^{165}Yb ε+β^+ decay (9.8 min) 1978Ad06,1973Ta18

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 194,460 (2024)	31-Oct-2022

Parent: ^{165}Yb: E=0.0; J$^\pi$=5/2$^-$; T$_{1/2}$=9.8 min *5*; Q(ε)=2635 *27*; %ε+%β^+ decay=100

^{165}Yb-J$^\pi$,T$_{1/2}$: From ^{165}Yb Adopted Levels.

^{165}Yb-Q(ε): From 2021Wa16.

1978Ad06 (also 1985Ad12): measured Eγ, Iγ, $\gamma\gamma$-coin, ce, $\gamma\gamma$(t) using Ge(Li), Si(Li) and NaI(T1) detectors, a toroidal β-spectrometer and magnetic β-spectrographs. Isobarically separated ^{165}Tm sources were produced by the YASNAPP facility at the JINR-Dubna Institute. Some revisions in the level scheme proposed by 1985Ad12. Deduced levels, J^π, β feedings, log *ft* values, band structures, Nilsson configurations.

1973Ta18: measured Eγ, Iγ, $\gamma\gamma$-coin. A total of 118 γ rays reported with placements proposed for 73 γ rays amongst 37 excited states, most of which are confirmed by 1978Ad06. ^{165}Yb sources were produced in ^{159}Tb(^{11}B,5n),E=60 MeV reaction at the Yale heavy-ion accelerator facility.

1968Ta05: measured T$_{1/2}$(^{165}Yb isotope), Eβ, Eγ, Iγ, ce, (x ray)γ, (x ray)γ(t), $\gamma\gamma$(t), (x-ray)γ(ce)(t). The conversion electron measurements were made using Si(Li) detector. The work is by the same author as the first author in 1973Ta18.

Others:

1980AlZE: measured lifetimes by ce(t).

1972Ch23, 1969DeZZ, 1967Pa04 (also 1964Pa07), 1961St05: measured T$_{1/2}$ of ^{165}Yb decay.

^{165}Tm Levels

The following levels proposed by 1973Ta18 are not confirmed by 1978Ad06 and are omitted here: 369.8, 609.5, 1424.8; tentative levels at 950.0, 1100.5, 1129.1, 1352.6.

A 1790.4 level proposed in 1978Ad06 is excluded in the reanalysis by 1985Ad12.

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]	Comments
0.0	1/2$^+$		
11.54 *6*	3/2$^+$	0.75 ns *5*	
80.36 *6*	7/2$^+$		
129.63 *5*	5/2$^+$	≤0.2 ns	
158.20? *25*	1/2$^-$		
158.93 *6*	7/2$^+$	322 ps *20*	T$_{1/2}$: adopted value from $\gamma\gamma$(t) in (α,4nγ). Other: ≤0.3 ns from this study.
160.46 *6*	7/2$^-$	9.0[@] μs *5*	%IT=100
181.72 *6*	5/2$^-$		
210.61 *8*	9/2$^+$		
252.42 *7*	9/2$^-$		
275.53 *20*	3/2$^-$		
293.51 *10*	9/2$^-$		
315.55 *6*	5/2$^+$		
362.28 *7*	9/2$^+$		
413.90 *11*	11/2$^+$		
415.94[&] *8*	(3/2$^+$)		
419.81 *7*	7/2$^+$		
450.32 *10*	7/2$^-$		
491.24 *7*	(5/2$^+$)		
552.11 *11*	9/2$^+$		
592.25 *10*	(7/2$^+$)		
725.86 *10*	(9/2$^+$)		
797.34 *9*			
830.97 *16*	(9/2$^-$)		
889.86 *23*			
921.38 *19*	(5/2$^-$,7/2)		
1012.76 *14*			

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^{165}Yb ε+$β^+$ decay (9.8 min) 1978Ad06,1973Ta18 (continued)

^{165}Tm Levels (continued)

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
1037.03 *9*	(7/2)	1307.73 *10*	(7/2$^+$)	1466.15 *16*		1846.56 *9*	(7/2)
1190.49 *8*		1315.00 *9*		1564.76 *8*	(7/2)	2194.9 *3*	(5/2$^-$,7/2)
1250.75 *8*	(5/2)$^-$	1325.97 *10*		1581.77 *7*	(7/2)$^-$		
1280.93 *14*		1370.10 *9*		1595.2?& *3*			

† From least-squares fit to Eγ data.
‡ From Adopted Levels.
# From ce-ce(t) and/or ce-γ(t) (1980AlZE), unless otherwise stated. The same values are adopted in Adopted Levels.
@ Adopted $T_{1/2}$ from γγ(t) (1978Ad06).
& Level proposed by 1985Ad12.

ε,$β^+$ radiations

av Eβ: Additional information 1.

E(decay)	E(level)	Iβ$^+$ †	Iε†	Log *ft*	I(ε+$β^+$)†	Comments
(440 *27*)	2194.9		0.096 *13*	6.15 *14*	0.096 *13*	εK=0.7995 *32*; εL=0.1510 *22*; εM+=0.0495 *7*
(788 *27*)	1846.56		0.57 *5*	5.93 *9*	0.57 *5*	εK=0.8174 *10*; εL=0.1381 *6*; εM+=0.04452 *27*
(1040 *27*)	1595.2?	5.21×10^{-13}	0.018 *9*	7.681 *27*	0.018 *9*	av Eβ=6 *20*; εK=0.8223 *7*; εL=0.1345 *4*; εM+=0.04315 *19*
(1053 *27*)	1581.77	9×10^{-9} *9*	2.28 *14*	5.59 *7*	2.28 *14*	av Eβ=10 *22*; εK=0.8225 *6*; εL=0.1344 *4*; εM+=0.04309 *18*
(1070 *27*)	1564.76	1.×10^{-8} *1*	0.73 *5*	6.10 *8*	0.73 *5*	av Eβ=25 *23*; εK=0.8228 *6*; εL=0.1342 *4*; εM+=0.04303 *18*
(1169 *27*)	1466.15	7.71×10^{-7}	0.113 *19*	6.99 *+12−11*	0.113 *19*	av Eβ=79 *13*; εK=0.8240 *6*; εL=0.13333 *32*; εM+=0.04268 *18*
(1265 *27*)	1370.10	4.×10^{-5} *3*	0.50 *6*	6.42 *+10−9*	0.50 *6*	av Eβ=124 *13*; εK=0.8249 *5*; εL=0.13260 *29*; εM+=0.04240 *16*
(1309 *27*)	1325.97	1.2×10^{-4} *7*	0.69 *5*	6.31 *7*	0.69 *5*	av Eβ=144 *12*; εK=0.8253 *5*; εL=0.13229 *27*; εM+=0.04229 *15*
(1320 *27*)	1315.00	1.6×10^{-4} *8*	0.78 *6*	6.26 *8*	0.78 *6*	av Eβ=149 *12*; εK=0.8253 *5*; εL=0.13221 *27*; εM+=0.04226 *15*
(1327 *27*)	1307.73	6.5×10^{-5} *34*	0.29 *2*	6.70 *7*	0.29 *2*	av Eβ=153 *12*; εK=0.8254 *5*; εL=0.13216 *27*; εM+=0.04224 *15*
(1354 *27*)	1280.93	7.1×10^{-5} *33*	0.218 *21*	6.84 *8*	0.218 *21*	av Eβ=165 *12*; εK=0.8255 *5*; εL=0.13199 *26*; εM+=0.04217 *15*
(1384 *27*)	1250.75	0.0017 *7*	3.6 *3*	5.64 *8*	3.6 *3*	av Eβ=178 *12*; εK=0.8256 *5*; εL=0.13179 *25*; εM+=0.04210 *15*
(1445‡ *27*)	1190.49	6.334×10^{-5}	<0.06994	>7.4	<0.07	av Eβ=206 *12*; εK=0.8257 *5*; εL=0.13140 *24*; εM+=0.04196 *14* I(ε+$β^+$): 0.02 *5* from transition intensity balance.
(1598 *27*)	1037.03	0.0029 *7*	0.93 *8*	6.36 *+8−7*	0.93 *8*	av Eβ=273 *12*; εK=0.8249 *7*; εL=0.13038 *23*; εM+=0.04157 *13*
(1622 *27*)	1012.76	3.7×10^{-4} *8*	0.101 *11*	7.34 *+9−8*	0.101 *11*	av Eβ=284 *12*; εK=0.8246 *7*; εL=0.13021 *23*; εM+=0.04152 *13*
(1714 *27*)	921.38	5.3×10^{-4} *11*	0.083 *10*	7.47 *9*	0.084 *10*	av Eβ=324 *12*; εK=0.8229 *9*; εL=0.12952 *24*; εM+=0.04127 *13*
(1745 *27*)	889.86	9.7×10^{-4} *33*	0.13 *4*	7.30 *+20−16*	0.13 *4*	av Eβ=338 *12*; εK=0.8221 *10*; εL=0.12925 *24*; εM+=0.04118 *13*

