^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia	NDS 209,1 (2026)	1-Oct-2025

Parent: ^{169}Yb: E=0.0; $J^\pi=7/2^+$; $T_{1/2}$=32.016 d *8*; Q(ε)=899.1 *8*; %ε decay=100

^{169}Yb-J^π,$T_{1/2}$: from ^{169}Yb Adopted Levels.

^{169}Yb-Q(ε): from 2021Wa16.

Others: 1950Co16, 1951Ma25, 1955Jo23, 1956Bi30, 1956Co13, 1956Ha68, 1956Ko21, 1956Mi05, 1957Ba59, 1958Ca11, 1958Gr05, 1958Ha31, 1958Na06, 1958Se71, 1958Sh64, 1959Ha09, 1959Ke25, 1959Ko56, 1962El08, 1962Gr09, 1963Al12, 1963Va32, 1964Su06, 1964Su06, 1965Bo08, 1965Dz07, 1966Dz10, 1966Er03, 1966Ko01, 1967Br31, 1968Gi02, 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, 1987AbZY, 1987BaZB, 1990AdZZ, 1993BaZQ, 1994Co02, 1994De01, 1997De02, 1999Sc05, 2000AlZY, 2000Iw06, 2000MeZW, 2000Mo02, 2000Sa07, 2001De06, 2001KoZQ, 2015In02, 2021Fr11.

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), γγ 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.

2015In02: ^{169}Yb source was produced by the spallation reaction of metallic tantalum bombarded by 660 MeV protons from the synchrocyclotron at JINR, Dubna, Russia. Internal conversion electrons were detected with an electrostatic electron spectrometer. Measured E(ce), I(ce). Deduced levels, precise γ transition energies, conversion coefficients, mixing ratios.

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 the work in 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^π‡	$T_{1/2}$‡	Comments
0.0#	$1/2^+$	stable	
8.41017# *15*	$3/2^+$	4.09 ns *6*	Additional information 1. E(level): from the recoil-corrected energy difference between Eγ=118.18940 *14* and Eγ=109.77924 *3* (2000He14). E(level): from Adopted Levels. $T_{1/2}$: other data from ε decay: 4.22 ns *11* (1987AbZY) from ce-γ(t); 4.13 ns *12* (1966Mc08); 4.10 ns *21* (1974Fu01).
118.18945# *4*	$5/2^+$	62.4 ps *28*	$T_{1/2}$: other: 62 ps *10* (1959Bl15).
138.93316# *5*	$7/2^+$	302 ps *9*	$T_{1/2}$: from Adopted Levels. ε decay data: 1959Bl15 (290 ps *70*), 1960Be28, 1964Su06 (321 ps *14*), 1966Mc08 (289 ps *24*).
316.14633@ *5*	$7/2^+$	660 ns *3*	$T_{1/2}$: weighted average of 658 ns *3* (1950Fu63), 665 ns *5* (1974En09), 660 ns *5* (1994De01) from γγ(t). Others: 0.67 μs (1951Ma25), 0.64 μs *4* (1956Mi05), 670 ns *20* (1959Be62), 0.65 μs (1972Ni03), 650 ns *26* (1974Bo30). 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).
379.26678a *6*	$7/2^-$	50.5 ns *16*	$T_{1/2}$: unweighted average of 49.8 ns *15* (1974Bo30), 54.1 ns *5* (1974En09), 51.6 ns *3*

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^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02 (continued)

^{169}Tm Levels (continued)

E(level)†	Jπ‡	$T_{1/2}$‡	Comments
			(1974Vi05), and 46.4 ns *15* (1997De02), all from γγ(t). Others: 45 ns (1956Mi05), 36 ns *1* (1959Be62).
430.121[&] *11*	(9/2)−		
433.521[@] *19*	(9/2)+		
472.88128[a] *10*	9/2−	0.14 ns *7*	
474.969[&] *9*	(3/2)−		A possible but unobserved 129.94γ with Iγ<1.5 was listed in the previous evaluation (2008Ba31). Authors of 2021Fr11 did not find any evidence of this γ ray. In this dataset the 129.94γ is removed.
570.832[b] *11*	3/2+	10 ps *6*	
633.292[b] *3*	5/2+	0.27 ps *+33−12*	
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] *9*	(7/2+)		

† From Least-squares fit to Eγ; E(8.4 level) was held fixed at 8.41017 *15*. ΔE=1 keV was assumed for Eγ with missing uncertainty, weaker gamma transitions.
‡ 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

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).
Additional information 2.
εK, εL, εM, εN: Additional information 3.

