^{152}Tb ε decay (4.2 min) 1980Zo02

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. J. Martin	NDS 114, 1497 (2013)	31-Aug-2013

Parent: ^{152}Tb: E=501.74 *19*; $J^{\pi}=8^{+}$; $T_{1/2}$=4.2 min *1*; Q(ε)=3990 *40*; %ε+%$β^{+}$ decay=21.1 *6*
$J^{\pi}(^{152}Tb\ (4.2\ min))=8^{+}$.

^{152}Gd Levels

1980Zo02, 1971Bo12: measured: γ, ce, γγ.
1974Zo01: measured ce.
The decay scheme is that proposed by 1971Bo12 with additions by 1980Zo02.

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
0.0	0^{+}	1123.2 *3*	3^{-}	1668.06 *15*	6^{+}	2138.7 *3*	8^{+}
344.27 *7*	2^{+}	1227.28 *14*	6^{+}	1746.69 *16*	8^{+}	2173.33 *21*	6^{-}
615.27 *23*	0^{+}	1282.17 *14*	4^{+}	1807.6 *5*		2301.72 *19*	7^{+}
755.38 *11*	4^{+}	1433.95 *16*	3^{+}	1861.51 *14*	5^{+}	2394.11 *14*	7^{+}
930.47 *14*	2^{+}	1470.47 *20*	5^{-}	1880.2 *4*	7^{-}		
1109.0? *3*	2^{+}	1549.98 *21*	4^{+}	1997.79 *20*	6^{+}		

† From 1980Zo02.
‡ From Adopted Levels.

ε,$β^{+}$ radiations

E(decay)	E(level)	Iβ+ ‡	Iε‡	Log *ft*	I(ε+β+)†‡	Comments
(2.10×10^{3} *4*)	2394.11	0.84 *12*	17.0 *12*	4.75 *5*	17.8 *13*	av Eβ=491 *18*; εK=0.798 *5*; εL=0.1197 *9*; εM+=0.03472 *25*
(2.19×10^{3} *4*)	2301.72	<0.008	<0.2	>6.7	<0.2	av Eβ=532 *18*; εK=0.786 *6*; εL=0.1178 *10*; εM+=0.0341 *3*
(2.32×10^{3} *4*)	2173.33	<0.002	<0.09	>8.4[1u]	<0.09	av Eβ=604 *18*; εK=0.8129 *22*; εL=0.1265 *6*; εM+=0.03688 *16*
(2.35×10^{3} *4*)	2138.7	<0.03	<0.3	>6.6	<0.3	av Eβ=604 *18*; εK=0.761 *8*; εL=0.1136 *12*; εM+=0.0329 *4*
(2.61×10^{3} *4*)	1880.2	0.052 *7*	0.29 *3*	6.71 *6*	0.34 *4*	av Eβ=656 *7*; εK=0.739 *3*; εL=0.1102 *5*; εM+=0.03191 *14*
(2.75×10^{3} *4*)	1746.69	<0.2	<0.7	>6.4	<0.9	av Eβ=778 *18*; εK=0.679 *10*; εL=0.1009 *15*; εM+=0.0292 *5*

† Deduced from level scheme with ΣI(γ+ce)(g.s.)=100%. There are some intensity imbalances at some low-spin levels, indicating perhaps, that there are some missing low energy gammas in this decay scheme.
‡ Absolute intensity per 100 decays.

^{152}Tb ε decay (4.2 min) 1980Zo02 (continued)

γ(^{152}Gd)

Iγ normalization: From ΣI(γ+ce)(g.s.)=100%.