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^{165}Yb $\varepsilon+\beta^+$ decay (9.8 min) 1978Ad06,1973Ta18 (continued)

ϵ,β^+ radiations (continued)

E(decay)	E(level)	$I\beta^+$ †	$I\varepsilon$†	Log *ft*	$I(\varepsilon+\beta^+)$†	Comments
(1804‡ *27*)	830.97					$I(\varepsilon+\beta^+)$: −0.023 *15* from transition intensity balance.
(1838 *27*)	797.34	3.4×10^{-4} *19*	0.029 *16*	8.0 *+4−2*	0.029 *16*	av Eβ=379 *12*; εK=0.8191 *13*; εL=0.12841 *27*; εM+=0.04090 *13*
(1909 *27*)	725.86	1.6×10^{-4} *6*	0.049 *17*	8.92^{1u} *+23−18*	0.049 *17*	av Eβ=425 *12*; εK=0.8177 *6*; εL=0.13550 *29*; εM+=0.04353 *17*
(2043 *27*)	592.25	0.0034 *6*	0.131 *21*	7.43 *+11−10*	0.134 *21*	av Eβ=468 *12*; εK=0.8084 *21*; εL=0.1261 *4*; εM+=0.04011 *14*
(2083 *27*)	552.11	6.1×10^{-4} *34*	0.09 *5*	8.8^{1u} *+4−2*	0.09 *5*	av Eβ=500 *12*; εK=0.8163 *8*; εL=0.13397 *27*; εM+=0.04298 *15*
(2144 *27*)	491.24	0.0052 *21*	0.14 *6*	7.43 *+26−18*	0.15 *6*	av Eβ=512 *12*; εK=0.8009 *25*; εL=0.1246 *4*; εM+=0.03964 *15*
(2185 *27*)	450.32	0.0034 *7*	0.083 *17*	7.69 *+13−11*	0.086 *17*	av Eβ=530 *12*; εK=0.7974 *27*; εL=0.1239 *4*; εM+=0.03943 *15*
(2215‡ *27*)	419.81	<0.005546	<0.12445	>7.5	<0.13	av Eβ=543 *12*; εK=0.7946 *28*; εL=0.1234 *5*; εM+=0.03925 *16* $I(\varepsilon+\beta^+)$: 0.05 *8* from transition intensity balance.
(2219 *27*)	415.94	0.0101 *11*	0.225 *18*	7.27 *7*	0.235 *18*	av Eβ=545 *12*; εK=0.7943 *29*; εL=0.1234 *5*; εM+=0.03923 *16*
(2273‡ *27*)	362.28	$<7.69\times10^{-4}$	<0.05923	>9.2^{1u}	<0.06	av Eβ=581 *12*; εK=0.8126 *10*; εL=0.13221 *27*; εM+=0.04235 *14* $I(\varepsilon+\beta^+)$: 0.02 *4* from γ-transition intensity balance.
(2319 *27*)	315.55	0.014 *5*	0.25 *9*	7.27 *+22−16*	0.26 *9*	av Eβ=589 *12*; εK=0.7841 *33*; εL=0.1216 *5*; εM+=0.03864 *17*
(2342‡ *27*)	293.51					$I(\varepsilon+\beta^+)$: 0.005 *23* from γ-transition intensity balance.
(2360 *27*)	275.53	0.0068 *13*	0.104 *20*	7.66 *+12−11*	0.111 *20*	av Eβ=607 *12*; εK=0.780 *3*; εL=0.1208 *6*; εM+=0.03839 *17*
(2383‡ *27*)	252.42					$I(\varepsilon+\beta^+)$: −0.01 *15* from γ-transition intensity balance.
(2424 *27*)	210.61	0.0045 *22*	0.23 *11*	8.68^{1u} *+33−21*	0.23 *11*	av Eβ=645 *12*; εK=0.8078 *13*; εL=0.13065 *29*; εM+=0.04181 *14*
(2453 *27*)	181.72	0.032 *11*	0.39 *14*	7.12 *+21−16*	0.42 *14*	av Eβ=648 *12*; εK=0.768 *4*; εL=0.1188 *6*; εM+=0.03775 *18*
(2475 *27*)	160.46	7.5 *18*	88 *22*	4.78 *+15−13*	95 *22*	av Eβ=658 *12*; εK=0.765 *4*; εL=0.1183 *6*; εM+=0.03760 *19* E(decay): measured value=2602 *20* (1967Pa04). Other: 2722 *50* (1968Ta05).
(2476 *27*)	158.93	0.08 *4*	0.9 *5*	6.76 *+34−21*	1.0 *5*	av Eβ=658 *12*; εK=0.765 *4*; εL=0.1183 *6*; εM+=0.03759 *19*
(2477‡ *27*)	158.20?	0.00124 *20*	0.054 *8*	9.34 *+11−10*	0.055 *8*	av Eβ=668 *12*; εK=0.8057 *14*; εL=0.13007 *30*; εM+=0.04161 *14* log *ft* is too low for ΔJ=2, no $\beta^++\varepsilon$ transition.
(2505‡ *27*)	129.63					$I(\varepsilon+\beta^+)$: −0.2 *7* from γ-transition intensity balance.
(2555‡ *27*)	80.36					$I(\varepsilon+\beta^+)$: −8 *22* from γ-transition intensity balance.

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

γ(^{165}Tm)

Iγ normalization: From ΣI(γ+ce)(to g.s.+11.5 level)=100%, and assumed no ε+β$^+$ feeding to levels below 158.2 keV. Note that I(ε+β$^+$)(g.s.) <0.6% from log $f^{1u}t$>8.5 and I(ε+β$^+$)(to levels up to 129 keV)<8% from log *ft*>5.9.

