^{169}Yb ε decay (32.018 d) 2000Mo02,1990Wa28

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin	NDS 109, 2033 (2008)	15-Jun-2008

Parent: ^{169}Yb: E=0.0; J$^{\pi}$=7/2^{+}; T$_{1/2}$=32.018 d *5*; Q(ε)=910 *4*; %ε decay=100.0

Others: 1950Co16, 1951Ma25, 1955Jo23, 1956Bi30, 1956Co13, 1956Ha68, 1956Ko21, 1956Mi05, 1957Ba59, 1958Ca11, 1958Gr05, 1958Na06, 1958Se71, 1958Sh64, 1959Ha09, 1959Ke25, 1959Ko56, 1962El08, 1962Gr09, 1963Al12, 1963Va32, 1964Su06, 1965Bo08, 1965Dz07, 1966Dz10, 1966Er03, 1966Ko01, 1967Br31, 1968Ka14, 1969Ar23, 1969Gu01, 1969Mi17, 1970Al02, 1970An37, 1970Be83, 1970Mi15, 1970Ne11, 1971Bo49, 1972Ag03, 1972Bb13, 1972Ca35, 1972De67, 1972Kr18, 1972Se08, 1972Se14, 1973El15, 1973Ge14, 1973La15, 1974Be26, 1974Bo30, 1974En09, 1974Fu01, 1974ScYU, 1975Bo07, 1975Bu10, 1976Ge21, 1977Ge12, 1982RuZV, 1984Ak05, 1984Br13, 1985AkZW, 1986Ad07, 1987AbZY, 1987BaZB, 1990AdZZ, 1993BaZQ, 1994Co02, 1994De01, 1997De02, 1999Sc05, 2000AlZY, 2000Iw06, 2000MeZW, 2000Mo02, 2000Sa07, 2001De06, 2001KoZQ.

1986Ad07: sources from neutron bombardments of 25% enriched ^{168}Yb or from spallation of tantalum by 680-MeV protons, mass separation; measured Eγ, Iγ (anti-Compt spect), $\gamma\gamma$ coin).

1990Wa28: extension of work In 1986Ad07; measured Eγ, Iγ, E(ce), Ice. See also 1990WaZZ and 1990AdZZ.

2000Mo02: summary of measurements made In eleven laboratories As part of the EUROMET-410 project. Measured Iγ (relative and absolute). See 1999MoZV for a more detailed report.

The decay scheme is based on that of 1986Ad07 (this scheme is considerably more complex than earlier ones). Additional weak transitions and decay-scheme modifications have been added, based primarily on work by 1990Wa28.

^{169}Yb is a radionuclide that is important in nuclear medicine (brachytherapy) and as a standard source for γ-ray energy and intensity calibrations. consequently, many precise measurements of Iγ and Eγ have been undertaken. These have been collectively analyzed here, and the resulting energy and intensity values are given below. See, e.g., 2002Be05, 1996Ch27 for prior evaluations of ^{169}Yb ε decay data.

^{169}Tm Levels

E(level)[†]	J$^{\pi}$[‡]	T$_{1/2}$[‡]	Comments
0.0[#]	1/2^{+}	stable	
8.41017[#] *11*	3/2^{+}	4.09 ns *5*	T$_{1/2}$: other data from ε decay: 4.22 ns *11* (1987AbZY) from ce-γ(t); 4.39 ns *17* (1963Mc13); 1966Mc08; 4.10 ns *21* (1974Fu01).
118.18945[#] *11*	5/2^{+}	62 ps *3*	T$_{1/2}$: 62 ps *10* (1959Bl15).
138.93315[#] *11*	7/2^{+}	302 ps *2*	T$_{1/2}$: adopted value. ε decay data: 1959Bl15 (290 ps *70*), 1960Be28, 1964Su06 (321 ps *14*), 1966Mc08 (289 ps *24*).
316.14633[@] *11*	7/2^{+}	659.9 ns *23*	T$_{1/2}$: weighted average of 658 ns *3* (1950Fu63), 665 ns *5* (1974En09), 660 ns *5* (1994De01) from $\gamma\gamma$(t). Other data from ^{169}Yb decay: 1951Ma25 (0.67 μs), 1955Jo23, 1956Mi05 (0.64 μs *4*), 1959Be62, 1972Ni03 (0.65 μs), 1974Bo30 (650 ns *26*), 1975Bu10. g: 0.044 *2* from DPAC (1972Ni03).
332.117[#] *11*	9/2^{+}	18.8 ps *5*	
345.028[&] *3*	5/2^{-}		
367.65?[#] *5*	11/2^{+}	41.6 ps *21*	Level (and 229γ which deexcites it) introduced to accommodate two possible weak transitions from higher states. A 367.7 level is well established in Coulomb excitation and ^{170}Er(p,2nγ), (d,3nγ).
379.26678[a] *11*	7/2^{-}	52.2 ns *8*	T$_{1/2}$: weighted average of 49.8 ns *15* (1974Bo30), 54.1 ns *5* (1974En09), 51.6 ns *3* (1974Vi05), all from $\gamma\gamma$(t). Others: 1956Ko21, 1956Mi05 (45 ns), 1959Be62, 1997De02 (46.4 ns *15*).
430.121[&] *11*	(9/2)$^{-}$		
433.521[@] *19*	(9/2)$^{+}$		
472.88128[a] *13*	9/2^{-}	0.14 ns *7*	
474.970[&] *9*	(3/2)$^{-}$		
570.832[b] *11*	3/2^{+}	10 ps *7*	
633.292[b] *3*	5/2^{+}		

Continued on next page (footnotes at end of table)

^{169}Yb ε decay (32.018 d) 2000Mo02,1990Wa28 (continued)

^{169}Tm Levels (continued)

E(level)[†]	Jπ[‡]
646.759[&] *10*	(7/2⁻)
718.786[b] *4*	(7/2⁺)
781.796[c] *6*	(5/2)⁺
832.42[b] *7*	(9/2⁺)
878.35[c] *10*	(7/2⁺)

[†] Least-squares adjusted values based on adopted Eγ; E(8.4 level) was held fixed At 8.41017 *15*, the difference between E(118γ) and E(110γ) after recoil correction.
[‡] Adopted values, except as noted.
[#] Band(A): 1/2[411] band.
[@] Band(B): 7/2[404] band.
[&] Band(C): 1/2[541] band.
[a] Band(D): 7/2[523] band.
[b] Band(E): 3/2[411] band + K-2 γ vibration built on 1/2[411].
[c] Band(F): 5/2[402] band.

ε radiations

ε feedings are from intensity imbalance at each level, unless noted to the contrary. No feeding is expected to g.s. (ΔJ=3), or to 8.4 level (ΔJ=2, Δπ=no).

1987Sa53 used γ-K x ray sum coin in single intrinsic Ge solid-state detector to determine relative K-capture probabilities: 0.812 *29* (472.9 level), 0.823 *34* (379.3 level), 0.825 *43* (316.1 level).

E(decay)	E(level)	Iε[†]	Log *ft*	Comments
(32 *4*)	878.35	4.1×10⁻⁶ *5*	10.91 *17*	εL=0.64 *3*; εM+=0.36 *3*
(78 *4*)	832.42	2.11×10⁻⁵ *24*	11.26 *11*	εK=0.26 *7*; εL=0.54 *5*; εM+=0.200 *20*
(128 *4*)	781.796	6.72×10⁻⁴ *8*	10.54 *5*	εK=0.627 *13*; εL=0.278 *9*; εM+=0.094 *4*
(191 *4*)	718.786	0.00353 *4*	10.32 *3*	εK=0.726 *4*; εL=0.207 *3*; εM+=0.0670 *10*
(263 *4*)	646.759	1.21×10⁻⁴ *3*	12.137 *20*	εK=0.7658 *15*; εL=0.1778 *11*; εM+=0.0564 *4*
(277 *4*)	633.292	0.01088 *17*	10.236 *17*	εK=0.7703 *13*; εL=0.1746 *10*; εM+=0.0552 *4*
(339 *4*)	570.832	0.000253 *9*	12.080 *20*	εK=0.7853 *8*; εL=0.1636 *6*; εM+=0.05114 *21*
(435 *4*)	474.970	3.55×10⁻⁴ *8*	11.952[1u] *21*	εK=0.7323 *15*; εL=0.2017 *11*; εM+=0.0659 *4*
(437 *4*)	472.88128	12.27 *16*	7.648 *11*	εK=0.7987 *5*; εL=0.1537 *3*; εM+=0.04754 *11*
(476 *4*)	433.521	0.114 *9*	9.76 *4*	εK=0.8023 *4*; εL=0.15107 *25*; εM+=0.04658 *9*
(480 *4*)	430.121	0.00440 *15*	11.184 *17*	εK=0.8026 *4*; εL=0.15087 *25*; εM+=0.04651 *9*
(531 *4*)	379.26678	81.1 *9*	7.016 *9*	εK=0.8063 *3*; εL=0.14815 *20*; εM+=0.04553 *7*
(565 *4*)	345.028	0.0139 *11*	10.84 *4*	εK=0.8084 *3*; εL=0.14663 *17*; εM+=0.04498 *6*
(578 *4*)	332.117	0.0143 *17*	10.85 *6*	εK=0.8091 *3*; εL=0.14611 *16*; εM+=0.04479 *6*
(594 *4*)	316.14633	6.1 *10*	8.25 *8*	εK=0.8099 *2*; εL=0.14550 *15*; εM+=0.04457 *6*

[†] Absolute intensity per 100 decays.

