ground state is most likely the high-spin level and the isomer the low-spin level. J^π: from the Adopted Levels.

(HI,xnγ) 1993Ru03

1993Ru03, 1993Ka24: 99.98% enriched ^{58}Ni target; measured γ rays using the OSIRIS array of 12 Compton-suppressed HPGe detectors. Reactions: ^{58}Ni(^{36}Ar,3pnγ), E=149 MeV. Measured Eγ, Iγ, $\gamma\gamma$ coin, DCO ratios; ^{58}Ni(^{35}Cl,2pnγ), E=120 MeV. Measured $\gamma\gamma(\theta)$ for θ=0° to 90°, angular correlation coefficients, n$\gamma\gamma$ coin.

1994Ru13: 99.8% enriched ^{58}Ni target. Measured level half-lives using the recoil distance doppler-shift method (RDDS). Data were also analyzed using the differential decay curve method (DDCM). Reactions: ^{58}Ni(^{36}Ar,3pn), E=140 MeV; ^{58}Ni(^{35}Cl,2pn), E=120 MeV.

1993Ka24: general treatment of DCO ratio analysis applied to a few transitions in ^{90}Tc.

1993Zh16: 99.8% enriched ^{58}Ni(^{35}Cl,2pn) reaction, E=124 MeV; measured Eγ, Iγ, n$\gamma\gamma$ coin, DCO ratios; used an array of five Compton-suppressed HPGe detectors.

Others: 1992CrZY, 1992LiZT, 1992WeZR, 1993RuZV.

^{90}Tc Levels

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]	Comments
0.0[a]	8$^+$		J$^\pi$: based on systematics of Jπ=8$^+$ ground states in neighboring odd-odd ^{92}Tc(N=49), ^{90}Nb(N=49) and ^{88}Nb(N=47) nuclei. Shell-model calculations predict Jπ=8$^+$ for the g.s. of ^{90}Tc.
103.70 *22*	(6$^+$)		J$^\pi$: shell-model calculations predict a Jπ=6$^+$ state at 106 keV.
152.52[&] *21*	4$^-$		
340.34[&] *18*	5$^-$		
494.09[a] *8*	9$^+$		
993.72[a] *8*	10$^+$	1.4 ps *5*	
1023.84[&] *16*	7$^-$		
1485.90[a] *10*	11$^+$	<5 ps	
1613.85 *11*	(10$^+$)		
1631.94[&] *12*	9$^-$		
1698.78 *14*	(10$^+$)		
1938.56[a] *10*	12$^+$	2.8 ps *5*	
1995.09[&] *10*	11$^-$	33 ps *4*	
2186.48 *11*	11$^-$	13 ps *2*	
2247.95 *18*	(12$^+$)		
2537.40[a] *11*	13$^+$	<0.7 ps	
2557.88[&] *11*	12$^-$	<0.7 ps	
2600.49 *11*	12$^-$	5.3[@] ps *8*	
2775.61[&] *11*	13$^-$	2.7 ps *3*	
2946.74 *13*	(13$^+$)		
2982.01 *12*	(13$^-$)		
3167.77[a] *12*	14$^+$	1.0 ps *3*	
3201.19 *15*	(13$^-$)		
3383.26[a] *13*	15$^+$	1.8 ps *4*	
3405.73 *15*	(14$^+$)		
3488.65[&] *12*	14$^-$	<1.4 ps	
3593.08 *14*	15$^+$	1.2 ps *3*	
3672.91[&] *13*	15$^-$	1.1 ps *3*	
4486.42[a] *16*	(16$^+$)		
4512.12[a] *14*	17$^+$	1.5 ps *3*	
4637.12[&] *16*	17$^-$	1.6 ps *2*	
4864.66 *17*	(17$^+$)		
5599.18[a] *17*	(18$^+$)		
5651.25[a] *17*	19$^+$	2.4 ps *1*	
5705.93[&] *19*	19$^-$	1.3 ps *2*	
5808.21 *21*	(19$^+$)		

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(HI,xnγ) 1993Ru03 (continued)

^{90}Tc Levels (continued)

E(level)[†]	J$^{\pi}$[‡]	T$_{1/2}$[#]	E(level)[†]	J$^{\pi}$[‡]	E(level)[†]	J$^{\pi}$[‡]
6338.54 *24*	(19$^+$)		7373.4 *3*	(20$^+$)	8756.5[a] *3*	(22$^+$)
6455.27[a] *21*	(20$^+$)	<0.7[@] ps	7439.6[&] *4*	(22$^-$)	9342.1 *3*	(23$^+$)
6884.81 *23*	(21$^+$)		7678.8 *3*	(21$^+$)	9804.2 *4*	(24$^+$)
6993.94[&] *22*	21$^-$	0.8[@] ps *2*	8394.4[&] *5*	(23$^-$)	11246.4 *4*	(26$^+$)

[†] Deduced by evaluators from a least-squares fit to γ-ray energies.
[‡] Spin and parity assignments for excited states are based on γ-ray multi-polarities, and on the assumption that γ-ray deexcitation takes place through yrast states. Spin and parities between parenthesis are based on shell-model calculations which use a configuration space of only the 2p1/2 and 1g9/2 orbitals for protons and neutrons (1993Ru03).
[#] Recoil distance Doppler-shift method (1994Ru13).
[@] Effective half-life, not corrected for feeding (1994Ru13).
[&] Seq.(A): Negative-parity sequence.
[a] Seq.(B): Positive-parity sequence.

γ(^{90}Tc)