The following γ rays with Eγ (Iγ relative to 100 for 80.11γ) were reported by 1973Ta18 only: 282.5 *5* (weak), 292.2 *5* (0.04), 427.0 *5* (0.06), 589.3 *7* (weak), 675.1 *1* (0.13), 736.8 *5* (0.09), 920.0 *10* (0.04), 944.0 *10* (0.06), 963 *1* (0.05), 976.8 *10* (0.04), 1100.6 *10* (0.1), 1253.2 *10* (0.01), 1306 *1* (0.04). Placements were proposed for only the 589.3 and 1100.6 γ rays, but the corresponding levels have not been confirmed by 1978Ad06.

Eγ‡	Iγ‡c	Ei(level)	Jπi	Ef	Jπf	Mult.b	δ	α†	I(γ+ce)c	Comments
11.60 *10*		11.54	3/2+	0.0	1/2+	M1(+E2)	≤0.06	4.3×10^2 *14*	1110 *70*	ce(L)/(γ+ce)=0.77 *17*; ce(M)/(γ+ce)=0.18 *8* ce(N)/(γ+ce)=0.041 *19*; ce(O)/(γ+ce)=0.0055 *24*; ce(P)/(γ+ce)=2.1×10^{-4} *7* α(L)=3.3×10^2 *11*; α(M)=76 *26* α(N)=18 *6*; α(O)=2.3 *7*; α(P)=0.0910 *27* I(γ+ce): from transition intensity balance. Mult.: from M1:M2:M3=≈860:≤200:≤200 (1978Ad06). δ: δ(E2/M1)≤0.3 from ce data in ^{165}Yb decay gives B(E2)(W.u.)<20510, much higher than RUL=1000 which gives δ(E2/M1)<0.06, which is adopted here. Ice(M1)≈860, Ice(M2)≤200, Ice(M3)≤200 (1978Ad06).
(22.78 *7*)		181.72	5/2−	158.93	7/2+	(E1)		3.48 *6*	≈2	ce(L)/(γ+ce)=0.605 *6*; ce(M)/(γ+ce)=0.1381 *26* ce(N)/(γ+ce)=0.0305 *6*; ce(O)/(γ+ce)=0.00337 *7*; ce(P)/(γ+ce)=8.44×10^{-5} *17* α(L)=2.71 *4*; α(M)=0.619 *10* α(N)=0.1369 *22*; α(O)=0.01509 *24*; α(P)=0.000379 *6* I(γ+ce)(52.10γ+22.78γ)≈4 (1978Ad06) based on γγ-coin data. Evaluators divide equally between the two transitions.
(29.31 *5*)		158.93	7/2+	129.63	5/2+	[M1+E2]		4×10^2 *4*	14 *5*	ce(L)/(γ+ce)=0.8 *5*; ce(M)/(γ+ce)=0.19 *23* ce(N)/(γ+ce)=0.04 *6*; ce(O)/(γ+ce)=0.005 *6*; ce(P)/(γ+ce)=9.E−6 *10* α(L)=3.0×10^2 *29*; α(M)=7.E1 7 α(N)=16 *16*; α(O)=1.9 *18*; α(P)=0.0036 *22* I(γ+ce): from γγ-coin (1978Ad06).
30.80 *10*	11.8 *20*	160.46	7/2−	129.63	5/2+	E1		1.517 *25*		α(L)=1.183 *20*; α(M)=0.268 *4* α(N)=0.0598 *10*; α(O)=0.00697 *11*; α(P)=0.0001969 *31* Ice(L1)<100 (1978Ad06). α(L1)exp<2.8, K/L=7 +*8*−*4*, α(K)exp=1.0 *4* (1968Ta05).
(52.10 *7*)		181.72	5/2−	129.63	5/2+	[E1]		0.352 *5*	≈2	ce(L)/(γ+ce)=0.2033 *24*; ce(M)/(γ+ce)=0.0456 *7* ce(N)/(γ+ce)=0.01033 *15*; ce(O)/(γ+ce)=0.001294 *19*; ce(P)/(γ+ce)=4.39×10^{-5} *7*

From ENSDF

γ(^{165}Tm) (continued)

E_γ [‡]	I_γ [‡c]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [b]	δ	α [†]	Comments
									α(L)=0.275 *4*; α(M)=0.0616 *9* α(N)=0.01397 *20*; α(O)=0.001750 *25*; α(P)=5.94×10^{-5} *9* I(γ+ce)(52.10γ+22.78γ)≈4 (1978Ad06) based on γγ-coin data. Evaluators divide equally between the two transitions.
68.86 *5*	70 *4*	80.36	7/2$^+$	11.54	3/2$^+$	E2		13.56 *19*	α(K)=1.853 *26*; α(L)=8.95 *13*; α(M)=2.197 *32* α(N)=0.498 *7*; α(O)=0.0571 *8*; α(P)=9.95×10^{-5} *14* Mult.: from K:L1:L2:L3=≈400:≤70:770:800 (1978Ad06). Others: L2/L3≈0.91 (1967Pa04), α(L)exp=7.6 *20* (1968Ta05). Ice(K)≈400, Ice(L1)≤70, Ice(L2)=770, Ice(L3)=800 (1978Ad06).
80.11 *2*	374 *20*	160.46	7/2$^-$	80.36	7/2$^+$	E1+M2	0.14 *3*	1.9 *6*	α(K)=1.4 *4*; α(L)=0.38 *14*; α(M)=0.090 *33* α(N)=0.021 *8*; α(O)=0.0029 *11*; α(P)=1.3×10^{-4} *5* Mult.,δ: from α(K)exp=1.42 with uncertainty of 0.50 assumed by evaluators. Others: K:L1:L2=≈1600:180:≈40 (1978Ad06). K/L≈5.5, α(K)exp≈0.88 (1967Pa04). Ice(K)≈1600, Ice(L1)=180, Ice(L2)≈40 (1978Ad06).
91.97 *5*	2.6 *3*	252.42	9/2$^-$	160.46	7/2$^-$	M1+E2		4.09 *16*	α(K)=2.3 *10*; α(L)=1.4 *9*; α(M)=0.34 *22* α(N)=0.08 *5*; α(O)=0.009 *5*; α(P)=1.3×10^{-4} *7* Mult.: M1+E2 from α(K)exp=2.01. Ice(K)=16 (1978Ad06).
104.26 *7*	1.21 *15*	419.81	7/2$^+$	315.55	5/2$^+$	M1		2.75 *4*	α(K)exp=2.74 α(K)=2.303 *33*; α(L)=0.349 *5*; α(M)=0.0778 *11* α(N)=0.01820 *26*; α(O)=0.00261 *4*; α(P)=0.0001415 *20* Ice(K)=10 (1978Ad06).
118.06 *5*	18.4 *10*	129.63	5/2$^+$	11.54	3/2$^+$	(M1)		1.928 *27*	α(K)=1.615 *23*; α(L)=0.2441 *34*; α(M)=0.0544 *8* α(N)=0.01273 *18*; α(O)=0.001830 *26*; α(P)=9.91×10^{-5} *14* Ice(K)=45 (1978Ad06). Mult.: E2 or M1+E2 from α(K)exp=0.81; M1+E2 from level scheme, most likely M1.
129.59 *6*	3.0 *5*	129.63	5/2$^+$	0.0	1/2$^+$	(E2)		1.173 *17*	α(K)=0.551 *8*; α(L)=0.477 *7*; α(M)=0.1161 *16* α(N)=0.0264 *4*; α(O)=0.00311 *4*; α(P)=2.350×10^{-5} *33* Mult.: D or E2 from α(K)exp≤1.3; E2 from ΔJ^π. Ice(K)≤12 (1978Ad06).
130.26 *7*	2.2 *5*	210.61	9/2$^+$	80.36	7/2$^+$	(M1+E2)	+1.00 *12*	1.305 *27*	α(K)=0.88 *4*; α(L)=0.325 *18*; α(M)=0.077 *5* α(N)=0.0177 *11*; α(O)=0.00221 *11*; α(P)=4.90×10^{-5} *34* Mult.: from the Adopted Gammas. Other: E2 or E1 from α(K)exp≤0.75. Ice(K)≤5 (1978Ad06).
132.32 *10*	0.80 *20*	552.11	9/2$^+$	419.81	7/2$^+$	[M1+E2]		1.24 *15*	α(K)=0.84 *32*; α(L)=0.31 *13*; α(M)=0.073 *33* α(N)=0.017 *7*; α(O)=0.0021 *8*; α(P)=4.7×10^{-5} *25*
134.60 *8*	0.75 *15*	293.51	9/2$^-$	158.93	7/2$^+$	(E1)		0.1520 *21*	α(K)=0.1267 *18*; α(L)=0.01973 *28*; α(M)=0.00439 *6* α(N)=0.001010 *14*; α(O)=0.0001363 *19*; α(P)=5.89×10^{-6} *8*

