^{172}Tm β^- decay (63.6 h) 1974Re07,1967Ot03,1968Wi22

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 75,199 (1995)	31-May-1995

Parent: ^{172}Tm: E=0.0; J$^\pi$=2$^-$; $T_{1/2}$=63.6 h *3*; Q(β^-)=1880 *6*; %β^- decay=100.0

Source obtained from chemical separation of ^{172}Tm activity from ^{172}Er β^- decay. ^{172}Er produced by double-neutron capture in enriched ^{170}Er.

1974Re07: measured G.

1967Ot03: measured $T_{1/2}$, γ, $\gamma\gamma$.

1968Wi22: measured γ, $\gamma\gamma$, ce, β, $\beta\gamma$, βce.

1966Ha15: measured β, $\beta\gamma$, $\beta\gamma(\theta)$ (shape factors).

Earlier measurements:

γ: 1961Or01, 1961He11, 1961Ha42, 1961Ku10, 1956Ne08.

$\gamma\gamma$: 1961Or01, 1961He11, 1961Ha42.

β: 1963Ku22, 1961Or01, 1961He11, 1961Ha42, 1960Vo08, 1956Ne08.

$\beta\gamma$: 1961Ha42, 1961Or01, 1961He11.

$\gamma\gamma(\theta)$: 1973HoYJ and 1972WuZZ (thesis).

$\gamma\gamma(\theta$,H,t): 1970Wa25, 1970He17, 1969Fo07.

$T_{1/2}$ and isotopic identification: 1963Ku22, 1961Or01, 1961Ha42, 1961Ku10, 1961He11, 1960Vo08, 1956Ne08.

Systematics of β decay: 1979Mi17.

^{172}Yb Levels

The 1376, 1750, and 1807 levels proposed by 1967Ot03 are omitted since the γ rays connecting these levels are not reported in other studies.

E(level)[d]	J$^\pi$[e]	$T_{1/2}$	Comments
0.0[†]	0$^+$		
78.750[†] *7*	2$^+$	1.61 ns *3*	$T_{1/2}$: $\gamma\gamma$(t) (1970He17). Other: 1.60 ns *11* (1969Fo07). g factor=0.335 *10* (1970He17). Method: $\gamma\gamma(\theta$,H).
260.269[†] *11*	4$^+$		
539.67[†] *7*	6$^+$		
1042.84[#] *4*	0$^+$		
1117.80[#] *3*	2$^+$		
1154.91[‡] *3*	1$^-$		
1172.322[b] *15*	3$^+$	7.95 ns *9*	Q(1172 level)/Q(79 level)=1.55 *23* (1969Fo07), 1.33 *14* (1970Wa25). Method: $\gamma\gamma(\theta$,t). $T_{1/2}$: $\gamma\gamma$(t) (1970He17).
1198.51[‡] *9*	2$^-$		
1262.94[b] *3*	4$^+$		
1286.4[#] *3*	4$^+$		
1465.849[&] *8*	2$^+$		
1476.62[@] *3*	2$^+$		
1549.06[&] *5*	3$^+$		
1608.417[a] *15*	2$^+$		
1662.740[c] *20*	3$^+$		
1700.57[a] *4*	3$^+$		

[†] Band(A): g.s. band.

[‡] Band(B): K$^\pi$=1$^-$ octupole band.

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^{172}Tm β^- decay (63.6 h) 1974Re07,1967Ot03,1968Wi22 (continued)

^{172}Yb Levels (continued)

[#] Band(C): $K^\pi=0^+$ band.
[@] Band(D): $K^\pi=0^+$ band.
[&] Band(E): $K^\pi=2^+$ γ-band.
[a] Band(F): $K^\pi=2^+$ band.
[b] Band(G): $K^\pi=3^+$ band.
[c] Band(H): $K^\pi=3^+$ band.
[d] From least-squares fit to Eγ's.
[e] From Adopted Levels.

