^{163}Yb ε decay (11.05 min) 1975Ad09

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	C. W. Reich, Balraj Singh	NDS 111,1211 (2010)	12-Apr-2010

Parent: ^{163}Yb: E=0.0; J$^{\pi}$=3/2^{-}; T$_{1/2}$=11.05 min *25*; Q(ε)=3431 *17*; %ε+%β^{+} decay=100

^{163}Yb-J$^{\pi}$,T$_{1/2}$: From the ^{163}Yb Adopted Levels.

^{163}Yb-Q(ε): From 2009AuZZ, 2003Au03.

^{163}Yb-Configuration=ν3/2[521].

1975Ad09 (and 1985Ad12): ^{163}Yb isotope obtained by bombardment of tantalum by a 660-MeV proton beam followed by chemical separation. Measured γ, ce, prompt and delayed $\gamma\gamma$ coin, $\beta\gamma$ coin. 1985Ad12 reanalyzed data.

Others:

Identification and T$_{1/2}$ of ^{163}Yb: 1967Pa20, 1968GrZX, 1970DeZF, 1972Ch23.

γ: 1970DeZF (about 40 γ rays reported).

The decay scheme and all data, except as noted, are from 1975Ad09 as modified by 1985Ad12. The major modifications were: new levels at 175 and 254, removal of levels at 224 and 288, introduction of 5/2[402] and 3/2[411] bands, and changes in spins and parities of the 137, 498, and 559 levels.

^{163}Tm Levels

Bands: from 1977Fo08 and 1975Ad09. Modified and extended by 1985Ad12, based on a reanalysis of data and systematics of odd Tm nuclides (A=161 to 169). See the Adopted Levels for parameter values.

See 1985Ad12 for structure of nonrotational states (independent quasiparticles and quasiparticle-phonon model).

E(level)[†]	J$^{\pi}$[‡]	T$_{1/2}$[#]	Comments
0.0[@]	1/2^{+}		
13.52[@] *2*	3/2^{+}	<0.9 ns	
23.28 *5*	(7/2)$^{+}$		π7/2[404] bandhead.
86.92[&] *5*	(7/2)$^{-}$	0.38 μs *3*	T$_{1/2}$: from $\gamma\gamma$(t) (1975Ad09).
136.71[b] *2*	5/2^{+}	60 ps *10*	
144.39[@] *2*	(5/2)$^{+}$	110 ps *25*	T$_{1/2}$: from 1975VaYW (ceγ(t)).
174.59[&] *6*	(9/2)$^{-}$		Level added (by 1985Ad12) based on (^{3}He,5nγ) data.
175.00[@] *4*	(7/2)$^{+}$		
217.14[a] *4*	(1/2)$^{-}$		
247.97? *5*	(5/2^{-})		Level added (evaluators) based on (^{19}F,4nγ).
258.35[b] *3*	(7/2)$^{+}$		
326.20[a] *4*	3/2^{-}		
366.36[c] *6*	3/2^{+}		
369.1[a] *5*	(9/2^{-})		
449.21[c] *6*	(5/2)$^{+}$		
497.98[a] *15*	(7/2)$^{-}$		
559.56[c] *9*	(7/2)$^{+}$		
629.10 *22*	(≤7/2)		
683.73 *14*	(≤7/2)		
774.08 *7*	(5/2,7/2)$^{+}$		
806.12 *7*	(3/2,5/2^{+})		
823.93 *9*	(5/2^{-})		
947.28 *5*	(5/2)$^{-}$		Probable π5/2[532] state.
1130.73 *15*	(3/2^{+},5/2^{-})		
1345.32 *6*	1/2,3/2,5/2$^{(+)}$		
1362.92 *18*	(≤7/2)		
1780.09 *9*	(1/2^{+},3/2,5/2)		
1819.57 *12*	(3/2,5/2)		

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^{163}Yb ε decay (11.05 min) 1975Ad09 (continued)

^{163}Tm Levels (continued)

E(level)[†]	J^π[‡]	Comments
1820.78 *10*	(1/2$^+$,3/2,5/2)	
1833.48 *5*	(5/2$^-$)	Possible configuration=π7/2[523]⊗ν3/2[521]⊗ν 5/2[532].
1994.77 *11*	(5/2$^-$)	

[†] From least-squares fit to Eγ′s.
[‡] From Adopted Levels.
[#] From 1980AlZE (ceγ(t) and γγ(t)), unless otherwise stated.
[@] Band(A): π1/2[411] band. From configuration of g.s. and agreement with neighboring odd Tm nuclides.
[&] Band(B): π7/2[523] band. From comparison with neighboring odd-A Tm nuclides.
[a] Band(C): π1/2[541] band (?).
[b] Band(D): π5/2[402] band.
[c] Band(E): Probable π3/2[411] band.

ε,β$^+$ radiations

Intensity balance gives apparent %ε+β$^+$ feeding of 1.9 *7* for 174.59, (9/2)$^-$ level, whereas none is expected from 3/2$^-$ parent state. Also at 86.9 level, there is a negative intensity balance of −4.8 *24*. These discrepancies are most likely due to missing or incorrect placements.

E(decay)	E(level)	Iβ$^+$ [‡]	Iε[‡]	Log *ft*[†]	I(ε+β$^+$)[†‡]	Comments
(1436 *17*)	1994.77	0.0033 *11*	3.8 *10*	5.7 *1*	3.8 *10*	av Eβ=202.6 *77*; εK=0.8255; εL=0.1334 *2*; εM+=0.04022 *4*
(1598 *17*)	1833.48	0.040 *11*	12 *3*	5.2 *1*	12 *3*	av Eβ=274.1 *75*; εK=0.8246 *3*; εL=0.1323 *2*; εM+=0.03984 *5*
(1610 *17*)	1820.78	0.0057 *19*	1.6 *5*	6.1 *2*	1.6 *5*	av Eβ=279.7 *75*; εK=0.8244 *3*; εL=0.1322 *2*; εM+=0.03981 *5*
(1611 *17*)	1819.57	0.0065 *23*	1.8 *6*	6.1 *2*	1.8 *6*	av Eβ=280.2 *77*; εK=0.8244 *3*; εL=0.1322 *2*; εM+=0.03981 *5*
(1651 *17*)	1780.09	0.018 *5*	3.9 *10*	5.8 *1*	3.9 *10*	av Eβ=297.8 *75*; εK=0.8238 *4*; εL=0.13186 *14*; εM+=0.03971 *5*
(2068 *17*)	1362.92	0.041 *12*	1.4 *4*	6.4 *2*	1.4 *4*	av Eβ=481.0 *75*; εK=0.8053 *13*; εL=0.1273 *3*; εM+=0.03826 *8*
(2086 *17*)	1345.32	0.090 *25*	2.8 *8*	6.1 *1*	2.9 *8*	av Eβ=488.7 *75*; εK=0.8039 *14*; εL=0.1270 *3*; εM+=0.03818 *9*
(2300 *17*)	1130.73	0.079 *23*	1.3 *4*	6.5 *2*	1.4 *4*	av Eβ=583.3 *75*; εK=0.7835 *20*; εL=0.1232 *4*; εM+=0.03701 *11*
2.42×10^3 *10*	947.28	2.3 *6*	25 *6*	5.3 *1*	27 *7*	av Eβ=664.3 *76*; εK=0.7600 *25*; εL=0.1192 *5*; εM+=0.03577 *13* E(decay): from (860γ)(β$^+$) coin.
(2607 *17*)	823.93	0.17 *5*	1.4 *4*	6.6 *2*	1.6 *5*	av Eβ=719.0 *76*; εK=0.741 *3*; εL=0.1160 *5*; εM+=0.03481 *14*
(2657 *17*)	774.08	0.39 *11*	2.9 *8*	6.3 *1*	3.3 *9*	av Eβ=741.1 *76*; εK=0.733 *3*; εL=0.1146 *5*; εM+=0.03439 *15*
(2747[#] *17*)	683.73	0.15 *4*	0.9 *3*	6.8 *1*	1.1 *3*	av Eβ=781.3 *76*; εK=0.717 *3*; εL=0.1120 *5*; εM+=0.03361 *16*
(2802 *17*)	629.10	0.054 *18*	0.31 *10*	7.3 *2*	0.36 *12*	av Eβ=805.7 *76*; εK=0.707 *4*; εL=0.1104 *6*; εM+=0.03311 *16*
(2871 *17*)	559.56	0.033 *9*	0.56 *15*	8.6[1u] *1*	0.59 *16*	av Eβ=842.4 *74*; εK=0.7792 *15*; εL=0.1261 *3*; εM+=0.03805 *9*
(2933[#] *17*)	497.98	0.11 *4*	0.51 *17*	7.2 *2*	0.62 *21*	av Eβ=864.3 *76*; εK=0.682 *4*; εL=0.1062 *6*; εM+=0.03186 *17*

