^{98}Y β^- decay (2.32 s) 2017Ur03,1994St31,1977Si05

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen, Balraj Singh	NDS 164, 1 (2020)	15-Feb-2020

Parent: ^{98}Y: E=465.7 *7*; J^π=(7^+,6^+); $T_{1/2}$=2.32 s *8*; Q(β^-)=8992 *12*; %β^- decay=90 *10*

^{98}Y-E,J^π,$T_{1/2}$: From ^{98}Y Adopted Levels.

^{98}Y-Q(β^-): From 2017Wa10.

^{98}Y-%β^- decay: %β^-=90 *10*, assuming %IT<20 (or 10% *10*) for the decay of the 2.32-s isomer from ^{98}Y Adopted Levels.

2017Ur03: ^{98}Y source obtained as a fission fragment and using Lohengrin separator. Measured Eγ, Iγ, $\beta\gamma$-coin $\gamma\gamma$-coin, using two clover Ge detectors for γ detection and three β detectors. The A=98 ions were deposited on a tape whose movement was correlated with the beam ON and beam OFF cycles. Deduced levels, J^π, β feedings, multipolarities, mixing ratios. Angular correlation measurements were made in the study of prompt γ rays from ^{235}U(n,Fγ) and ^{252}Cf SF decay. Polarization measurement for a γ-ray cascade with 1801.6-keV γ ray was also made in ^{235}U(n,Fγ). See these two datasets for data from Table IX in 2017Ur03.

1994St31 (also 1988StZS): Eγ, Iγ, $\gamma\gamma(\theta)$ using JOSEF separator at Julich.

1977Si05: measured Eγ, Iγ, $\gamma\gamma$-coin, β, $\beta\gamma$-coin, (ce)γ(t). Two independent measurements of Eγ and Iγ were made, one using JOSEF separator at Julich and the other LOHENGRIN at Grenoble. Separate Eγ and Iγ data, as well as averages of the two were reported by 1977Si05.

2010Be30: A=98 nuclei produced by thermal neutron-induced fission out of a 400 μg/cm^2 ^{235}U target and selected by the Lohengrin mass separator at the high-flux reactor of the Institut Laue-Langevin in Grenoble, France. Detector array of a thin plastic scintillator, a $LaBr_3$(Ce) scintillation detector (LaBr) and a high-purity germanium clover detector (HPGe). Measured $\beta\gamma\gamma$-timing, lifetimes of both yrast and non-yrast states.

Others:

1979Bo26: measured Eγ, Iγ.

$T_{1/2}$: 1983Re10, 1981En05, 1979En02.

$\beta\gamma$-coin, Q^- measurement: 1988GrZX, 1978St02.

^{98}Zr Levels

Level scheme is based on the works of 1977Si05 and 1994St31, and extended significantly by 2017Ur03.

E(level)†	J^π‡	$T_{1/2}$	Comments
0.0	0^+		
854.09 *9*	0^+		
1222.97 *8*	2^+		
1590.83 *8*	2^+		
1806.23 *8*	3^-		
1843.47 *8*	4^+	20 ps *6*	J^π: $\gamma\gamma(\theta)$ (1988StZS,1994St31) suggests J=3. $T_{1/2}$: from $\beta\gamma$(t) (2010Be30). Other: 28 ps *12* (quoted by 1994ST31 from thesis by M. Liang, University of Cologne (1992).
2047.76 *10*	4^+		
2276.98 *9*	(4^+)		
2491.03 *8*	6^+	<10 ps	J^π: $\gamma\gamma(\theta)$ (1988StZS,1994St31) suggested J=4. $T_{1/2}$: from $\beta\gamma$(t) (2010Be30).
2800.25 *10*	5^-		
3065.14 *13*	$5^{(-)}$		E(level): level proposed by 2017Ur03.
3117.14 *12*	(6^+)		
3216.34 *22*	8^+		E(level): level proposed by 2017Ur03.
3249.05 *23*	$(5,6,7^-)$		E(level): level proposed by 2017Ur03.
4278.85 *13*			
4292.46 *11*	6^+		J^π: $\gamma\gamma(\theta)$ (1988StZS,1994St31) suggests J=6.
4545.86 *15*	(7^+)		E(level): level proposed by 2017Ur03.
6415+x			E(level): x<3043 *15* from Q(β^-)(^{98m}Y)-S(n)(^{98}Zr), where Q(β^-)=9458 *12* for ^{98}Y isomer decay, and S(n)=6415 *8*.