$^{165}_{69}$Tm$_{96}$-5

γ(^{165}Tm) (continued)

E_γ[‡]	I_γ[‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	α[†]	Comments
147.29 *5*	7.9 *4*	158.93	7/2$^+$	11.54	3/2$^+$	E2	0.743 *10*	α(K)=0.389 *5*; α(L)=0.271 *4*; α(M)=0.0657 *9* α(N)=0.01498 *21*; α(O)=0.001781 *25*; α(P)=1.701×10^{-5} *24* Mult.: E2 or M1+E2 from α(K)exp=0.46; E2 from ΔJ^π. Ice(K)=11 (1978Ad06).
156.51 *15*	1.05 *10*	315.55	5/2$^+$	158.93	7/2$^+$	M1	0.867 *12*	α(K)exp=0.63 α(K)=0.727 *10*; α(L)=0.1095 *16*; α(M)=0.02439 *35* α(N)=0.00571 *8*; α(O)=0.000821 *12*; α(P)=4.45×10^{-5} *6* Ice(K)=2 (1978Ad06).
158.20 *25*	0.56 *7*	158.20?	1/2$^-$	0.0	1/2$^+$	[E1]	0.0992 *14*	α(K)=0.0829 *12*; α(L)=0.01269 *19*; α(M)=0.00282 *4* α(N)=0.000651 *10*; α(O)=8.85×10^{-5} *13*; α(P)=3.94×10^{-6} *6*
170.25 *5*	4.45 *22*	181.72	5/2$^-$	11.54	3/2$^+$	(E1)	0.0817 *11*	α(K)=0.0684 *10*; α(L)=0.01041 *15*; α(M)=0.002312 *32* α(N)=0.000534 *7*; α(O)=7.29×10^{-5} *10*; α(P)=3.29×10^{-6} *5* Mult.: E1 or (E2) from α(K)exp=0.11. Ice(K)=1.5 (1978Ad06).
185.88 *6*	4.45 *22*	315.55	5/2$^+$	129.63	5/2$^+$	E2	0.332 *5*	α(K)exp=0.19 α(K)=0.2019 *28*; α(L)=0.1002 *14*; α(M)=0.02412 *34* α(N)=0.00551 *8*; α(O)=0.000668 *9*; α(P)=9.30×10^{-6} *13* Ice(K)=2.5 (1978Ad06).
203.32 *7*	2.81 *15*	362.28	9/2$^+$	158.93	7/2$^+$	M1	0.418 *6*	α(K)exp=0.35 α(K)=0.351 *5*; α(L)=0.0526 *7*; α(M)=0.01171 *16* α(N)=0.00274 *4*; α(O)=0.000394 *6*; α(P)=2.142×10^{-5} *30* Ice(K)=3 (1978Ad06).
^{x}208.5 *5*	0.17 *4*							
^{x}228.34[#] *20*	0.22 *3*							
232.61 *8*	1.87 *10*	362.28	9/2$^+$	129.63	5/2$^+$	E2	0.1584 *22*	α(K)exp=0.09 α(K)=0.1061 *15*; α(L)=0.0403 *6*; α(M)=0.00960 *14* α(N)=0.002199 *31*; α(O)=0.000272 *4*; α(P)=5.15×10^{-6} *7* Ice(K)=0.5 (1978Ad06).
235.21 *9*	0.73 *6*	315.55	5/2$^+$	80.36	7/2$^+$	M1	0.280 *4*	α(K)exp=0.27 α(K)=0.2351 *33*; α(L)=0.0351 *5*; α(M)=0.00782 *11* α(N)=0.001830 *26*; α(O)=0.000263 *4*; α(P)=1.433×10^{-5} *20* Ice(K)=0.6 (1978Ad06).
255.00 *10*	0.41 *5*	413.90	11/2$^+$	158.93	7/2$^+$	[E2]	0.1181 *17*	α(K)=0.0816 *11*; α(L)=0.0281 *4*; α(M)=0.00668 *9* α(N)=0.001531 *22*; α(O)=0.0001913 *27*; α(P)=4.05×10^{-6} *6*
260.87 *9*	0.75 *8*	419.81	7/2$^+$	158.93	7/2$^+$	[M1,E2]	0.16 *5*	α(K)=0.13 *5*; α(L)=0.0261 *5*; α(M)=0.00600 *14* α(N)=0.001389 *23*; α(O)=0.000187 *12*; α(P)=7.3×10^{-6} *35*
^{x}263.89 *20*	0.16 *4*							
275.53 *20*	1.2 *2*	275.53	3/2$^-$	0.0	1/2$^+$	E1	0.02373 *33*	α(K)exp<0.04

γ(^{165}Tm) (continued)