^{169}Yb ε decay (32.018 d) 2000Mo02,1990Wa28 (continued)

$\gamma(^{169}$Tm)

Iγ normalization: weighted average (using limitation of relative statistical weights method) of %Iγ(198) data: 36.26 *18*, 35.7 *6*, 36.3 *11*, 35.9 *7*, 35.49 *39*, 36.06 *14*, 35.95 *54*, all from the Euromet-410 project (2000Mo02), 35.14 *28* (1999Mi01), 35.5 *4* (1994Co02), 36.0 *5* (1983Fu12). Other %Iγ(198): 37.3 *5* (datum '3-E' In 2000Mo02), a statistical outlier). were the latter datum included the normalization would change from 0.3593 *12* to 0.3598 *14*. Iγ normalization deduced from total I(γ+ce) (to g.s. plus 8.4 level) minus Ti(8.4γ)=100% (negligible ε feeding to g.s. expected because ΔJ=3) is 0.360 *5*.

1983Fu12, 1986Me07, 1990Wa28, 1996Bh08, 2000Mo02 give x-ray intensity data, as summarized below.

For Auger electron data see, e.g., 1976Ar06, 1982Ar22, 1983IsZX, 1985AkZY, 1985Bu23, 1986Ba60, 2000AlZY.

1986Ad07 confirm that 285.0γ, 295.0γ, 304.0γ, 316.2γ, 320.0γ, 328.0γ, 354.7γ, 425.0γ, 492.4γ and 614.3γ, reported in earlier work, should not be assigned to ^{169}Yb decay.

1990WaZZ give intensity upper limits for the following γ's previously assigned to ^{169}Yb ε decay: 140.0γ (<0.0021), 160γ(<0.003), 207.0γ(<0.0015), 218.0γ(<0.0015), 229.0γ(<0.0011), 252γ(<0.0017), 285.0γ(<0.0007), 288γ(<0.0009), 304.0γ(<0.027), 316.2γ(<0.00028), 317γ(<0.00021), 320.0γ(<0.00017), 328.0γ(<0.00006), 354.7γ(<0.00004), 363γ(<0.00004), 394γ(<0.0003), 411γ(<0.000014), 417γ(<0.000014), 425.0γ(<0.000013), 492.4γ(<0.000023) and 614.8γ(<0.00012); Iγ for all are given relative to Iγ=100 for 198.0γ.

1985Be01 used ce linewidths for 20.8γ in an attempt to measure finite mass for the electron anti-neutrino.

Summary of x-ray and γ relative intensity data for strongest γ's:

All intensities are given relative to I(198γ)=100.0. Calculated Values Assume %Iγ(198)=35.93 12. The Weighted Averages Include All Data, Except Those Identified As Statistical Outliers Based On The Chauvenet Criterion; Outliers Are Indicated By The Symbol 'x'. Calculated Values Are From The Program RADLST.

Reference	L(I)	L($\alpha\eta$)	L(β1)	8.4γ+L(β2)	L(γ1)	L(γ23)
1983Fu12	2.58 22	55.8 22	44.2 25	12.5 8	6.1 4 x	2.03 14 x
1986Me07	3.85 18	70.4 29	-	-	-	-
1990Wa28	-	-	-	-	-	-
1996Bh08	-	-	-	-	-	-
2000Mo02(1E)	3.7 13	66 5	49.7 37	13.8 15	7.4 13	2.7 9
2000Mo02(7E)	3.23 16	62.8 31	46.5 23	12.1 8	6.98 34	2.56 14
2000Mo02(10×10^1)	3.18 5	63.9 18	48.6 12	14.4 6	7.61 18	2.45 13
2000Mo02(10×10^2)	3.54 11	61.7 12	48.8 6	12.65 15	7.41 19	2.74 5
Recommended	3.30 10	62.3 15	48.5 5	12.74 17	7.46 13	2.69 4
Calculated	3.14 5					

Reference	L(γ4)	L(tot)+8.4	20.8γ	K(α2)	K(α1)	K(α)
1983Fu12	-	-	0.53 6	148.6 31	262.5 58	-
1986Me07	-	-	0.578 24	156.2 22	272.7 40	-
1990Wa28	-	-	-	157 4	271 9	-
1996Bh08	-	-	-	153.0 5	271.0 10	-
2000Mo02(1E)	-	-	0.586 33	149.2 25	263.7 47	412.6 54
2000Mo02(7E)	-	134.7 40	0.535 29	140 6	249 9	388 11
2000Mo02(8E)	-	-	0.45 4 x			419 8
2000Mo02(9E)	-	-	0.514 27	143.7 24	253.9 38	397.6 48

2000Mo02(10×10^{1})	0.488 75	140.6 17	0.547 8	146.4 22	260.1 39	406.3 45
2000Mo02(10×10^{2})	0.480 33	137.3 14	0.544 8	146.7 19	(260 3)	406.5 41
2000Mo02(11E)	-	-	0.55 5	150.5 30	264.3 53	414.5 62
Recommended	0.48 3	138.4 12	0.547 5	150.9 21	267 4	407.0 24
Calculated		135+Iγ 3		148 4	261 7	

Reference	K(β135)	K(β240)	K(β)	63.1γ	93.6γ	109.8γ
1977Ge12	-	-		116 6	7.1 4	48.5 15
1978Ve07	-	-		125 3	7.61 18	49.7 9
1983Fu12	85.8 20	21.9 5		124.2 17	7.22 11	48.6 6
1986Me07	83.5 12	22.8 4		124.9 17	7.28 10	48.9 5
1990Wa28	78.7 22	20.0 5 x		120 3	7.31 13	49.0 7
1996Bh08	89.0 20	23.0 10		120.0 5	6.6 5	47.1 10
1999Mi01	-	-		-	7.01 9	48.8 6
2000Mo02(1E)	85.9 40	22.8 10	108.7 41	122.6 12	7.12 9	47.96 34
2000Mo02(3E)	-	-	-	115.9 23	6.86 12	46.05 64
2000Mo02(4E)	-	-	-	123.5 22	7.28 17	48.8 6
2000Mo02(7E)	81.4 27	21.4 7	102.8 28	123.3 39	7.05 23	47.2 15
2000Mo02(8E)	-	-	103.1 32	121.4 27	6.87 17	46.0 12
2000Mo02(9E)	80.6 12	21.67 46	102.2 13	121.4 6	7.44 13	48.9 10
2000Mo02(10×10^{1})	81.4 8	22.63 43	104.0 9	123.3 6	7.19 3	48.45 24
2000Mo02(10×10^{2})	84.2 11	22.66 32	106.8 12	123.4 15	7.23 9	48.75 59
2000Mo02(11E)	85.8 21	23.0 7	108.8 23	121.2 28	6.72 15	48.3 7
Recommended	83.0 16	22.49 18	104.9 8	121.4 5	7.18 4	48.39 18
Calculated			107 3			

Reference	117.4γ	118.2γ	117γ+118γ	130.5γ	156.7γ	177.2γ
1977Ge12	-	5.31 16	-	32.0 10	-	62.2 19
1978Ve07	0.055 20	5.38 9	-	31.8 12	-	61.4 10
1983Fu12	-	5.17 6	-	31.33 28	-	62.3 6
1986Me07	0.081 10	5.24 5	-	31.68 25	0.027 1	62.4 5
1990Wa28	0.116 6	5.26 8	-	31.7 5	0.0278 9	61.7 11
1996Bh08	-	5.13 10	-	31.6 10	-	62.2 10
1999Mi01	-	5.18 7	-	31.60 36	-	61.9 7
2000Mo02(1E)	-	-	5.18 5	31.55 19	0.029 6	61.91 37
2000Mo02(3E)	-	5.17 10	-	31.18 44	-	61.9 9
2000Mo02(4E)	-	-	5.45 11	32.38 36	-	62.7 11
2000Mo02(7E)	0.121 22	5.33 18	5.45 18	31.4 10	0.026 6	62.6 19
2000Mo02(8E)	-	5.15 14	-	31.2 7	-	62.2 12
2000Mo02(9E)	-	5.13 7	-	30.7 5	-	63.1 3 x
2000Mo02(10×10^{1})	0.130 11	5.21 3	5.333 27	31.81 10	0.0297 45	61.95 25
2000Mo02(10×10^{2})	0.116 6	5.24 6	5.35 6	-	-	-
2000Mo02(11E)	-	-	5.21 10	32.38 45	-	62.4 9
Recommended	0.111 7	5.216 20	5.30 3	31.68 11	0.0275 7	62.01 21

Reference	198.0γ	240.3γ	261.1 γ	307.7γ	336.6γ
1972Bb13	-	-	-	(27.96 9)	0.0280 8
1977Ge12	-	-	4.69 14	27.5 8	0.0321 17 x
1978Ve07	100.0 30	0.367 20	5.43 7 x	30.9 4	0.026 8
1983Fu12	100.0 14	0.301 3	4.67 8	28.1 6	-