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^{163}Yb ε decay (11.05 min) 1975Ad09 (continued)

ε,β^+ radiations (continued)

E(decay)	E(level)	Iβ^+ ‡	Iε‡	Log *ft*†	I(ε+β^+)†‡	Comments
(2982 *17*)	449.21	0.44 *13*	1.9 *6*	6.6 *2*	2.3 *7*	av Eβ=886.1 *77*; εK=0.672 *4*; εL=0.1046 *6*; εM+=0.03138 *17*
(3065 *17*)	366.36	0.64 *17*	2.4 *6*	6.5 *1*	3.0 *8*	av Eβ=923.3 *77*; εK=0.655 *4*; εL=0.1019 *6*; εM+=0.03054 *18*
(3105 *17*)	326.20	0.71 *20*	2.5 *7*	6.5 *2*	3.2 *9*	av Eβ=941.3 *77*; εK=0.646 *4*; εL=0.1005 *6*; εM+=0.03013 *18*
(3173 *17*)	258.35	0.18 *6*	1.7 *5*	8.3[1u] *2*	1.9 *6*	av Eβ=972.8 *74*; εK=0.7501 *19*; εL=0.1205 *4*; εM+=0.03633 *11*
(3183# *17*)	247.97?	0.44 *15*	1.4 *5*	6.8 *2*	1.8 *6*	av Eβ=976.5 *77*; εK=0.629 *4*; εL=0.0978 *6*; εM+=0.02931 *18*
(3214 *17*)	217.14	0.50 *15*	1.5 *4*	6.8 *2*	2.0 *6*	av Eβ=990.3 *77*; εK=0.623 *4*; εL=0.0967 *6*; εM+=0.02899 *18*
(3256 *17*)	175.00	0.12 *4*	1.0 *4*	8.6[1u] *2*	1.1 *4*	av Eβ=1009.0 *74*; εK=0.7406 *21*; εL=0.1188 *4*; εM+=0.03579 *12*
(3256# *17*)	174.59	0.6 *2*	1.6 *5*	6.7 *2*	2.2 *7*	av Eβ=1009.5 *77*; εK=0.613 *4*; εL=0.0952 *6*; εM+=0.02854 *18* I(ε+β^+): no feeding is expected for ΔJ=3, Δπ=no; log *ft*=6.7 is too low to be realistic.
(3287 *17*)	144.39	1.0 *5*	2.8 *12*	6.5 *2*	3.8 *17*	av Eβ=1023.1 *77*; εK=0.607 *4*; εL=0.0941 *6*; εM+=0.02822 *18*
(3294 *17*)	136.71	0.7 *4*	1.7 *11*	6.7 *3*	2.4 *15*	av Eβ=1026.6 *77*; εK=0.605 *4*; εL=0.0939 *6*; εM+=0.02814 *18*
(3408# *17*)	23.28	0.8 *4*	5 *3*	7.9[1u] *2*	6 *3*	av Eβ=1075.0 *75*; εK=0.7217 *23*; εL=0.1154 *4*; εM+=0.03476 *12*
(3418# *17*)	13.52	≤6	≤14	≥5.9	≤20	av Eβ=1082.2 *77*; εK=0.577 *4*; εL=0.0895 *6*; εM+=0.02682 *19* I(ε+β^+): from log *ft*≥5.9 for first-forbidden transitions. Intensity balance gives 70 *50*. A similar β transition in the decay of ^{161}Er (1984He18) with log *ft*≥6.9 would imply I(ε+β+)(13.5)≤1.9%.
(3431# *17*)	0.0	≤6	≤14	≥5.9	≤20	av Eβ=1088.3 *77*; εK=0.574 *4*; εL=0.0890 *6*; εM+=0.02668 *19* I(ε+β^+): from log *ft*≥5.9 for first-forbidden transitions. See also comment for ε feeding to 13.5 level.

† All values are considered as approximate since many γ rays remain unplaced and ε, β^+ feeding of g.s. and 13.5 level are not known.

‡ Absolute intensity per 100 decays.

Existence of this branch is questionable.

γ(^{163}Tm)

Iγ normalization, I(γ+ce) normalization: ΣI(γ+ce)(to g.s.+13.5)=100−I(ε+β)(g.s.+13.5) where I(ε+β)(g.s.+13.5)=19 *19* based on log *ft*>5.9 expected for first-forbidden transitions. The normalization is considered as approximate since many transitions (with as much as 15% of the total intensity) are still unplaced.

≈13% of the total transition intensity is unplaced.

α(K)exp: normalized via theoretical α(K)(104γ,M1)=2.16 from ^{163}Tm decay.