β^- radiations

E(decay)[†]	E(level)	Iβ^-[‡]	Log *ft*	Comments
(179 *6*)	1700.57	0.220 *18*	7.38 *6*	av Eβ=48.4 *18*
(217 *6*)	1662.740	1.30 *10*	6.87 *5*	av Eβ=59.5 *18*
(272 *6*)	1608.417	10.0 *8*	6.29 *5*	av Eβ=75.9 *19*
(331 *6*)	1549.06	2.40 *19*	7.19 *5*	av Eβ=94.4 *20*
(403 *6*)	1476.62	1.11 *9*	7.80 *5*	av Eβ=117.8 *20*
(414 *6*)	1465.849	10.1 *8*	6.88 *4*	av Eβ=121.3 *20*
(594 *6*)	1286.4	0.008 *4*	10.66^{1u} *22*	av Eβ=194.7 *21*
(617 *6*)	1262.94	0.027 *14*	10.22^{1u} *23*	av Eβ=202.8 *21*
(681 *6*)	1198.51	0.244 *22*	9.23 *5*	av Eβ=214.6 *22*
(708 *6*)	1172.322	6.6 *6*	7.85 *5*	av Eβ=224.2 *22*
(725 *6*)	1154.91	0.96 *8*	8.73 *4*	av Eβ=230.6 *23*
(762 *6*)	1117.80	0.291 *24*	9.32 *4*	av Eβ=244.4 *23*
(837 *6*)	1042.84	0.29 *3*	9.86^{1u} *5*	av Eβ=281.0 *22*
1610 *10*	260.269	1.2 *2*	10.79^{1u} *8*	av Eβ=583.9 *25* The 1610β has a first-forbidden unique shape (1966Ha15). Iβ^-: 0.91 *9* (1966Ha15). Others: 1961He11, 1961Ha42.
1790 *10*	78.750	36 *4*	8.60 *5*	av Eβ=668 *3* Shape of 1790β is similar to that for a first-forbidden unique transition (1966Ha15). From (1790β)(79γ)(θ) (1966Ha15), 2^- to 2^+ β^-transition is deduced as pure L=2 (ΔK=2) transition. log $f^{1u}t$ for 1790β would be 9.57 *5*. Iβ^-: 36 *4* (1966Ha15). Others: 1961He11, 1961Ha42.
1870 *10*	0.0	29 *4*	9.77^{1u} *6*	av Eβ=691.0 *25* The 1870β has a first-forbidden unique shape (1966Ha15). Iβ^-: from 1966Ha15. Others: 24 *8* (1961He11), 1961Or01, 1961Ha42. E(decay): others: 1963Ku22, 1961Or01, 1961He11, 1961Ha42, 1960Vo08.

[†] From 1966Ha15. Others: 1963Ku22, 1961Or01, 1961He11, 1961Ha42, 1960Vo08.
[‡] Absolute intensity per 100 decays.

γ(^{172}Yb)

Iγ normalization: Σ (I(γ+ce) of γ's to g.s.)=71 *4*. Iβ(g.s.)=29 *4* (1966Ha15).

The following γ rays with Eγ(Iγ) reported by 1967Ot03 are omitted since these seem to belong to background radiation: 133.6 ($\approx$0.1), 238.5 ($\approx$0.2), 351.8 ($\approx$0.2), 1461.0 (3.9), 1592.7 (1.4).

The following γ rays with Eγ(Iγ) reported by 1967Ot03 are omitted since these are not confirmed in later studies (1968Wi22,1974Re07): 112.8 ($\approx$0.1), 145.0 ($\approx$0.2), 203.6 ($\approx$0.1), 374.1 ($\approx$0.1), 542.0 ($\approx$0.1), 1116.0 ($\approx$1), 1184.0 ($\approx$1), 1491.0 ($\approx$0.5), 1545.0 ($\approx$0.5). None of these γ rays is observed by 1968Wi22. The following upper limits are quoted, respectively: 0.15, 0.2, 0.3, 0.2, 0.1, 1.0, 1.0, 0.1, 0.1.