1986Me07	100.0 8	0.334 4	4.75 3	27.94 20	0.0284 16
1990Wa28	100.0	0.332 17	4.66 7	27.5 4	0.0248 4
1996Bh08	100.0	0.314 5	4.66 10	27.1 10	-
1999Mi01	100.0 8	-	4.69 5	28.09 32	-
1999Sc05	100.0	-	-	-	0.025 3
2000Mo02(1E)	100.0 5	0.282 15	4.641 32	27.94 11	-
2000Mo02(3E)	100.0 14	0.334 9	4.65 7	27.40 38	-
2000Mo02(4E)	100.0 17	0.359 23	4.84 8 x	28.45 37	-
2000Mo02(7E)	100.0 31	0.261 14	4.61 14	28.2 9	-
2000Mo02(8E)	100.0 19	0.396 29	4.70 14	28.3 5	-
2000Mo02(9E)	100.0 11	0.332 8	5.00 7 x	29.67 33 x	-
2000Mo02(10×10^1)	100.0 4	0.288 12	4.653 42	28.01 8	-
2000Mo02(10×10^2)	100.0 28	-	-	-	-
2000Mo02(11E)	100.0 15	0.283 28	4.73 11	28.23 40	-
Recommended	100.00	0.317 17	4.684 20	27.96 9	0.0263 8

E_γ †	I_γ ‡f	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	δ#	αg	$I_{(\gamma+ce)}$ f	Comments
8.41017 *15*	1.000 *24*	8.41017	3/2+	0.0	1/2+	M1+E2	0.0328 *5*	263 *5*	264 *4*	ce(M)/(γ+ce)=0.789 *9*; ce(N+)/(γ+ce)=0.207 *5* ce(N)/(γ+ce)=0.182 *5*; ce(O)/(γ+ce)=0.0240 *6*; ce(P)/(γ+ce)=0.000899 *21* E_γ: from the recoil-corrected energy difference between Eγ=118.18940 *14* and Eγ=109.77924 *3* (2000He14). $I_{(\gamma+ce)}$: from intensity balance at 8.4 level; ε feeding not expected (ΔJ=2, Δπ=no). Σ (Ice)=253 *7* (1976Ar06). I_γ: deduced from I(γ+ce) and α. Mult.: M1:M2:M3:N:O=43 *5*:13 *3*:15 *3*:16 *3*:3.3 *5* (1976Ar06); M1:M2:M3:M4:M5=100:34.5 *20*:39.0 *20*:7.1 *9*:5.8 *8* (2000AlZY); O1:O2:O3:P1=18.6 *7*:5.5 *3*:4.4 *3*:1.0 *1* (2001KoZQ) (cf. 18.6:7.9:135:1.10 from theory). See ^{169}Er β^- decay and ^{169}Tm(γ,γ) Mossbauer datasets for additional ce data. Mult.,δ: from Adopted Gammas (based on subshell ratios In β^- decay).
20.752 *9*	0.547 *5*	138.93315	7/2+	118.18945	5/2+	M1+E2	0.0292 *16*	54.9 *9*	30.8 *22*	ce(L)/(γ+ce)=0.765 *8*; ce(M)/(γ+ce)=0.172 *4*; ce(N+)/(γ+ce)=0.0459 *10* ce(N)/(γ+ce)=0.0400 *9*; ce(O)/(γ+ce)=0.00565 *13*; ce(P)/(γ+ce)=0.000288 *6* $I_{(\gamma+ce)}$: from intensity balance at 118.2 and 138.9 levels. Identical positive and negative corrections to Ti(exp) (=34.4 *16*) are consistent with zero ε feeding to each. I_γ: deduced from I(γ+ce) and α. Iγ(exp)=0.578 *24*

From ENSDF

γ(^{169}Tm) (continued)

E_γ[†]	I_γ[‡f]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	α[g]	Comments
								(1986Me07), 0.53 *6* (1983Fu12), 0.486 *33*, 0.535 *29*, 0.45 *4*, 0.514 *27*, 0.547 *8*, 0.55 *5* (all from 2000Mo02); the average of these is 0.545 *9*. δ: unweighted average of 0.0323 *21* (from L2/L3=0.135 *5*, weighted average of data from 1969Gu01, 1976Ar06, 2000AlZY) and 0.0274 *8* (from L3/L1=0.0526 *22*, weighted average of data from 1969Gu01, 1976Ar06, 2000AlZY); the weighted average is 0.0280 *16*. Other: 0.00 *5* ($\gamma\gamma(\theta)$, 1967BeZX). Mult.: α(L)exp=38 *4*, α(M)exp=8.7 *7* (Ice from 1976Ar06); L1:L2:L3:M1:M2:M3=6.3 *6*:0.82 *7*:0.36 *4*:1.42 *13*:0.19 *2*:0.08 *1* (1976Ar06); L1:L2:L3=100:13.3 *7*:5.4 *8*, M1:M2:M3:(N+O)=100:13.7 *3*:5.26 *25*:30 *4*, M/(N+O)=0.25 *3* (apparently misprinted) (1969Gu01); L1:L2:L3=100:14 *1*:5.0 *6* (2000AlZY).
[x]39.58[e]								
42.76[dh]	<0.7[d]	472.88128	9/2$^-$	430.121	(9/2)$^-$			
45.94[dh]	<0.03[d]	878.35	(7/2$^+$)	832.42	(9/2$^+$)			
50.61[dh]	<1.5[d]	832.42	(9/2$^+$)	781.796	(5/2)$^+$			
50.86[dh]	<1.5[d]	430.121	(9/2)$^-$	379.26678	7/2$^-$			
51.51[dh]	<0.05[d]	367.65?	11/2$^+$	316.14633	7/2$^+$			
[x]62.45[e]								
63.01[dh]	<6.0[d]	781.796	(5/2)$^+$	718.786	(7/2$^+$)			
63.12044 *3*	121.4 *5*	379.26678	7/2$^-$	316.14633	7/2$^+$	E1	1.098	α(K)=0.892 *13*; α(L)=0.1611 *23*; α(M)=0.0360 *5*; α(N+..)=0.00929 *13* α(N)=0.00820 *12*; α(O)=0.001047 *15*; α(P)=3.77×10^{-5} *6* δ for possible M2 admixture: −0.01 *6* (nuclear orientation, 1987Da11,1987Kr12); 0.0 from weighted average L2/L1=0.352 *5* (1969Gu01, 1976Ar06, 1985AkZW, 1987BaZB, 2000AlZY); 0.013 *+4−6* from weighted average L3/L1=0.475 *8* (1969Gu01, 1976Ar06, 1985AkZW, 1987BaZB, 2000AlZY) (or <0.010 from unweighted average). Mult.: α(K)exp=0.83 *16* (Ice from 1976Ar06), 1.02 *15* (K x ray/γ measurement, 1974Vi05); α(L1)exp=0.0911 *25* (Ice from 1976Ar06); L1:L2:L3=100:37.2 *20*:46.5 *20* (1969Gu01); K:L1:L2:L3:M:N=36 *7*:3.96 *11*:1.40 *4*:1.80 *6*:1.7 *2*:0.40 *5* (1976Ar06); L1:L2:L3:M1:M2:M3:(M4+M5):N1:N2:N3:(N4+N5):(O+P)= 100.0 *13*:34.8 *6*:48.3 *7*:19.3 *6*:7.9 *4*:9.4 *4*:1.5 *2*:4.8 *2*:1.5 *2*: 2.4 *4*:0.3 *1*:0.17 *2* (1985AkZW); L1:L2:L3=100:34.5 *12*:45.5 *24* (1987BaZB); L1:L2:L3=100:35 *3*:42 *3* (2000AlZY).
65.86[dh]	<0.029[d]	433.521	(9/2)$^+$	367.65?	11/2$^+$			
72.028[dh]	<0.01[d]	718.786	(7/2$^+$)	646.759	(7/2$^-$)			
85.09[dh]	<0.008[d]	430.121	(9/2)$^-$	345.028	5/2$^-$			
[x]85.30[e]								

$^{169}_{69}$Tm$_{100}$-6

γ(^{169}Tm) (continued)