E_γ	I_γ [@]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [‡]	δ [‡]	α [&]	$I_{(\gamma+ce)}$ [†@]	Comments
(7.68 *3*)	0.063 *21*	144.39	(5/2)$^+$	136.71	5/2$^+$	(M1)		219 *4*	15 *5*	ce(M)/(γ+ce)=0.784 *10*; ce(N+)/(γ+ce)=0.211 *5* ce(N)/(γ+ce)=0.184 *5*; ce(O)/(γ+ce)=0.0263 *7*; ce(P)/(γ+ce)=0.00141 *4* E_γ: from level-energy difference. γ expected from γγ coin. I(γ+ce) from γγ coin. Iγ from I(γ+ce) and α. Mult.: no E2 or M2 allowed by RUL.
9.74 *5*	0.00118 *5*	23.28	(7/2)$^+$	13.52	3/2$^+$	E2		1.32×10^5	156 *7*	α(L)=8.55×10^4; α(M)=3.47×10^4; α(N+..)=1.16×10^4 calc Eγ from ce data. Iγ from I(γ+ce) and α. α(M1):α(M2):α(M3)=0.010:0.70:1.00. Mult.: from M1<<M2≈M3.
13.53 *3*	≈2.32	13.52	3/2$^+$	0.0	1/2$^+$	M1+E2	≈0.04	≈240	5.8×10^2 *16*	ce(L)/(γ+ce)≈0.773; ce(M)/(γ+ce)≈0.176; ce(N+)/(γ+ce)≈0.0466 ce(N)/(γ+ce)≈0.0408; ce(O)/(γ+ce)≈0.00555; ce(P)/(γ+ce)≈0.000239 Eγ from ce data. Iγ from I(γ+ce) and α. α: assuming Δδ=50%. M1/M2≈4.
63.62 *3*	64 *3*	86.92	(7/2)$^-$	23.28	(7/2)$^+$	E1		1.077		α(K)=0.875 *13*; α(L)=0.1576 *23*; α(M)=0.0352 *5*; α(N+..)=0.00908 *13* α(N)=0.00802 *12*; α(O)=0.001025 *15*; α(P)=3.70×10^{-5} *6* α(L1)=0.087; α(L2)=0.032; α(L3)=0.040 Mult.,δ: from α(L)exp=0.18 *9*, α(M)exp≈0.06, L1:L2:L3=2.7:1:1.3; δ(M2/E1)<0.35.
^{x}79.96 *5*	1.0 *2*					M1+E2	0.67 *47*	6.4 *4*		α(K)=3.9 *9*; α(L)=1.9 *10*; α(M)=0.45 *25*; α(N+..)=0.12 *7* α(N)=0.10 *6*; α(O)=0.013 *7*; α(P)=0.00023 *7* α(L1)=0.53 *15* α(K)exp=4 *1*, K/L1≈6.7. E_γ: from ce spectrum. Placement from a 224 level (1975Ad09) is omitted by 1985Ad12.

^{163}Yb ε decay (11.05 min) 1975Ad09 (continued)

$\gamma(^{163}Tm)$ (continued)

E_γ	I_γ[@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[&]	Comments
87.67 *3*	2.0 *2*	174.59	(9/2)⁻	86.92	(7/2)⁻	M1(+E2)	0.4 *+5−4*	4.61 *19*	α(K)=3.5 *8*; α(L)=0.9 *7*; α(M)=0.21 *18*; α(N+..)=0.05 *5* α(N)=0.05 *4*; α(O)=0.006 *5*; α(P)=0.00021 *6* α(L1)=0.48 *+6−13* α(K)exp=3.5 *7*, K/L1≈7. Placement from a 224 level is revised by 1985Ad12.
113.91 *3*	2.7 *2*	258.35	(7/2)⁺	144.39	(5/2)⁺	M1(+E2)	0.2 *+28−2*	2.13 *23*	α(K)=1.7 *9*; α(L)=0.3 *5*; α(M)=0.07 *13*; α(N+..)=0.02 *4* α(N)=0.02 *3*; α(O)=0.002 *3*; α(P)=0.00011 *7* α(L1)=0.25 *+1−16* α(K)exp=1.8 *9*, K/L1≈6.2.
121.73 *5*	2.0 *2*	258.35	(7/2)⁺	136.71	5/2⁺	M1(+E2)	0.1 *+4−1*	1.76 *7*	α(K)=1.47 *16*; α(L)=0.23 *8*; α(M)=0.051 *20*; α(N+..)=0.014 *5* α(N)=0.012 *5*; α(O)=0.0017 *5*; α(P)=9.0×10⁻⁵ *13* α(L1)=0.207 *+2−28* α(K)exp=1.5 *8*, K/L1≈5.
123.21 *2*	19.6 *7*	136.71	5/2⁺	13.52	3/2⁺	M1+E2	0.28 *4*	1.686 *25*	α(K)=1.37 *3*; α(L)=0.244 *9*; α(M)=0.0552 *22*; α(N+..)=0.0147 *6* α(N)=0.0129 *5*; α(O)=0.00178 *6*; α(P)=8.33×10⁻⁵ *17* α(L1)=0.191 *3*; α(L2)=0.037 *6* α(K)exp=1.4 *7*, K:L1:L2=6.7:1:≤0.15.
130.86 *2*	13.1 *4*	144.39	(5/2)⁺	13.52	3/2⁺	M1(+E2)	0.5 *5*	1.38 *10*	α(K)=1.07 *21*; α(L)=0.24 *9*; α(M)=0.055 *22*; α(N+..)=0.014 *6* α(N)=0.013 *5*; α(O)=0.0017 *5*; α(P)=6.4×10⁻⁵ *16* α(L1)=0.15 *4*; α(L2)=0.06 *+6−4* α(K)exp=1.12 *23*, K:L1:L2=6.4:1:≤0.24. Additional information 1.
136.70 *3*	2.24 *10*	136.71	5/2⁺	0.0	1/2⁺	E2		0.968	α(K)=0.478 *7*; α(L)=0.376 *6*; α(M)=0.0914 *13*; α(N+..)=0.0233 *4* α(N)=0.0208 *3*; α(O)=0.00246 *4*; α(P)=2.06×10⁻⁵ *3* α(K)exp=0.8 *2* gives M1+E2, but E2 is consistent with Alaga rules (1985Ad12).
141.21 *6*	1.10 *10*	947.28	(5/2)⁻	806.12	(3/2,5/2⁺)				
144.39 *3*	4.9 *2*	144.39	(5/2)⁺	0.0	1/2⁺	E2		0.797	α(K)=0.411 *6*; α(L)=0.295 *5*; α(M)=0.0717 *10*; α(N+..)=0.0183 *3* α(N)=0.01635 *23*; α(O)=0.00194 *3*; α(P)=1.79×10⁻⁵ *3* α(L2)=0.14; α(L3)=0.12 α(K)exp=0.5 *1*, K:L2:L3=3:≈1:≈1.
[x]152.2 *5*	0.40 *15*								Placement from a 288 level (1975Ad09) is omitted by 1985Ad12 since 152γ-123γ coin also found in a higher part of the decay scheme.
161.49 *3*	10.6 *4*	175.00	(7/2)⁺	13.52	3/2⁺	E2		0.538	α(K)=0.301 *5*; α(L)=0.182 *3*; α(M)=0.0440 *7*; α(N+..)=0.01125 *16* α(N)=0.01003 *14*; α(O)=0.001201 *17*; α(P)=1.342×10⁻⁵ *19* α(L1)=0.031; α(L2)=0.084; α(L3)=0.068 α(K)exp=0.35 *7*, K:L1:L2:L3=4:≤0.4:1:0.8.

γ(^{163}Tm) (continued)