E_γ[‡]	I_γ[‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	α[†]	Comments
								α(K)=0.01998 *28*; α(L)=0.00293 *4*; α(M)=0.000649 *9* α(N)=0.0001506 *21*; α(O)=2.095×10^{-5} *30*; α(P)=1.014×10^{-6} *14* E_γ,I_γ: total intensity of 275.53 *7* doublet=1.50 *8*. Ice(K)≤0.2 (1978Ad06).
275.70 *20*	≈0.3	1466.15		1190.49				
286.03[@] *15*	0.24 *3*	415.94	(3/2$^+$)	129.63	5/2$^+$	[M1,E2]	0.12 *4*	α(K)=0.10 *4*; α(L)=0.0194 *12*; α(M)=0.00444 *15* α(N)=0.00103 *4*; α(O)=0.000139 *15*; α(P)=5.7×10^{-6} *27*
290.32 *16*	0.41 *4*	419.81	7/2$^+$	129.63	5/2$^+$	M1,E2	0.12 *4*	α(K)=0.09 *4*; α(L)=0.0185 *13*; α(M)=0.00423 *18* α(N)=0.00098 *5*; α(O)=0.000133 *15*; α(P)=5.5×10^{-6} *26* Mult.: D or E2 from α(K)exp≤0.24; M1,E2 from ΔJ^π. Ice(K)≤0.3 (1978Ad06).
304.03 *6*	8.3 *5*	315.55	5/2$^+$	11.54	3/2$^+$	(E2)	0.0686 *10*	α(K)=0.0498 *7*; α(L)=0.01453 *20*; α(M)=0.00342 *5* α(N)=0.000787 *11*; α(O)=0.0001001 *14*; α(P)=2.56×10^{-6} *4* Mult.: E2 or M1+E2 from α(K)exp=0.064. Ice(K)=1.6 (1978Ad06).
312.2 *3*	0.31 *5*	725.86	(9/2$^+$)	413.90	11/2$^+$	[M1,E2]	0.097 *33*	α(K)=0.078 *32*; α(L)=0.0147 *15*; α(M)=0.00336 *26* α(N)=0.00078 *7*; α(O)=0.000106 *15*; α(P)=4.5×10^{-6} *21*
314.3 *3*	0.37 *5*	1564.76	(7/2)	1250.75	(5/2)$^-$			
320.68 *8*	1.70 *10*	450.32	7/2$^-$	129.63	5/2$^+$	(E1)	0.0163 *2*	α(K)exp≤0.04 α(K)=0.01377 *19*; α(L)=0.001999 *28*; α(M)=0.000443 *6* α(N)=0.0001028 *14*; α(O)=1.437×10^{-5} *20*; α(P)=7.08×10^{-7} *10* Ice(K)≤0.2 (1978Ad06).
332.30 *20*	1.0 *3*	491.24	(5/2$^+$)	158.93	7/2$^+$	(E2)	0.0527 *7*	α(K)=0.0390 *5*; α(L)=0.01055 *15*; α(M)=0.002475 *35* α(N)=0.000569 *8*; α(O)=7.32×10^{-5} *10*; α(P)=2.036×10^{-6} *29* Mult.: E1 or E2 from α(K)exp≤0.07; ΔJ^π requires E2. Ice(K)≤0.2 (1978Ad06).
339.67 *20*	0.54 *18*	419.81	7/2$^+$	80.36	7/2$^+$	[M1,E2]	0.077 *27*	α(K)=0.062 *25*; α(L)=0.0113 *16*; α(M)=0.00258 *30* α(N)=0.00060 *7*; α(O)=8.2×10^{-5} *15*; α(P)=3.6×10^{-6} *17*
361.59 *10*	2.00 *14*	491.24	(5/2$^+$)	129.63	5/2$^+$	[M1,E2]	0.065 *23*	α(K)=0.053 *22*; α(L)=0.0094 *15*; α(M)=0.00213 *30* α(N)=0.00050 *7*; α(O)=6.8×10^{-5} *14*; α(P)=3.1×10^{-6} *14*
363.6 *3*	0.71 *10*	725.86	(9/2$^+$)	362.28	9/2$^+$	[M1,E2]	0.064 *23*	α(K)=0.052 *21*; α(L)=0.0092 *15*; α(M)=0.00210 *30* α(N)=0.00049 *7*; α(O)=6.7×10^{-5} *14*; α(P)=3.0×10^{-6} *14*
[x]382.49[#] *20*	0.24 *3*							
[x]389.9[#] *5*	0.35 *20*							
391.40 *8*	2.3 *3*	1581.77	(7/2)$^-$	1190.49				
404.47[@] *10*	1.08 *7*	415.94	(3/2$^+$)	11.54	3/2$^+$	[M1,E2]	0.048 *18*	α(K)=0.039 *16*; α(L)=0.0068 *14*; α(M)=0.00153 *28* α(N)=0.00036 *7*; α(O)=4.9×10^{-5} *11*; α(P)=2.3×10^{-6} *10*
404.57[@]	≈0.4	1595.2?		1190.49				
416.03[@] *13*	1.26 *10*	415.94	(3/2$^+$)	0.0	1/2$^+$	[M1,E2]	0.044 *17*	α(K)=0.036 *15*; α(L)=0.0062 *13*; α(M)=0.00141 *27* α(N)=0.00033 *6*; α(O)=4.6×10^{-5} *11*; α(P)=2.1×10^{-6} *10*

$\gamma(^{165}$Tm) (continued)

E_γ[‡]	I_γ[‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	α[†]	Comments
422.26 *25*	0.29 *3*	552.11	9/2$^+$	129.63	5/2$^+$	[E2]	0.0267 *4*	α(K)=0.02069 *29*; α(L)=0.00469 *7*; α(M)=0.001086 *15* α(N)=0.0002508 *35*; α(O)=3.30×10^{-5} *5*; α(P)=1.119×10^{-6} *16*
[x]430.8[#] *5*	0.13 *3*							
433.35 *10*	1.44 *10*	592.25	(7/2$^+$)	158.93	7/2$^+$	[M1,E2]	0.040 *15*	α(K)=0.033 *13*; α(L)=0.0055 *12*; α(M)=0.00125 *25* α(N)=0.00029 *6*; α(O)=4.1×10^{-5} *10*; α(P)=1.9×10^{-6} *9*
[x]446.1 *3*	0.26 *3*							
462.63 *15*	0.83 *9*	592.25	(7/2$^+$)	129.63	5/2$^+$	[M1,E2]	0.034 *13*	α(K)=0.028 *11*; α(L)=0.0046 *11*; α(M)=0.00104 *23* α(N)=0.00024 *5*; α(O)=3.4×10^{-5} *9*; α(P)=1.6×10^{-6} *7*
479.72 *7*	2.68 *20*	491.24	(5/2$^+$)	11.54	3/2$^+$	[M1,E2]	0.031 *12*	α(K)=0.025 *10*; α(L)=0.0042 *10*; α(M)=0.00094 *21* α(N)=0.00022 *5*; α(O)=3.1×10^{-5} *8*; α(P)=1.5×10^{-6} *7*
[x]492.9[#] *6*	0.26 *9*							
[x]522.76 *20*	0.26 *7*							
527.5[d] *3*	0.15[d] *3*	889.86		362.28	9/2$^+$			
527.5[d] *3*	0.15[d] *3*	1564.76	(7/2)	1037.03	(7/2)			
[x]533.3 *4*	0.12 *4*							
545.24 *20*	0.44 *6*	797.34		252.42	9/2$^-$			
558.0[@] *4*	0.18 *6*	1595.2?		1037.03	(7/2)			
566.90 *10*	0.97 *8*	725.86	(9/2$^+$)	158.93	7/2$^+$	[M1,E2]	0.020 *7*	α(K)=0.017 *7*; α(L)=0.0026 *7*; α(M)=5.9×10^{-4} *15* α(N)=1.4×10^{-4} *4*; α(O)=1.9×10^{-5} *6*; α(P)=1.0×10^{-6} *4*
578.58 *16*	0.51 *5*	830.97	(9/2$^-$)	252.42	9/2$^-$			
[x]597.2 *3*	0.38 *8*							
599.6[@] *3*	0.38 *8*	2194.9	(5/2$^-$,7/2)	1595.2?				
606.24 *25*	0.38 *6*	921.38	(5/2$^-$,7/2)	315.55	5/2$^+$			
[x]609.4[#] *3*	0.20 *6*							
[x]613.52 *20*	0.36 *5*							
628.1 *6*	0.12 *4*	921.38	(5/2$^-$,7/2)	293.51	9/2$^-$			
636.79 *10*	1.48 *10*	797.34		160.46	7/2$^-$			
644.2[f] *3*	0.20 *4*	1370.10		725.86	(9/2$^+$)			
650.0 *3*	0.18 *4*	1012.76		362.28	9/2$^+$			
656.00 *7*	2.89 *16*	1846.56	(7/2)	1190.49				
[x]675.75 *20*	0.49 *6*							
708.1 *4*	0.25 *8*	889.86		181.72	5/2$^-$			
722.3 *5*	0.17 *8*	1315.00		592.25	(7/2$^+$)			
728.8 *3*	0.29 *8*	2194.9	(5/2$^-$,7/2)	1466.15				
739.0 *3*	0.43 *5*	921.38	(5/2$^-$,7/2)	181.72	5/2$^-$			
744.6 *8*	0.12 *6*	1037.03	(7/2)	293.51	9/2$^-$			
[x]772.61 *20*	0.51 *7*							
784.43 *10*	1.60 *12*	1581.77	(7/2)$^-$	797.34				
[x]796.2 *4*	0.26 *5*							