E(decay)	E(level)	Iε†	Log *ft*	Comments
(20.8 *13*)	878.35	0.26 *13*	5.66 *22*	εL=0.508 *18*; εM=0.359 *12*; εN+=0.133 *5*
(66.7 *13*)	832.42	0.27 *14*	6.98 *23*	εK=0.084 *14*; εL=0.649 *10*; εM+=0.2676 *40*
(117.3 *13*)	781.796	0.9 *6*	7.35 *29*	εK=0.5941 *35*; εL=0.2973 *23*; εM+=0.1086 *10*
(180.3 *13*)	718.786	<0.45	>8.2	εK=0.7178 *11*; εL=0.2096 *7*; εM+=0.07260 *34* I(ε+β+): feeding overlaps zero value. Upper limit from GTOL code: Method 1.
(252.3 *13*)	646.759	0.0021 *17*	10.91 *35*	εK=0.7625 *6*; εL=0.17759 *33*; εM+=0.05987 *21*
(265.8 *13*)	633.292	0.027 *8*	9.86 *13*	εK=0.7674 *6*; εL=0.17407 *30*; εM+=0.05848 *20*
(328.3 *13*)	570.832	2.53×10^{-4} *9*	11.609 *16*	εK=0.6828 *10*; εL=0.2351 *6*; εM+=0.08216 *33*
(426.2 *13*)	472.88128	12.39 *17*	7.677 *7*	εK=0.79804 *36*; εL=0.15207 *16*; εM+=0.04989 *13*
(465.6 *13*)	433.521	0.106 *13*	9.83 *5*	εK=0.80183 *34*; εL=0.14934 *15*; εM+=0.04883 *13*
(469.0 *13*)	430.121	<0.4	>9.3	εK=0.80212 *34*; εL=0.14913 *15*; εM+=0.04875 *13* I(ε+β+): feeding overlaps zero value. Upper limit from GTOL code: Method 1.

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^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02 (continued)

ε radiations (continued)

E(decay)	E(level)	Iε†	Log *ft*	Comments
(519.8 *13*)	379.26678	80.8 *9*	7.056 *5*	εK=0.80598 *32*; εL=0.14635 *14*; εM+=0.04768 *13*
(554.1 *13*)	345.028	0.010 *2*	11.02 *9*	εK=0.80812 *31*; εL=0.14480 *13*; εM+=0.04708 *13*
(567.0 *13*)	332.117	0.010 *3*	11.05 *13*	εK=0.80885 *31*; εL=0.14427 *13*; εM+=0.04687 *13*
(583.0 *13*)	316.14633	6.1 *9*	8.29 *6*	εK=0.80971 *30*; εL=0.14365 *13*; εM+=0.04664 *13*

† Absolute intensity per 100 decays.

^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02 (continued)

γ(^{169}Tm)

Iγ normalization: weighted average 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, 2000Ra04), 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*. Other: 0.360 *5* can be obtained from total I(γ+ce) (to g.s. plus 8.4 level) minus I(γ+ce)(8.4γ)=100% (negligible ε feeding to g.s. expected because ΔJ=3).

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.

K(α2)/K(α1)=0.590 *15* and 0.589 *4* (2021Fr11).

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(1)	L(αη)	L(β1)	8.4γ+L(β2)	L(γ1)	L(γ2 3)
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(1-E)	3.7 *13*	66 *5*	49.7 *37*	13.8 *15*	7.4 *13*	2.7 *9*
2000Mo02(7-E)	3.23 *16*	62.8 *31*	46.5 *23*	12.1 *8*	6.98 *34*	2.56 *14*
2000Mo02(10-E1)	3.18 *5*	63.9 *18*	48.6 *12*	14.4 *6*	7.61 *18*	2.45 *13*
2000Mo02(10-E2)	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(1-E)	-	-	0.586 *33*	149.2 *25*	263.7 *47*	412.6 *54*
2000Mo02(7-E)	-	134.7 *40*	0.535 *29*	140 *6*	249 *9*	388 11