E_γ	I_γ[@]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[&]	Comments
181.84 *5*	2.40 *15*	326.20	3/2$^-$	144.39	(5/2)$^+$	E1		0.0688	α(K)=0.0576 *8*; α(L)=0.00871 *13*; α(M)=0.00194 *3*; α(N+..)=0.000511 *8* α(N)=0.000447 *7*; α(O)=6.12×10^{-5} *9*; α(P)=2.79×10^{-6} *4* δ: <0.13 from α(K)exp. α(K)exp<0.1.
189.40 *10*	2.6 *5*	326.20	3/2$^-$	136.71	5/2$^+$	E1		0.0619	α(K)=0.0518 *8*; α(L)=0.00781 *11*; α(M)=0.001735 *25*; α(N+..)=0.000459 *7* α(N)=0.000401 *6*; α(O)=5.50×10^{-5} *8*; α(P)=2.52×10^{-6} *4* δ: <0.15 from α(K)exp. α(K)exp<0.1.
194.1 *5*	0.45 *15*	369.1	(9/2$^-$)	175.00	(7/2)$^+$	[E1]		0.0580	α(K)=0.0487 *8*; α(L)=0.00732 *12*; α(M)=0.00162 *3*; α(N+..)=0.000430 *7* α(N)=0.000376 *6*; α(O)=5.16×10^{-5} *8*; α(P)=2.38×10^{-6} *4*
203.60 *4*	5.4 *3*	217.14	(1/2)$^-$	13.52	3/2$^+$	E1+M2	0.14 *4*	0.09 *3*	α(K)=0.075 *21*; α(L)=0.014 *5*; α(M)=0.0031 *11*; α(N+..)=0.0008 *3* α(N)=0.00072 *25*; α(O)=0.00010 *4*; α(P)=4.8×10^{-6} *17* α(K)exp=0.075 *15*.
217.17 *5*	4.3 *4*	217.14	(1/2)$^-$	0.0	1/2$^+$	E1		0.0434	α(K)=0.0364 *6*; α(L)=0.00543 *8*; α(M)=0.001206 *17*; α(N+..)=0.000319 *5* α(N)=0.000279 *4*; α(O)=3.85×10^{-5} *6*; α(P)=1.80×10^{-6} *3* δ(M2/E1)<0.12 from α(K)exp. α(K)exp=0.04 *1*.
221.74 *20*	0.93 *15*	366.36	3/2$^+$	144.39	(5/2)$^+$	(E2)		0.185	α(K)=0.1216 *18*; α(L)=0.0487 *7*; α(M)=0.01164 *17*; α(N+..)=0.00300 *5* α(N)=0.00266 *4*; α(O)=0.000328 *5*; α(P)=5.84×10^{-6} *9* α(K)exp≈0.09.
[x]234.45 *5*	7.7 *4*					E1		0.0357	α(K)=0.0300 *5*; α(L)=0.00444 *7*; α(M)=0.000986 *14*; α(N+..)=0.000261 *4* α(N)=0.000228 *4*; α(O)=3.16×10^{-5} *5*; α(P)=1.496×10^{-6} *21* α(K)exp=0.026 *5*.
234.45[b] *5*	7.7 *4*	247.97?	(5/2$^-$)	13.52	3/2$^+$	E1		0.0357	α(K)=0.0300 *5*; α(L)=0.00444 *7*; α(M)=0.000986 *14*; α(N+..)=0.000261 *4* α(N)=0.000228 *4*; α(O)=3.16×10^{-5} *5*; α(P)=1.496×10^{-6} *21* Placement (by evaluators) based on (^{19}F,4nγ).
274.30 *15*	2.2 *3*	449.21	(5/2)$^+$	175.00	(7/2)$^+$	[M1,E2]		0.14 *5*	α(K)=0.11 *5*; α(L)=0.0222 *10*; α(M)=0.00508 *9*; α(N+..)=0.00134 *5* α(N)=0.00118 *3*; α(O)=0.000159 *14*; α(P)=6.E−6 *3*
304.67 *20*	1.3 *2*	449.21	(5/2)$^+$	144.39	(5/2)$^+$	M1+E2	0.62 *45*	0.119 *19*	α(K)=0.098 *18*; α(L)=0.0165 *8*; α(M)=0.00373 *13*; α(N+..)=0.00100 *5* α(N)=0.00087 *4*; α(O)=0.000121 *8*; α(P)=5.8×10^{-6} *12* α(K)exp=0.10 *2*.
312.52 *6*	3.2 *5*	449.21	(5/2)$^+$	136.71	5/2$^+$	M1+E2	≈2	≈0.0765	α(K)≈0.0587; α(L)≈0.01375; α(M)≈0.00319; α(N+..)≈0.000837

From ENSDF

^{163}Yb ε decay (11.05 min) 1975Ad09 (continued)

γ(^{163}Tm) (continued)

E_γ	I_γ[@]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[&]	Comments
									α(N)≈0.000737; α(O)≈9.68×10^{-5}; α(P)≈3.23×10^{-6} E_γ: from level-energy difference. Unresolved doublet at 312.62. α: assuming $\Delta\delta$=50%. α(K)exp≈0.06. I_γ: from $\gamma\gamma$.
312.71 *4*	1.9 *5*	326.20	3/2$^-$	13.52	3/2$^+$	[E1]		0.01736	α(K)=0.01463 *21*; α(L)=0.00213 *3*; α(M)=0.000471 *7*; α(N+..)=0.0001254 *18* α(N)=0.0001094 *16*; α(O)=1.528×10^{-5} *22*; α(P)=7.51×10^{-7} *11* E_γ: see comment on 312.52γ. I_γ: from $\gamma\gamma$.
326.20 *7*	15.5 *6*	326.20	3/2$^-$	0.0	1/2$^+$	E1		0.01566	α(K)=0.01321 *19*; α(L)=0.00192 *3*; α(M)=0.000424 *6*; α(N+..)=0.0001130 *16* α(N)=9.85×10^{-5} *14*; α(O)=1.378×10^{-5} *20*; α(P)=6.81×10^{-7} *10* α(K)exp=0.011 *2*.
352.95 *10*	7.2 *4*	366.36	3/2$^+$	13.52	3/2$^+$	E2(+M1)	>0.93	0.058 *14*	α(K)=0.045 *13*; α(L)=0.0094 *9*; α(M)=0.00216 *17*; α(N+..)=0.00057 *5* α(N)=0.00050 *4*; α(O)=6.7×10^{-5} *8*; α(P)=2.6×10^{-6} *9* α(K)exp=0.033 *7*.
353.8 *3*	2.0 *5*	497.98	(7/2)$^-$	144.39	(5/2)$^+$	[E1]		0.01288	α(K)=0.01088 *16*; α(L)=0.001569 *23*; α(M)=0.000347 *5*; α(N+..)=9.26×10^{-5} *13* α(N)=8.07×10^{-5} *12*; α(O)=1.131×10^{-5} *16*; α(P)=5.64×10^{-7} *8* E_γ: from level-energy difference. I_γ: from $\gamma\gamma$.
361.55 *20*	2.4 *2*	497.98	(7/2)$^-$	136.71	5/2$^+$	E1		0.01224	α(K)=0.01033 *15*; α(L)=0.001489 *21*; α(M)=0.000330 *5*; α(N+..)=8.78×10^{-5} *13* α(N)=7.65×10^{-5} *11*; α(O)=1.074×10^{-5} *16*; α(P)=5.37×10^{-7} *8* α(K)exp≈0.015 gives δ(M2/E1)<0.13.
366.30 *10*	7.1 *3*	366.36	3/2$^+$	0.0	1/2$^+$	M1+E2	0.86 *45*	0.066 *13*	α(K)=0.054 *12*; α(L)=0.0093 *9*; α(M)=0.00210 *17*; α(N+..)=0.00056 *5* α(N)=0.00049 *5*; α(O)=6.8×10^{-5} *8*; α(P)=3.2×10^{-6} *8* α(K)exp=0.055 *11*.
384.62 *10*	2.23 *15*	559.56	(7/2)$^+$	175.00	(7/2)$^+$	M1+E2	1.4 *8*	0.048 *16*	α(K)=0.039 *15*; α(L)=0.0074 *12*; α(M)=0.00168 *23*; α(N+..)=0.00044 *7* α(N)=0.00039 *6*; α(O)=5.3×10^{-5} *10*; α(P)=2.2×10^{-6} *10* α(K)exp=0.04 *1*.
407.72 *10*	1.42 *10*	774.08	(5/2,7/2)$^+$	366.36	3/2$^+$	E2		0.0294	α(K)=0.0226 *4*; α(L)=0.00526 *8*; α(M)=0.001220 *18*; α(N+..)=0.000320 *5* α(N)=0.000281 *4*; α(O)=3.70×10^{-5} *6*; α(P)=1.219×10^{-6} *17* α(K)exp≈0.02.
415.0 *3*	0.48 *7*	559.56	(7/2)$^+$	144.39	(5/2)$^+$	[M1,E2]		0.045 *17*	α(K)=0.037 *15*; α(L)=0.0063 *14*; α(M)=0.0014 *3*; α(N+..)=0.00038 *8* α(N)=0.00033 *7*; α(O)=4.6×10^{-5} *11*; α(P)=2.1×10^{-6} *10*