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^{172}Tm β^- decay (63.6 h) 1974Re07,1967Ot03,1968Wi22 (continued)

$\gamma(^{172}Yb)$ (continued)

E_γ[†]	I_γ[†#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[@]	Comments
78.750 *7*	109 *8*	78.750	2+	0.0	0+	E2		8.4	α(K)= 1.573; α(L)= 5.17; α(M)= 1.271; α(N+..)= 0.350
90.605 *25*	0.40 *3*	1262.94	4+	1172.322	3+	E2+M1	−1.64 *2*	4.7	
131.83 *4*	0.17 *2*	1608.417	2+	1476.62	2+	[M1,E2]		1.4 *2*	
142.56 *2*	1.69 *8*	1608.417	2+	1465.849	2+	[M1,E2]		1.1 *2*	
181.520 *9*	45.9 *24*	260.269	4+	78.750	2+	E2		0.376	α(K)= 0.2192; α(L)= 0.1202; α(M)= 0.0290; α(N+..)=0.00790
186.11 *20*	0.036 *12*	1662.740	3+	1476.62	2+	[M1,E2]		0.5 *1*	
197.02 *6*	0.10 *1*	1662.740	3+	1465.849	2+	[M1,E2]		0.4 *1*	
267.14 *20*	0.036 *12*	1465.849	2+	1198.51	2−	[E1]		0.027	
279.40 *7*	0.08 *2*	539.67	6+	260.269	4+	E2		0.093	α(K)=0.0646; α(L)=0.02142; α(M)=0.00508; α(N+..)=0.00146
286.30 *20*	0.105 *20*	1549.06	3+	1262.94	4+	(M1)		0.183	α(K)=0.1534; α(L)=0.02300
293.61 *6*	0.19 *2*	1465.849	2+	1172.322	3+	[M1,E2]		0.09 *3*	
321.70 *11*	0.06 *1*	1476.62	2+	1154.91	1−	E1		0.017	α(K)=0.01414; α(L)=0.00208
348.04 *6*	0.28 *2*	1465.849	2+	1117.80	2+	[M1,E2]		0.08 *3*	
358.86 *6*	0.16 *2*	1476.62	2+	1117.80	2+	(E2)		0.044	α(K)=0.0327; α(L)=0.00868
399.74 *4*	1.98 *12*	1662.740	3+	1262.94	4+	M1(+E2)	−0.07 *7*	0.075	
423.04 *6*	0.26 *2*	1465.849	2+	1042.84	0+	[E2]		0.028	
431.29 *8*	0.10 *1*	1549.06	3+	1117.80	2+	(M1)		0.062	α(K)=0.0517; α(L)=0.00768
436.102 *16*	4.12 *15*	1608.417	2+	1172.322	3+	[M1,E2]		0.04 *2*	
490.422 *16*	6.9 *4*	1662.740	3+	1172.322	3+	M1(+E2)	+0.04 *4*	0.044	
528.26 *4*	2.10 *12*	1700.57	3+	1172.322	3+	M1(+E2)	+0.01 *3*	0.037	α(K)=0.0306; α(L)=0.00451
544.82 *20*	0.093 *20*	1662.740	3+	1117.80	2+	[M1,E2]		0.025 *10*	
565.56 *5*	0.69 *4*	1608.417	2+	1042.84	0+	[E2]		0.013	α(K)=0.01056; α(L)=0.00207
(723.0)	0.03	1262.94	4+	539.67	6+				E_γ,I_γ: from adopted gammas.
(747.0)	0.04	1286.4	4+	539.67	6+				E_γ,I_γ: rounded off values from adopted gammas.
857.54 *4*	2.29 *13*	1117.80	2+	260.269	4+				
912.064 *22*	23.6 *7*	1172.322	3+	260.269	4+	D+Q	−2.7 *7*		ce(K)(912γ)/ce(K)(1094)=34 *9* (1968Wi22). δ: from (912γ)(79γ)(θ): A_2=0.27 *5*, A_4=−0.07 *6* (1972WuZZ,1973HoYJ). δ=−0.60 +*9*−*15* is also possible from γγ(θ). δ=−2.36 *15* from adopted gammas.
964.11 *6*	5.7 *3*	1042.84	0+	78.750	2+				(964γ)(79γ)(θ): A_2=0.12 *12*, A_4=1.22 *24* (1972WuZZ,1973HoYJ).
1002.67 *10*	0.37 *5*	1262.94	4+	260.269	4+				
1026.15 *25*	0.09 *4*	1286.4	4+	260.269	4+				
1039.06 *7*	2.30 *12*	1117.80	2+	78.750	2+				ce(K)(1039γ)/ce(K)(1094)=10 *6* (1968Wi22).
1076.15 *3*	13.2 *7*	1154.91	1−	78.750	2+	D			ce(K)(1076γ)/ce(K)(1094)≤7 (1968Wi22). Mult.: (1076γ)(79γ)(θ): A_2=−0.22 *7*, A_4=−0.09 *12* (1972WuZZ,1973HoYJ) give δ(Q/D)=−0.02 *6*. Mult=E1 from adopted gammas.
1093.59 *3*	100 *5*	1172.322	3+	78.750	2+	D+Q	−2.7 *6*		δ: from (1094γ)(79γ)(θ): A_2=−0.44 *4*, A_4=−0.022 *23* (1972WuZZ, 1973HoYJ).