E_γ[†]	I_γ[‡f]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[g]	Comments
93.61447 *7*	7.18 *4*	472.88128	9/2⁻	379.26678	7/2⁻	M1+E2	+0.183 *3*	3.75	α(K)=3.07 *5*; α(L)=0.529 *8*; α(M)=0.1193 *18*; α(N+..)=0.0319 *5* α(N)=0.0278 *4*; α(O)=0.00389 *6*; α(P)=0.000188 *3* δ: weighted average of 0.187 *7* and 0.183 *4* (based on L2/L1=0.168 *6* and L3/L1=0.087 *3*, respectively, from weighted average of data from 1969Gu01, 1976Ar06, 1985AkZW, 1987BaZB, 2000MeZW), and +0.167 *17* (nuclear orientation, 1987Da11,1987Kr12). However, from time differential γγ(θ), 1997De02 conclude that 94γ is pure M1 and discrepancy with δ from ce data is due to penetration effects; see comment on δ(198γ) also. Mult.: α(K)exp=2.9 *3* (Ice from 1976Ar06); L1:L2:L3=100:16.9 *10*:9.3 *4* (1969Gu01); K:L1:L2:L3:M:N=7.5 *7*:1.18 *4*:0.19 *3*:0.10 *2*:0.4 *1*:0.16 *4* (1976Ar06); K:L1:L2:L3:M1:M2:M3:N= 199.0 *27*:31.9 *5*:4.9 *3*:2.5 *2*:7.2 *4*:1.6 *2*:0.8 *1*:0.25 *3* (1985AkZW): L1:L2:L3=1.0:0.179 *6*:0.085 *5* (2000MeZW).
95.70[dh]	<0.006[d]	474.970	(3/2)⁻	379.26678	7/2⁻				
95.85[dh]	<0.006[d]	570.832	3/2⁺	474.970	(3/2)⁻				
98.01[dh]	<0.005[d]	430.121	(9/2)⁻	332.117	9/2⁺				
101.405[dh]	<0.02[d]	433.521	(9/2)⁺	332.117	9/2⁺				
[x]102.8[e]									
105.19 *10*	0.0072[c] *21*	472.88128	9/2⁻	367.65?	11/2⁺	E1		0.292	α(K)=0.242 *4*; α(L)=0.0389 *6*; α(M)=0.00867 *13*; α(N+..)=0.00227 *4* α(N)=0.00199 *3*; α(O)=0.000265 *4*; α(P)=1.087×10^{-5} *16* Mult.: from unenumerated ce data of 1993BaZQ. Seen in only one spectrum; existence questionable (1990Wa28).
109.77924 *3*	48.39 *18*	118.18945	5/2⁺	8.41017	3/2⁺	M1+E2	−0.139 *10*	2.37	α(K)=1.97 *3*; α(L)=0.314 *5*; α(M)=0.0704 *11*; α(N+..)=0.0189 *3* α(N)=0.0165 *3*; α(O)=0.00234 *4*; α(P)=0.0001203 *17* δ: from Adopted Gammas. δ from ε decay: −0.145 *14* (1969Gu01, γγ(θ)), 0.143 *5* (from L2/L1=0.1224 *23*, weighted average of data from 1969Gu01, 1975Me08, 1976Ar06, 1985AkZW, 1987BaZB), 0.149 *3* (from L3/L1=0.0478 *16*, weighted average of data from 1969Gu01, 1975Me08, 1976Ar06, 1985AkZW, 1987BaZB), −0.160 *16* (γγ(θ), 1978Ve07), and −0.21 *6* (nuclear orientation, 1987Da11,1987Kr12); the weighted average of these is 0.1478 *25* (unweighted average, 0.161 *13*). Mult.: α(K)exp=2.02 *7* (Ice from 1976Ar06), 2.04 *2* (1995Zh20); α(L)exp=0.325 *3* (Ice from 1990Wa28);

From ENSDF

$^{169}_{69}$Tm$_{100}$-7

γ(^{169}Tm) (continued)

E_γ [†]	I_γ [‡f]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [#]	δ [#]	α [g]	Comments
									L1:L2:L3=100:12.3 6:4.79 16 (1969Gu01); K:L1:L2:L3=34.9 11:4.87 9:0.56 6:0.24 2 (1976Ar06); L1:L2:L3=100:12.58 25:5.0 2 (1975Me08); L1:L2:L3:M1:M2:M3:N:(O+P)= 129.0 16:14.9 4:5.6 2:20.4 7:3.8 3:1.6 2:6.1 10:1.7 3 (1985AkZW); L1:L2:L3=100:12.7 5:5.32 25 (1987BaZB).
113.62[dh]	<0.03[d]	832.42	(9/2$^+$)	718.786	(7/2$^+$)				
113.98[dh]	<0.024[d]	430.121	(9/2)$^-$	316.14633	7/2$^+$				
[x]114.1[e]									
[x]115.29[e]									
117.376 19	0.111 7	433.521	(9/2)$^+$	316.14633	7/2$^+$	[M1,E2]		1.82 14	α(K)=1.2 5; α(L)=0.50 25; α(M)=0.12 7; α(N+..)=0.031 16 α(N)=0.027 15; α(O)=0.0033 15; α(P)=7.E−5 4
118.18940 14	5.216 20	118.18945	5/2$^+$	0.0	1/2$^+$	E2		1.642	α(K)=0.701 10; α(L)=0.721 10; α(M)=0.1759 25; α(N+..)=0.0447 7 α(N)=0.0400 6; α(O)=0.00469 7; α(P)=2.95×10^{-5} 5 Mult.: α(K)exp=0.69 3 (Ice from 1976Ar06); K:M=1.28 6:0.30 5 (1976Ar06); K:L1:L2:L3=31.9 5:3.4 2:16.0 4:14.5 6 (1985AkZW).
129.94[dh]	<1.5[d]	474.970	(3/2)$^-$	345.028	5/2$^-$				
130.52293 4	31.68 11	138.93315	7/2$^+$	8.41017	3/2$^+$	E2		1.143	α(K)=0.541 8; α(L)=0.462 7; α(M)=0.1124 16; α(N+..)=0.0286 4 α(N)=0.0256 4; α(O)=0.00302 5; α(P)=2.31×10^{-5} 4 Mult.: α(K)exp=0.545 5 (1995Zh20, K x ray-γ coin); α(L)exp=0.484 18 (Ice from 1990Wa28); L1:L2:L3=29.2 5:114 2:100 (1966Er03); L1:L2:L3= 28.5 9:113 2:100 (1975Me08); K:L1:L2:L3:M:N= 6.2 3:0.72 9:2.5 1:2.2 1:1.6 3:0.33 5 (1976Ar06); L1:L2:L3=28.8 6:110 10:100, L3/M3=4.17 15, M1:M2:M3=28 3:115 8:100 (1968Gi06); K:L:M:N=44.9 14:39.7 15:9.78 15:2.30 8 (1990Wa28). Other: 1972Ag03.
[x]141.8[e]									
[x]147.5[e]									
[x]148.5[e]									
156.724 11	0.0275 7	472.88128	9/2$^-$	316.14633	7/2$^+$	E1		0.1016	α(K)=0.0850 12; α(L)=0.01302 19; α(M)=0.00289 4; α(N+..)=0.000762 11 α(N)=0.000668 10; α(O)=9.08×10^{-5} 13; α(P)=4.04×10^{-6} 6 Mult.: from unenumerated ce data of 1993BaZQ.
173.88[dh]	<0.008[d]	646.759	(7/2$^-$)	472.88128	9/2$^-$				
177.21307 4	62.01 21	316.14633	7/2$^+$	138.93315	7/2$^+$	M1+E2	−0.30 13	0.594 19	α(K)=0.490 22; α(L)=0.081 4; α(M)=0.0182 10;

From ENSDF

$\gamma(^{169}Tm)$ (continued)

E_γ †	I_γ ‡f	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	δ#	αg	Comments
									α(N+..)=0.00488 23 α(N)=0.00425 21; α(O)=0.000598 20; α(P)=2.97×10^{-5} 16 δ: unweighted average of 0.41 3 (α(L3)exp, 1972Ag03), 0.425 9 and 0.434 7 (from L2/L1=0.211 5 and L3/L1=0.118 3, respectively, the weighted averages of data from 1969Gu01, 1975Me08, 1976Ar06, 1987BaZB), −0.20 +8−11 and −0.19 5 (1978Ve07, $\gamma\gamma(\theta)$), −0.44 1 (nuclear orientation, 1987Da11,1987Kr12), 0.32 10 (α(K)exp, 1990Wa28), −0.20 +4−3 (1994De01, $\gamma\gamma(\theta)$), 0.19 +4−5 (α(K)exp, 1995Zh20); uncertainty (0.04) expanded to 0.13 to include most precise datum. Additional information 1. Mult.: α(K)exp=0.515 5 (1995Zh20, K x ray-γ coin), 0.498 14 (Ice from 1990Wa28), 0.48 3 (Ice from 1976Ar06), 0.52 3 (1973El15), 0.488 25 (Ice from 1976Ar06); α(L3)exp=0.0071 7 (1972Ag03); L1:L2:L3=100:21.2 10:12.0 4 (1969Gu01); K:L1:L2:L3=729 15:100:21.2 8:11.5 5 (1975Me08); K:L1:L2:L3:M:N=10.7 7:1.59 5:0.31 3:0.17 2:0.43 3:0.12 1 (1976Ar06); L1:L2:L3=100:21.3 9:11.9 6 (1987BaZB); K:L:M:N=80.2 23:14.91 18:3.31 7:0.84 3 (1990Wa28).
193.15 5	0.021[c] 3	332.117	9/2$^+$	138.93315	7/2$^+$	M1+E2[b]	−0.126[b] 21	0.479	α(K)=0.401 6; α(L)=0.0610 9; α(M)=0.01362 20; α(N+..)=0.00367 6 α(N)=0.00319 5; α(O)=0.000457 7; α(P)=2.44×10^{-5} 4
197.95675 4	100	316.14633	7/2$^+$	118.18945	5/2$^+$	M1+E2	−0.326 6	0.433	α(K)=0.358 5; α(L)=0.0586 9; α(M)=0.01318 19; α(N+..)=0.00353 5 α(N)=0.00308 5; α(O)=0.000433 6; α(P)=2.16×10^{-5} 3 δ: weighted average of −0.306 17 (1969Gu01, $\gamma\gamma(\theta)$), 0.329 7 (from L2/L1=0.1430 23, weighted average of data In 1969Gu01, 1975Me08, 1976Ar06, 1987BaZB), 0.320 8 (from L3/L1=0.0571 22, weighted average of data of 1969Gu01, 1975Me08, 1976Ar06, 1987BaZB), −0.352 18 (nuclear orientation, 1987Da11,1987Kr12). Other values: −0.29 +5−10 (1978Ve07, $\gamma\gamma(\theta)$), −6.1 +4−6 (1994De01, $\gamma\gamma(\theta)$). 1994De01 advocate the larger of the $\gamma\gamma(\theta)$ solutions and attribute the discrepancy between their δ and that from ce data to penetration effects; the evaluator rejects this δ because, as also noted by 1999Sc05, it would have a deleterious effect on decay scheme intensity balance. Mult.: α(K)exp=0.388 4 (1995Zh20), 0.375 14 (Ice from 1976Ar06), 0.386 7 (Ice from 1990Wa28), α(K)exp=0.39 2 (1973El15), α(K)exp=0.38 2 (1975Me08); L1:L2:L3=100:15.6 9:6.1 3 (1969Gu01); K:L1:L2:L3=732 15:100:14.2 3:5.71 23 (1975Me08); K:L1:L2:L3:M:N=13.4