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$^{169}_{69}Tm_{100}$-4

2000Mo02(8-E)	-	-	0.45 *4*	x			419 *8*					
2000Mo02(9-E)	-	-	0.514 *27*	143.7 *24*	253.9 *38*	397.6 *48*						
2000Mo02(10-E1)	0.488 *75*	140.6 *17*	0.547 *8*	146.4 *22*	260.1 *39*	406.3 *45*						
2000Mo02(10-E2)	0.480 *33*	137.3 *14*	0.544 *8*	146.7 *19*	(260 *3*)	406.5 *41*						
2000Mo02(11-E)	-	-	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(1-E)	85.9 *40*	22.8 *10*	108.7 *41*	122.6 *12*	7.12 *9*	47.96 *34*
2000Mo02(3-E)	-	-	-	115.9 *23*	6.86 *12*	46.05 *64*
2000Mo02(4-E)	-	-	-	123.5 *22*	7.28 *17*	48.8 *6*
2000Mo02(7-E)	81.4 *27*	21.4 *7*	102.8 *28*	123.3 *39*	7.05 *23*	47.2 *15*
2000Mo02(8-E)	-	-	103.1 *32*	121.4 *27*	6.87 *17*	46.0 *12*
2000Mo02(9-E)	80.6 *12*	21.67 *46*	102.2 *13*	121.4 *6*	7.44 *13*	48.9 *10*
2000Mo02(10-E1)	81.4 *8*	22.63 *43*	104.0 *9*	123.3 *6*	7.19 *3*	48.45 *24*
2000Mo02(10-E2)	84.2 *11*	22.66 *32*	106.8 *12*	123.4 *15*	7.23 *9*	48.75 *59*
2000Mo02(11-E)	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(1-E)	-	-	5.18 *5*	31.55 *19*	0.029 *6*	61.91 *37*
2000Mo02(3-E)	-	5.17 *10*	-	31.18 *44*	-	61.9 *9*
2000Mo02(4-E)	-	-	5.45 *11*	32.38 *36*	-	62.7 *11*
2000Mo02(7-E)	0.121 *22*	5.33 *18*	5.45 *18*	31.4 *10*	0.026 *6*	62.6 *19*
2000Mo02(8-E)	-	5.15 *14*	-	31.2 *7*	-	62.2 *12*
2000Mo02(9-E)	-	5.13 *7*	-	30.7 *5*	-	63.1 *3* x
2000Mo02(10-E1)	0.130 *11*	5.21 *3*	5.333 *27*	31.81 *10*	0.0297 *45*	61.95 *25*
2000Mo02(10-E2)	0.116 *6*	5.24 *6*	5.35 *6*	-	-	-
2000Mo02(11-E)	-	-	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

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$^{169}_{69}Tm_{100}$-5

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(1-E)	100.0 *5*	0.282 *15*	4.641 *32*	27.94 *11*	-	
2000Mo02(3-E)	100.0 *14*	0.334 *9*	4.65 *7*	27.40 *38*	-	
2000Mo02(4-E)	100.0 *17*	0.359 *23*	4.84 *8*	x 28.45 *37*	-	
2000Mo02(7-E)	100.0 *31*	0.261 *14*	4.61 *14*	28.2 *9*	-	
2000Mo02(8-E)	100.0 *19*	0.396 *29*	4.70 *14*	28.3 *5*	-	
2000Mo02(9-E)	100.0 *11*	0.332 *8*	5.00 *7*	x 29.67 *33*	x -	
2000Mo02(10-E1)	100.0 *4*	0.288 *12*	4.653 *42*	28.01 *8*	-	
2000Mo02(10-E2)	100.0 *28*	-	-	-	-	
2000Mo02(11-E)	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 [#g]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	δ[b]	α[f]	$I_{(\gamma+ce)}$[g]
8.41017 *15*	1.000 *24*	8.41017	3/2$^+$	0.0	1/2$^+$	M1+E2	0.0323 *10*	263 *5*	264 *4*

Comments

ce(M)/(γ+ce)=0.789 *9*
ce(N)/(γ+ce)=0.182 *4*; ce(O)/(γ+ce)=0.0240 *6*; ce(P)/(γ+ce)=0.000899 *20*
α(M)=209 *4*
α(N)=48.1 *9*; α(O)=6.35 *11*; α(P)=0.2375 *33*
%Iγ=0.359 *9*
E_γ: from level energy differences. Other: 8.4101 *4* (2015In02) from weighted average of measured energies of the M1, M2, N1, N3 and O1 conversion electron lines.
$I_{(\gamma+ce)}$: from intensity balance at 8.4 level; ε feeding not expected (ΔJ=2, $\Delta\pi$=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); M2:M1=100:34 *4* and N3:N1=100:40 *6* (2015In02). 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), except where otherwise noted.