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^{172}Tm β^- decay (63.6 h) 1974Re07,1967Ot03,1968Wi22 (continued)

γ(^{172}Yb) (continued)

E_γ[†]	I_γ[†#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	Comments
								δ=−0.58 +7−12 is also possible from $\gamma\gamma(\theta)$. A_2=−0.28 (1970He17). Mult=M1+E2, δ=−4.0 3 from adopted gammas.
1117.93 15	0.86 12	1117.80	2+	0.0	0+			
1119.72 9	4.08 24	1198.51	2−	78.750	2+			
1154.91 8	2.73 16	1154.91	1−	0.0	0+			
1205.60 8	2.59 11	1465.849	2+	260.269	4+			
1216.35 11	0.58 8	1476.62	2+	260.269	4+			α(K)=0.0021
1288.76 6	8.4 4	1549.06	3+	260.269	4+	D,Q		δ: −0.40 +18−28 or −5 +3−34 from (1289γ)(79γ)(θ): A_2=0.17 13, A_4=0.01 18 (1972WuZZ). Mult=M1+E2, δ=2.8 +7−10 from adopted gammas.
1348.13 7	2.91 15	1608.417	2+	260.269	4+			
1387.093 4	93 5	1465.849	2+	78.750	2+	D+Q	−5.0 5	δ: (1387γ)(79γ)(θ): A_2=0.076 14, A_4=0.36 10 (1972WuZZ). δ=−5.1 +11−16 from adopted gammas.
1397.87 6	13.1 6	1476.62	2+	78.750	2+	D+Q		δ: +0.69 +15−11 or +5 +4−2 from (1398γ)(79γ)(θ): A_2=−0.20 5, A_4=0.20 9 (1972WuZZ). Mult=M1+E2(+E0), δ(E2/M1)=0.8 5 from adopted gammas.
1402.46 9	2.35 15	1662.740	3+	260.269	4+			
1440.26 13	0.27 3	1700.57	3+	260.269	4+			
1465.86 4	75 4	1465.849	2+	0.0	0+			
1470.28 10	31.1 14	1549.06	3+	78.750	2+	D+Q		δ: −7.2 +17−28 or −0.32 4 from (1470γ)(79γ)(θ): A_2=−0.31 3, A_4=−0.07 4 (1972WuZZ). Mult=M1+E2, δ=−7.6 +19−36 from adopted gammas.
1476.64 10	4.9 2	1476.62	2+	0.0	0+			
1529.64 4	85 5	1608.417	2+	78.750	2+	Q+D	+10 3	δ: (1530γ)(79γ)(θ): A_2=−0.146 14, A_4=0.36 3 (1972WuZZ). Mult=E2+M1(+E0) from adopted gammas.
1583.91 6	9.6 5	1662.740	3+	78.750	2+	D,Q		δ: >10 or −0.20 6 from (1584γ)(79γ)(θ): A_2=−0.23 4, A_4=−0.10 7 (1972WuZZ). Mult=E2(+M1), δ=+55 +94−22 from adopted gammas.
1608.37 6	69 4	1608.417	2+	0.0	0+			
1621.73 11	1.20 8	1700.57	3+	78.750	2+			

† From 1974Re07.

