^{178}Ta ε decay (9.31 min) 1974Ha63,1972Li03,1972Si26

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. Achterberg, O. A. Capurro, G. V. Marti	NDS 110, 1473 (2009)	31-May-2008

Parent: ^{178}Ta: E=0.0+y; $J^\pi=1^+$; $T_{1/2}$=9.31 min *3*; Q(ε)=1937 *15*; %ε+%$β^+$ decay=100.0

^{178}Ta-$T_{1/2}$ from 2003Au02, Q($β^+$) from 2003Au03.

Measured Eγ, Iγ, Ice. Detectors: Ge(Li), Si(Li) (1974Ha63). Studied E0 admixtures in various transitions, calculated X(E0/E2) values. Determined conversion coefficients from electron spectra, and assigned multipolarities.

Measured Eγ, Iγ, γγ coin, γγ(θ). Detectors: Ge(Li) (1972Li03). Coincidence spectra, and tables of multipolarity assignments and of angular distribution coefficients are shown.

Measured Eγ, Iγ. Detector: Ge(Li) (1972Si26).

Other: 1967Ni02. Measured Eγ, Iγ, γγ-coin, $T_{1/2}$.

^{178}Hf Levels

E(level)[†]	J^π	$T_{1/2}$	Comments
0.0[‡]	0^+		
93.14[‡] *4*	2^+	1.50 ns *3*	$T_{1/2}$: from 1962Ka14. Others 1.49 ns *5* (1962Bo13), 1.25 ns *8* (1961Ga05). g_R=0.36 *4* (1962Bo13).
306.52[‡] *6*	4^+		
1174.61[#] *6*	2^+		
1199.22[@] *8*	0^+		
1276.54[@] *5*	2^+		J^π: from E0 component in 1183γ to 2^+ 93 keV.
1309.92 *7*	1^-		
1362.37 *9*	2^-		
1433.99[&] *10*	0^+		J^π: from E0 1434γ to 0^+ g.s.
1443.83 *8*	0^+		J^π: from E0 1443γ to 0^+ g.s.
1496.01[&] *7*	2^+		J^π: From E2 1496γ to 0^+ g.s.
1513.65 *8*			Additional information 1.
1561.27 *5*	2^+		
1566.46 *11*	2^-		
1771.93 *19*	0^+		J^π: from E0 1772γ to 0^+ g.s.

[†] From a least-squares fit to γ-ray energies.
[‡] $K^\pi=0^+$ g.s. rotational band.
[#] $K^\pi=2^+$ γ-vibrational band.
[@] $K^\pi=0^+$ band.
[&] $K^\pi=0^+$ band.

ε,$β^+$ radiations

E(decay)	E(level)	Iε[†]	Log *ft*	I(ε+$β^+$)[†]	Comments
(165 *15*)	1771.93	0.039 *5*	5.47 *14*	0.039 *5*	εK=0.67 *3*; εL=0.247 *21*; εM+=0.084 *8*
(371 *15*)	1566.46	0.013 *3*	6.85 *11*	0.013 *3*	εK=0.779 *3*; εL=0.1677 *21*; εM+=0.0534 *8*
(376 *15*)	1561.27	0.058 *2*	6.22 *5*	0.058 *2*	εK=0.780 *3*; εL=0.1670 *20*; εM+=0.0531 *8*
(423 *15*)	1513.65	0.028 *2*	6.65 *5*	0.028 *2*	εK=0.7868 *20*; εL=0.1620 *15*; εM+=0.0512 *6*
(441 *15*)	1496.01	0.82 *1*	5.23 *4*	0.82 *1*	εK=0.7889 *18*; εL=0.1604 *14*; εM+=0.0507 *5*
(493 *15*)	1443.83	1.20 *3*	5.17 *4*	1.20 *3*	εK=0.7942 *14*; εL=0.1566 *10*; εM+=0.0492 *4*
(503 *15*)	1433.99	1.03 *3*	5.26 *4*	1.03 *3*	εK=0.7951 *14*; εL=0.1559 *10*; εM+=0.0490 *4*
(575 *15*)	1362.37	0.014 *4*	7.25 *13*	0.014 *4*	εK=0.8003 *10*; εL=0.1521 *7*; εM+=0.0476 *3*
(627 *15*)	1309.92	0.033 *2*	6.96 *4*	0.033 *2*	εK=0.8032 *8*; εL=0.1500 *6*; εM+=0.04681 *22*

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^{178}Ta ε decay (9.31 min) 1974Ha63,1972Li03,1972Si26 (continued)