E_γ[†]	I_γ[†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[a]	Comments
92.4 *2*	4.9 *5*	2394.11	7^+	2301.72	7^+	[M1,E2]	2.9 *5*	α(K)=1.8 *4*; α(L)=0.9 *6*; α(M)=0.21 *15*; α(N+..)=0.05 *4* α(N)=0.05 *4*; α(O)=0.006 *4*; α(P)=0.00011 *5*
197.4 *3*	4.9 *4*	1668.06	6^+	1470.47	5^-	[E1]	0.0470	α(K)=0.0398 *6*; α(L)=0.00565 *9*; α(M)=0.001220 *18*; α(N+..)=0.000322 *5* α(N)=0.000278 *4*; α(O)=4.18×10^{-5} *6*; α(P)=2.43×10^{-6} *4*
220.7 *3*	7.3 *6*	2394.11	7^+	2173.33	6^-	[E1]	0.0350	α(K)=0.0297 *5*; α(L)=0.00418 *6*; α(M)=0.000904 *13*; α(N+..)=0.000239 *4* α(N)=0.000206 *3*; α(O)=3.11×10^{-5} *5*; α(P)=1.84×10^{-6} *3*
255.4 *3*	6.1 *5*	2394.11	7^+	2138.7	8^+	M1,E2	0.123 *24*	α(K)=0.10 *3*; α(L)=0.0189 *13*; α(M)=0.0042 *4*; α(N+..)=0.00110 *8* α(N)=0.00096 *8*; α(O)=0.000141 *5*; α(P)=6.9×10^{-6} *24* Mult.: α(K)exp=0.096 *24*.
271.0 *3*	1.3 *8*	615.27	0^+	344.27	2^+	E2	0.0827	α(K)=0.0621 *9*; α(L)=0.01603 *24*; α(M)=0.00365 *6*; α(N+..)=0.000944 *14* α(N)=0.000824 *12*; α(O)=0.0001160 *17*; α(P)=3.81×10^{-6} *6*
303.7[@] *4*	1.0 *5*	2301.72	7^+	1997.79	6^+	[M1,E2]	0.075 *18*	α(K)=0.061 *17*; α(L)=0.0108 *3*; α(M)=0.00240 *4*; α(N+..)=0.000632 *15* α(N)=0.000547 *10*; α(O)=8.1×10^{-5} *5*; α(P)=4.3×10^{-6} *15*
311.4[@] *4*	1.3 *5*	1861.51	5^+	1549.98	4^+	[M1,E2]	0.070 *17*	α(K)=0.057 *16*; α(L)=0.0100 *4*; α(M)=0.00221 *5*; α(N+..)=0.000585 *20* α(N)=0.000505 *14*; α(O)=7.5×10^{-5} *5*; α(P)=4.0×10^{-6} *14*
315.2 *3*	2.3 *5*	930.47	2^+	615.27	0^+	(E2)	0.0518	α(K)=0.0399 *6*; α(L)=0.00924 *14*; α(M)=0.00209 *3*; α(N+..)=0.000543 *8* α(N)=0.000473 *7*; α(O)=6.74×10^{-5} *10*; α(P)=2.52×10^{-6} *4*
344.26 *7*	336 *17*	344.27	2^+	0.0	0^+	E2	0.0397	α(K)=0.0310 *5*; α(L)=0.00678 *10*; α(M)=0.001527 *22*; α(N+..)=0.000398 *6* α(N)=0.000346 *5*; α(O)=4.97×10^{-5} *7*; α(P)=1.99×10^{-6} *3* E_γ: from 1971Bo12.
351.7 *1*	30.5 *20*	1282.17	4^+	930.47	2^+	E2	0.0373	α(K)=0.0292 *4*; α(L)=0.00630 *9*; α(M)=0.001418 *20*; α(N+..)=0.000369 *6* α(N)=0.000321 *5*; α(O)=4.63×10^{-5} *7*; α(P)=1.88×10^{-6} *3* Mult.: α(K)exp=0.031 *4*. δ: δ>1.8 from α(K)exp.
385.9 *1*	55 *3*	1668.06	6^+	1282.17	4^+	E2	0.0285	α(K)=0.0226 *4*; α(L)=0.00461 *7*; α(M)=0.001033 *15*; α(N+..)=0.000270 *4* α(N)=0.000234 *4*; α(O)=3.40×10^{-5} *5*; α(P)=1.468×10^{-6} *21* Mult.: α(K)exp=0.031 *12*.
396.4 *3*	2.2 *5*	2394.11	7^+	1997.79	6^+	[M1,E2]	0.036 *10*	α(K)=0.030 *9*; α(L)=0.0048 *7*; α(M)=0.00106 *12*; α(N+..)=0.00028 *4*

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^{152}Tb ε decay (4.2 min) 1980Zo02 (continued)