$^{165}_{69}$Tm$_{96}$-8

γ(^{165}Tm) (continued)

E_γ[‡]	I_γ[‡c]	E_i(level)	J^π_i	E_f	J^π_f
[x]820.9 *4*	0.29 *14*				
826.33 *10*	1.44 *12*	1037.03	(7/2)	210.61	$9/2^+$
831.12 *13*	0.94 *9*	1012.76		181.72	$5/2^-$
838.83 *20*	0.48 *8*	1564.76	(7/2)	725.86	$(9/2^+)$
[x]853.05 *20*	0.68 *7*				
856.00 *20*	0.77 *7*	1581.77	$(7/2)^-$	725.86	$(9/2^+)$
877.0 *6*	0.8 *4*	1037.03	(7/2)	160.46	$7/2^-$
878.6[d] *5*	1.0[d] *4*	889.86		11.54	$3/2^+$
878.6[d] *5*	1.0[d] *4*	1370.10		491.24	$(5/2^+)$
892.9[f] *6*	0.44 *20*	1307.73	$(7/2^+)$	413.90	$11/2^+$
895.21 *20*	1.06 *25*	1315.00		419.81	$7/2^+$
906.10 *17*	0.50 *20*	1325.97		419.81	$7/2^+$
935.17 *8*	3.21 *20*	1250.75	$(5/2)^-$	315.55	$5/2^+$
937.96 *25*	0.71 *8*	1190.49		252.42	$9/2^-$
[x]946.8 *7*	0.21 *10*				
956.68 *7*	8.3 *5*	1037.03	(7/2)	80.36	$7/2^+$
[x]967.94 *15*	0.70 *10*				
[x]973.10[#] *22*	0.43 *10*				
990.0 *3*	0.61 *14*	1581.77	$(7/2)^-$	592.25	$(7/2^+)$
998.38 *8*	≈1.0	1250.75	$(5/2)^-$	252.42	$9/2^-$
999.46 *10*	≈3.9	1315.00		315.55	$5/2^+$
1009.3[d] *8*	0.18[d] *9*	1190.49		181.72	$5/2^-$
1009.3[d] *8*	0.18[d] *9*	1325.97		315.55	$5/2^+$
1012.4 *4*	0.47 *15*	1564.76	(7/2)	552.11	$9/2^+$
1015.7[d] *3*	0.77[d] *15*	1466.15		450.32	$7/2^-$
1015.7[d] *3*	0.77[d] *15*	1846.56	(7/2)	830.97	$(9/2^-)$
1030.05 *7*	5.2 *3*	1190.49		160.46	$7/2^-$
1032.3[f] *8*	0.29 *15*	1325.97		293.51	$9/2^-$
1073.54[e] *10*	≈2.4[e]	1564.76	(7/2)	491.24	$(5/2^+)$
1073.56[e] *13*	≈4.8[e]	1325.97		252.42	$9/2^-$
1090.28[a] *8*	33.9 *20*	1250.75	$(5/2)^-$	160.46	$7/2^-$
1090.54 *9*	≈0.7	1581.77	$(7/2)^-$	491.24	$(5/2^+)$
1117.74 *10*	1.55 *15*	1370.10		252.42	$9/2^-$
1122.00 *12*	1.28 *15*	1280.93		158.93	$7/2^+$
1126.34 *12*	1.25 *15*	1307.73	$(7/2^+)$	181.72	$5/2^-$
1145.3 *3*	0.84 *12*	1564.76	(7/2)	419.81	$7/2^+$

E_γ[‡]	I_γ[‡c]	E_i(level)	J^π_i	E_f	J^π_f
1148.56 *10*	1.49 *15*	1307.73	$(7/2^+)$	158.93	$7/2^+$
1154.54 *8*	3.52 *25*	1315.00		160.46	$7/2^-$
1161.78 *18*	0.74 *9*	1581.77	$(7/2)^-$	419.81	$7/2^+$
1165.53 *10*	1.90 *15*	1325.97		160.46	$7/2^-$
1172.7[f] *5*	0.28 *9*	1466.15		293.51	$9/2^-$
1188.40 *13*	1.05 *10*	1370.10		181.72	$5/2^-$
[x]1193.47 *15*	0.60 *15*				
1202.54 *14*	0.97 *10*	1564.76	(7/2)	362.28	$9/2^+$
1209.4 *5*	0.52 *20*	1370.10		160.46	$7/2^-$
[x]1212.3 *5*	0.63 *20*				
1219.41 *8*	3.9 *3*	1581.77	$(7/2)^-$	362.28	$9/2^+$
[x]1229.3[#] *8*	0.18 *10*				
1239.56[f] *9*	2.28 *15*	1250.75	$(5/2)^-$	11.54	$3/2^+$
1249.5 *10*	0.29 *15*	1564.76	(7/2)	315.55	$5/2^+$
1266.13 *10*	1.66 *12*	1581.77	$(7/2)^-$	315.55	$5/2^+$
1269.87[f] *12*	1.14 *11*	1280.93		11.54	$3/2^+$
[x]1282.65 *12*	1.22 *10*				
1289.65 *12*	1.22 *10*	1370.10		80.36	$7/2^+$
1294.5[f] *5*	0.59 *20*	1846.56	(7/2)	552.11	$9/2^+$
[x]1296.81 *20*	1.68 *20*				
1296.81[f]		1307.73	$(7/2^+)$	11.54	$3/2^+$
[x]1308.7 *5*	0.36 *7*				
1312.12 *11*	1.08 *8*	1564.76	(7/2)	252.42	$9/2^-$
1329.36 *8*	2.82 *20*	1581.77	$(7/2)^-$	252.42	$9/2^-$
[x]1339.9[&] *5*	0.14 *7*				
[x]1351.9 *3*	0.23 *4*				
[x]1356.05 *25*	0.32 *4*				
[x]1367.57 *12*	1.13 *10*				
1371.33 *12*	1.12 *10*	1581.77	$(7/2)^-$	210.61	$9/2^+$
1386.0 *4*	0.20 *5*	1466.15		80.36	$7/2^+$
[x]1390.47 *14*	0.71 *8*				
[x]1401.41 *16*	0.68 *8*				
1404.7 *3*	0.30 *5*	1564.76	(7/2)	160.46	$7/2^-$
1421.35 *10*	2.46 *15*	1581.77	$(7/2)^-$	160.46	$7/2^-$
1426.91 *12*	0.95 *12*	1846.56	(7/2)	419.81	$7/2^+$
1435.28 *16*	0.81 *12*	1564.76	(7/2)	129.63	$5/2^+$