Continued on next page (footnotes at end of table)

^{98}Y β^- decay (2.32 s) 2017Ur03,1994St31,1977Si05 (continued)

^{98}Zr Levels (continued)

† From a least-squares fit to Eγ data.
‡ From the Adopted Levels.

β^- radiations

E(decay)	E(level)	Iβ^-†@	Log ft#	Comments
(1.5×10^3[a] *15*)	6415+x	3.44 *95*		Iβ^-: from %β^-n=3.44 *95* for decay of ^{98}Y isomer.
(4912 *12*)	4545.86	1.6 *4*	6.3 *1*	av Eβ=2178.4 *58*
(5165 *12*)	4292.46	43 *6*	5.0 *1*	av Eβ=2300.2 *58*
(5179 *12*)	4278.85	3.9 *7*	6.0 *1*	av Eβ=2306.8 *58*
(6209 *12*)	3249.05	1.0 *3*	6.9 *2*	av Eβ=2802.3 *58*
(6241 *12*)	3216.34	1.0 *3*	7.0 *2*	av Eβ=2818.0 *58*
(6341 *12*)	3117.14	2.9 *10*	6.5 *2*	av Eβ=2865.8 *58*
(6393 *12*)	3065.14	1.3 *6*	6.9 *2*	av Eβ=2890.8 *58*
(6657 *12*)	2800.25	4.4 *11*	6.4 *1*	av Eβ=3018.3 *58*
(6967 *12*)	2491.03	20 *4*	5.9 *1*	av Eβ=3167.1 *58*
(7181& *12*)	2276.98	2.1‡ *8*	6.9 *2*	av Eβ=3270.1 *58*
(7410& *12*)	2047.76	7.5‡ *14*	6.4 *1*	av Eβ=3380.4 *58*
(7651& *12*)	1806.23	1.8‡ *13*	7.1 *4*	av Eβ=3496.6 *58*

† Deduced by evaluators from γ+ce intensity balances. Deduced Iβ values to 0, 854, 1223, 1590 and 1843 levels are consistent with no feeding to these levels, as expected from ΔJ^π involved.
‡ No β feeding is expected to this level if J^π(^{98}Y isomer)=(7$^+$,6$^+$). Apparent feeding reflects incomplete decay scheme.
# Deduced by evaluators using the LOGFT code.
@ Absolute intensity per 100 decays.
& Existence of this branch is questionable.
[a] Estimated for a range of levels.

^{98}Y β^- decay (2.32 s) 2017Ur03,1994St31,1977Si05 (continued)

$\gamma(^{98}Zr)$

Iγ normalization: Deduced by evaluators from summed intensity of γ+ce to g.s. equal to 96.6 *10* from %β^-n=3.44 *95* of the 2.32-s isomer. 2017Ur03 give γ-normalization factor=2.45 *36* by using absolute intensities of high-energy γ rays from ^{98}Y isomer decay in a previous ENSDF evaluation published by 2003Si07.
A γ with Eγ=1267.8, Iγ=0.3 reported by 1994St31 is omitted here as a 6^+ to 2^+ transition is unlikely.