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

^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02 (continued)

γ(^{169}Tm) (continued)

E_γ[†]	I_γ[#g]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	δ[b]	α[f]	$I_{(\gamma+ce)}$[g]	Comments
20.7439 *3*	0.547 *5*	138.93316	7/2$^+$	118.18945	5/2$^+$	M1+E2	0.0280 *15*	54.7 *8*	30.8 *22*	ce(L)/(γ+ce)=0.765 *8*; ce(M)/(γ+ce)=0.1715 *34* ce(N)/(γ+ce)=0.0400 *9*; ce(O)/(γ+ce)=0.00566 *12*; ce(P)/(γ+ce)=0.000290 *6* α(L)=42.6 *7*; α(M)=9.55 *15* α(N)=2.227 *35*; α(O)=0.315 *5*; α(P)=0.01613 *23* %Iγ=0.197 *2* E_γ: From 2015In02: from weighted average of measured energies of the L1, L2, L3, M1, M2, N1, and O1 conversion electron lines. Other: 20.752 *9* (1990Wa28). I_γ: deduced from I(γ+ce) and α. Iγ(exp)=0.578 *24* (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*. $I_{(\gamma+ce)}$: from intensity balance at 118.2 and 138.9 levels. Identical positive and negative corrections to I(γ+ce)(exp) (=34.4 *16*) are consistent with zero ε feeding to each. 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). Also the L2/L1, L3/L1, M2/M1, M3/M1, N2/N1,N3/N1 data of 2015In02 – listed in δ. δ: from L2/L3=0.135 *5* (weighted average of data from 1969Gu01, 169TM3cG, 1976Ar06, 2000AlZY), L3/L1=0.0526 *22* (weighted average of data from 1969Gu01, 1976Ar06, 2000AlZY); L2/L1=0.108 *3*, L3/L1=0.057 *3*, M2/M1=0.112 *11*, M3/M1=0.050 *14*, N2/N1=0.128 *4*, N3/N1=0.046 *4* (2015In02). Other: 0.00 *5* (γγ(θ), 1967BeZX). δ was deduced using the BriccMixing code (v2.3b).
^{x}39.58[‡]										
42.76[ah]	<0.7[a]	472.88128	9/2$^-$	430.121	(9/2)$^-$					%Iγ<0.3
45.93[ah]	<0.03[a]	878.35	(7/2$^+$)	832.42	(9/2$^+$)					%Iγ<0.01
50.63[ah]	<1.5[a]	832.42	(9/2$^+$)	781.796	(5/2)$^+$					%Iγ<0.5
50.86[ah]	<1.5[a]	430.121	(9/2)$^-$	379.26678	7/2$^-$					%Iγ<0.5

From ENSDF

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

^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02 (continued)

γ(^{169}Tm) (continued)

E_γ [†]	I_γ [#g]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	δ[b]	α[f]	Comments
51.51[ah]	<0.05[a]	367.65?	11/2$^+$	316.14633	7/2$^+$				%Iγ<0.02
[x]62.45[‡]									
63.01[ah]	<6.0[a]	781.796	(5/2)$^+$	718.786	(7/2$^+$)				%Iγ<2.2
63.12044 *4*	121.4 *5*	379.26678	7/2$^-$	316.14633	7/2$^+$	E1		1.098 *15*	α(K)=0.892 *12*; α(L)=0.1611 *23*; α(M)=0.0360 *5* α(N)=0.00820 *11*; α(O)=0.001047 *15*; α(P)=3.77×10^{-5} *5* %Iγ=43.6 *2* E_γ: other: 63.1216 *12* (2015In02 – from measurement of K-conversion electron line). 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), L1:L2:L3=100:36.0 *6*:44.8 *8* (from L1/L2=2.78 *5* and L1/L3=2.23 *4* in 1966Ha04).
65.87[ah]	<0.029[a]	433.521	(9/2)$^+$	367.65?	11/2$^+$				%Iγ<0.010
72.027[ah]	<0.01[a]	718.786	(7/2$^+$)	646.759	(7/2$^-$)				%Iγ<0.004
85.09[ah]	<0.008[a]	430.121	(9/2)$^-$	345.028	5/2$^-$				%Iγ<0.003
[x]85.30[‡]									
93.61447 *8*	7.18 *4*	472.88128	9/2$^-$	379.26678	7/2$^-$	M1+E2	+0.183 *3*	3.75 *5*	α(K)=3.07 *4*; α(L)=0.529 *8*; α(M)=0.1193 *17* α(N)=0.0278 *4*; α(O)=0.00389 *6*; α(P)=0.0001883 *26* %Iγ=2.58 *2* 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,

From ENSDF

γ(^{169}Tm) (continued)