γ(^{152}Gd) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[a]	Comments
								α(N)=0.00024 *3*; α(O)=3.7×10^{-5} *6*; α(P)=2.1×10^{-6} *8*
411.1 *1*	304 *15*	755.38	4$^+$	344.27	2$^+$	E2	0.0238	α(K)=0.0190 *3*; α(L)=0.00374 *6*; α(M)=0.000837 *12*; α(N+..)=0.000219 *3* α(N)=0.000190 *3*; α(O)=2.77×10^{-5} *4*; α(P)=1.246×10^{-6} *18* Mult.: α(K)exp=0.0204 *15*.
427.6 *2*	15.6 *9*	1861.51	5$^+$	1433.95	3$^+$	E2	0.0213	α(K)=0.01708 *24*; α(L)=0.00330 *5*; α(M)=0.000736 *11*; α(N+..)=0.000193 *3* α(N)=0.0001674 *24*; α(O)=2.45×10^{-5} *4*; α(P)=1.126×10^{-6} *16* Mult.: α(K)exp=0.017 *8* gives mult=E2(+M1) with δ>0.9.
440.2[‡]	6[‡] *3*	2301.72	7$^+$	1861.51	5$^+$	[E2]	0.0197	α(K)=0.01580 *23*; α(L)=0.00301 *5*; α(M)=0.000671 *10*; α(N+..)=0.0001760 *25* α(N)=0.0001526 *22*; α(O)=2.24×10^{-5} *4*; α(P)=1.046×10^{-6} *15*
440.8[‡]	6.7[‡] *25*	1668.06	6$^+$	1227.28	6$^+$	(M1+E2)	0.027 *8*	α(K)=0.023 *7*; α(L)=0.0036 *6*; α(M)=0.00078 *12*; α(N+..)=0.00021 *4* α(N)=0.00018 *3*; α(O)=2.7×10^{-5} *5*; α(P)=1.6×10^{-6} *6*
441.2 *5*	3 *2*	1549.98	4$^+$	1109.0?	2$^+$	[E2]	0.0195	α(K)=0.01571 *23*; α(L)=0.00299 *5*; α(M)=0.000666 *10*; α(N+..)=0.000175 *3* α(N)=0.0001515 *22*; α(O)=2.22×10^{-5} *4*; α(P)=1.040×10^{-6} *15* Eγ: Assignment considered tentative by the authors, but it is confirmed in 17.5-h Tb ε decay, with Iγ/Iγ(794γ)=0.261 *10*, and thus an expected Iγ of 0.81 *13*. In 13-y Eu β$^-$ decay, this ratio is 0.50 *7* which leads to an expected Iγ of 1.6 *4*.
447.7 *4*	1.6 *4*	1997.79	6$^+$	1549.98	4$^+$	[E2]	0.0188	α(K)=0.01511 *22*; α(L)=0.00285 *4*; α(M)=0.000636 *9*; α(N+..)=0.0001668 *24* α(N)=0.0001446 *21*; α(O)=2.12×10^{-5} *3*; α(P)=1.002×10^{-6} *15*
470.7 *5*	8 *3*	2138.7	8$^+$	1668.06	6$^+$	E2	0.01638	α(K)=0.01326 *19*; α(L)=0.00244 *4*; α(M)=0.000543 *8*; α(N+..)=0.0001428 *21* α(N)=0.0001237 *18*; α(O)=1.82×10^{-5} *3*; α(P)=8.84×10^{-7} *13*
471.9 *1*	198 *10*	1227.28	6$^+$	755.38	4$^+$	E2	0.01627	α(K)=0.01317 *19*; α(L)=0.00242 *4*; α(M)=0.000539 *8*; α(N+..)=0.0001416 *20* α(N)=0.0001227 *18*; α(O)=1.81×10^{-5} *3*; α(P)=8.78×10^{-7} *13* Mult.: α(K)exp=0.0145 *12* gives mult=E2(+M1) with δ>1.9.
519.4 *1*	79 *6*	1746.69	8$^+$	1227.28	6$^+$	E2	0.01263	α(K)=0.01030 *15*; α(L)=0.00182 *3*; α(M)=0.000403 *6*; α(N+..)=0.0001061 *15* α(N)=9.18×10^{-5} *13*; α(O)=1.360×10^{-5} *19*; α(P)=6.93×10^{-7} *10* Mult.: α(K)exp=0.0114 *18* gives mult=E2(+M1) with δ>2.3.
526.8 *2*	27.5 *20*	1282.17	4$^+$	755.38	4$^+$	M1+E2+E0	0.094 *8*	Mult.: α(K)exp=0.076 *9*. α: from adopted gammas.
532.6 *1*	72 *4*	2394.11	7$^+$	1861.51	5$^+$	E2	0.01184	α(K)=0.00967 *14*; α(L)=0.001689 *24*;

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^{152}Tb ε decay (4.2 min) 1980Zo02 (continued)

γ(^{152}Gd) (continued)