E$_{\gamma}$[†]	I$_{\gamma}$[†]	E$_i$(level)	J$^{\pi}_i$	E$_f$	J$^{\pi}_f$	Mult.[‡]	δ[‡]	Comments
48.8 *1*		152.52	4$^-$	103.70	(6$^+$)			
(104)		103.70	(6$^+$)	0.0	8$^+$			
175.0 *1*	45 *5*	2775.61	13$^-$	2600.49	12$^-$	(D+Q)		Mult.: R(DCO)<1.
184.2 *1*	175 *7*	3672.91	15$^-$	3488.65	14$^-$	D+Q		Mult.: R(DCO)=0.37 *9*.
187.4 *1*	34 *3*	3593.08	15$^+$	3405.73	(14$^+$)			
187.8 *1*	51 *6*	340.34	5$^-$	152.52	4$^-$	D+Q	0.23 *+7−6*	Mult.: A$_2$=−0.55 *2*, A$_4$=0.05 *3*; R(DCO)<1.
191.6 *1*	49 *3*	2186.48	11$^-$	1995.09	11$^-$	D+Q	0.20 *+30−10*	Mult.: A$_2$=0.31 *4*, A$_4$=−0.01 *4*; R(DCO)=1.13 *12*.
209.2 *2*	20 *4*	5808.21	(19$^+$)	5599.18	(18$^+$)			
210.1 *4*	9 *4*	3593.08	15$^+$	3383.26	15$^+$			
215.5 *1*	249 *10*	3383.26	15$^+$	3167.77	14$^+$	D+Q	≤0.06	Mult.: A$_2$=−0.27 *2*, A$_4$=0.08 *3*; R(DCO)=0.37 *6*.
217.7 *1*	258 *10*	2775.61	13$^-$	2557.88	12$^-$	D+Q	0.06 *3*	Mult.: A$_2$=−0.33 *2*, A$_4$=0.02 *2*; R(DCO)=0.35 *7*.
221.2 *1*	27 *2*	3167.77	14$^+$	2946.74	(13$^+$)	D+Q		Mult.: A$_2$=−0.52 *11*, A$_4$=0.19 *14*; R(DCO)<1.
236.8 *3*	5 *3*	340.34	5$^-$	103.70	(6$^+$)			
238.1 *2*	5 *2*	3405.73	(14$^+$)	3167.77	14$^+$			
287.5 *1*	19 *2*	3488.65	14$^-$	3201.19	(13$^-$)			
296.3 *1*	7 *3*	1995.09	11$^-$	1698.78	(10$^+$)			
305.4 *2*	8 *2*	7678.8	(21$^+$)	7373.4	(20$^+$)			
309.5 *2*	9 *2*	2247.95	(12$^+$)	1938.56	12$^+$			
363.3 *1*	26 *6*	1995.09	11$^-$	1631.94	9$^-$			
371.4 *1*	24 *2*	2557.88	12$^-$	2186.48	11$^-$			
378.1 *1*	10 *2*	4864.66	(17$^+$)	4486.42	(16$^+$)			
381.3 *1*	21 *4*	1995.09	11$^-$	1613.85	(10$^+$)			
381.3 *1*	16 *3*	2982.01	(13$^-$)	2600.49	12$^-$			
409.4 *1*	14 *1*	2946.74	(13$^+$)	2537.40	13$^+$			
413.9 *1*	34 *3*	2600.49	12$^-$	2186.48	11$^-$	(D+Q)		Mult.: R(DCO)<1.
424.2 *1*	65 *6*	2982.01	(13$^-$)	2557.88	12$^-$			
425.3 *1*	83 *3*	3593.08	15$^+$	3167.77	14$^+$	D+Q		Mult.: R(DCO)=0.62 *7*.
429.6 *1*	39 *4*	6884.81	(21$^+$)	6455.27	(20$^+$)	(D+Q)		Mult.: R(DCO)=0.73 *10*.
445.7 *3*	40 *2*	7439.6	(22$^-$)	6993.94	21$^-$			
452.6 *1*	32 *2*	1938.56	12$^+$	1485.90	11$^+$	D+Q		Mult.: A$_2$=−0.35 *14*, A$_4$=−0.09 *16*. Mult.: R(DCO)=0.41 *11* (1993Zh16).

Continued on next page (footnotes at end of table)

(HI,xnγ) 1993Ru03 (continued)

$\gamma(^{90}Tc)$ (continued)

E_γ †	I_γ †	E_i(level)	J^π_i	E_f	J^π_f	Mult. ‡	δ ‡	Comments
462.1 *1*	36 *4*	9804.2	(24+)	9342.1	(23+)	(D+Q)		Mult.: R(DCO)=0.65 *14*.
492.1 *1*	139 *5*	1485.90	11+	993.72	10+	D+Q	0.15 *4*	Mult.: A_2=−0.51 *3*, A_4=0.10 *3*; R(DCO)=0.50 *7*.
494.1 *1*	130 *5*	494.09	9+	0.0	8+	D+Q	0.20 *+6−5*	Mult.: A_2=−0.60 *4*, A_4=0.16 *5*; R(DCO)=0.40 *14*.
499.7 *1*	55 *3*	993.72	10+	494.09	9+	D+Q	0.3 *2*	Mult.: A_2=−0.59 *6*, A_4=−0.04 *8*; R(DCO)<1.
505.0 *2*	20 *4*	3672.91	15−	3167.77	14+			
506.5 *1*	43 *5*	3488.65	14−	2982.01	(13−)			
509.1 *1*	97 *9*	1995.09	11−	1485.90	11+	D		Mult.: A_2=0.38 *8*, A_4=0.05 *9*; R(DCO)=1.10 *23*.
554.4 *1*	33 *1*	2186.48	11−	1631.94	9−	Q		Mult.: R(DCO)=0.85 *7*.
562.8 *1*	295 *9*	2557.88	12−	1995.09	11−	D+Q	0.08 *3*	Mult.: A_2=−0.35 *2*, A_4=−0.01 *2*; R(DCO)=0.47 *7*.
585.7 *2*	33 *4*	9342.1	(23+)	8756.5	(22+)	(D+Q)		Mult.: R(DCO)=0.73 *14*.
589.3 *1*	19 *3*	2775.61	13−	2186.48	11−			
598.9 *1*	182 *6*	2537.40	13+	1938.56	12+	D+Q	0.07 *+10−8*	Mult.: A_2=−0.37 *4*, A_4=0.08 *4*; R(DCO)=0.53 *7*.
600.9 *2*	24 *5*	3201.19	(13−)	2600.49	12−			
605.2 *1*	57 *3*	2600.49	12−	1995.09	11−	D+Q		Mult.: R(DCO)=0.64 *12*.
608.1 *1*	53 *5*	1631.94	9−	1023.84	7−	Q		Mult.: A_2=0.28 *6*, A_4=−0.02 *6*; R(DCO)=0.82 *18*.
620.2 *4*	7 *2*	1613.85	(10+)	993.72	10+			
630.4 *1*	26 *3*	3167.77	14+	2537.40	13+	D+Q		Mult.: R(DCO)=0.44 *13*.
647.1 *1*	17 *2*	6455.27	(20+)	5808.21	(19+)			
683.5 *1*	53 *3*	1023.84	7−	340.34	5−	Q		Mult.: A_2=0.31 *8*, A_4=−0.03 *8*; R(DCO)=1.07 *13*.
698.9 *2*	7 *2*	2946.74	(13+)	2247.95	(12+)			
713.1 *1*	87 *3*	3488.65	14−	2775.61	13−	D+Q	0.14 *+9−6*	Mult.: A_2=−0.50 *4*, A_4=0.10 *4*; R(DCO)=0.39 *10*.
780.6 *1*	103 *4*	2775.61	13−	1995.09	11−	Q		Mult.: A_2=0.39 *6*, A_4=−0.09 *6*; R(DCO)=0.92 *15*.
803.9 *2*	138 *6*	6455.27	(20+)	5651.25	19+	(D+Q)		Mult.: R(DCO)=0.52 *18*.
837.1 *1*	41 *2*	2775.61	13−	1938.56	12+			
845.8 *1*	119 *5*	3383.26	15+	2537.40	13+	Q		Mult.: R(DCO)=1.15 *12*.
868.4 *2*	19 *4*	3405.73	(14+)	2537.40	13+			
897.4 *1*	402 *14*	3672.91	15−	2775.61	13−	Q		Mult.: A_2=0.34 *3*, A_4=−0.05 *3*; R(DCO)=0.99 *19*.
919.1 *1*	77 *3*	4512.12	17+	3593.08	15+	Q		Mult.: A_2=0.30 *12*, A_4=0.08 *13*; R(DCO)=1.28 *11*.
930.6 *2*	29 *2*	3488.65	14−	2557.88	12−	(Q)		Mult.: R(DCO)=0.76 *18*.
944.9 *1*	554 *17*	1938.56	12+	993.72	10+	Q		Mult.: A_2=0.30 *3*, A_4=−0.08 *3*; R(DCO)=0.95 *6*.
954.8 *2*	28 *3*	8394.4	(23−)	7439.6	(22−)			
964.2 *1*	443 *12*	4637.12	17−	3672.91	15−	Q		Mult.: A_2=0.30 *2*, A_4=−0.10 *2*; R(DCO)=1.02 *7*.
991.5 *2*	14 *3*	1485.90	11+	494.09	9+			
993.7 *1*	1.00×10^3 *3*	993.72	10+	0.0	8+	Q		Mult.: A_2=0.31 *2*, A_4=−0.06 *2*; R(DCO)=1.02 *7*.
1001.4 *1*	423 *14*	1995.09	11−	993.72	10+	D		Mult.: A_2=−0.36 *3*, A_4=0.08 *3*; R(DCO)=0.59 *6*.
1008.5 *2*	19 *4*	2946.74	(13+)	1938.56	12+			
1051.5 *1*	29 *2*	2537.40	13+	1485.90	11+			
1068.8 *1*	286 *9*	5705.93	19−	4637.12	17−	Q		Mult.: A_2=0.34 *3*, A_4=−0.08 *4*; R(DCO)=1.02 *10*.