$^{169}_{69}Tm_{100}$-9

γ(^{169}Tm) (continued)

E_γ[†]	I_γ[‡f]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	δ[#]	α[g]	Comments
									5:1.81 4:0.25 2:0.10 1:0.5 1:0.14 3 (1976Ar06); L1:L2:L2=100:14.3 4:4.8 5 (1987BaZB); K:L:M=100.0 18:16.85 23:3.82 6 (1990Wa28); M/L=0.235 7, N+/M=0.281 17 (1970Mi15). Other: 1972Ag03.
199.77[dh]	<0.09[d]	633.292	5/2+	433.521	(9/2)+				
205.99 6	0.0094 23	345.028	5/2−	138.93315	7/2+	E1		0.0497	α(K)=0.0417 6; α(L)=0.00625 9; α(M)=0.001387 20; α(N+..)=0.000367 6 α(N)=0.000321 5; α(O)=4.42×10^{-5} 7; α(P)=2.05×10^{-6} 3 I_γ: weighted average of 0.0071 4 (1990AdZZ,1990Wa28) and 0.0116 1 (1986Me07). Mult.: from unenumerated ce data of 1993BaZQ.
213.935 17	0.0081[c] 6	332.117	9/2+	118.18945	5/2+	E2[b]		0.208	α(K)=0.1348 19; α(L)=0.0563 8; α(M)=0.01347 19; α(N+..)=0.00347 5 α(N)=0.00308 5; α(O)=0.000378 6; α(P)=6.42×10^{-6} 9
226.3 7	0.0007[c] 5	345.028	5/2−	118.18945	5/2+				
228.71[h] 5	<0.0011	367.65?	11/2+	138.93315	7/2+	E2[b]		0.1673	α(K)=0.1113 16; α(L)=0.0430 6; α(M)=0.01027 15; α(N+..)=0.00265 4 α(N)=0.00235 4; α(O)=0.000291 4; α(P)=5.39×10^{-6} 8 See comment with 367.7 level. E_γ: from Adopted Gammas. I_γ: upper limit estimated from spectrum (1990WaZZ).
240.331 3	0.317 17	379.26678	7/2−	138.93315	7/2+	E1(+M2)	<+0.12	0.042 9	α(K)=0.035 7; α(L)=0.0056 15; α(M)=0.0013 4; α(N+..)=0.00033 9 α(N)=0.00029 8; α(O)=4.1×10^{-5} 11; α(P)=2.0×10^{-6} 6 δ: <0.12 (from K/L1, 1972Ag03) and +0.5 4 (nuclear orientation, 1987Da11,1987Kr12). Other: 0.095 16 reported by 1976Ar06, but basis for this is unclear. Mult.: α(K)exp=0.041 3 (Ice from 1972Ag03); K:L1:L2:L3=857 107:100:15 6:16 7 (1972Ag03); K:L=45 5:10 5 (1976Ar06).
261.07712 5	4.674 20	379.26678	7/2−	118.18945	5/2+	E1+M2	−0.07 3	0.032 5	α(K)=0.026 4; α(L)=0.0041 8; α(M)=0.00091 18; α(N+..)=0.00024 5 α(N)=0.00021 4; α(O)=3.0×10^{-5} 6; α(P)=1.4×10^{-6} 3 δ: ≤0.025 (from K/L1, 1972Ag03), 0.032 8 (1976Ar06), −0.123 +22−20 (γγ(θ), 1978Ve07), −0.060 19 (nuclear orientation, 1987Da11,1987Kr12), −0.03 4 (1988MeZW, γγ(θ), evaluator's analysis). Mult.: α(K)exp=0.030 1 (Ice from 1972Ag03), 0.024 2 (Ice from 1976Ar06); K:L1:L2:L3=867 67:100:13.8 12:14.2 10 (1972Ag03).
291.188 11	0.0120[c] 4	430.121	(9/2)−	138.93315	7/2+	E1		0.0207	α(K)=0.01742 25; α(L)=0.00255 4; α(M)=0.000564 8; α(N+..)=0.0001500 21

$^{169}_{69}$Tm$_{100}$-10

γ(^{169}Tm) (continued)

E_γ[†]	I_γ[‡f]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[g]	Comments
									α(N)=0.0001309 *19*; α(O)=1.82×10^{-5} *3*; α(P)=8.89×10^{-7} *13* Mult.: from unenumerated ce data of 1993BaZQ.
294.54 *11*	0.0027 *7*	433.521	(9/2)$^+$	138.93315	7/2$^+$	M1		0.1522	α(K)=0.1279 *18*; α(L)=0.0190 *3*; α(M)=0.00423 *6*; α(N+..)=0.001139 *16* α(N)=0.000989 *14*; α(O)=0.0001424 *20*; α(P)=7.77×10^{-6} *11* I_γ: from 1990Wa28. other Iγ: 0.020 *2* (1978Ve07). Mult.: from unenumerated ce data of 1993BaZQ. Seen in only one spectrum; existence questionable (1990Wa28).
301.73[dh]	<0.013[d]	646.759	(7/2$^-$)	345.028	5/2$^-$				
306.83[dh]	<0.5[d]	781.796	(5/2)$^+$	474.970	(3/2)$^-$				
307.52[dh]	<1.4[d]	878.35	(7/2$^+$)	570.832	3/2$^+$				
307.73586 *4*	27.96 *9*	316.14633	7/2$^+$	8.41017	3/2$^+$	E2		0.0662	α(K)=0.0481 *7*; α(L)=0.01390 *20*; α(M)=0.00327 *5*; α(N+..)=0.000851 *12* α(N)=0.000752 *11*; α(O)=9.58×10^{-5} *14*; α(P)=2.48×10^{-6} *4* Mult.: α(K)exp=0.053 *5* (Ice from 1962Gr16), 0.050 *2* (Ice from 1976Ar06), 0.0514 *10* (Ice from 1990Wa28); K/L=3.49 *11*, K/L3=15.5 *8* (1971Bo49); K:L1:L2:L3=1641 *87*:195 *7*:172 *5*:100, M1:M2:M3=161 *16*:152 *15*:100, L/M=4.17 *17* (1968Gi06); K:L=50 *2*:15 *2* (1976Ar06); K:L:M:N=3.73 *7*:1.15 *3*:0.266 *13*:0.068 *10* (1990Wa28).
333.963 *12*	0.00485 *17*	472.88128	9/2$^-$	138.93315	7/2$^+$				I_γ: from Iγ=0.0077 *43* and 0.0044 *3* (2000Mo02), 0.00493 *15* (1990Wa28), 0.0070 *9* (1986Me07), 0.0045 *8* (1976Ge21), 0.0045 *6* (1972Bb13).
336.618 *3*	0.0263 *8*	345.028	5/2$^-$	8.41017	3/2$^+$	E1(+M2)	≤0.66	0.07 *6*	α(K)=0.06 *5*; α(L)=0.011 *10*; α(M)=0.0025 *21*; α(N+..)=0.0007 *6* α(N)=0.0006 *5*; α(O)=8.E−5 *7*; α(P)=4.E−6 *4* Mult.,δ: E1,M2 from unenumerated ce data of 1993BaZQ; α(K)exp≤0.11 (Ice from 1970Al02).
356.74 *5*	3.92×10^{-4}[c] *17*	474.970	(3/2)$^-$	118.18945	5/2$^+$				
370.854 *8*	0.00245 *26*	379.26678	7/2$^-$	8.41017	3/2$^+$	[M2][a]		0.300	α(K)=0.243 *4*; α(L)=0.0446 *7*; α(M)=0.01020 *15*; α(N+..)=0.00275 *4* α(N)=0.00239 *4*; α(O)=0.000340 *5*; α(P)=1.751×10^{-5} *25* I_γ: from 0.00181 *11* and <0.0055 (2000Mo02), 0.00267 *10* (1990Wa28), 0.0034 *9* (1976Ge12), 0.00292 *11* (1972Bb13). 0.010 *5* (2000Mo02, data set E-1) is a statistical outlier. Other Iγ: 0.0228 *16* (186me07),

$\gamma(^{169}$Tm) (continued)