E_γ[†]	I_γ[†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	α[a]	Comments
204.3 *1*	0.5 *1*	2047.76	4^+	1843.47	4^+	[M1+E2]		
215.5 *2*	0.36 *10*	1806.23	3^-	1590.83	2^+	[E1]	0.01222	α(K)=0.01078 *16*; α(L)=0.001199 *17*; α(M)=0.000207 *3* α(N)=2.91×10^{-5} *5*; α(O)=1.96×10^{-6} *3* I$_\gamma$: 0.4 *1* in 2017Ur03 (Table VIII) is probably the total intensity from the two activities in ^{98}Y. Evaluators have subtracted 0.044 *12* units to account for contribution from the 0.548-s g.s. decay obtained from intensity balance at 1806 level in ^{98}Y β^- decay (0.548 s).
241.5 *1*	3.6 *3*	2047.76	4^+	1806.23	3^-	[E1]		Eγ=241.7, Iγ=2.5 (1994St31,1988StZS). Eγ=241.5, Iγ=5.6 (1984Be50), assigned incorrectly to the decay of ^{98}Y g.s. Eγ=241.5 *2*, Iγ=2.5 *5* (1977Si05).
252.7 *2*	0.4 *1*	1843.47	4^+	1590.83	2^+	[E2]	0.0392	α(K)=0.0340 *5*; α(L)=0.00434 *7*; α(M)=0.000754 *11* α(N)=0.0001038 *15*; α(O)=6.08×10^{-6} *9* Eγ=253.1 *2*, Iγ=1.5 *10* (1977Si05), γ could also correspond to the proposed placement of a 253.4γ from 4545 level in 2017Ur03.
253.4 *1*	0.6 *1*	4545.86	(7^+)	4292.46	6^+	[M1+E2]	0.028 *11*	α(K)=0.024 *10*; α(L)=0.0030 *13*; α(M)=0.00052 *23* α(N)=7.E−5 *3*; α(O)=4.5×10^{-6} *16*
367.8 *1*	0.24[‡] *3*	1590.83	2^+	1222.97	2^+	[M1+E2]		Eγ=367.1, Iγ=0.4 (1994St31,1988StZS). Eγ=367.6 *2* (1977Si05).
368.8 *1*	0.76[‡] *7*	1222.97	2^+	854.09	0^+	[E2]	0.01087	α(K)=0.00950 *14*; α(L)=0.001145 *16*; α(M)=0.000199 *3* α(N)=2.77×10^{-5} *4*; α(O)=1.749×10^{-6} *25* Eγ=368.6, Iγ=0.7 (1994St31,1988StZS). Eγ=368.5 *2*, Iγ=0.5 *2* (1977Si05).
433.5 *1*	0.5 *1*	2276.98	(4^+)	1843.47	4^+			Eγ=433.7, Iγ=0.8 (1994St31,1988StZS).
448.8 *2*	0.4 *1*	3249.05	$(5,6,7^-)$	2800.25	5^-			
456.8 *2*	0.4 *1*	2047.76	4^+	1590.83	2^+	[E2]		Eγ=456.5, Iγ=0.2 (1994St31,1988StZS).
583.258[#] *30*	5.34 *22*	1806.23	3^-	1222.97	2^+	E1		Eγ=583.2 *1* (2017Ur03). Eγ=583.3, Iγ=4.6 (1994St31,1988StZS). Eγ=583.3 *2*, Iγ=6.5 *5*(1977Si05). I$_\gamma$: 6.0 *2* in 2017Ur03 (Table VIII) is probably the total intensity from the two activities in ^{98}Y. Evaluators have subtracted 0.66 *10* units to account for contribution from the 0.548-s g.s. decay obtained from intensity balance at 1806 level in ^{98}Y β^- decay (0.548 s).
620.505[#] *19*	23.0 *7*	1843.47	4^+	1222.97	2^+	E2		Eγ=620.5 *1* (2017Ur03).

$^{98}_{40}Zr_{58}$-3

^{98}Y β^- decay (2.32 s) 2017Ur03,1994St31,1977Si05 (continued)