E_γ[†]	I_γ[#g]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	δ[b]	α[f]	Comments
									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), α(L)exp=0.490 *15* and α(M)exp=0.158 *6* (2020Vi11); L1:L2:L3=100:16.9 *10*:9.26 *35* (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[ah]	<0.006[a]	474.969	(3/2)$^-$	379.26678	7/2$^-$				%Iγ<0.002
95.86[ah]	<0.006[a]	570.832	3/2$^+$	474.969	(3/2)$^-$				%Iγ<0.002
98.01[ah]	<0.005[a]	430.121	(9/2)$^-$	332.117	9/2$^+$				%Iγ<0.002
101.404[ah]	<0.02[a]	433.521	(9/2)$^+$	332.117	9/2$^+$				%Iγ<0.01
[x]102.8[‡]									
105.19 *10*	0.0072[@] *21*	472.88128	9/2$^-$	367.65?	11/2$^+$	E1		0.292 *4*	α(K)=0.2421 *34*; α(L)=0.0389 *6*; α(M)=0.00867 *12* α(N)=0.001990 *28*; α(O)=0.000265 *4*; α(P)=1.087×10^{-5} *15* %Iγ=0.0026 *8* Mult.: from unenumerated ce data of 1993BaZQ. Seen in only one spectrum; existence questionable (1990Wa28).
109.77924 *4*	48.39 *18*	118.18945	5/2$^+$	8.41017	3/2$^+$	M1+E2	−0.153 *11*	2.369 *33*	α(K)=1.966 *28*; α(L)=0.314 *5*; α(M)=0.0704 *11* α(N)=0.01645 *26*; α(O)=0.002336 *35*; α(P)=0.0001203 *17* %Iγ=17.39 *9* 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

From ENSDF

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

^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02 (continued)

γ(^{169}Tm) (continued)

E_γ [†]	I_γ [#g]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	α[f]	Comments
								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), 2.05 10 (2020Vi11); 0.325 3 (Ice from 1990Wa28), 0.33 2 (2020Vi11); 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).
113.64[ah]	<0.03[a]	832.42	(9/2$^+$)	718.786	(7/2$^+$)			%Iγ<0.01
113.98[ah]	<0.024[a]	430.121	(9/2)$^-$	316.14633	7/2$^+$			%Iγ<0.009
[x]114.1[‡]								
[x]115.29[‡]								
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 6 α(N)=0.027 14; α(O)=0.0033 15; α(P)=6.5×10^{-5} 35 %Iγ=0.040 3
118.18940 14	5.216 20	118.18945	5/2$^+$	0.0	1/2$^+$	E2	1.642 23	α(K)=0.701 10; α(L)=0.721 10; α(M)=0.1759 25 α(N)=0.0400 6; α(O)=0.00469 7; α(P)=2.95×10^{-5} 4 %Iγ=1.875 10 Mult.: α(K)exp=0.69 3 (Ice from 1976Ar06), 0.710 3 (2020Vi11); α(L)exp=0.70 4 (2020Vi11); 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).
130.52293 6	31.68 11	138.93316	7/2$^+$	8.41017	3/2$^+$	E2	1.143 16	α(K)=0.541 8; α(L)=0.462 6; α(M)=0.1124 16 α(N)=0.0256 4; α(O)=0.00302 4; α(P)=2.309×10^{-5} 32 %Iγ=11.39 6 Mult.: α(K)exp=0.545 5 (1995Zh20, K x ray-γ coin), 0.549 17 (2020Vi11); α(L)exp=0.484 18 (Ice from 1990Wa28), 0.46 3 (2020Vi11); α(M)exp=0.134 5 (2020Vi11); 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), L1:L2:L3=30 3:107 10:100 (1972Ag03).
[x]141.8[‡]								
[x]147.5[‡]								
[x]148.5[‡]								

From ENSDF

γ(^{169}Tm) (continued)

E_γ [†]	I_γ [#g]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	δ[b]	α[f]	Comments
156.724 *11*	0.0275 *7*	472.88128	9/2$^-$	316.14633	7/2$^+$	E1		0.1016 *14*	α(K)=0.0850 *12*; α(L)=0.01302 *18*; α(M)=0.00289 *4* α(N)=0.000668 *9*; α(O)=9.08×10^{-5} *13*; α(P)=4.04×10^{-6} *6* %Iγ=0.0099 *3* Mult.: from unenumerated ce data of 1993BaZQ.
173.88[ah]	<0.008[a]	646.759	(7/2$^-$)	472.88128	9/2$^-$				%Iγ<0.003
177.21307 *6*	62.01 *21*	316.14633	7/2$^+$	138.93316	7/2$^+$	M1+E2	−0.30 *13*	0.594 *18*	α(K)=0.490 *22*; α(L)=0.0809 *35*; α(M)=0.0182 *9* α(N)=0.00425 *21*; α(O)=0.000598 *19*; α(P)=2.97×10^{-5} *16* %Iγ=22.29 *11* 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, γγ(θ)), −0.44 *1* (nuclear orientation, 1987Da11, 1987Kr12), 0.32 *10* (α(K)exp, 1990Wa28), −0.20 *+4−3* (1994De01, γγ(θ)), 0.19 *+4−5* (α(K)exp, 1995Zh20); uncertainty (0.04) expanded to 0.13 to include most precise datum. Additional information 4. 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), 0.453 *15* (2020Vi11); α(L)exp=0.085 *5* (2020Vi11); α(L3)exp=0.0071 *7* (1972Ag03); α(M)exp=0.024 *3* (2020Vi11); 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[@] *3*	332.117	9/2$^+$	138.93316	7/2$^+$	M1+E2[e]	−0.126[e] *21*	0.479 *7*	α(K)=0.401 *6*; α(L)=0.0610 *9*; α(M)=0.01362 *19* α(N)=0.00319 *5*; α(O)=0.000457 *6*; α(P)=2.444×10^{-5} *35* %Iγ=0.008 *1*
197.95675 *7*	100	316.14633	7/2$^+$	118.18945	5/2$^+$	M1+E2	−0.326 *6*	0.433 *6*	α(K)=0.358 *5*; α(L)=0.0586 *8*; α(M)=0.01318 *19* α(N)=0.00308 *4*; α(O)=0.000433 *6*; α(P)=2.161×10^{-5}