γ(^{163}Tm) (continued)

E_γ	I_γ[@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[&]	Comments
[x]416.8 *3*	0.60 *8*								
422.80 *20*	0.30 *10*	559.56	(7/2)$^+$	136.71	5/2$^+$	[M1,E2]		0.043 *16*	α(K)=0.035 *15*; α(L)=0.0059 *13*; α(M)=0.0013 *3*; α(N+..)=0.00036 *8* α(N)=0.00031 *7*; α(O)=4.4×10^{-5} *11*; α(P)=2.0×10^{-6} *10*
435.62 *7*	6.0 *4*	449.21	(5/2)$^+$	13.52	3/2$^+$	E2(+M1)	>2.2	0.027 *3*	α(K)=0.0214 *23*; α(L)=0.00445 *22*; α(M)=0.00102 *5*; α(N+..)=0.000270 *13* α(N)=0.000237 *11*; α(O)=3.17×10^{-5} *18*; α(P)=1.18×10^{-6} *15* α(K)exp=0.020 *4*.
[x]447.36 *20*	0.70 *4*								
[x]457.4[#] *5*	0.30 *10*								
[x]481.97 *20*	0.86 *10*								
484.6 *3*	0.9 *2*	629.10	(≤7/2)	144.39	(5/2)$^+$				
492.5 *3*	0.6 *2*	629.10	(≤7/2)	136.71	5/2$^+$				
[x]520.7 *7*	0.64 *15*								
539.33 *14*	3.3 *3*	683.73	(≤7/2)	144.39	(5/2)$^+$				
547.3 *7*	1.2 *3*	683.73	(≤7/2)	136.71	5/2$^+$				
[x]561.52 *30*	0.78 *11*								
[x]567.71 *20*	1.00 *11*								
571.9 *5*	0.70 *11*	1130.73	(3/2$^+$,5/2$^-$)	559.56	(7/2)$^+$				
588.8[b] *10*	0.64 *17*	1362.92	(≤7/2)	774.08	(5/2,7/2)$^+$				
599.2 *3*	2.6 *3*	774.08	(5/2,7/2)$^+$	175.00	(7/2)$^+$				
[x]601.0 *30*	0.20 *6*								
[x]606.02 *15*	5.5 *3*								
[x]619.3 *3*	1.2 *2*								
[x]622.2 *4*	1.0 *2*								
[x]643.8 *3*	0.70 *10*								
649.33 *15*	2.2 *2*	823.93	(5/2$^-$)	174.59	(9/2)$^-$				
661.98 *15*	1.86 *19*	806.12	(3/2,5/2$^+$)	144.39	(5/2)$^+$				
[x]670.0 *5*	1.0 *3*								
687.22 *10*	16.0 *8*	774.08	(5/2,7/2)$^+$	86.92	(7/2)$^-$	(E1)		0.00297	α(K)=0.00252 *4*; α(L)=0.000349 *5*; α(M)=7.70×10^{-5} *11*; α(N+..)=2.06×10^{-5} *3* α(N)=1.79×10^{-5} *3*; α(O)=2.56×10^{-6} *4*; α(P)=1.355×10^{-7} *19* α(K)exp=0.0037 *8*.
688.94 *8*	2.0 *5*	947.28	(5/2)$^-$	258.35	(7/2)$^+$				I_γ: from γγ.
[x]694.64 *30*	2.4 *3*								
[x]709.67 *20*	1.1 *3*								
[x]730.05 *20*	1.6 *2*								
737.05 *10*	7.4 *4*	823.93	(5/2$^-$)	86.92	(7/2)$^-$				
[x]739.9[#] *7*	0.9 *2*								
[x]743.7 *5*	0.78 *15*								

$^{163}_{69}Tm_{94}$-8

γ(^{163}Tm) (continued)

E_γ	I_γ[@]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	α[&]	Comments
[x]759.1 3	1.0 2							
772.67[b] 10	2.54 14	947.28	(5/2)$^-$	174.59	(9/2)$^-$			Placement from level energy difference (evaluators).
[x]797.0 3	1.7 2							
802.96 15	3.5 3	947.28	(5/2)$^-$	144.39	(5/2)$^+$			
805.6[ab] 16	0.30[a] 5	806.12	(3/2,5/2$^+$)	0.0	1/2$^+$			
805.6[ab] 16	0.30[a] 5	1130.73	(3/2$^+$,5/2$^-$)	326.20	3/2$^-$			
810.60 10	6.1 3	947.28	(5/2)$^-$	136.71	5/2$^+$			
[x]817.9 5	0.93 15							
[x]841.1 12	1.5 7							
[x]848.5 7	2.7 7							
[x]853.0 5	4.0 7							
860.28 6	100.0 35	947.28	(5/2)$^-$	86.92	(7/2)$^-$	M1,E2	0.0072 24	α(K)=0.0061 21; α(L)=0.0009 3; α(M)=0.00020 6; α(N+..)=5.4×10^{-5} 16 α(N)=4.7×10^{-5} 14; α(O)=6.7×10^{-6} 20; α(P)=3.5×10^{-7} 13 Mult.: α(K)exp≈0.006. Additional information 2.
[x]867.5 8	2.3 7							
871.9 10	1.8 7	1819.57	(3/2,5/2)	947.28	(5/2)$^-$			
[x]881.43[#] 50	0.56 15							
886.08 20	1.5 2	1833.48	(5/2$^-$)	947.28	(5/2)$^-$			
[x]904.34 25	2.8 3							
913.7[a] 6	1.0[a] 2	1130.73	(3/2$^+$,5/2$^-$)	217.14	(1/2)$^-$			
913.7[a] 6	1.0[a] 2	1362.92	(≤7/2)	449.21	(5/2)$^+$			
[x]920.28 20	2.8 3							
[x]934.91 50	1.5 3							
[x]942.20 20	4.8 4							
[x]948.5 6	1.4 2							
[x]959.14 15	3.4 2							
[x]970.00 20	3.0 2							
973.6 3	2.0 3	1780.09	(1/2$^+$,3/2,5/2)	806.12	(3/2,5/2$^+$)			
[x]983.0 10	1.2 3							
985.94 20	2.5 3	1130.73	(3/2$^+$,5/2$^-$)	144.39	(5/2)$^+$			
994.17 25	1.9 3	1130.73	(3/2$^+$,5/2$^-$)	136.71	5/2$^+$			
996.50 20	2.3 3	1362.92	(≤7/2)	366.36	3/2$^+$			
[x]1002.68 15	2.5 2							
1006.11 10	4.1 2	1780.09	(1/2$^+$,3/2,5/2)	774.08	(5/2,7/2)$^+$			
1009.59 15	2.78 16	1833.48	(5/2$^-$)	823.93	(5/2$^-$)			
[x]1015.3 5	0.40 15							
[x]1019.8 5	0.5 2							
[x]1023.28 14	2.82 17							