E_γ[†]	I_γ[†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[a]	Comments
									α(M)=0.000374 *6*; α(N+..)=9.85×10^{-5} *14* α(N)=8.52×10^{-5} *12*; α(O)=1.265×10^{-5} *18*; α(P)=6.52×10^{-7} *10*
579.2 *3*	3.7 *3*	1861.51	5$^+$	1282.17	4$^+$	[M1,E2]		0.014 *4*	Mult.: α(K)exp=0.0099 *12* gives mult=E2(+M1) with δ>2.3. α(K)=0.011 *4*; α(L)=0.0017 *4*; α(M)=0.00037 *8*; α(N+..)=9.8×10^{-5} *21* α(N)=8.4×10^{-5} *18*; α(O)=1.3×10^{-5} *3*; α(P)=8.E−7 *3*
586.2 *2*	23.0 *19*	930.47	2$^+$	344.27	2$^+$	E2+M1+E0		0.0242 *11*	Mult.: α(K)exp=0.023 *3*. α: from adopted gammas.
634.2 *2*	15.8 *12*	1861.51	5$^+$	1227.28	6$^+$	[M1,E2]		0.011 *4*	α(K)=0.009 *3*; α(L)=0.0013 *3*; α(M)=0.00029 *7*; α(N+..)=7.7×10^{-5} *18* α(N)=6.7×10^{-5} *15*; α(O)=1.02×10^{-5} *25*; α(P)=6.5×10^{-7} *22*
647.4 *2*	72 *5*	2394.11	7$^+$	1746.69	8$^+$	M1		0.01321	α(K)=0.01124 *16*; α(L)=0.001546 *22*; α(M)=0.000334 *5*; α(N+..)=8.98×10^{-5} *13* α(N)=7.70×10^{-5} *11*; α(O)=1.199×10^{-5} *17*; α(P)=8.18×10^{-7} *12*
652.9 *3*	5.7 *4*	1880.2	7$^-$	1227.28	6$^+$	E1		0.00264 *4*	Mult.: α(K)exp=0.0102 *12* gives mult=M1(+E2) with δ<0.86. α=0.00264 *4*; α(K)=0.00226 *4*; α(L)=0.000301 *5*; α(M)=6.47×10^{-5} *9*; α(N+..)=1.726×10^{-5} *25* α(N)=1.483×10^{-5} *21*; α(O)=2.29×10^{-6} *4*; α(P)=1.502×10^{-7} *21*
678.6 *3*	3.2 *4*	1433.95	3$^+$	755.38	4$^+$	E2+M1	+4.1 *+17−11*	0.00680 *25*	α=0.00680 *25*; α(K)=0.00566 *22*; α(L)=0.00089 *3*; α(M)=0.000196 *6*; α(N+..)=5.19×10^{-5} *15* α(N)=4.47×10^{-5} *13*; α(O)=6.76×10^{-6} *21*; α(P)=3.90×10^{-7} *17*
715.0 *2*	9.8 *7*	1470.47	5$^-$	755.38	4$^+$	[E1]		0.00219 *3*	α=0.00219 *3*; α(K)=0.00187 *3*; α(L)=0.000248 *4*; α(M)=5.34×10^{-5} *8*; α(N+..)=1.425×10^{-5} *20* α(N)=1.224×10^{-5} *18*; α(O)=1.89×10^{-6} *3*; α(P)=1.249×10^{-7} *18*
726.0 *2*	53 *3*	2394.11	7$^+$	1668.06	6$^+$	M1		0.00995 *14*	Mult.: D from adopted gammas. α=0.00995 *14*; α(K)=0.00847 *12*; α(L)=0.001161 *17*;

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^{152}Tb ε decay (4.2 min) 1980Zo02 (continued)

γ(^{152}Gd) (continued)