γ(^{165}Tm) (continued)

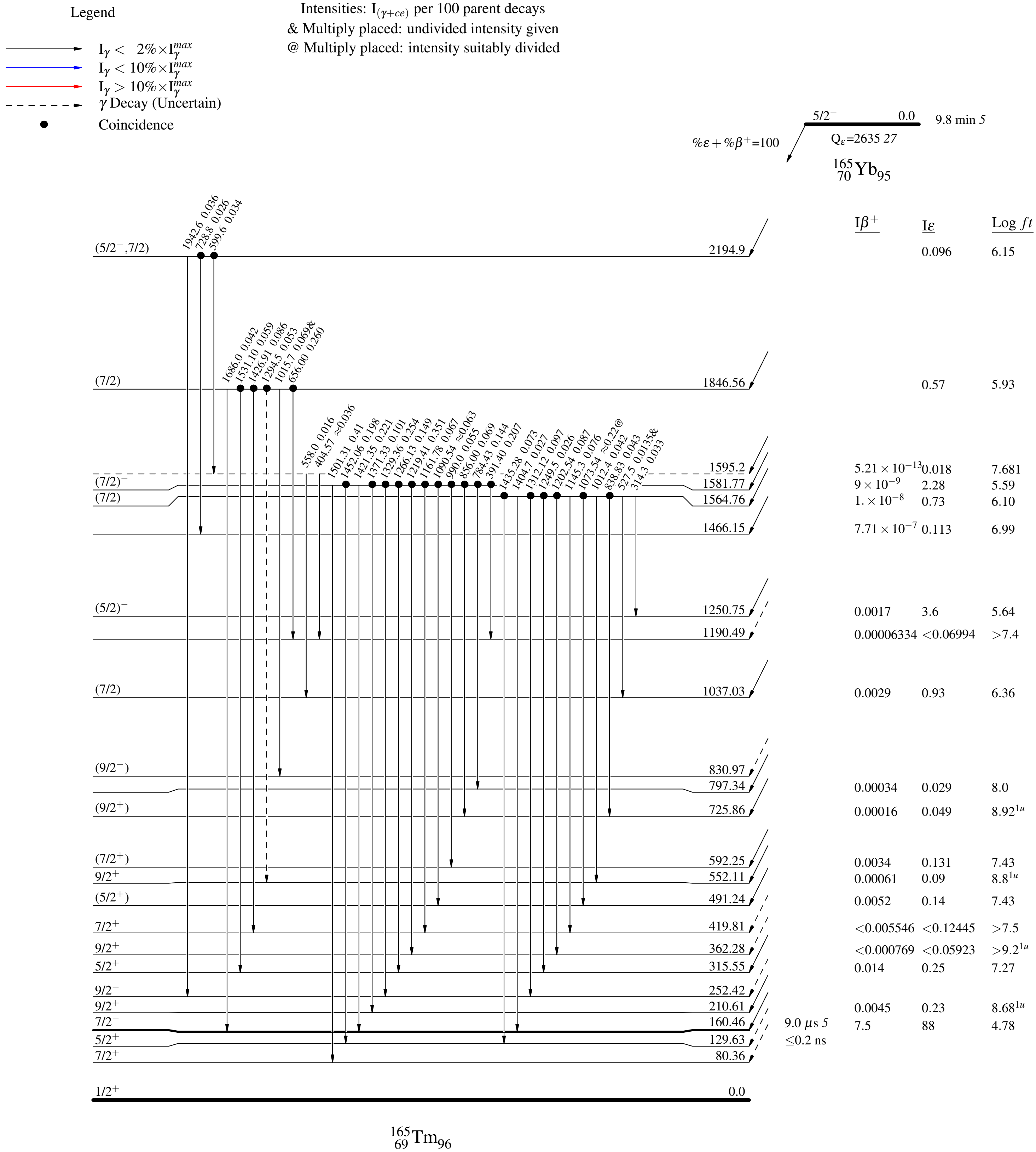
E_γ[‡]	I_γ[‡c]	E_i(level)	J^π_i	E_f	J^π_f
1452.06 *11*	2.20 *15*	1581.77	(7/2)$^-$	129.63	5/2$^+$
1501.31 *8*	4.5 *3*	1581.77	(7/2)$^-$	80.36	7/2$^+$
1531.10 *17*	0.65 *7*	1846.56	(7/2)	315.55	5/2$^+$
1686.0 *4*	0.47 *8*	1846.56	(7/2)	160.46	7/2$^-$
[x]1709.0[&] *4*	0.28 *6*				
[x]1726.1 *4*	0.32 *6*				
[x]1784.8 *5*	0.29 *7*				
[x]1788.9 *5*	0.37 *7*				
[x]1802.8 *8*	0.20 *5*				
[x]1827.0 *15*	0.15 *7*				
[x]1881.0 *10*	0.15 *6*				
[x]1916.5 *10*	0.25 *10*				
1942.6 *10*	0.40 *6*	2194.9	(5/2$^-$,7/2)	252.42	9/2$^-$
[x]1957.4 *10*	0.44 *6*				
[x]1978.0 *15*	0.20 *8*				
[x]2204.5 *15*	0.20 *8*				

[†] Additional information 2.
[‡] From 1978Ad06.
[#] Assignment to ^{165}Yb decay is uncertain.
[@] Placement from 1985Ad12.
[&] Placement proposed by 1978Ad06 is excluded by 1985Ad12.
[a] 1090.28+1090.54 are unresolved.
[b] From ce data. The α(K)exp were normalized to α(K)(68.86γ)=1.89 for E2. Electron intensities given by 1978Ad06 for 21 transitions are normalized to γ-ray intensities and assuming that 68.86γ is pure E2 from L-subshell ratios measured by 1978Ad06.
[c] For absolute intensity per 100 decays, multiply by 0.090 *5*.
[d] Multiply placed with undivided intensity.
[e] Multiply placed with intensity suitably divided.
[f] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