γ(^{163}Tm) (continued)

E_γ	I_γ[@]	E_i(level)	J_i^π	E_f	J_f^π
[x]1035.9 *3*	1.7 *2*				
[x]1040.8 *3*	2.2 *2*				
[x]1045.11 *20*	3.0 *2*				
[x]1052.2 *7*	0.5 *2*				
1058.9 *3*	1.9 *2*	1833.48	(5/2$^-$)	774.08	(5/2,7/2)$^+$
[x]1065.3 *4*	1.30 *17*				
[x]1095.04 *25*	1.1 *2*				
[x]1102.12 *17*	1.0 *2*				
[x]1108.0[#] *7*	0.37 *10*				
[x]1113.9 *5*	0.9 *2*				
[x]1115.9[#] *20*	0.22 *16*				
[x]1124.24 *20*	1.22 *15*				
[x]1158.0 *7*	0.43 *13*				
[x]1164.80 *20*	1.3 *3*				
[x]1172.0 *10*	0.2 *1*				
[x]1178.0 *15*	0.6 *2*				
1218.6 *5*	0.6 *1*	1362.92	(≤7/2)	144.39	(5/2)$^+$
1226.5 *5*	1.5 *2*	1362.92	(≤7/2)	136.71	5/2$^+$
[x]1235.3 *3*	1.25 *15*				
[x]1240.88 *25*	1.30 *15*				
[x]1252.5 *5*	1.0 *2*				
[x]1284.0 *5*	0.40 *15*				
[x]1291.0 *8*	0.22 *10*				
[x]1303.6 *4*	0.5 *2*				
[x]1315.3 *7*	0.5 *1*				
1331.84 *8*	6.5 *3*	1345.32	1/2,3/2,5/2$^{(+)}$	13.52	3/2$^+$
1335.77 *20*	1.86 *13*	1833.48	(5/2$^-$)	497.98	(7/2)$^-$
1345.27 *8*	5.7 *2*	1345.32	1/2,3/2,5/2$^{(+)}$	0.0	1/2$^+$
[x]1364.1 *3*	1.7 *2*				
1370.0 *5*	1.6 *2*	1819.57	(3/2,5/2)	449.21	(5/2)$^+$
1384.0 *6*	1.2 *2*	1833.48	(5/2$^-$)	449.21	(5/2)$^+$
[x]1414.2 *3*	1.31 *17*				
1453.62 *20*	6.1 *5*	1780.09	(1/2$^+$,3/2,5/2)	326.20	3/2$^-$
[x]1465.6[#] *10*	0.8 *3*				
1493.35 *12*	3.5 *2*	1819.57	(3/2,5/2)	326.20	3/2$^-$
[x]1498.0[#] *10*	0.5 *2*				
[x]1506.6 *3*	1.18 *13*				
[x]1511.8 *5*	0.8 *2*				
[x]1514.0[#] *15*	0.30 *15*				

γ(^{163}Tm) (continued)

E_γ	I_γ[@]	E_i(level)	J_i^π	E_f	J_f^π	Comments
[x]1520.5 *4*	0.74 *14*					
[x]1545.3 *5*	0.40 *8*					Placement from a 1833 level (1975Ad09) is omitted by 1985Ad12.
[x]1560.5 *3*	1.0 *2*					
1574.92 *10*	3.53 *15*	1833.48	(5/2$^-$)	258.35	(7/2)$^+$	
[x]1591.4 *3*	0.75 *10*					
[x]1598.5[#] *8*	0.30 *12*					
1603.05[ab] *20*	1.24[a] *14*	1819.57	(3/2,5/2)	217.14	(1/2)$^-$	
1603.05[ab] *20*	1.24[a] *14*	1820.78	(1/2$^+$,3/2,5/2)	217.14	(1/2)$^-$	
[x]1611.48 *15*	1.96 *15*					
[x]1619.2 *5*	0.51 *10*					
1625.7 *8*	0.7 *2*	1994.77	(5/2$^-$)	369.1	(9/2$^-$)	
[x]1651.4 *8*	0.6 *2*					
1658.40 *16*	3.9 *3*	1833.48	(5/2$^-$)	175.00	(7/2)$^+$	
1676.54 *13*	3.5 *2*	1820.78	(1/2$^+$,3/2,5/2)	144.39	(5/2)$^+$	
1683.87 *16*	2.26 *14*	1820.78	(1/2$^+$,3/2,5/2)	136.71	5/2$^+$	
1689.11 *8*	7.5 *4*	1833.48	(5/2$^-$)	144.39	(5/2)$^+$	
1696.80 *20*	5.0 *4*	1833.48	(5/2$^-$)	136.71	5/2$^+$	
[x]1708.3 *3*	0.95 *11*					
[x]1734.6 *3*	0.90 *13*					
1746.68 *15*	17.0 *10*	1833.48	(5/2$^-$)	86.92	(7/2)$^-$	
1766.52 *15*	4.0 *3*	1780.09	(1/2$^+$,3/2,5/2)	13.52	3/2$^+$	
[x]1788.55 *20*	1.20 *15*					
1820.17 *15*	2.02 *15*	1833.48	(5/2$^-$)	13.52	3/2$^+$	
[x]1843.7 *4*	0.68 *8*					
[x]1857.1[#] *8*	0.40 *8*					
[x]1861.0[#] *9*	0.4 *1*					
[x]1871.2 *4*	0.7 *1*					
[x]1883.0[#] *3*	0.46 *8*					
1907.84 *10*	15.2 *6*	1994.77	(5/2$^-$)	86.92	(7/2)$^-$	
[x]2014.4 *6*	0.31 *6*					
[x]2026.0 *6*	0.30 *6*					
[x]2052.8 *6*	0.25 *6*					
[x]2060.6 *6*	0.24 *6*					

[†] From ΣIce, except as noted.
[‡] From α(exp)′s and subshell ratios. δ′s derived by the evaluators.
[#] Questionable assignment.
[@] For absolute intensity per 100 decays, multiply by 0.24 *6*.

γ(^{163}Tm) (continued)

[&] 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.
[a] Multiply placed with undivided intensity.
[b] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