E_γ [†]	I_γ [†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	δ [#]	α [a]	Comments
									α(M)=0.000251 *4*; α(N+..)=6.74×10^{-5} *10* α(N)=5.78×10^{-5} *8*; α(O)=9.00×10^{-6} *13*; α(P)=6.15×10^{-7} *9* Mult.: α(K)exp=0.0077 *7*.
764.6[@] *4*	0.2 *2*	1109.0?	2$^+$	344.27	2$^+$				
770.4 *3*	2.6 *4*	1997.79	6$^+$	1227.28	6$^+$				
778.9 *3*	1.2 *8*	1123.2	3$^-$	344.27	2$^+$	E1		0.00184 *3*	α=0.00184 *3*; α(K)=0.001576 *22*; α(L)=0.000208 *3*; α(M)=4.47×10^{-5} *7*; α(N+..)=1.195×10^{-5} *17* α(N)=1.026×10^{-5} *15*; α(O)=1.585×10^{-6} *23*; α(P)=1.054×10^{-7} *15*
794.3 *3*	3.1 *5*	1549.98	4$^+$	755.38	4$^+$	D(+Q)	−0.4 *+7−12*	0.0075 *20*	α=0.0075 *20*; α(K)=0.0064 *18*; α(L)=0.00088 *21*; α(M)=0.00019 *5*; α(N+..)=5.1×10^{-5} *12* α(N)=4.4×10^{-5} *10*; α(O)=6.8×10^{-6} *17*; α(P)=4.6×10^{-7} *14*
930.4 *3*	4.6 *4*	930.47	2$^+$	0.0	0$^+$	(E2)		0.00321 *5*	α=0.00321 *5*; α(K)=0.00270 *4*; α(L)=0.000397 *6*; α(M)=8.64×10^{-5} *13*; α(N+..)=2.30×10^{-5} *4* α(N)=1.98×10^{-5} *3*; α(O)=3.02×10^{-6} *5*; α(P)=1.87×10^{-7} *3*
946.0 *2*	8.0 *6*	2173.33	6$^-$	1227.28	6$^+$				
[x]1041.0 *4*	2.3 *4*								
1052.2 *4*	1.2 *6*	1807.6		755.38	4$^+$				
1074.5 *2*	11.1 *8*	2301.72	7$^+$	1227.28	6$^+$				
1089.7 *2*	11.3 *8*	1433.95	3$^+$	344.27	2$^+$	E2+M1	+22 *+13−6*	0.00231 *4*	α=0.00231 *4*; α(K)=0.00195 *3*; α(L)=0.000278 *4*; α(M)=6.04×10^{-5} *9*; α(N+..)=1.611×10^{-5} *23* α(N)=1.385×10^{-5} *20*; α(O)=2.13×10^{-6} *3*; α(P)=1.354×10^{-7} *20*
1106.2 *2*	47 *3*	1861.51	5$^+$	755.38	4$^+$	E2		0.00223 *4*	α=0.00223 *4*; α(K)=0.00189 *3*; α(L)=0.000269 *4*; α(M)=5.83×10^{-5} *9*; α(N+..)=1.594×10^{-5} *23* α(N)=1.338×10^{-5} *19*; α(O)=2.06×10^{-6} *3*; α(P)=1.311×10^{-7} *19*; α(IPF)=3.76×10^{-7} *6* Mult.: α(K)exp=0.0019 *9* gives mult=E2(+M1) with δ>0.5.
1109.3[@] *4*	0.5 *4*	1109.0?	2$^+$	0.0	0$^+$	E2		0.00222 *4*	α=0.00222 *4*; α(K)=0.00188 *3*; α(L)=0.000267 *4*; α(M)=5.80×10^{-5} *9*; α(N+..)=1.589×10^{-5} *23* α(N)=1.329×10^{-5} *19*;

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^{152}Tb ε decay (4.2 min) 1980Zo02 (continued)

γ(^{152}Gd) (continued)

E_γ [†]	I_γ [†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[a]	Comments
								α(O)=2.04×10^{-6} *3*; α(P)=1.304×10^{-7} *19*; α(IPF)=4.23×10^{-7} *9*
1166.9 *2*	62 *4*	2394.11	7$^+$	1227.28	6$^+$	M1	0.00317 *5*	α=0.00317 *5*; α(K)=0.00270 *4*; α(L)=0.000365 *6*; α(M)=7.87×10^{-5} *11*; α(N+..)=2.41×10^{-5} *4* α(N)=1.81×10^{-5} *3*; α(O)=2.83×10^{-6} *4*; α(P)=1.95×10^{-7} *3*; α(IPF)=2.92×10^{-6} *5* Eγ: from 1971Bo12. Mult.: α(K)exp=0.0025 *7*.
1205.9 *5*	1.0 *4*	1549.98	4$^+$	344.27	2$^+$			
1242.6 *4*	1.7 *3*	1997.79	6$^+$	755.38	4$^+$			

† From 1980Zo02, unless otherwise noted. The Iγ are normalized to Iγ=1000 for the 283γ in Tb IT decay.

‡ The authors report Eγ=440.3 *2* doubly placed from the 1668 and 2302 levels with Iγ=6.7 *25* and 5.8 *29* from these two levels, respectively, determined by γγ. The evaluator gives Eγ values deduced from the decay scheme.