Continued on next page (footnotes at end of table)

(HI,xnγ) 1993Ru03 (continued)

$\gamma(^{90}Tc)$ (continued)

E_γ †	I_γ †	E_i(level)	J^π_i	E_f	J^π_f	Mult. ‡	Comments
1077.8 *5*	5 *2*	8756.5	(22$^+$)	7678.8	(21$^+$)		
1087.1 *1*	22 *2*	5599.18	(18$^+$)	4512.12	17$^+$		
1103.0 *1*	17 *2*	4486.42	(16$^+$)	3383.26	15$^+$		
1119.8 *1*	33 *2*	1613.85	(10$^+$)	494.09	9$^+$		
1128.8 *1*	240 *8*	4512.12	17$^+$	3383.26	15$^+$	Q	Mult.: R(DCO)=0.98 *9*.
1137.8 *3*	24 *6*	1631.94	9$^-$	494.09	9$^+$		
1139.1 *1*	200 *7*	5651.25	19$^+$	4512.12	17$^+$	Q	Mult.: A_2=0.25 *4*, A_4=−0.03 *5*; R(DCO)=0.96 *10*.
1192.8 *5*	7 *3*	2186.48	11$^-$	993.72	10$^+$		
1204.4 *4*	9 *3*	1698.78	(10$^+$)	494.09	9$^+$		
1229.0 *1*	288 *10*	3167.77	14$^+$	1938.56	12$^+$	Q	Mult.: A_2=0.31 *3*, A_4=−0.01 *4*; R(DCO)=1.00 *8*.
1288.0 *1*	169 *6*	6993.94	21$^-$	5705.93	19$^-$	Q	Mult.: A_2=0.27 *4*, A_4=−0.04 *4*; R(DCO)=0.87 *14*.
1340.2 *2*	15 *1*	7678.8	(21$^+$)	6338.54	(19$^+$)		
1442.2 *2*	23 *4*	11246.4	(26$^+$)	9804.2	(24$^+$)	(Q)	Mult.: R(DCO)=1.05 *21*.
1473.8 *2*	19 *2*	6338.54	(19$^+$)	4864.66	(17$^+$)		
1481.9 *2*	23 *2*	4864.66	(17$^+$)	3383.26	15$^+$		
1663.0 *4*	10 *2*	9342.1	(23$^+$)	7678.8	(21$^+$)		
1722.2 *5*	11 *3*	7373.4	(20$^+$)	5651.25	19$^+$		
1872.2 *3*	12 *3*	8756.5	(22$^+$)	6884.81	(21$^+$)		
2300.8 *3*	10 *2*	8756.5	(22$^+$)	6455.27	(20$^+$)		

† From ^{58}Ni(^{36}Ar,3pnγ), (^{35}Cl,2pnγ) (1993Ru03).
‡ From $\gamma(\theta)$ in ^{58}Ni(^{35}Cl,2pnγ) and DCO ratios in ^{58}Ni(^{36}Ar,3pnγ) (1993Ru03).

Adopted Levels, Gammas

Q(β^-)=−1.32×10^4 *SY*; S(n)=14.7×10^3 *SY*; S(p)=4778 *5*; Q(α)=−3198 *5* 2017Wa10
S(2n)=26690 (syst) *300*; S(2p)=6775 *5*; Q(εp)=2842 (syst) *5*.
ΔQ(β^-)=300; ΔS(n)=300.

^{90}Ru Levels

Cross Reference (XREF) Flags

A	^{90}Rh ε decay (29 ms)
B	^{90}Rh ε decay (0.56 s)
C	^{58}Ni(^{36}Ar,2p2nγ)
D	^{58}Ni(^{40}Ca,2$\alpha\gamma$)