^{163}Yb ε decay (11.05 min) 1975Ad09

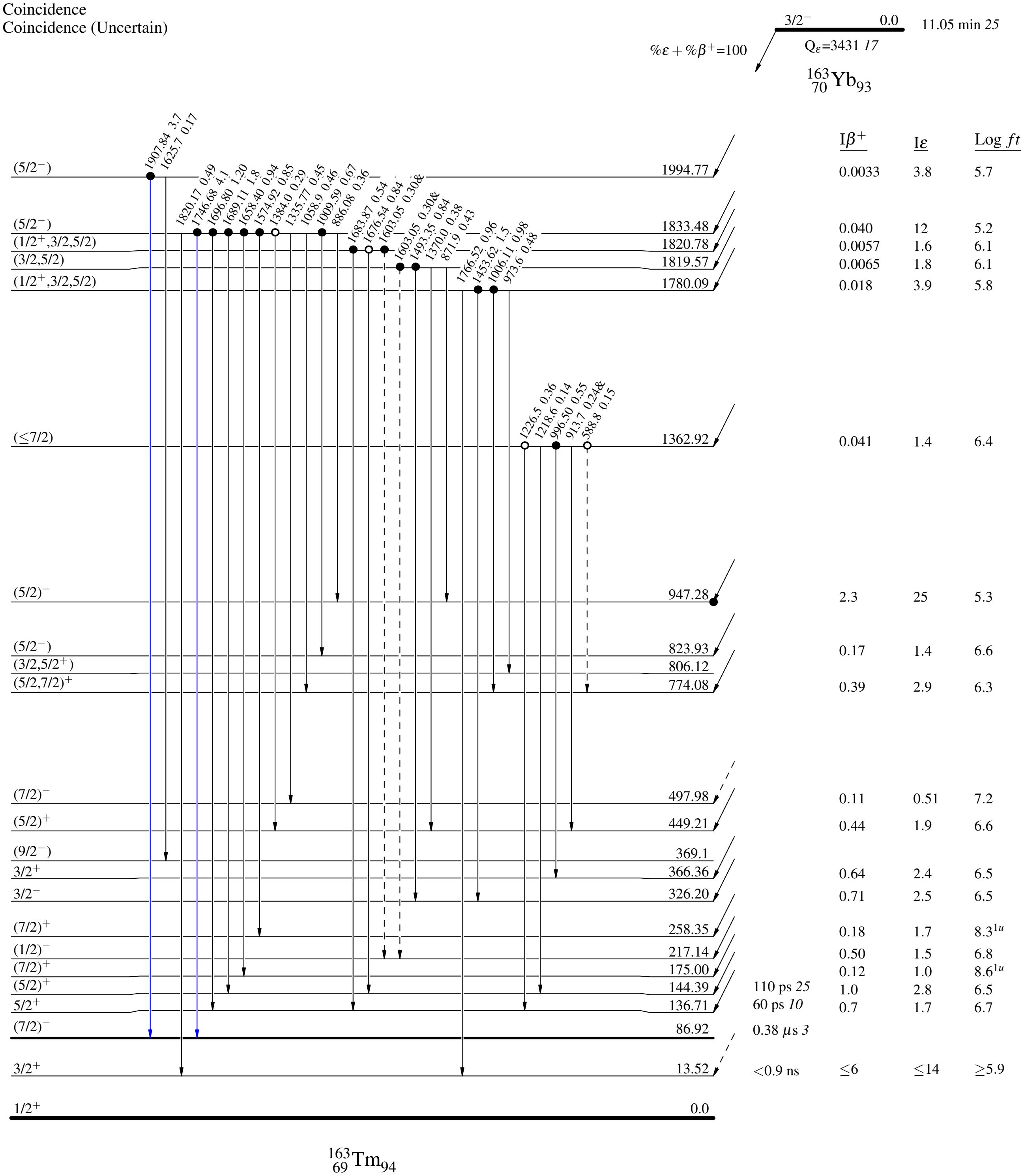
Legend

- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)
- Coincidence
- Coincidence (Uncertain)

Decay Scheme

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

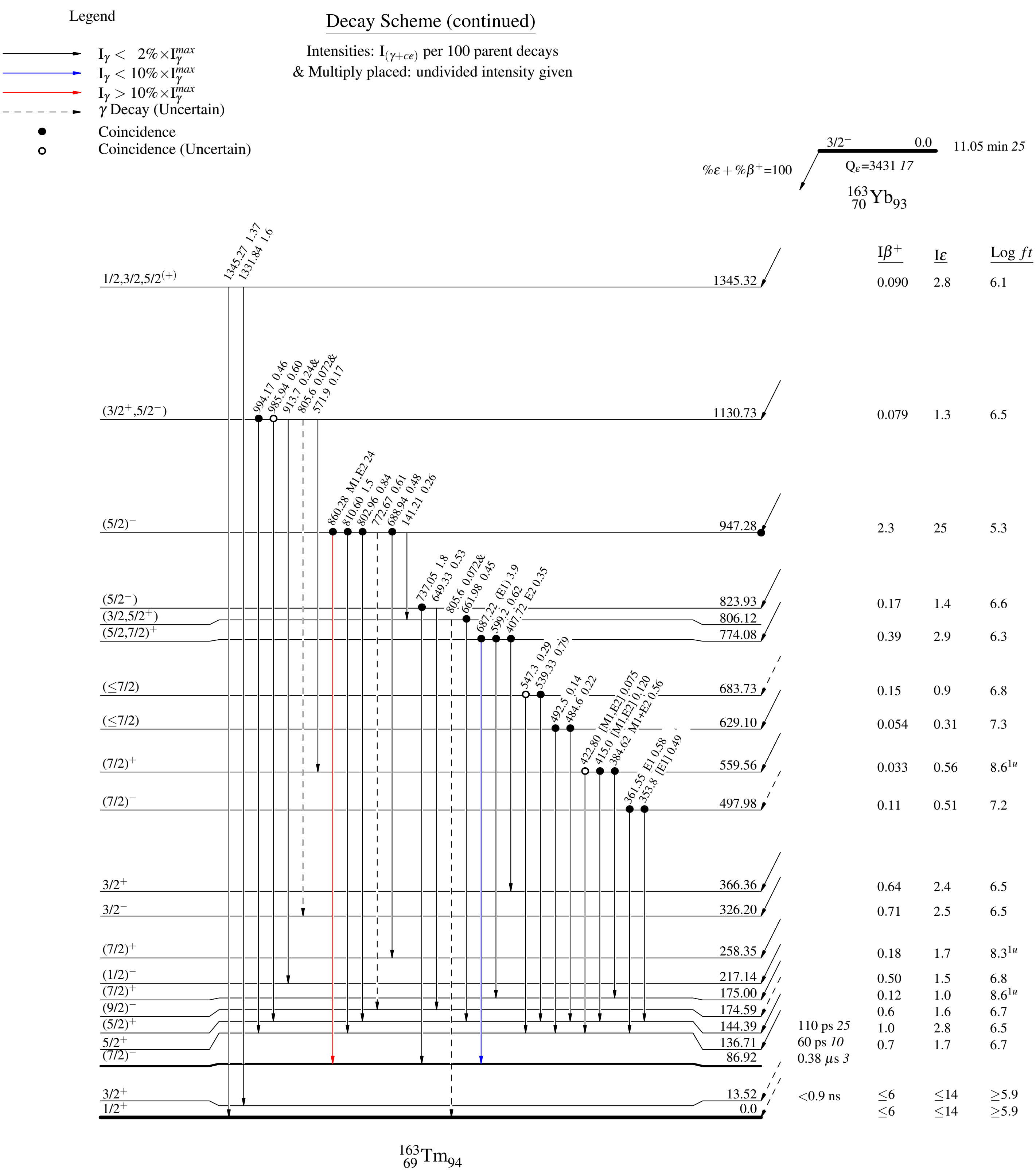
& Multiply placed: undivided intensity given