ε,β+ radiations (continued)

E(decay)	E(level)	Iβ+ †	Iε†	Log *ft*	I(ε+β+)†	Comments
(660 *15*)	1276.54		0.26 *1*	6.12 *3*	0.26 *1*	εK=0.8048 *7*; εL=0.1488 *6*; εM+=0.04638 *19*
(738 *15*)	1199.22		0.54 *1*	5.904 *21*	0.54 *1*	εK=0.8079 *6*; εL=0.1465 *4*; εM+=0.04554 *15*
(762 *15*)	1174.61		0.014 *5*	7.52 *16*	0.014 *5*	εK=0.8088 *5*; εL=0.1459 *4*; εM+=0.04531 *14*
(1844 *15*)	93.14	0.34 *5*	34 *5*	4.95 *7*	34 *5*	av Eβ=384.4 *66*; εK=0.8146 *5*; εL=0.13436 *15*; εM+=0.04117 *5* E(decay): Eβ+=800 *15* (1961Ga05).
(1937 *15*)	0.0	0.90 *9*	61 *5*	4.73 *4*	62 *5*	av Eβ=425.2 *66*; εK=0.8113 *7*; εL=0.13341 *17*; εM+=0.04086 *6* E(decay): Eβ+=890 *10* (1961Ga05). Iβ(g.s.)/Iβ(93)=2.7 *5* (1967Ni02).

† Absolute intensity per 100 decays.

γ(^{178}Hf)

Iγ normalization: From Iβ(g.s.)/Iβ(93)=2.7 *5* (1967Ni02), theoretical ε/β$^+$ ratios, and Iγ(γ$^±$)=460 *18* (weighted average of 436 *13* (1972Li03), 488 *14* (1972Si26), and 486 *98* (1967Ni02)).
Iγ and Ice intensity scales in 1974Ha63 are normalized assuming E2 multipolarity for the 1106γ, 1340γ, and 1350γ.

E_γ [†]	I_γ [†a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	α[b]	$I_{(\gamma+ce)}$[a]	Comments
93.13 *8*	1.37×10^3 *38*	93.14	2$^+$	0.0	0$^+$	E2	4.67		B(E2)(W.u.)=160 *4* E_γ,Mult.: from 1972Li03. I_γ: from 1967Ni02.
151.28[&] *14*	1.0 *2*	1513.65		1362.37	2$^-$	E0+M1+E2	0.99 *24*		E_γ,I_γ,Mult.: From 1972Li03. Seen (for 9.3 min ^{178}Ta ε decay) in singles and γγ coincidence spectra (gate 1269γ) only in 1972Li03. Not observed in any of the other decay or reaction datasets.
203.73[&] *12*	1.55 *15*	1513.65		1309.92	1$^-$	#			Reported (for 9.3 min ^{178}Ta ε decay) in 1972Li03 (γγ-coin, gate 1216γ), and in 1972Si26. Not observed in any of the other decay or reaction datasets. Additional information 3.
204.1[&]	0.8 *4*	1566.46	2$^-$	1362.37	2$^-$	M1	0.532		
213.39 *6*	17.9 *24*	306.52	4$^+$	93.14	2$^+$	E2	0.232		
256.54 *16*	0.70 *14*	1566.46	2$^-$	1309.92	1$^-$	M1+E2	0.21 *8*		E_γ,I_γ: from 1972Li03.
269.4 *1*	3.8 *9*	1443.83	0$^+$	1174.61	2$^+$	E2	0.1100		
970.03 *5*	11.5 *5*	1276.54	2$^+$	306.52	4$^+$	E2	0.00435		
1081.52 *7*	3.74 *17*	1174.61	2$^+$	93.14	2$^+$	E2	0.00349		Additional information 2.
1106.09 *7*	111.6 *25*	1199.22	0$^+$	93.14	2$^+$	E2	0.00334		Mult.: from α(K)exp=0.00283 *17* (1974Ha63), γγ(θ) in 1972Li03.
1174.63 *7*	3.29 *17*	1174.61	2$^+$	0.0	0$^+$	E2	0.00297		
1183.38 *7*	35.3 *10*	1276.54	2$^+$	93.14	2$^+$	E2+M1+E0	0.0042 *13*		Mult.: from α(K)exp=0.0124 *8* (1974Ha63), 0.0139 *17* (1971Oh03). Also from γγ(θ) in 1972Li03. δ: δ=0.41 *4*, from γγ(θ) (1972Li03).
1189.49 *10*	4.7 *5*	1496.01	2$^+$	306.52	4$^+$	E2	0.00290		
1199.0 *3*		1199.22	0$^+$	0.0	0$^+$	E0		0.0058 *17*	Mult.: α(K)/α(L)=3.4 *3* (1974Ha63), α(K)/α(L)=5.7 *4* (1972Gi05), α(K)/α(L)=5.7 *5* (1971Oh03). E_γ: from 1972Si26. E_γ,I_γ: from 1972Li03.
1216.79 *12*	1.38 *8*	1309.92	1$^-$	93.14	2$^+$				
1254.73 *12*	7.4 *4*	1561.27	2$^+$	306.52	4$^+$	E2	0.00262		
1269.23 *8*	5.94 *20*	1362.37	2$^-$	93.14	2$^+$	E1	1.11×10^{-3}		
1276.54 *8*	7.4 *6*	1276.54	2$^+$	0.0	0$^+$	E2	0.00254		Mult.: from α(K)exp=0.0019 *3* (1974Ha63), γγ(θ) in 1972Li03.
1309.90 *8*	8.6 *3*	1309.92	1$^-$	0.0	0$^+$	E1	1.08×10^{-3}		
1340.85 *9*	214 *5*	1433.99	0$^+$	93.14	2$^+$	E2	0.00232		Mult.: from α(K)exp=0.00187 *10* (1974Ha63), γγ(θ) in 1972Li03.