E(level)[†]	J$^\pi$	T$_{1/2}$	XREF	Comments
0.0[‡]	0$^+$	11.7 s *9*	ABCD	%ε+%β^+=100 T$_{1/2}$: from 2004De40. Others: 13 s *5* (1991Zh29); 11 s *3* (1994Zh26).
738.10[‡] *10*	2$^+$		BCD	J$^\pi$: E2 738γ to 0$^+$; band assignment.
1638.31[‡] *22*	4$^+$		BCD	J$^\pi$: E2 901γ to 2$^+$; band assignment.
2524.0[‡] *3*	6$^+$		B D	J$^\pi$: E2 886γ to 4$^+$; band assignment.
2602.0[#] *3*	(5$^-$)		D	J$^\pi$: D 964γ to 4$^+$; systematics of negative parity bands.
2802.2 *3*	(6$^+$)		B	J$^\pi$: from ε feeding from (6,7,8) parent, 1164γ to 4$^+$, and comparison to shell model calculations in 2019Pa16.
2954.9 *3*	(6$^+$)		B	J$^\pi$: from ε feeding from (6,7,8) parent, 1164γ to 4$^+$, and comparison to shell model calculations in 2019Pa16.
3036.3[‡] *4*	8$^+$		D	J$^\pi$: E2 512γ to 6$^+$; band assignment.
3299.9[#] *3*	(7$^-$)		D	J$^\pi$: E2 698γ to (5$^-$); band assignment.
3982.6[‡] *4*	10$^+$		CD	J$^\pi$: E2 946γ to 8$^+$; band assignment.
4197.4[#] *4*	(9$^-$)		D	J$^\pi$: E2 898γ to (7$^-$); band assignment.
4958.3[‡] *5*	12$^+$		CD	J$^\pi$: E2 976γ to 10$^+$; band assignment.
4979.7[#] *4*	(11$^-$)		D	J$^\pi$: E2 783γ to (9$^-$); band assignment.
5310.7? *5*			D	
5731.3[‡] *6*	14$^+$		CD	J$^\pi$: E2 773γ to 12$^+$; band assignment.
5815.9 *6*	(13)		D	J$^\pi$: D 858γ to 12$^+$.
5827.1[#] *5*	(13$^-$)		D	J$^\pi$: E2 847γ to (11$^-$); band assignment.
6098.5 *6*	(15)		CD	J$^\pi$: E2 283γ to (13); D 367γ to 14$^+$.
6143.3 *7*			D	
6260.7 *7*			D	
6389.0 *7*	(16)		CD	J$^\pi$: D 291γ to (15).
6748.9[#] *6*	(15$^-$)		D	J$^\pi$: E2 922γ to (13$^-$); band assignment.
7417.1 *7*	(18)		D	J$^\pi$: E2 1028γ to (16).
7654.9[#] *7*	(17$^-$)		D	J$^\pi$: E2 906γ to (15$^-$); band assignment.
7674.5 *7*			D	
8023.1 *7*			D	
8105.9? *7*			D	
8376.4[#] *7*	(19$^-$)		D	J$^\pi$: (E2) 722γ to (17$^-$); band assignment.
8622.3 *8*	(20$^+$)		D	J$^\pi$: E2 1205γ to (18$^+$); band assignment.
9476.7[#] *8*	(21$^-$)		D	J$^\pi$: (E2) 1100γ to (19$^-$); band assignment.

[†] From a least-squares fit to γ-ray energies, by evaluators.
[‡] Band(A): Yrast sequence.
[#] Band(B): Band based on (5$^-$).

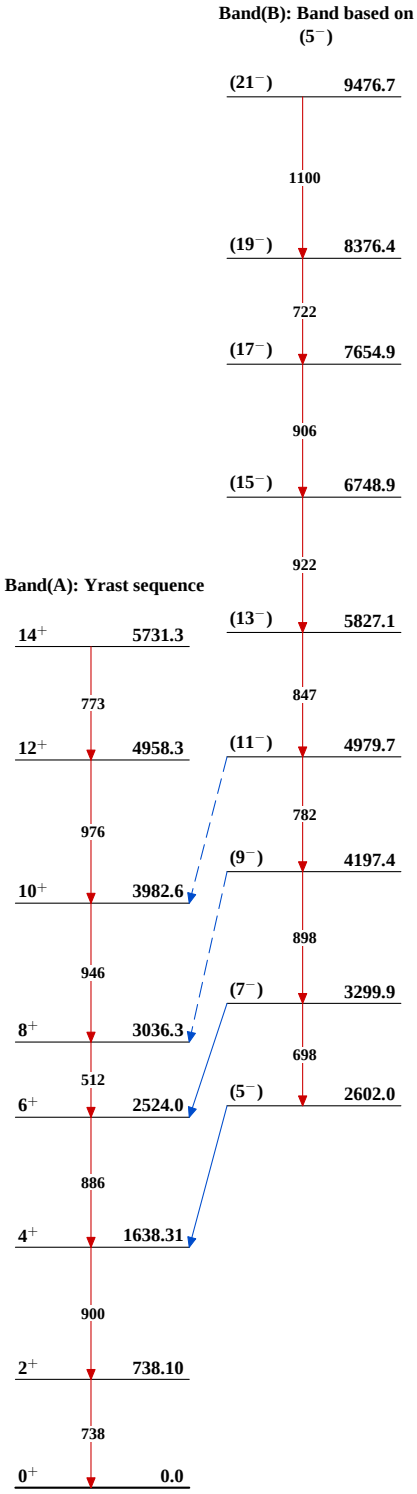
Adopted Levels, Gammas (continued)

$\gamma(^{90}Ru)$

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[‡]
738.10	2^+	738.1[§] *1*	100[§]	0.0	0^+	E2
1638.31	4^+	900.2[§] *2*	100[§]	738.10	2^+	E2
2524.0	6^+	885.7[§] *2*	100[§]	1638.31	4^+	E2
2602.0	(5^-)	963.7 *3*	100	1638.31	4^+	D
2802.2	(6^+)	1163.9[§] *2*	100[§]	1638.31	4^+	
2954.9	(6^+)	1316.6[§] *2*	100[§]	1638.31	4^+	
3036.3	8^+	512.2 *3*	100	2524.0	6^+	E2
3299.9	(7^-)	697.9 *3*	100 *13*	2602.0	(5^-)	E2
		776.0 *3*	7 *4*	2524.0	6^+	
3982.6	10^+	946.1 *3*	100	3036.3	8^+	E2
4197.4	(9^-)	897.5 *3*	100	3299.9	(7^-)	E2
		1161.3[&] *3*		3036.3	8^+	
4958.3	12^+	975.7 *3*	100	3982.6	10^+	E2
4979.7	(11^-)	782.5 *3*	100 *15*	4197.4	(9^-)	E2
		996.8[&] *3*	5 *3*	3982.6	10^+	
5310.7?		331.0[&] *3*	100	4979.7	(11^-)	
5731.3	14^+	773.0 *3*	100	4958.3	12^+	E2
5815.9	(13)	857.6 *3*	100	4958.3	12^+	D
5827.1	(13^-)	847.4 *3*	100	4979.7	(11^-)	E2
6098.5	(15)	282.6 *3*	21 *3*	5815.9	(13)	E2
		367.2 *3*	100 *11*	5731.3	14^+	D
6143.3		412.0 *3*	100	5731.3	14^+	
6260.7		444.8 *3*	100	5815.9	(13)	
6389.0	(16)	290.5 *3*	100	6098.5	(15)	D
6748.9	(15^-)	921.8 *3*	100	5827.1	(13^-)	E2
7417.1	(18)	1028.1 *3*	100	6389.0	(16)	E2
7654.9	(17^-)	906.0 *3*	100	6748.9	(15^-)	E2
7674.5		925.6 *3*	100	6748.9	(15^-)	
8023.1		348.6 *3*	100	7674.5		
8105.9?		451.0[&] *3*	100	7654.9	(17^-)	
8376.4	(19^-)	721.5 *3*	100	7654.9	(17^-)	(E2)
8622.3	(20^+)	1205.2 *3*	100	7417.1	(18)	E2
9476.7	(21^-)	1100.3 *3*	100	8376.4	(19^-)	(E2)