$\gamma(^{98}Zr)$ (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ[@]	$I_{(\gamma+ce)}$[&]	Comments
									Eγ=620.7, Iγ=27.6 (1994St31,1988StZS). Eγ=620.5 *2*, Iγ=27.0 *20* (1977Si05). (620γ)(1223γ)(θ): A_2=−0.09 *3* (1988StZS).
647.580[#] *30*	22.4 *7*	2491.03	6^+	1843.47	4^+	E2			E_γ: note that value from 1979Bo26 is in disagreement with 647.1 *1* from 2017Ur03 by ≈3 σ. Eγ=647.5, Iγ=23.2 (1994St31,1988StZS). Eγ=647.3 *2*, Iγ=20.0 *20* (1977Si05). (647γ)(620γ)(θ): A_2=−0.04 *7*. (647γ)[620γ](1223γ)(θ): A_2=−0.06 *3* (1988StZS).
686.2 *1*	1.4 *1*	2276.98	(4^+)	1590.83	2^+				Eγ=685.6, Iγ=1.9 (1994St31,1988StZS).
725.3 *2*	0.4 *1*	3216.34	8^+	2491.03	6^+	E2			
736.8 *1*	0.30[‡] *3*	1590.83	2^+	854.09	0^+	[E2]			Eγ=736.7 *2* (1977Si05).
752.5 *1*	2.4 *2*	2800.25	5^-	2047.76	4^+				Eγ=752.7, Iγ=2.0 (1994St31,1988StZS). Eγ=752.6 *2*, Iγ=2.5 *10* (1977Si05).
824.8 *2*	1.0 *1*	2047.76	4^+	1222.97	2^+	E2			Eγ=824.5, Iγ=0.9 (1994St31,1988StZS).
840.1 *1*	1.8 *2*	3117.14	(6^+)	2276.98	(4^+)				Eγ=839.7, Iγ=2.3 (1994St31,1988StZS). Eγ=840.3 *2*, Iγ=2.5 *10* (1977Si05), but assigned to the decay of ^{98}Y g.s.
854.09 *9*		854.09	0^+	0.0	0^+	E0		1.1[‡] *1*	Energy of E0 transition from level energy difference. $I_{(\gamma+ce)}$: from intensity balance.
956.6 *2*	0.3 *1*	2800.25	5^-	1843.47	4^+				
994.0 *1*	0.9 *2*	2800.25	5^-	1806.23	3^-				Eγ=994.0, Iγ=0.7 (1994St31,1988StZS).
1053.9 *1*	1.4 *1*	2276.98	(4^+)	1222.97	2^+				Eγ=1053.8, Iγ=1.6 (1994St31,1988StZS).
1174.9 *3*	1.2 *2*	4292.46	6^+	3117.14	(6^+)				E_γ: 1174.2 *2* in 2017Ur03 fits poorly in the level scheme. Value of 1174.9 from 1994St31 with an assigned uncertainty of 0.3 keV is used here, instead. Eγ=1174.9, Iγ=2.0 (1994St31,1988StZS).
1222.9 *1*	30.2[‡] *8*	1222.97	2^+	0.0	0^+	E2			Eγ=1222.8, Iγ=35.0 (1994St31,1988StZS). Eγ=122.8 *2* (1977Si05).
1258.9 *1*	0.5 *2*	3065.14	$5^{(-)}$	1806.23	3^-	Q			
1273.7 *2*	0.5 *2*	3117.14	(6^+)	1843.47	4^+	Q			
1492.0 *2*	1.5 *2*	4292.46	6^+	2800.25	5^-				Eγ=1492.5, Iγ=1.5 (1994St31,1988StZS).
1590.9 *1*	2.04[‡] *17*	1590.83	2^+	0.0	0^+	[E2]			Eγ=1590.7, Iγ=2.5 (1994St31,1988StZS). Eγ=1590.7 *2*, Iγ≈1 (1977Si05).
1787.8 *1*	1.5 *2*	4278.85		2491.03	6^+				Eγ=1787.1, Iγ=1.9 (1994St31,1988StZS). Eγ=1787.3 *5*, Iγ=1.5 *3* (1977Si05).
1801.6 *1*	13.0 *4*	4292.46	6^+	2491.03	6^+	M1+E2	+0.17 *8*		Eγ=1801.5, Iγ=17.4 (1994St31,1988StZS). Eγ=1801.6 *5*, Iγ=16.5 *15* (1977Si05). (1801γ)(647γ)(θ): A_2=−0.07 *4*; (1801γ)[647γ](620γ)(θ): A_2=−−0.03 *5*; (1801γ)[647γ][620γ](1223γ)(θ): A_2=+0.08 *7* (1988StZS).
2015.4 *2*	0.7 *1*	4292.46	6^+	2276.98	(4^+)				Eγ=2015.6, Iγ=0.9 (1994St31,1988StZS).

$^{98}_{40}Zr_{58}$-4

^{98}Y β^- decay (2.32 s) 2017Ur03,1994St31,1977Si05 (continued)

$\gamma(^{98}Zr)$ (continued)

E_γ [†]	I_γ [†&]	E_i(level)	J_i^π	E_f	J_f^π
2244.0 *4*	0.2 *1*	4292.46	6^+	2047.76	4^+
2448.8 *2*	0.4 *1*	4292.46	6^+	1843.47	4^+

[†] From 2017Ur03, unless otherwise stated. Quoted values of Iγ are relative to Iγ(1222.9)=100, the total intensity from the two activities in ^{98}Y.
[‡] Assigned by evaluators from intensity balances and using branching ratios from intensity data in Table VII of 2017Ur03.
[#] Precise Eγ from 1979Bo26 (curved-crystal data).
[@] From the Adopted Gammas. Assumed assignments given in square brackets are from ΔJ^π in this dataset.
[&] For absolute intensity per 100 decays, multiply by 2.6 *3*.
[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.

$^{98}_{40}Zr_{58}$-5

^{98}Y β^- decay (2.32 s) 2017Ur03,1994St31,1977Si05

Decay Scheme

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