‡ From adopted gammas for γ rays below 600 where internal conversion is significant (>1%). For γ rays above 600, values are from $\gamma\gamma(\theta)$ data (1973HoYJ,1972WuZZ).

\# For absolute intensity per 100 decays, multiply by 0.060 5.

@ 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.

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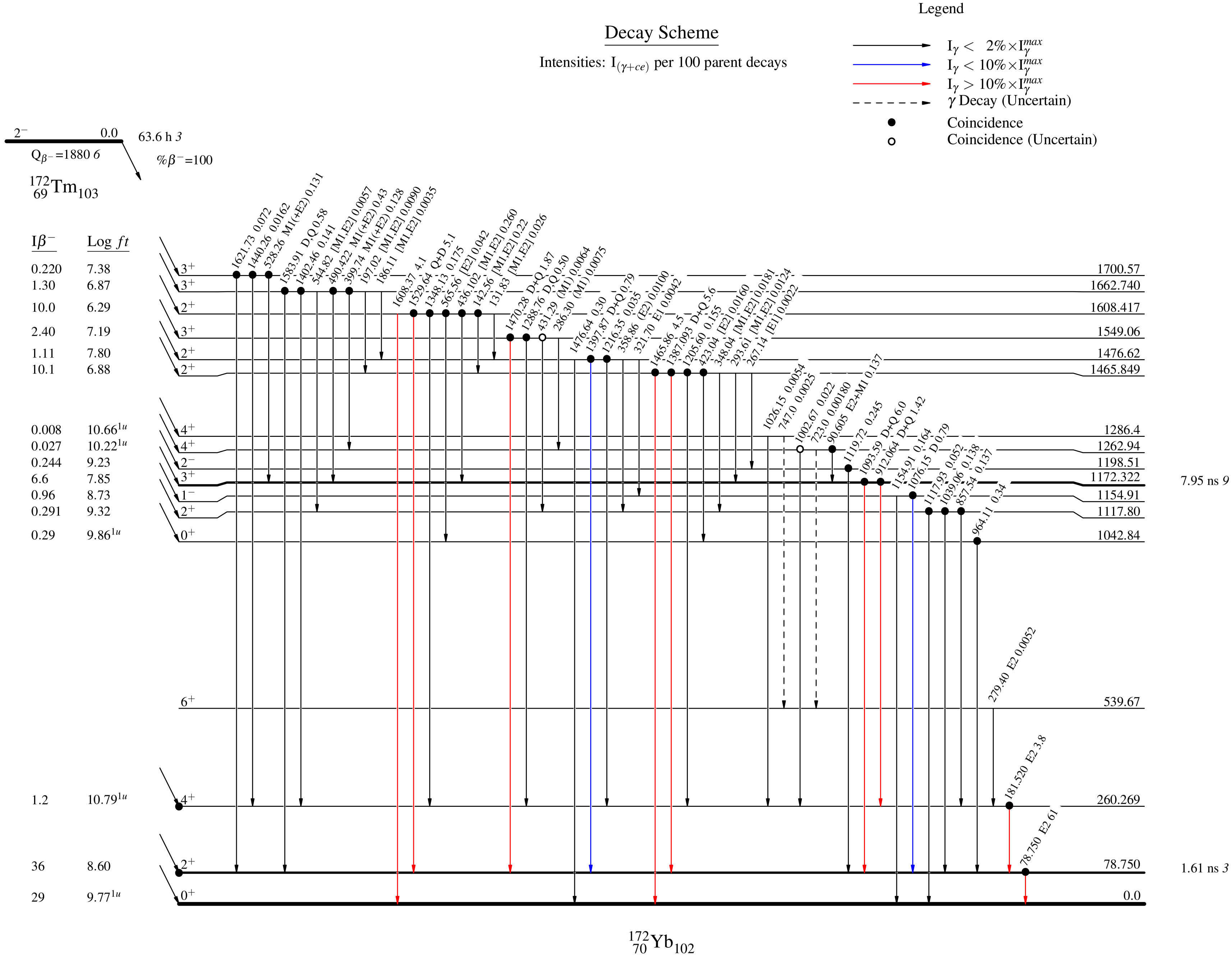