[†] From $^{58}Ni(^{40}Ca,2\alpha\gamma)$, except where noted.
[‡] From angular distribution and DCO data in $^{58}Ni(^{40}Ca,2\alpha\gamma)$. Stretched quadrupole transitions are assumed to be E2 in character.
[§] From ^{90}Rh ε decay (0.56 s).
[&] Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas



$^{90}_{44}Ru_{46}$

^{90}Rh ε decay (29 ms) 2019Pa16

Parent: ^{90}Rh: E=0.0; J^{π}=(0^+); $T_{1/2}$=29 ms *3*; Q(ε)=13.2×10^3 *3*; %ε+%β^+ decay=100.0

^{90}Rh-Q(ε): value is from systematics from 2017Wa10. In 2019Pa16, the Q value is measured as 13.19 MeV *+150 −116* from endpoint energy measurements.

2019Pa16: ^{90}Rh produced from fragmentation of a ^{124}Xe beam at E=345 MeV/nucleon on a 740 mg/cm^2 ^{9}Be target at RIKEN, Japan. Fragments separated by Bρ-ΔE-Bρ method in the first stages of BigRIPS and then Bρ-TOF-Bρ measurements using later stage of BigRIPS and the ZeroDegree spectrometer. Ions were implanted in WAS3ABi consisting of three double-sided silicon strip detectors and ten single-sided silicon strip detectors. Gamma rays were detected using the Euroball-RIKEN Cluster Array (EURICA) consisting of 84 HPGe crystals arranged in 12 clusters. Measured Eγ, Iγ, β spectra, E(p), I(p), $\beta\gamma$-coin, βp-coin, $\gamma\beta$p-coin, half-life, β-delayed proton emission probability.

^{90}Ru Levels

E(level)	J^{π}
0.0	0^+

ε,β^+ radiations

E(decay)	E(level)	Iβ^+ †	Iε †	Log *ft*	I($\varepsilon+\beta^+$) †
(1.32×10^4 *3*)	0.0	≈99.8	≈0.198	≈3.6	≈100

† Absolute intensity per 100 decays.

^{90}Rh ε decay (0.56 s) 2019Pa16

Parent: ^{90}Rh: E=0.0+x; J$^{\pi}$=(6,7,8); $T_{1/2}$=0.56 s *2*; Q(ε)=13.2×10^{3} *3*; %ε+%β^{+} decay=100.0

^{90}Rh-Q(ε): value is from systematics from 2017Wa10. In 2019Pa16, the Q value is measured as 13.19 MeV *+150 −116* from endpoint energy measurements.

2019Pa16: ^{90}Rh produced from fragmentation of a ^{124}Xe beam at E=345 MeV/nucleon on a 740 mg/cm^{2} ^{9}Be target at RIKEN, Japan. Fragments separated by Bρ-ΔE-Bρ method in the first stages of BigRIPS and then Bρ-TOF-Bρ measurements using later stage of BigRIPS and the ZeroDegree spectrometer. Ions were implanted in WAS3ABi consisting of three double-sided silicon strip detectors and ten single-sided silicon strip detectors. Gamma rays were detected using the Euroball-RIKEN Cluster Array (EURICA) consisting of 84 HPGe crystals arranged in 12 clusters. Measured Eγ, Iγ, β spectra, E(p), I(p), $\beta\gamma$-coin, βp-coin, $\gamma\beta$p-coin, half-life, β-delayed proton emission probability.

^{90}Ru Levels

E(level)†	J$^{\pi}$‡
0.0	0^{+}
738.10 *10*	2^{+}
1638.31 *22*	4^{+}
2524.0 *3*	6^{+}
2802.2 *3*	(6^{+})
2954.9 *3*	(6^{+})

† From Eγ.
‡ From the Adopted Levels.

ε,β^{+} radiations

E(decay)	E(level)	Iβ^{+} ‡	Iε‡	Log *ft*†	I($\varepsilon+\beta^{+}$)‡
(1.02×10^{4} *3*)	2954.9	18 *5*	0.081 *24*	5.09 *14*	18 *5*
(1.04×10^{4} *3*)	2802.2	24 *5*	0.10 *2*	5.00 *12*	24 *5*
(1.07×10^{4} *3*)	2524.0	37 *6*	0.14 *3*	4.87 *10*	37 *6*

† Calculated taking the isomer excitation energy to be zero.
‡ Absolute intensity per 100 decays.

γ(^{90}Ru)

Iγ normalization: From ΣI(γ+ce)(to g.s.)=90.4 % *10*, considering %εp=9.6 % *10* from 2019Pa16 and assuming no feeding to the ground state with ΔJ>5.

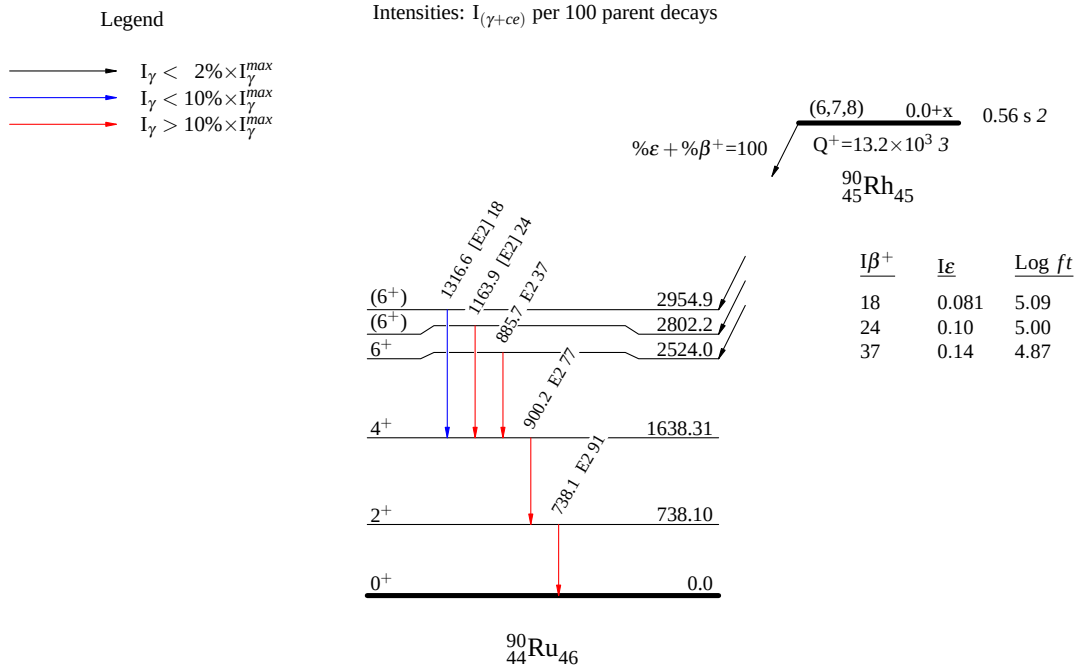
E$_{\gamma}$	I$_{\gamma}$‡	E$_i$(level)	J$^{\pi}_i$	E$_f$	J$^{\pi}_f$	Mult.†	α§
738.1 *1*	100 *12*	738.10	2^{+}	0.0	0^{+}	E2	0.00184
885.7 *2*	41 *7*	2524.0	6^{+}	1638.31	4^{+}	E2	1.17×10^{-3}
900.2 *2*	85 *11*	1638.31	4^{+}	738.10	2^{+}	E2	1.13×10^{-3}
1163.9 *2*	26 *6*	2802.2	(6^{+})	1638.31	4^{+}	[E2]	6.36×10^{-4}
1316.6 *2*	20 *6*	2954.9	(6^{+})	1638.31	4^{+}	[E2]	5.17×10^{-4}