$^{165}_{69}$Tm$_{96}$-10

^{165}Yb ε decay (9.8 min) 1978Ad06,1973Ta18

Decay Scheme

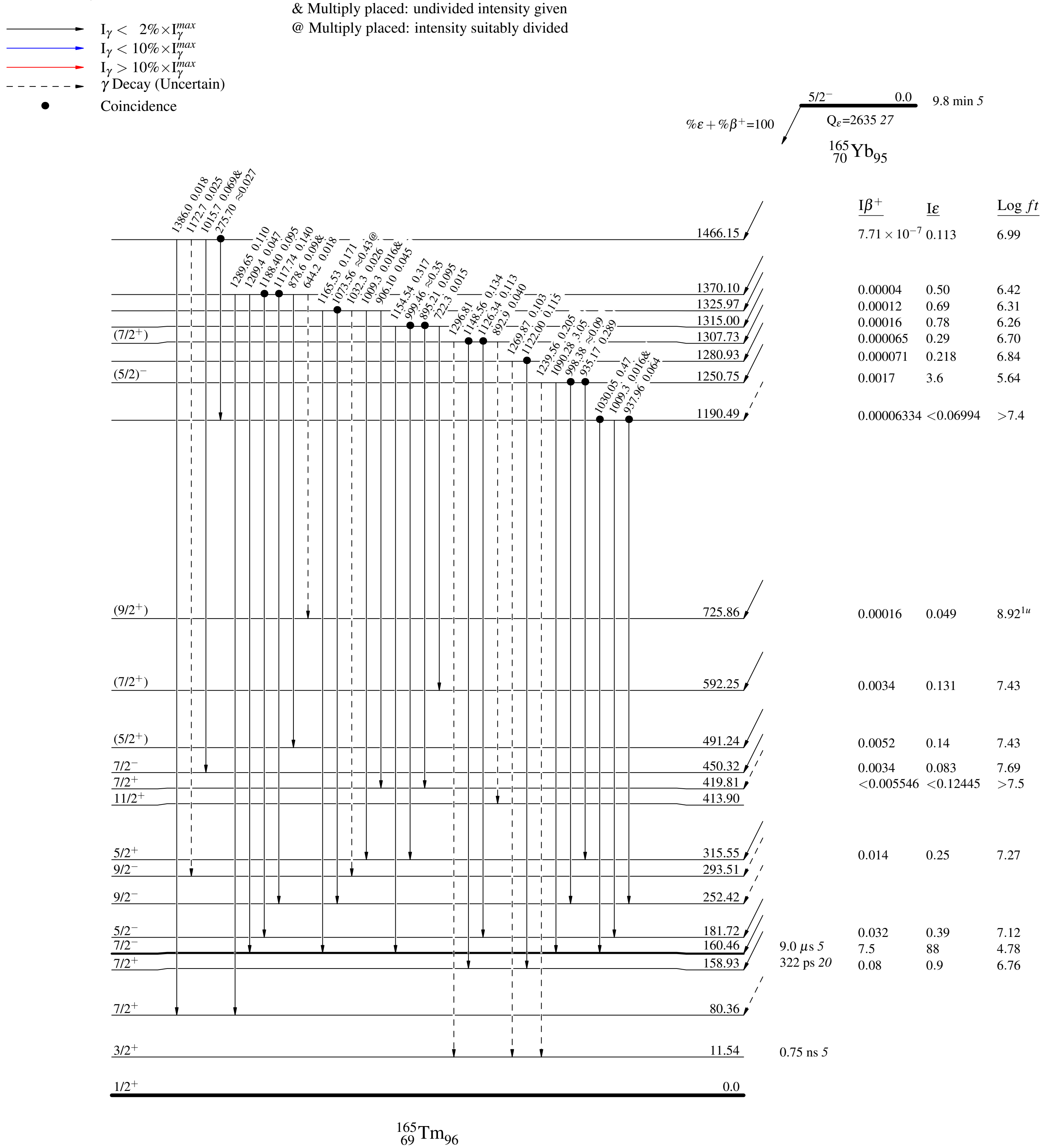


^{165}Yb ε decay (9.8 min) 1978Ad06,1973Ta18

Decay Scheme (continued)

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

Legend

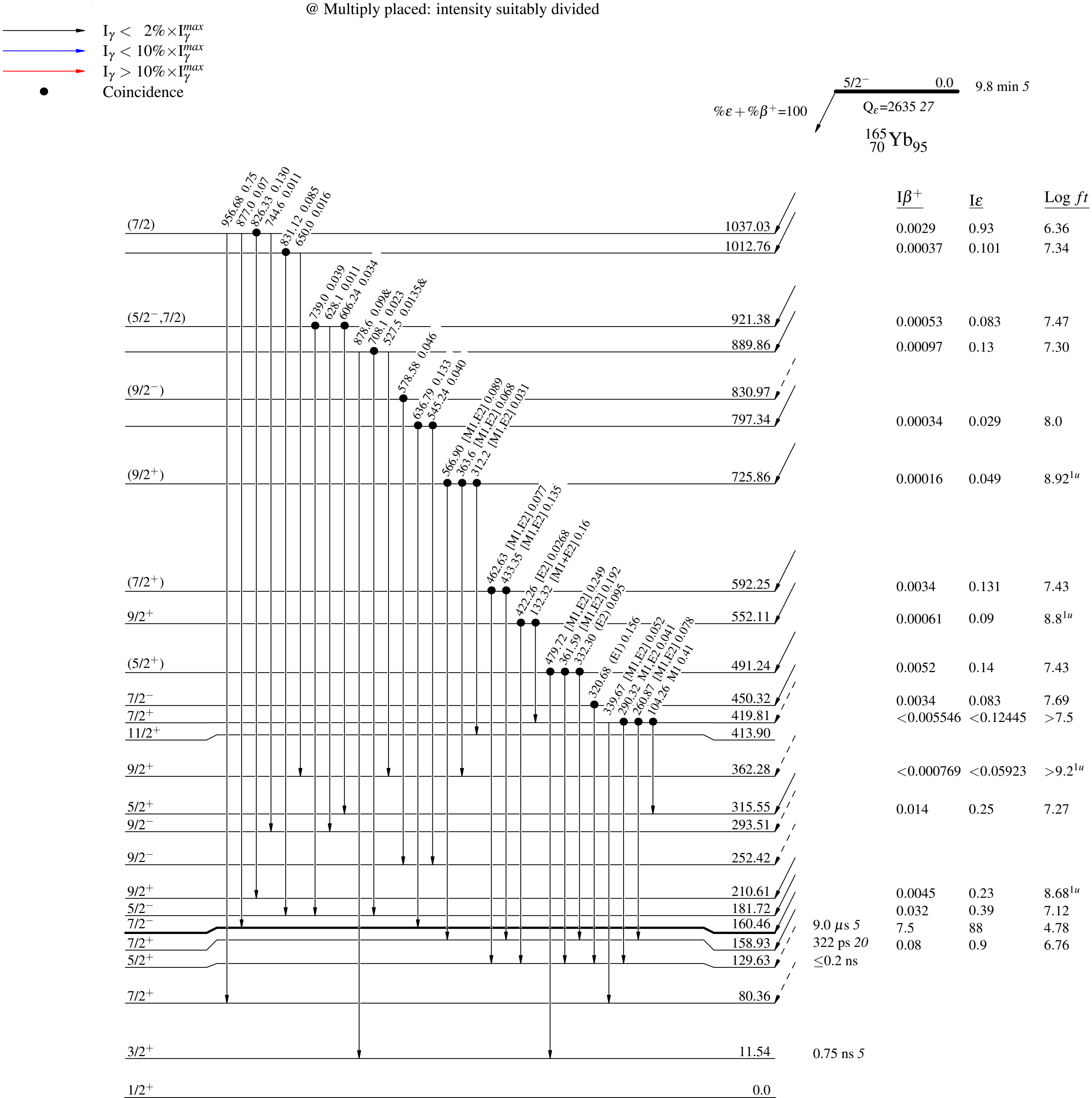


^{165}Yb ε decay (9.8 min) 1978Ad06,1973Ta18

Decay Scheme (continued)

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

Legend



^{165}Yb ε decay (9.8 min) 1978Ad06,1973Ta18

Decay Scheme (continued)

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