From ENSDF

$^{169}_{69}Tm_{100}$-11

γ(^{169}Tm) (continued)

E_γ[†]	I_γ[#g]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	α[f]	Comments
								31 %Iγ=35.94 *12* δ: weighted average of −0.306 *17* (1969Gu01, γγ(θ)), 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, γγ(θ)), −6.1 *+4−6* (1994De01, γγ(θ)). 1994De01 advocate the larger of the γγ(θ) 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), 0.39 *2* (1973El15), 0.38 *2* (1975Me08), 0.376 *6* (2020Vi11); α(L)exp=0.060 *4* (2020Vi11); α(M)exp=0.015 *2* (2020Vi11); 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 *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[ah]	<0.09[a]	633.292	5/2$^+$	433.521	(9/2)$^+$			%Iγ<0.03
205.99 *6*	0.0094 *23*	345.028	5/2$^-$	138.93316	7/2$^+$	E1	0.0497 *7*	α(K)=0.0417 *6*; α(L)=0.00625 *9*; α(M)=0.001387 *19* α(N)=0.000321 *4*; α(O)=4.42×10^{-5} *6*; α(P)=2.052×10^{-6} *29* %Iγ=0.0034 *8* 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[@] *6*	332.117	9/2$^+$	118.18945	5/2$^+$	E2[e]	0.2080 *29*	α(K)=0.1348 *19*; α(L)=0.0563 *8*; α(M)=0.01347 *19* α(N)=0.00308 *4*; α(O)=0.000378 *5*; α(P)=6.42×10^{-6} *9* %Iγ=0.0029 *2*
226.3 *7*	0.0007[@] *5*	345.028	5/2$^-$	118.18945	5/2$^+$			%Iγ=2.5×10^{-4} *18*
228.71[h] *5*	<0.0011	367.65?	11/2$^+$	138.93316	7/2$^+$	E2[e]	0.1673 *23*	α(K)=0.1113 *16*; α(L)=0.0430 *6*; α(M)=0.01027 *14* α(N)=0.002353 *33*; α(O)=0.000291 *4*; α(P)=5.39×10^{-6} *8* %Iγ<4.0×10^{-4} See comment with 367.7 level. E_γ: from Adopted Gammas. I_γ: upper limit estimated from spectrum (1990WaZZ).

From ENSDF

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

^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02 (continued)

γ(^{169}Tm) (continued)