† From the Adopted Levels.
‡ For absolute intensity per 100 decays, multiply by 0.904 *10*.
§ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

^{90}Rh ε decay (0.56 s) 2019Pa16

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



$I\beta^+$	$I\varepsilon$	Log ft
18	0.081	5.09
24	0.10	5.00
37	0.14	4.87

^{58}Ni(^{36}Ar,2p2nγ) 1994He09

1994He09: ^{58}Ni(^{36}Ar,2p2nγ), E=149 MeV. 99.98% enriched ^{58}Ni target. Measured γ rays using the OSIRIS array of 12 Compton-suppressed hyperpure germanium detectors. Measured Eγ, Iγ, n$\gamma\gamma$ coin, p$\gamma\gamma$ coin. Charge-particle and neutron detectors: ΔE silicon surface barrier for protons, NE213 for neutrons.

^{90}Ru Levels

E(level)†	J$^\pi$‡	Comments
0.0	0$^+$	
738.00 *10*	(2$^+$)	
1638.11 *14*	(4$^+$)	
2584.3 *3*	(6$^+$)	E(level): This level has been omitted from Adopted Levels; instead a level at 2524.5 keV has been adopted based on more extensive measurement in ^{58}Ni(^{40}Ca,2$\alpha\gamma$) dataset.
3096.2 *4*	(8$^+$)	E(level): This level has been omitted from Adopted Levels; instead a level at 3037.7 keV has been adopted based on more extensive measurement in ^{58}Ni(^{40}Ca,2$\alpha\gamma$) dataset.
3981.8 *7*	(10$^+$)	
4957.4 *8*	(12$^+$)	
5730.4 *13*	(13$^+$,14$^+$)	
6097.4 *16*	(15$^+$)	
6387.9 *19*	(16$^+$)	

† Deduced by evaluators from a least-squares fit to γ-ray energies.

‡ Jπ values are from authors' assignments based on systematics in this mass region and shell-model calculations. The energies of the most intense γ-ray transitions are very similar to those in the isotone ^{88}Mo. Thus, the detected γ rays have been assumed to belong to a cascade connecting yrast states with even parity.

γ(^{90}Ru)

E$_\gamma$†	I$_\gamma$	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Comments
290.5 *10*	22 *3*	6387.9	(16$^+$)	6097.4	(15$^+$)	
367.0 *10*	24 *3*	6097.4	(15$^+$)	5730.4	(13$^+$,14$^+$)	
511.9 *3*	64 *8*	3096.2	(8$^+$)	2584.3	(6$^+$)	
738.0 *1*	100 *12*	738.00	(2$^+$)	0.0	0$^+$	
773.0 *10*	26 *4*	5730.4	(13$^+$,14$^+$)	4957.4	(12$^+$)	
885.6 *5*	39 *7*	3981.8	(10$^+$)	3096.2	(8$^+$)	E$_\gamma$: This γ-ray has been interchanged with 946.2 keV γ-ray by 2004Bu13 in ^{58}Ni(^{40}Ca,2$\alpha\gamma$) dataset from intensity consideration and placed below 512.2 keV γ-transition.
900.1 *1*	90 *14*	1638.11	(4$^+$)	738.00	(2$^+$)	
946.2 *3*	73 *11*	2584.3	(6$^+$)	1638.11	(4$^+$)	E$_\gamma$: This γ-ray has been interchanged with 885.6 keV γ-ray by 2004Bu13 in ^{58}Ni(^{40}Ca,2$\alpha\gamma$) dataset from intensity consideration and placed above 512.2 keV γ-transition.
975.6 *5*	35 *5*	4957.4	(12$^+$)	3981.8	(10$^+$)	

† Uncertainties in Eγ are 0.1-1.0 keV, depending on the γ-ray energy and intensity. Values for individual transitions are estimates assigned by the evaluators.

^{58}Ni(^{40}Ca,2$\alpha\gamma$) 2004Bu13

2004Bu13: E(^{40}Ca)=135 MeV from Legnaro XTU tandem accelerator. Measured Eγ, Iγ, $\gamma\gamma$, $\gamma(\theta)$, $\gamma\gamma(\theta)$ with the GASP array consisting of 40 Compton-suppressed HPGe detectors and an 80 BGO element inner ball. The ISIS Si ball of 40 ΔE-E telescopes was used for the detection of charged particles.

^{90}Ru Levels

E(level)†	J$^\pi$	E(level)†	J$^\pi$	E(level)†	J$^\pi$	E(level)†	J$^\pi$
0.0‡	0$^+$	3983.5‡ *6*	10$^+$	5827.9# *7*	13$^{(-)}$	7655.7# *8*	(17$^-$)
738.4‡ *3*	2$^+$	4198.3# *6*	9$^{(-)}$	6099.4 *8*	15$^+$	7675.3 *8*	
1639.0‡ *5*	4$^+$	4959.2‡ *7*	12$^+$	6144.2 *8*		8023.9 *9*	
2524.9‡ *5*	6$^+$	4980.5# *6*	11$^{(-)}$	6261.6 *8*		8106.7? *9*	
2602.8# *5*	5$^{(-)}$	5311.5? *7*		6389.9 *8*	16$^+$	8377.2 *9*	
3037.2‡ *6*	8$^+$	5732.2‡ *8*	14$^+$	6749.7# *8*	15$^{(-)}$	8623.2 *9*	(20$^+$)
3300.8# *6*	7$^{(-)}$	5816.8 *8*	13$^+$	7418.0 *9*	(18$^+$)	9477.6 *9*	

† From least-squares fit to Eγ's, by evaluators.
‡ Band(A): Yrast Sequence.
# Band(B): Band based on 5$^{(-)}$.