E_γ[†]	I_γ[‡f]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[g]	Comments
									0.019 *1* (1978Ve07). Mult.: α(K)exp=0.17 *9* (Ice from 1990Wa28).
379.284 *18*	0.00113 *23*	379.26678	7/2$^-$	0.0	1/2$^+$	[E3][a]		0.1270	α(K)=0.0756 *11*; α(L)=0.0393 *6*; α(M)=0.00959 *14*; α(N+..)=0.00248 *4* α(N)=0.00220 *3*; α(O)=0.000273 *4*; α(P)=4.66$\times10^{-6}$ *7* I_γ: from Iγ=0.00172 *31* (2000Mo02), 0.00049 *3* (1990Wa28), 0.00084 *28* (1976Ge12), 0.00103 *20* (1972Bb13). Ice and Iγ from 1990Wa28 imply α(K)exp=0.35 *5* (cf. α(K)=0.074 for probable multipolarity). This suggests a major error in Iγ or Ice(K) in 1990Wa28, probably the latter. Iγ=0.00113 *23* if the datum from 1990Wa28 is omitted from the weighted average. Iγ=0.0034 *5* (1986Me07) is a statistical outlier.
386.671 *13*	9.32$\times10^{-4}$ *21*	718.786	(7/2$^+$)	332.117	9/2$^+$	[M1,E2]		0.054 *20*	α(K)=0.044 *18*; α(L)=0.0077 *15*; α(M)=0.0017 *3*; α(N+..)=0.00046 *9* α(N)=0.00041 *7*; α(O)=5.6$\times10^{-5}$ *13*; α(P)=2.6$\times10^{-6}$ *12*
452.62 *8*	4.9$\times10^{-5}$ *15*	570.832	3/2$^+$	118.18945	5/2$^+$	M1+E2[b]	1.5[b] *+9−4*	0.030 *5*	α(K)=0.025 *4*; α(L)=0.0045 *4*; α(M)=0.00101 *8*; α(N+..)=0.000269 *22* α(N)=0.000235 *19*; α(O)=3.2$\times10^{-5}$ *3*; α(P)=1.42$\times10^{-6}$ *25* I_γ: weighted average of 0.000046 *10* (1990Wa28) and 0.00014 *6* (1972Bb13).
464.7[@]	1.0$\times10^{-5}$[@] *6*	832.42	(9/2$^+$)	367.65?	11/2$^+$				
465.65[@]	5.30$\times10^{-4}$[@] *6*	781.796	(5/2)$^+$	316.14633	7/2$^+$				
466.7[@] *3*	5.4$\times10^{-5}$[@] *6*	474.970	(3/2)$^-$	8.41017	3/2$^+$				
474.970 *9*	5.41$\times10^{-4}$ *12*	474.970	(3/2)$^-$	0.0	1/2$^+$				I_γ: weighted average of 0.000540 *12* (1990Wa28), 0.00064 *22* (1976Ge21), 0.00056 *6* (1972Bb13).
494.357 *8*	0.00410 *7*	633.292	5/2$^+$	138.93315	7/2$^+$	M1[&]		0.0389	α(K)=0.0328 *5*; α(L)=0.00479 *7*; α(M)=0.001064 *15*; α(N+..)=0.000287 *4* α(N)=0.000249 *4*; α(O)=3.59$\times10^{-5}$ *5*; α(P)=1.97$\times10^{-6}$ *3* I_γ: weighted average of 0.00408 *7* (1990Wa28), 0.0048 *8* (1986Me07), 0.0048 *8* (1976Ge21), 0.00414 *20* (1972Bb13). Mult.: α(K)exp=0.035 *5* (Ice from 1970Al02); K/L=3.7 *21* (1970Al02).
500.35 *10*	2.46$\times10^{-5}$[c] *21*	832.42	(9/2$^+$)	332.117	9/2$^+$				
507.8 *3*	4.1$\times10^{-6}$[c] *22*	646.759	(7/2$^-$)	138.93315	7/2$^+$				

$^{169}_{69}$Tm$_{100}$-12

γ(^{169}Tm) (continued)

E$_\gamma$[†]	I$_\gamma$[‡f]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.[#]	δ[#]	α[g]	Comments
515.101 *6*	0.01161 *17*	633.292	5/2$^+$	118.18945	5/2$^+$	M1[&]		0.0350	α(K)=0.0295 *5*; α(L)=0.00430 *6*; α(M)=0.000956 *14*; α(N+..)=0.000258 *4* α(N)=0.000224 *4*; α(O)=3.23×10^{-5} *5*; α(P)=1.773×10^{-6} *25* I$_\gamma$: weighted average of 0.01154 *18* (1990Wa28), 0.0111 *8* (1986Me07), 0.013 *1* (1978Ve07), 0.0132 *11* (1976Ge21), 0.0117 *5* (1972Bb13). Mult.: α(K)exp=0.028 *4* (Ice from 1970Al02); α(K)exp=0.0340 *24* (Ice from 1990Wa28); K/L=6 *3* (1970Al02).
528.569 *10*	3.33×10^{-4} *8*	646.759	(7/2$^-$)	118.18945	5/2$^+$				I$_\gamma$: weighted average of 0.000333 *8* (1990Wa28), 0.00034 *25* (1976Ge21), 0.000341 *36* (1972Bb13) other Iγ: 0.0057 *8* (1986Me07).
546.16 *22*	4.1×10^{-6}[c] *11*	878.35	(7/2$^+$)	332.117	9/2$^+$				
562.410 *12*	3.31×10^{-4} *7*	570.832	3/2$^+$	8.41017	3/2$^+$	M1+E2[b]	0.8[b] *+5−4*	0.022 *4*	α(K)=0.018 *4*; α(L)=0.0029 *4*; α(M)=0.00064 *8*; α(N+..)=0.000171 *22* α(N)=0.000149 *19*; α(O)=2.1×10^{-5} *3*; α(P)=1.08×10^{-6} *22* I$_\gamma$: weighted average of 0.000329 *7* (1990Wa28), 0.00042 *25* (1976Ge21), 0.00038 *4* (1972Bb13). other Iγ: 0.0015 *3* (1986Me07). Mult.: α(K)exp≤0.053 (Ice from 1970Al02).
570.890 *27*	3.10×10^{-4} *18*	570.832	3/2$^+$	0.0	1/2$^+$	M1+E2[b]	0.8[b] *+5−4*	0.021 *4*	α(K)=0.018 *4*; α(L)=0.0027 *4*; α(M)=0.00061 *8*; α(N+..)=0.000165 *22* α(N)=0.000143 *19*; α(O)=2.0×10^{-5} *3*; α(P)=1.04×10^{-6} *21* I$_\gamma$: weighted average of 0.000297 *20* (1990Wa28), 0.00039 *28* (1976Ge21), 0.00036 *3* (1972Bb13). other Iγ: 0.0009 *2* (1986Me07). Mult.: α(K)exp≤0.065 (Ice from 1970Al02).
579.851 *5*	0.00536 *8*	718.786	(7/2$^+$)	138.93315	7/2$^+$	(M1)[&]		0.0259	α(K)=0.0218 *3*; α(L)=0.00317 *5*; α(M)=0.000703 *10*; α(N+..)=0.000190 *3* α(N)=0.0001646 *23*; α(O)=2.38×10^{-5} *4*; α(P)=1.308×10^{-6} *19* I$_\gamma$: weighted average of 0.00535 *9* (1990Wa28), 0.0063 *10* (1986Me07), 0.005 *2* (1978Ve07), 0.062 *8* (1976Ge21), 0.00528 *22* (1972Bb13). Mult.: α(K)exp=0.025 *3* (Ice from 1970Al02); α(K)exp=0.017 *4* (Ice from 1990Wa28).
600.603 *8*	0.00317 *5*	718.786	(7/2$^+$)	118.18945	5/2$^+$	(M1)[&]		0.0237	α(K)=0.0199 *3*; α(L)=0.00289 *4*; α(M)=0.000642 *9*; α(N+..)=0.0001732 *25* α(N)=0.0001503 *21*; α(O)=2.17×10^{-5} *3*;

From ENSDF

γ(^{169}Tm) (continued)