From Adopted Gammas. α(K)exp values determined in this work are given in comments. Except where noted otherwise, the values are from 1980Zo02 based on relative Iγ and Ice(K) intensities and normalized to α(K)exp(344γ E2)=0.0310.

@ Assignment to ^{152}Tb ε decay is tentative.

& For absolute intensity per 100 decays, multiply by 0.0595 *17*.

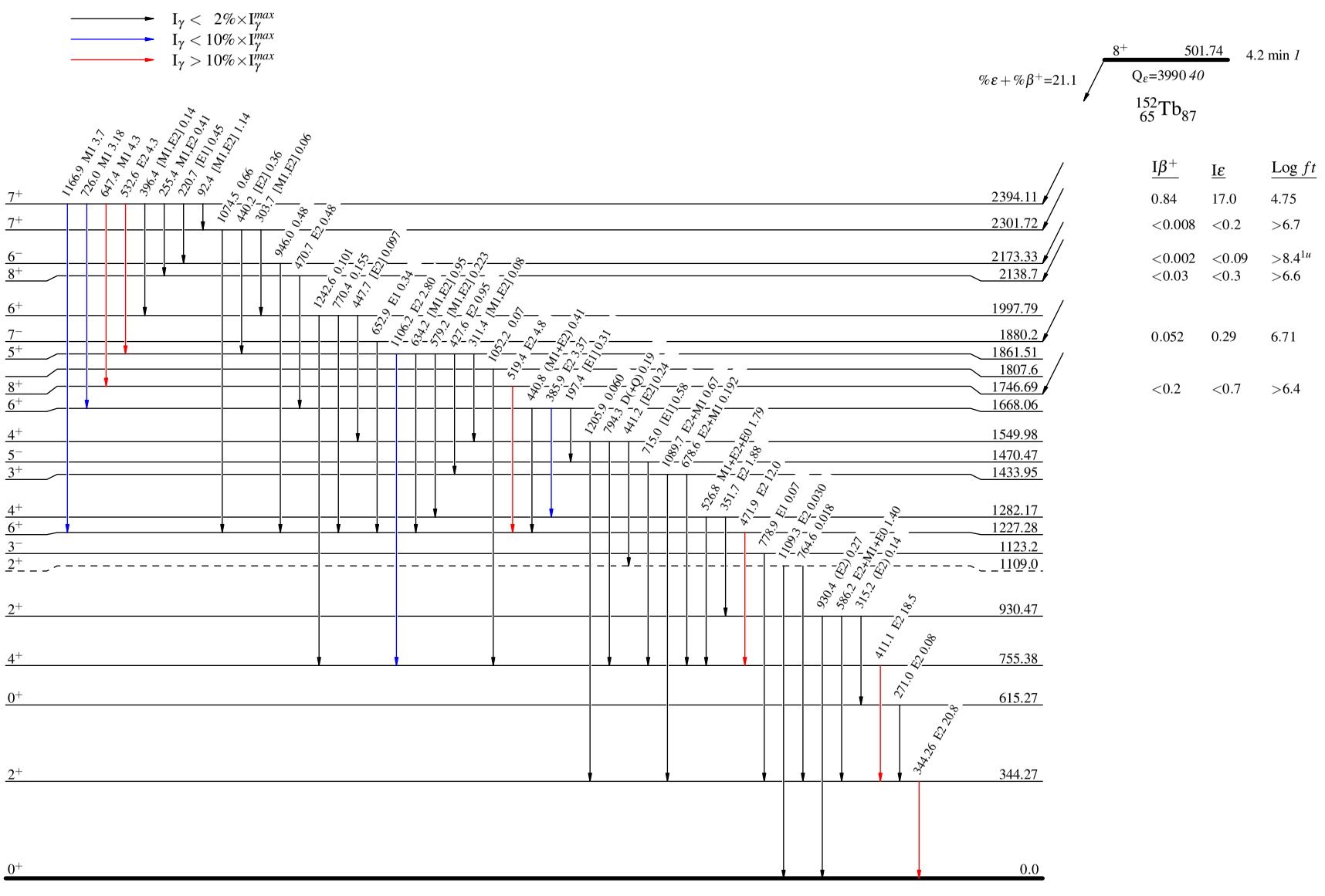
a Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

x γ ray not placed in level scheme.

^{152}Tb ε decay (4.2 min) 1980Zo02

Decay Scheme

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



$^{152}_{64}Gd_{88}$

$^{152}_{64}Gd_{88}$-7