γ(^{90}Ru)

R(DCO)=I(γ_1 at 72°,90° or 108°; γ_2 at 35° or 145°)/ I(γ_1 at 35° or 145°; γ_2 at 72°,90° or 108°). All gating transition were ΔJ=2 in character yielding expected values of 0.5 for stretched dipole transitions and 1.0 for stretched quadrupole transitions.

E$_\gamma$†	I$_\gamma$	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.	Comments
282.6 *3*	3.8 *6*	6099.4	15$^+$	5816.8	13$^+$	Q	A$_2$=+0.4 *3*; A$_4$=+0.1 *3*
290.5 *3*	15.0 *14*	6389.9	16$^+$	6099.4	15$^+$	D	DCO=0.46 *10*; A$_2$=−0.37 *14*; A$_4$=−0.03 *18*
331.0‡ *3*		5311.5?		4980.5	11$^{(-)}$		
348.6 *3*	2.6 *8*	8023.9		7675.3			
367.2 *3*	17.9 *19*	6099.4	15$^+$	5732.2	14$^+$	D	DCO=0.62 *9*; A$_2$=−0.31 *14*; A$_4$=+0.1 *3*
412.0 *3*	2.0 *5*	6144.2		5732.2	14$^+$		
444.8 *3*	2.7 *8*	6261.6		5816.8	13$^+$		
451.0‡ *3*		8106.7?		7655.7	(17$^-$)		
512.2 *3*	57 *4*	3037.2	8$^+$	2524.9	6$^+$	Q	DCO=0.93 *5*; A$_2$=+0.35 *12*; A$_4$=+0.16 *18*
697.9 *3*	32 *4*	3300.8	7$^{(-)}$	2602.8	5$^{(-)}$	Q	DCO=1.04 *7*; A$_2$=+0.23 *23*; A$_4$=−0.1 *3*
721.5 *3*	6.9 *12*	8377.2		7655.7	(17$^-$)	(Q)	DCO=0.95 *18*; A$_2$=+0.04 *22*; A$_4$=−0.3 *3*
738.4 *3*	100	738.4	2$^+$	0.0	0$^+$	Q	DCO=1.04 *6*; A$_2$=+0.27 *14*; A$_4$=−0.01 *18*
773.0 *3*	25 *3*	5732.2	14$^+$	4959.2	12$^+$	Q	DCO=1.16 *20*; A$_2$=+0.30 *10*; A$_4$=+0.04 *16*
776.0 *3*	2.2 *14*	3300.8	7$^{(-)}$	2524.9	6$^+$		
782.5 *3*	27 *4*	4980.5	11$^{(-)}$	4198.3	9$^{(-)}$	Q	DCO=1.06 *11*; A$_2$=+0.27 *9*; A$_4$=−0.09 *14*
847.4 *3*	21 *4*	5827.9	13$^{(-)}$	4980.5	11$^{(-)}$	Q	DCO=0.86 *12*; A$_2$=+0.44 *15*; A$_4$=+0.02 *24*
857.6 *3*	7.1 *12*	5816.8	13$^+$	4959.2	12$^+$	D	DCO=0.46 *12*; A$_2$=−0.11 *23*; A$_4$=+0.8 *5*
886.0 *3*	61 *5*	2524.9	6$^+$	1639.0	4$^+$	Q	DCO=1.00 *11*; A$_2$=+0.26 *10*; A$_4$=−0.03 *16*
897.5 *3*	32 *5*	4198.3	9$^{(-)}$	3300.8	7$^{(-)}$	Q	DCO=1.07 *17*; A$_2$=+0.14 *8*; A$_4$=−0.21 *12*
900.6 *3*	97 *4*	1639.0	4$^+$	738.4	2$^+$	Q	DCO=1.00 *9*; A$_2$=+0.20 *5*; A$_4$=−0.10 *8*
906.0 *3*	10.8 *16*	7655.7	(17$^-$)	6749.7	15$^{(-)}$	Q	DCO=0.98 *4*; A$_2$=+0.54 *21*; A$_4$=+0.27 *20*
921.8 *3*	14.9 *24*	6749.7	15$^{(-)}$	5827.9	13$^{(-)}$	Q	DCO=0.9 *3*; A$_2$=+0.28 *24*; A$_4$=+0.03 *33*
925.6 *3*	3.3 *9*	7675.3		6749.7	15$^{(-)}$		
946.1 *3*	45 *4*	3983.5	10$^+$	3037.2	8$^+$	Q	DCO=0.97 *8*; A$_2$=+0.19 *16*; A$_4$=−0.08 *21*
963.7 *3*	37 *4*	2602.8	5$^{(-)}$	1639.0	4$^+$	D	DCO=0.61 *5*; A$_2$=−0.15 *14*; A$_4$=+0.6 *3*
975.7 *3*	40 *4*	4959.2	12$^+$	3983.5	10$^+$	Q	DCO=0.92 *8*; A$_2$=+0.28 *9*; A$_4$=−0.10 *18*

Continued on next page (footnotes at end of table)

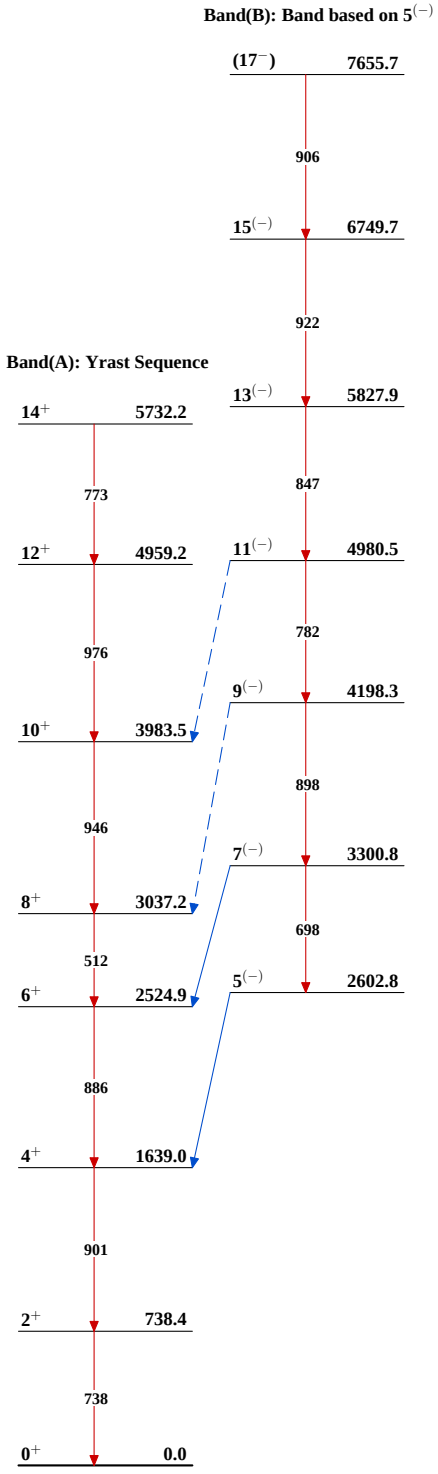
^{58}Ni(^{40}Ca,2$\alpha\gamma$) 2004Bu13 (continued)