Eγ[†]	Iγ[‡f]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	α[g]	Comments
								α(P)=1.195×10^{-6} *17* Iγ: weighted average of 0.00317 *6* (1990Wa28), 0.0026 *5* (1986Me07), 0.005 *3* (1978Ve07), 0.0035 *8* (1976Ge21), 0.00322 *14* (1972Bb13). Mult.: α(K)exp=0.021 *7* (Ice from 1970Al02).
624.881 *4*	0.0137 *4*	633.292	5/2$^+$	8.41017	3/2$^+$	M1[&]	0.0214	α(K)=0.0180 *3*; α(L)=0.00262 *4*; α(M)=0.000580 *9*; α(N+..)=0.0001565 *22* α(N)=0.0001358 *19*; α(O)=1.96×10^{-5} *3*; α(P)=1.080×10^{-6} *16* Iγ: weighted average of 0.01390 *25* (1990Wa28), 0.0116 *8* (1986Me07), 0.020 *5* (1978Ve07), 0.0154 *14* (1976Ge21), 0.0137 *6* (1972Bb13). Mult.: α(K)exp=0.0178 *21* (Ice from 1970Al02); α(K)exp=0.0155 *26* (Ice from 1990Wa28); K/L=6.0 *19* (1970Al02).
633.32 *10*	1.92×10^{-5}[c] *13*	633.292	5/2$^+$	0.0	1/2$^+$	[E2]	0.00959	α(K)=0.00778 *11*; α(L)=0.001410 *20*; α(M)=0.000320 *5*; α(N+..)=8.50×10^{-5} *12* α(N)=7.44×10^{-5} *11*; α(O)=1.018×10^{-5} *15*; α(P)=4.35×10^{-7} *6*
642.873 *9*	2.13×10^{-4} *5*	781.796	(5/2)$^+$	138.93315	7/2$^+$			Iγ: weighted average of 0.000212 *5* (1990Wa28), 0.00025 *22* (1976Ge21), 0.000224 *17* (1972Bb13).
663.599 *7*	5.38×10^{-4} *15*	781.796	(5/2)$^+$	118.18945	5/2$^+$			Iγ: weighted average of 0.000528 *17* (1990Wa28), 0.00062 *25* (1976Ge21), 0.000565 *28* (1972Bb13).
693.46 *8*	2.42×10^{-5}[c] *12*	832.42	(9/2$^+$)	138.93315	7/2$^+$			
710.354 *15*	9.5×10^{-5} *7*	718.786	(7/2$^+$)	8.41017	3/2$^+$			Iγ: weighted average of 0.000087 *6* (1990Wa28), 0.00008 *8* (1976Ge21), 0.000109 *8* (1972Bb13). Mult.: α(K)exp≤0.057 (Ice from 1970Al02).
739.42 *11*	5.1×10^{-6}[c] *6*	878.35	(7/2$^+$)	138.93315	7/2$^+$			
760.24 *24*	2.3×10^{-6}[c] *6*	878.35	(7/2$^+$)	118.18945	5/2$^+$			
773.386 *14*	5.81×10^{-4} *9*	781.796	(5/2)$^+$	8.41017	3/2$^+$			Iγ: weighted average of 0.000578 *10* (1990Wa28), 0.00062 *28* (1976Ge21), 0.000607 *28* (1972Bb13).
781.64 *8*	8.4×10^{-6}[c] *7*	781.796	(5/2)$^+$	0.0	1/2$^+$			

† Eγ quoted to 0.01 eV are from the evaluation by 2000He14 (with energy scale based on Eγ=411.80205 keV *17* for the "Gold standard" (2$^+$ to g.s. transition in ^{198}Hg)) and ΔE is quoted here without the 0.3 ppm uncertainty arising from the energy-wavelength conversion. All other Eγ are based on data from 1990Wa28, except where noted (the calibration energies assumed by 1990Wa28 are 5.8x10^{-4}% higher than those given in 2000He14, so all Eγ data from 1990Wa28 have been reduced accordingly). The additional 0.3 ppm uncertainty applicable to Eγ from 2000He14 was taken into account when deducing E(level) values from Eγ.

‡ Iγ relative to I(198γ)=100.0; weighted averages (using limitation of relative statistical weights method for discrepant data sets) of data from 1972Bb13, 1976Ge21, 1977Ge12, 1978Ve07, 1983Fu12, 1986Me07, 1990Wa28, 1996Bh08, 1999Mi01 and the nine sets of measurements reported In 2000Mo02, except as noted. note that 2000Mo02 report the results from the various groups participating In the EUROMET-410 project; however, some data from that exercise were also published independently by 1999Sc05, 2000ZaZY (2 measurements, see also 2000Sa07) and 2000Iw06 (see also 2001De06). occasionally, a datum from one of the latter sources differs from that reported In 2000Mo02. 2000Iw06 give 1.9% uncertainty for I(198γ) and the evaluator adopts this; the value of 1.1% In %I(198γ) given In 2000Mo02 is possibly a misprint of 2.1%. Iγ data for the 21γ, 334γ and 371γ are 0.539 *29*, 0.0051 *5* and 0.0019 *6*, respectively, In

γ(^{169}Tm) (continued)

1999Sc05, but 0.586 *33*, 0.008 *4* and 0.010 *5* In 2000Mo02; the evaluator has used the data from the later of the two publications. 2000Sa07 present Iγ values which are close to, but differ from, those of study '3-E' In 2000Mo02; the latter were used In the present evaluator′s averages upon the advice of one of the authors. data identified As statistical outliers (based on the Chauvenet criterion) were excluded from averages (13 cases). Uncertainties arising from source activity measurements (1999MoZV, 1983Fu12), when significant, were subtracted In quadrature from reported absolute intensities before scaling data to give I(198γ)=100. Uncertainties In the 198γ reference line were added In quadrature to uncertainties In the other lines prior to averaging. Data from 1970Al02, 1972Bb13, 1976Ge12, 1986Ad07 were reported relative to I(308γ) so were renormalized so I(308γ)=27.96, the value adopted here, to enable intercomparison of all authors′ data. Data from 2000Mo02, data set 10-E2, do not include the 198γ, but it is clear from tables 16 and 18 of 1999MoZV that those authors assumed the same source activity when converting from relative to absolute Iγ, so the evaluator has done likewise. Iγ values In 1976Ar06 are not used here because they are derived from measured ce intensities and assumed multipolarities. data from 1986Ad07 are presumed to have been superseded by 1990Wa28.

[#] From ce data summarized by 1976Ar06, except where noted; the photon and ce intensity scales were normalized through α(K)=0.547 (E2 theory) for 130.5γ (for 1976Ar06, 1990Wa28) or through α(K)=0.0484 (E2 theory) for 308γ (for 1970Al02, 1972Ag03).

[@] Eγ=465.748 *10*, Iγ=0.000578 *13* for complex peak (1990Wa28); consistent with Iγ=0.00067 *6* In 1972Bb13 and 0.00081 *22* In 1976Ge21. This peak could Be resolved experimentally into two peaks (Eγ=465.662 *22* and 466.66 *28*, Iγ=0.000523 *11* and 0.000062 *7*, respectively) (1990Wa28); however, since the authors expected three transitions near this energy, they assumed Eγ from the decay scheme and deduced Iγ from a three-peak decomposition of the multiplet. it is that Iγ which is given here, along with Eγ from the decay scheme.

[&] From α(K)exp calculated using Ice from 1970Al02 (normalized so α(K)exp(308γ)=0.0484 (E2 theory)) and Iγ adopted here.

[a] Comparison to RUL shows calculated strength within recommended limit.

[b] From Adopted Gammas.

[c] From 1990Wa28.

[d] Eγ (from decay scheme) and Iγ (upper limit estimated from γ-ray spectrum) for possible (but unobserved) E1, M1, E2, or M1+E2 transition. See 1990WaZZ for additional, but weaker, possible γ′s (Iγ<0.004, relative to Iγ=100 for 198.0γ). Placement is shown As tentative here, and γ is not included In Adopted Gammas, unless there exists some independent evidence for its existence.

[e] From 1993BaZQ only; uncertainty unstated by authors.

[f] For absolute intensity per 100 decays, multiply by 0.3593 *12*.

[g] 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.

[h] Placement of transition in the level scheme is uncertain.

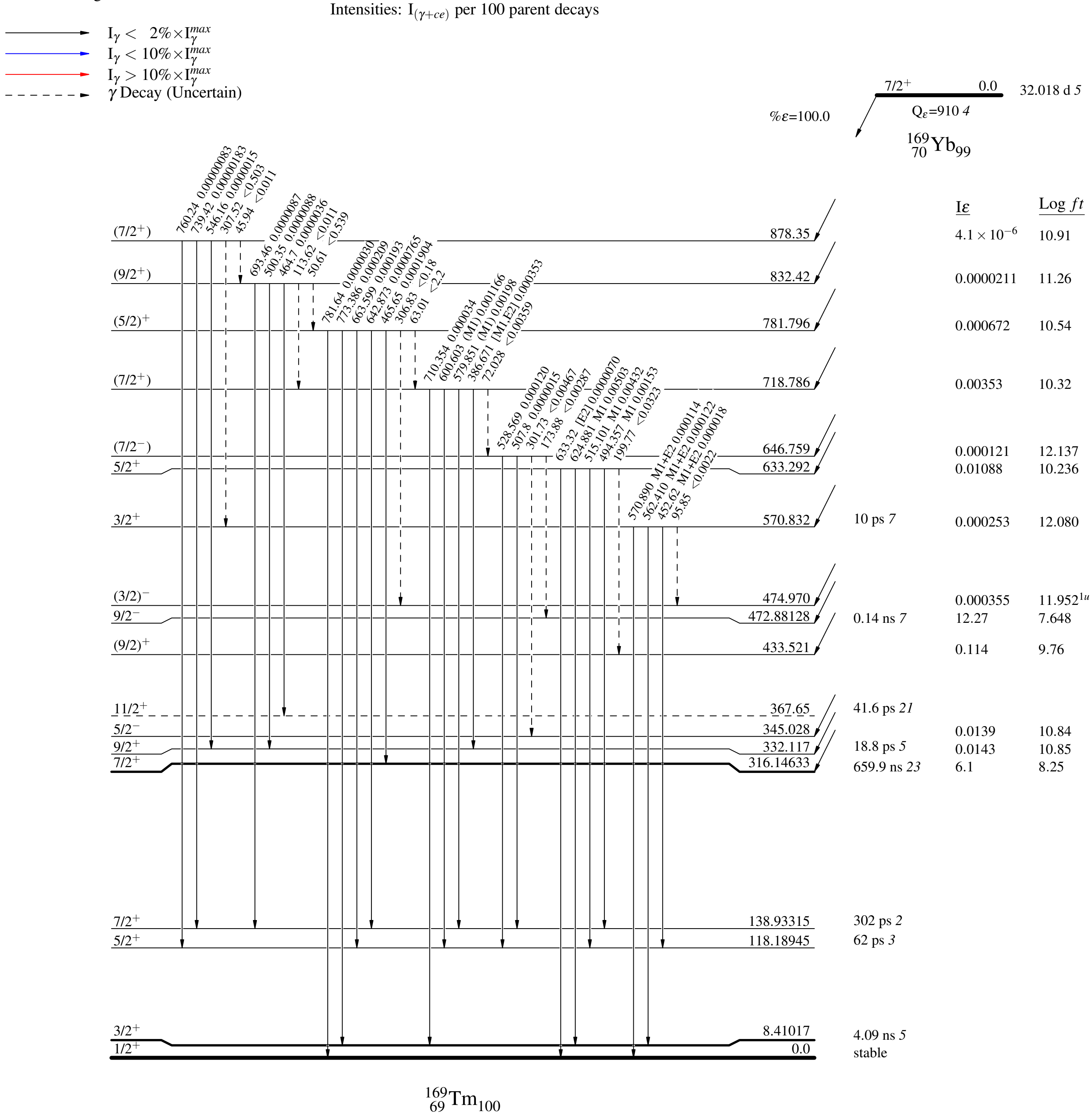
[x] γ ray not placed in level scheme.