E_γ[†]	I_γ[#g]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	δ[b]	α[f]	Comments
240.331 *3*	0.317 *17*	379.26678	7/2⁻	138.93316	7/2⁺	E1(+M2)	<+0.12	0.042 *9*	α(K)=0.035 *7*; α(L)=0.0056 *14*; α(M)=0.00125 *33* α(N)=2.9×10⁻⁴ *8*; α(O)=4.1×10⁻⁵ *11*; α(P)=2.0×10⁻⁶ *5* %Iγ=0.114 *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), 0.040 *2* (2020Vi11); α(M)exp=0.005 *1* (2020Vi11); K:L1:L2:L3=857 *107*:100:15 *6*:16 *7* (1972Ag03); K:L=45 *5*:10 *5* (1976Ar06).
261.07712 *9*	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 *7*; α(M)=0.00091 *17* α(N)=0.00021 *4*; α(O)=3.0×10⁻⁵ *6*; α(P)=1.43×10⁻⁶ *29* %Iγ=1.680 *9* 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), 0.027 *1* (2020Vi11); K:L1:L2:L3=867 *67*:100:13.8 *12*:14.2 *10* (1972Ag03).
291.188 *11*	0.0120[@] *4*	430.121	(9/2)⁻	138.93316	7/2⁺	E1		0.02068 *29*	α(K)=0.01742 *24*; α(L)=0.00255 *4*; α(M)=0.000564 *8* α(N)=0.0001309 *18*; α(O)=1.824×10⁻⁵ *26*; α(P)=8.89×10⁻⁷ *12* %Iγ=0.0043 *2* Mult.: from unenumerated ce data of 1993BaZQ.
294.54 *11*	0.0027 *7*	433.521	(9/2)⁺	138.93316	7/2⁺	M1		0.1522 *21*	α(K)=0.1279 *18*; α(L)=0.01899 *27*; α(M)=0.00423 *6* α(N)=0.000989 *14*; α(O)=0.0001424 *20*; α(P)=7.77×10⁻⁶ *11* %Iγ=9.7×10⁻⁴ *25* 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[ah]	<0.013[a]	646.759	(7/2⁻)	345.028	5/2⁻				%Iγ<0.005
306.83[ah]	<0.5[a]	781.796	(5/2)⁺	474.969	(3/2)⁻				%Iγ<0.2
307.52[ah]	<1.4[a]	878.35	(7/2⁺)	570.832	3/2⁺				%Iγ<0.5
307.73586 *10*	27.96 *9*	316.14633	7/2⁺	8.41017	3/2⁺	E2		0.0662 *9*	α(K)=0.0481 *7*; α(L)=0.01390 *19*; α(M)=0.00327 *5*

From ENSDF

$^{169}_{69}Tm_{100}$-13

γ(^{169}Tm) (continued)

E_γ[†]	I_γ[#g]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	δ[b]	α[f]	Comments
									α(N)=0.000752 *11*; α(O)=9.58×10^{-5} *13*; α(P)=2.479×10^{-6} *35* %Iγ=10.05 *5* Mult.: α(K)exp=0.053 *5* (Ice from 1962Gr16), 0.050 *2* (Ice from 1976Ar06), 0.0514 *10* (Ice from 1990Wa28), 0.045 *3* (2020Vi11); α(L)exp=0.015 *2* (2020Vi11); 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 *13*	0.00485 *17*	472.88128	9/2$^-$	138.93316	7/2$^+$				%Iγ=0.00174 *6* 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 *9*; α(M)=0.0025 *21* α(N)=6; α(O)=8; α(P)=4 %Iγ=0.0095 *3* 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}[@] *17*	474.969	(3/2)$^-$	118.18945	5/2$^+$				%Iγ=1.41×10^{-4} *6*
370.854 *8*	0.00245 *26*	379.26678	7/2$^-$	8.41017	3/2$^+$	[M2][d]		0.300 *4*	α(K)=0.2427 *34*; α(L)=0.0446 *6*; α(M)=0.01020 *14* α(N)=0.002393 *34*; α(O)=0.000340 *5*; α(P)=1.751×10^{-5} *25* %Iγ=8.8×10^{-4} *10* I_γ: from 0.00181 *11* and <0.0055 (2000Mo02), 0.00267 *10* (1990Wa28), 0.0034 *9* (1976Ge21), 0.00292 *11* (1972Bb13). 0.010 *5* (2000Mo02, data set E-1) is a statistical outlier. Other Iγ: 0.0228 *16* (1986Me07), 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][d]		0.1270 *18*	α(K)=0.0756 *11*; α(L)=0.0393 *6*; α(M)=0.00959 *13* α(N)=0.002205 *31*; α(O)=0.000273 *4*; α(P)=4.66×10^{-6} *7* %Iγ=4.1×10^{-4} *8* I_γ: from Iγ=0.00172 *31* (2000Mo02), 0.00049 *3*

From ENSDF

$^{169}_{69}Tm_{100}$-14

^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02 (continued)

γ(^{169}Tm) (continued)