γ(^{90}Ru) (continued)

E_γ †	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.	Comments
996.8‡ *3*	1.4 *8*	4980.5	$11^{(-)}$	3983.5	10^+		
1028.1 *3*	12.2 *18*	7418.0	(18^+)	6389.9	16^+	Q	DCO=0.9 *3*; A_2=+0.2 *3*; A_4=−0.05 *43*
1100.3 *3*	3.9 *10*	9477.6		8377.2		(Q)	DCO=0.9 *3*; A_2=−0.2 *3*; A_4=+0.3 *4* Mult.: negative value of A_2 is inconsistent with Q assignment.
1161.3‡ *3*		4198.3	$9^{(-)}$	3037.2	8^+		E_γ: from figure 1 of 2004Bu13; not listed in authors′ table I.
1205.2 *3*	8.3 *17*	8623.2	(20^+)	7418.0	(18^+)	Q	DCO=1.09 *22*; A_2=+0.15 *18*; A_4=+0.3 *4*

† 0.3 keV uncertainty assigned by evaluators based on a general statement by 2004Bu13 that errors are below 0.3 keV.
‡ Placement of transition in the level scheme is uncertain.

^{58}Ni(^{40}Ca,2$\alpha\gamma$) 2004Bu13



$^{90}_{44}Ru_{46}$

Adopted Levels

Q(β^-)=−11990 *SY*; S(n)=13910 *SY*; S(p)=730 *SY*; Q(α)=−2550 *SY* 2017Wa10
ΔQ(β^-)=500; ΔS(n)=470; ΔS(p)=ΔQ(α)=420 (2017Wa10).
S(2n)=30980 (syst) *500*; S(2p)=4600 (syst) *340*; Q(εp)=8410 (syst) *300* (2017Wa10).

1995He39,1995Mo26,1994He28: ^{90}Rh produced by fragmentation of a ^{106}Cd beam (E=6.36 GeV) on a natural Ni target. Mass separation and identification of ^{90}Rh using the A1200 Fragment Mass Separator of the National Superconducting Cyclotron Laboratory at Michigan State University.

2001Ki13,2002Fa13: ^{90}Rh produced by fragmentation of a ^{112}Sn beam (E=1GeV/A) on a Be target. Halflives and other decay properties measured after isotopic separation by Fragment Separator (FRS) of GSI, Darmstadt and implanting the radionuclides in a stack of position sensitive Si-detectors, used as a microcalorimeter. The microcalorimeter was surrounded by a segmented NaI-detector and a Ge-clover detector allowing β-γ coincidence studies of implanted and identified nuclei.

2019Pa16: ^{90}Rh produced in fragmentation of a ^{124}Xe beam with E=345 MeV/nucleon on a ^{9}Be target at RIKEN. Fragments separated and identified using the BigRIPS and ZeroDegree spectrometers. Nuclei were implanted into one of the DSSDs of the WAS3ABi array consisting of three DSSDs and ten single-sided silicon strip detectors. Measured implant-β, implant-β-p, implant-β(t), and implant-β-p(t). Deduced $T_{1/2}$ and decay branching ratio.

^{90}Rh Levels

E(level)	J^π	$T_{1/2}$	Comments
0.0	(0^+)	29 ms *3*	%ε+%β^+=100; %εp=0.7<(2019Pa16) $T_{1/2}$: from implant-β(t) in 2019Pa16. Other: 12 ms +*9*−*4* from implant-β(t) (2001Ki13, 2002Fa13). %εp: from the number of βp decays relative to the total number decays (2019Pa16). J^π: from log *ft*=3.6 to 0^+ ground state of ^{90}Ru.
0.0+x	(6,7,8)	0.56 s *2*	%ε+%β^+=100; %εp=9.6 *10* (2019Pa16) $T_{1/2}$: weighted average of 0.55 s *3* from implant-β(t) and 0.58 s *4* from implant-β-p(t), both from 2019Pa16. Other: 1.0 s +*3*−*2* from implant-β(t) (2001Ki13, 2002Fa13). %εp: from the number of βp decays relative to the total number decays (2019Pa16). J^π: no β feeding to yrast 4^+ in ^{90}Ru; population of ($13/2^+$) and ($9/2^+$) levels in βp decay to ^{89}Tc; shell model calculations in 2019Pa16 predict Jπ=7^+.

Adopted Levels

S(p)=1140 *SY*; Q(α)=−2360 *SY* 2017Wa10
ΔS(p)=540; ΔQ(α)=570 (2017Wa10).
S(2p)=−50 (syst) *500*; Q(εp)=11260 (syst) *500* (2017Wa10).
First identification of ^{90}Pd nuclide.
2016Ce02: ^{90}Pd nuclide produced and identified at RIBF-RIKEN facility in ^{9}Be(^{124}Xe,X) reaction at E=345 MeV/nucleon.
Separation of ions based on Bρ-TOF-ΔE measurements using the BigRIPS separator and Zero Degree spectrometer (ZDS). Nuclei were implanted in a wide range silicon-strip stopper array for ion and β particle detection (WAS3ABi), consisting of three highly-segmented 1 mm thick double-sided silicon detectors and a stack of ten segmented 1 1 mm thick single-sided silicon strip detectors. Deduced existence of ^{90}Pd.

^{90}Pd Levels

E(level)	J^π	Comments
0	0^+	%ε+%β^+=100; %εp=?; %2p=? %ε+%β^+: expected decay modes assigned by the evaluators. Systematic values suggest ^{90}Pd is bound to 1 proton emission (S(p)=1140 syst *540*) but potentially unbound (S(2p)=−50 *500*) to 2p emission (2017Wa10). A total of two events were assigned by 2016Ce02 to ^{90}Pd. $T_{1/2}$: > 760 ns from time-of-flight (2016Ce02) through the BigRIPS fragment separator and ZDS spectrometer (2016Ce02). Theoretical calculations predict a $T_{1/2}$ of 73 ms (2019Mo01).

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