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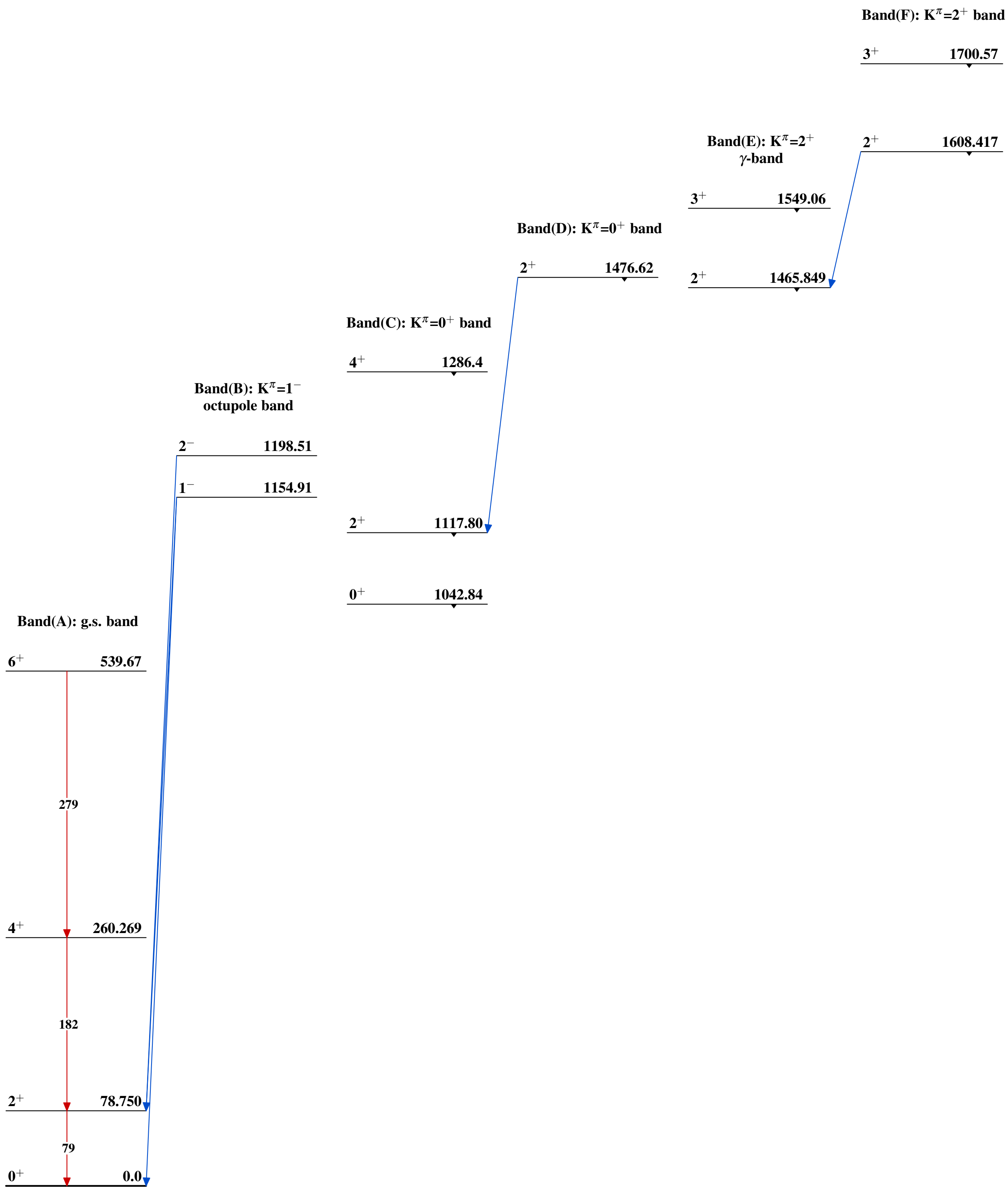

$^{172}_{70}Yb_{102}$

^{172}Tm β^- decay (63.6 h) 1974Re07,1967Ot03,1968Wi22 (continued)