From ENSDF

^{178}Ta ε decay (9.31 min) 1974Ha63,1972Li03,1972Si26 (continued)

γ(^{178}Hf) (continued)

E_γ[†]	I_γ[†a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ	α[b]	$I_{(\gamma+ce)}$[a]	Comments
1350.55 *9*	245 *6*	1443.83	0^+	93.14	2^+	E2		0.00229		Mult.: from α(K)exp=0.00191 *11* (1974Ha63), γγ(θ) in 1972Li03.
1402.87 *9*	100	1496.01	2^+	93.14	2^+	E2+M1+E0	−0.73 *5*	0.00315 *7*		Mult.: from α(K)exp=0.0076 *4* and α(K)/α(L)=7.1 *7* (1974Ha63). α(K)/α(L)=6.6 *9* (1972Gi05),α(K/L)=6.7 *+14−10* (1971Oh03). Also γγ(θ) in 1972Li03. δ: from γγ(θ) (1972Li03).
1420.54 *10*	0.87 *6*	1513.65		93.14	2^+	E0+M1+E2[#]		0.0028 *8*		
1434.0		1433.99	0^+	0.0	0^+	E0			0.0025 *1*	Mult.: from 1974Ha63, 1972Gi05, 1971Oh03, and γγ(θ) in 1972Li03. E_γ: from 1974Ha63.
1443.7		1443.83	0^+	0.0	0^+	E0				Mult.: from α(K)/α(L)/α(M) 248/43.9 *20*/ 11.4 *8* (1974Ha63). α(K)/α(L) 248/40.8 *9* (1972Gi05), α(K/L)=6.05 *20* (1971Oh03). Also from γγ(θ) in 1972Li03. E_γ: from 1974Ha63.
1468.13 *2*	2.55 *21*	1561.27	2^+	93.14	2^+	E2(+E0+M1)[#]		0.0027 *7*		
1473.32 *12*	0.65 *5*	1566.46	2^-	93.14	2^+					E_γ,I_γ: from 1972Li03.
1496.01 *11*	56.0 *13*	1496.01	2^+	0.0	0^+	E2		0.00194		Mult.: from α(K)exp=0.00157 (1974Ha63), γγ(θ) in 1972Li03.
1513.63 *12*	0.96 *4*	1513.65		0.0	0^+	E2[#]		0.00190		
1561.30 *13*	2.20 *7*	1561.27	2^+	0.0	0^+	E2[#]		0.00181		
1678.81 *18*	0.77 *10*	1771.93	0^+	93.14	2^+	E2[#]		1.64×10^{-3}		
1772		1771.93	0^+	0.0	0^+	E0[@]			0.00022 *6*	

[†] Weighted averages of data from 1972Li03 and 1972Si26, unless otherwise specified.
[‡] From adopted gammas, unless otherwise specified.
[#] From γγ(θ) in 1972Li03.
[@] From conversion electron measurements in 1974Ha63.
[&] From level energy differences.
[a] For absolute intensity per 100 decays, multiply by 0.0048 *4*.
[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.

From ENSDF

$^{178}_{72}Hf_{106}$-4

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Decay Scheme

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