^{163}Yb ε decay (11.05 min) 1975Ad09

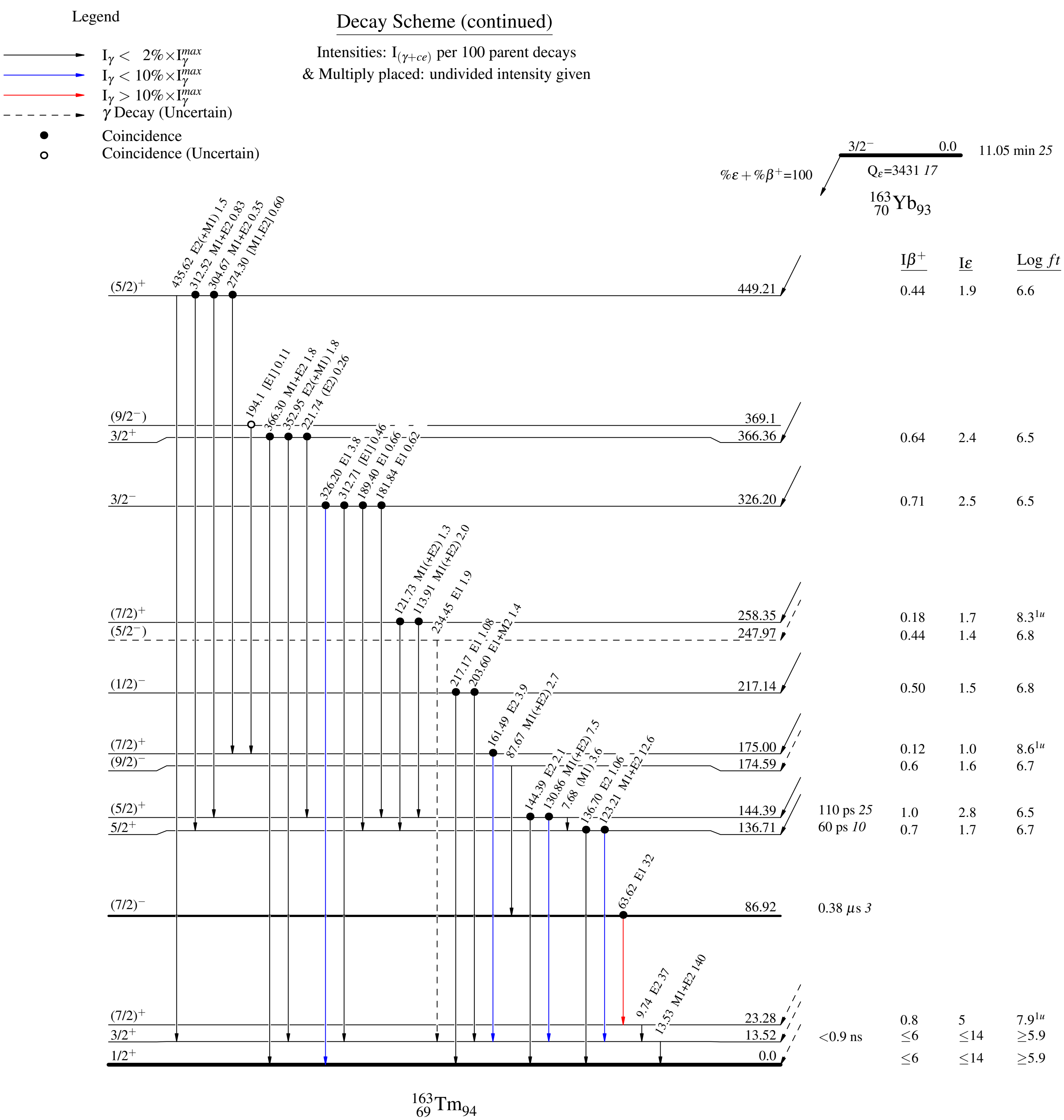
Decay Scheme (continued)

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

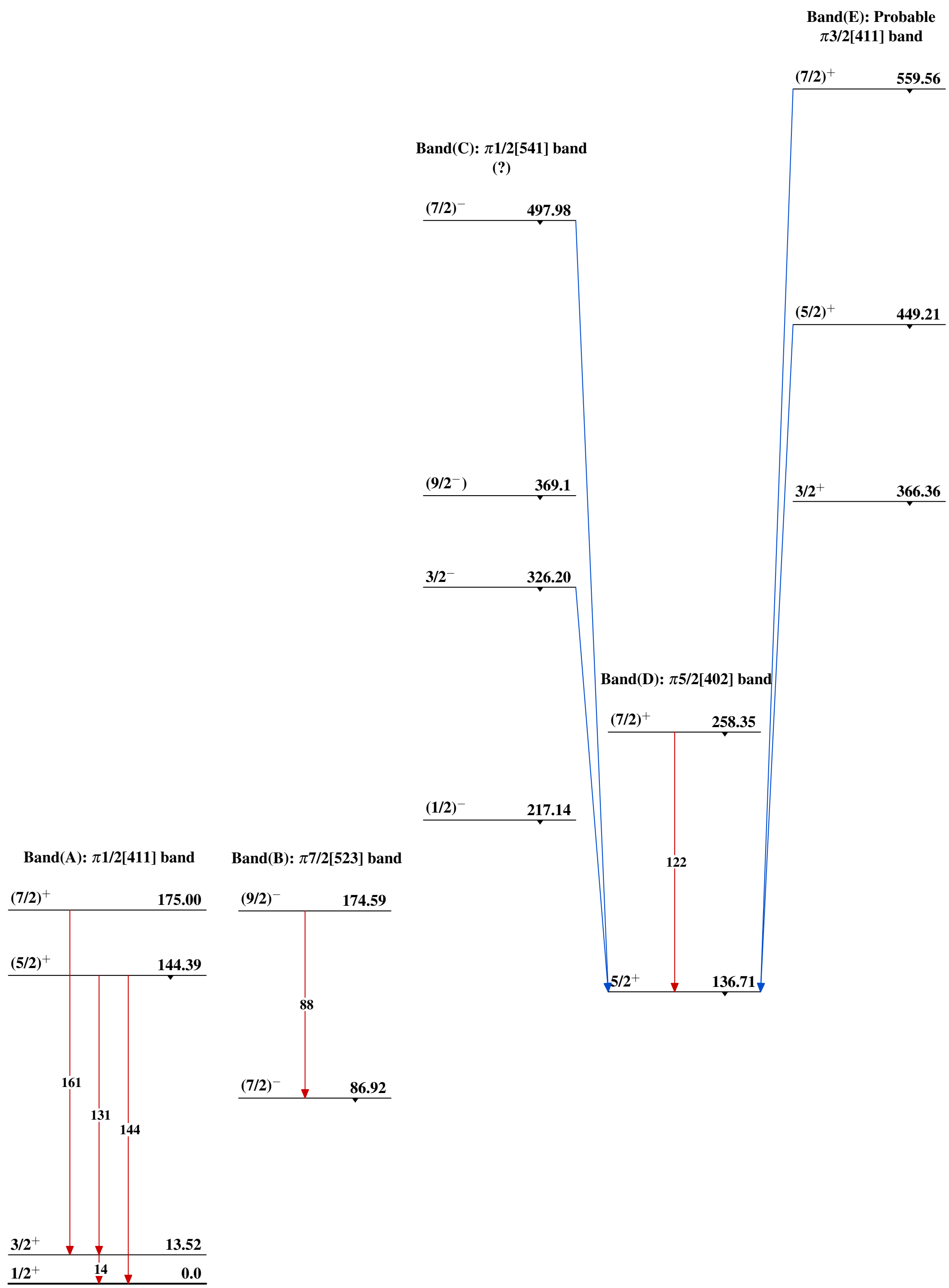


^{163}Yb ε decay (11.05 min) 1975Ad09

Decay Scheme (continued)



^{163}Yb ε decay (11.05 min) 1975Ad09



$^{163}_{69}Tm_{94}$