$^{169}_{69}Tm_{100}$-15

^{169}Yb ε decay (32.018 d) 2000Mo02,1990Wa28

Decay Scheme

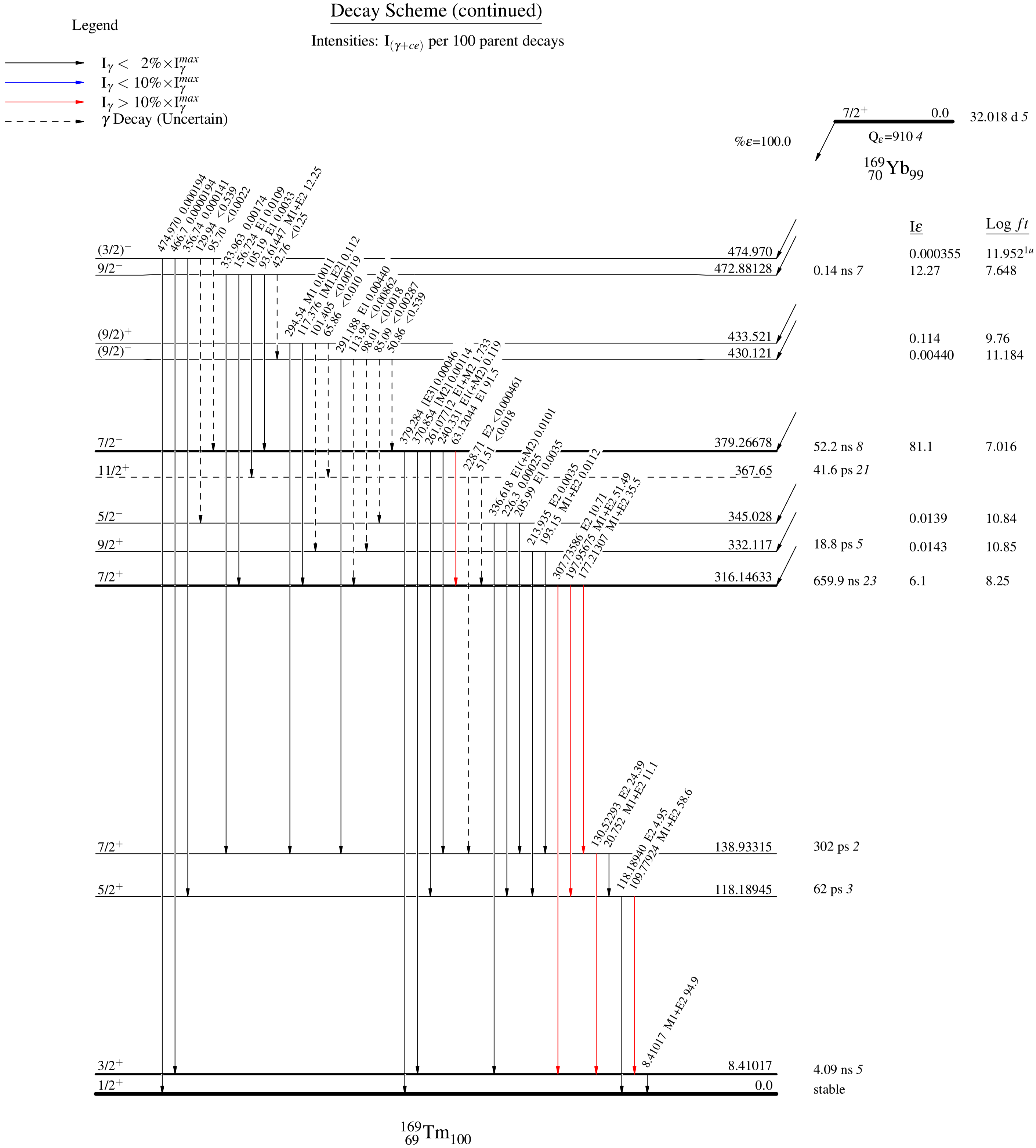
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



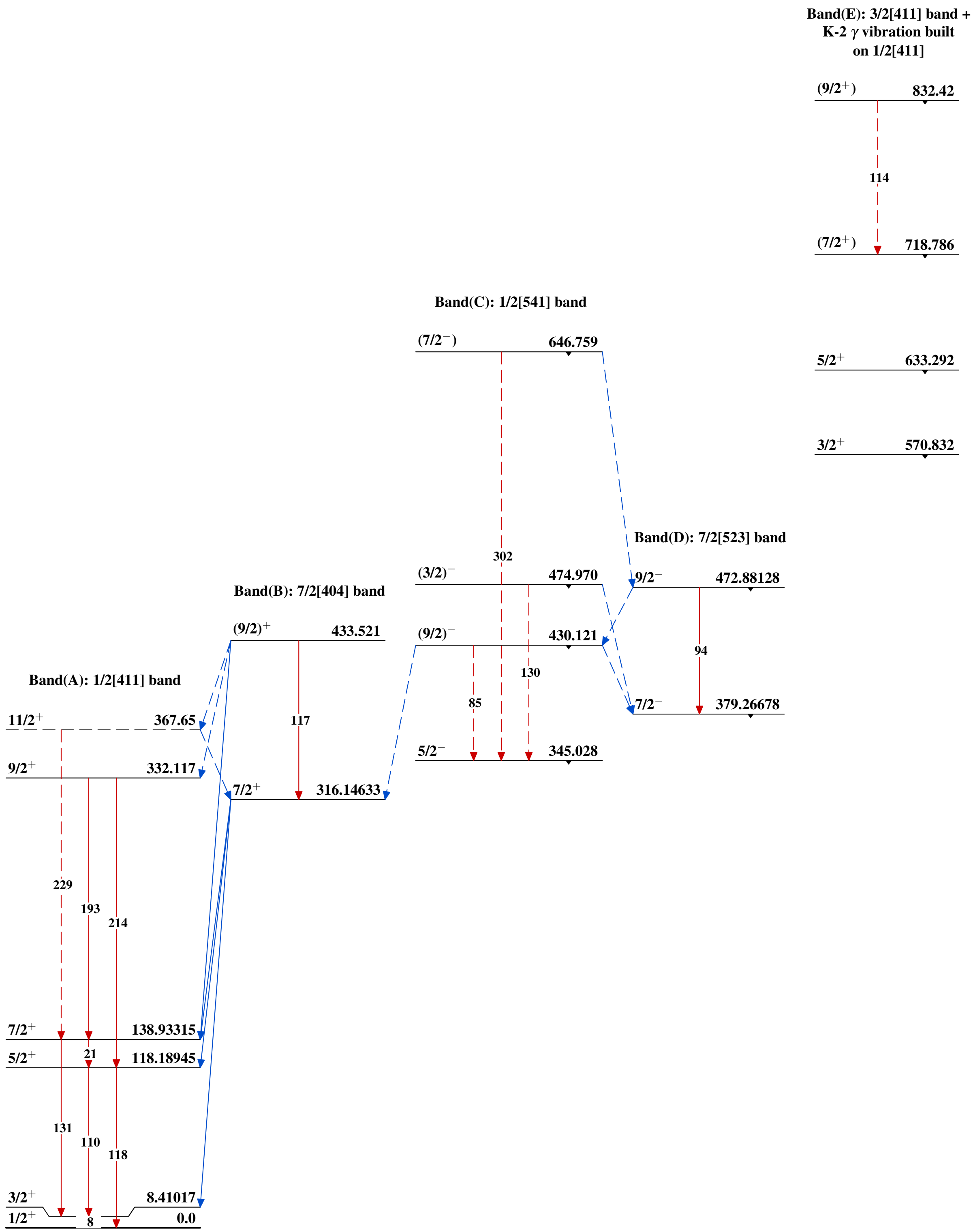
^{169}Yb ε decay (32.018 d) 2000Mo02,1990Wa28

Decay Scheme (continued)

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



^{169}Yb ε decay (32.018 d) 2000Mo02,1990Wa28



$^{169}_{69}Tm_{100}$

^{169}Yb ε decay (32.018 d) 2000Mo02,1990Wa28 (continued)

Band(F): 5/2[402] band

$^{169}_{69}Tm_{100}$