E_γ[†]	I_γ[#g]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	δ[b]	α[f]	Comments
									(1990Wa28), 0.00084 *28* (1976Ge21), 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*	9.32×10^{-4} *21*	718.786	(7/2$^+$)	332.117	9/2$^+$	[M1,E2]		0.054 *20*	α(K)=0.044 *18*; α(L)=0.0077 *14*; α(M)=0.00175 *29* α(N)=0.00041 *7*; α(O)=5.6×10^{-5} *12*; α(P)=2.6×10^{-6} *12* %Iγ=3.35×10^{-4} *8*
452.62 *8*	4.9×10^{-5} *15*	570.832	3/2$^+$	118.18945	5/2$^+$	M1+E2[e]	1.5[e] +9–4	0.030 *4*	α(K)=0.025 *4*; α(L)=0.0045 *4*; α(M)=0.00101 *8* α(N)=0.000235 *18*; α(O)=3.23×10^{-5} *30*; α(P)=1.42×10^{-6} *25* %Iγ=1.8×10^{-5} *6* Iγ: weighted average of 0.000046 *10* (1990Wa28) and 0.00014 *6* (1972Bb13).
464.7[&]	1.0×10^{-5}[&] *6*	832.42	(9/2$^+$)	367.65?	11/2$^+$				%Iγ=3.6×10^{-6} *22* Eγ: from level energy difference. Other: 464.72 *9* (1990WaZZ).
465.65[&]	5.30×10^{-4}[&] *6*	781.796	(5/2)$^+$	316.14633	7/2$^+$				%Iγ=1.905×10^{-4} *23* Eγ: from level energy difference. Other: 465.657 *6* (1990WaZZ).
466.56[&]	5.4×10^{-5}[&] *6*	474.969	(3/2)$^-$	8.41017	3/2$^+$				%Iγ=1.94×10^{-5} *22* Eγ: from level energy difference. Other: 466.562 *8* (1990WaZZ).
474.970 *9*	5.41×10^{-4} *12*	474.969	(3/2)$^-$	0.0	1/2$^+$				%Iγ=1.94×10^{-4} *5* Iγ: 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$^+$	138.93316	7/2$^+$	M1[c]		0.0389 *5*	α(K)=0.0328 *5*; α(L)=0.00479 *7*; α(M)=0.001064 *15* α(N)=0.0002490 *35*; α(O)=3.59×10^{-5} *5*; α(P)=1.972×10^{-6} *28* %Iγ=0.00147 *3* Iγ: 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*	2.46×10^{-5}[@] *21*	832.42	(9/2$^+$)	332.117	9/2$^+$				%Iγ=8.8×10^{-6} *8*
507.8 *3*	4.1×10^{-6}[@] *22*	646.759	(7/2$^-$)	138.93316	7/2$^+$				%Iγ=1.5×10^{-6} *8*

From ENSDF

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

^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02 (continued)

γ(^{169}Tm) (continued)

E_γ[†]	I_γ[#g]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	δ[b]	α[f]	Comments
515.101 *6*	0.01161 *17*	633.292	5/2$^+$	118.18945	5/2$^+$	M1[c]		0.0350 *5*	α(K)=0.0295 *4*; α(L)=0.00430 *6*; α(M)=0.000956 *13* α(N)=0.0002237 *31*; α(O)=3.23×10^{-5} *5*; α(P)=1.773×10^{-6} *25* %Iγ=0.00417 *6* I_γ: 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$^+$				%Iγ=1.20×10^{-4} *3* I_γ: 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}[@] *11*	878.35	(7/2$^+$)	332.117	9/2$^+$				%Iγ=1.5×10^{-6} *4*
562.410 *12*	3.31×10^{-4} *7*	570.832	3/2$^+$	8.41017	3/2$^+$	M1+E2[e]	0.8[e] *+5−4*	0.022 *4*	α(K)=0.0184 *34*; α(L)=0.0029 *4*; α(M)=0.00064 *8* α(N)=0.000149 *19*; α(O)=2.12×10^{-5} *29*; α(P)=1.08×10^{-6} *21* %Iγ=1.19×10^{-4} *3* I_γ: 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[e]	0.8[e] *+5−4*	0.021 *4*	α(K)=0.0177 *32*; α(L)=0.0027 *4*; α(M)=0.00061 *8* α(N)=0.000143 *18*; α(O)=2.03×10^{-5} *28*; α(P)=1.04×10^{-6} *21* %Iγ=1.11×10^{-4} *7* I_γ: 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$^+$)	138.93316	7/2$^+$	(M1)[c]		0.0259 *4*	α(K)=0.02181 *31*; α(L)=0.00317 *4*; α(M)=0.000703 *10* α(N)=0.0001646 *23*; α(O)=2.375×10^{-5} *33*; α(P)=1.308×10^{-6} *18* %Iγ=0.00193 *3* I_γ: weighted average of 0.00535 *9* (1990Wa28), 0.0063 *10* (1986Me07), 0.005 *2* (1978Ve07), 0.062

From ENSDF

$^{169}_{69}Tm_{100}$-16

^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02 (continued)

γ(^{169}Tm) (continued)

E_γ[†]	I_γ[#g]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[b]	α[f]	Comments
								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)[c]	0.02366 *33*	α(K)=0.01995 *28*; α(L)=0.00289 *4*; α(M)=0.000642 *9* α(N)=0.0001503 *21*; α(O)=2.170×10^{-5} *30*; α(P)=1.195×10^{-6} *17* %Iγ=0.00114 *2* I_γ: 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[c]	0.02140 *30*	α(K)=0.01805 *25*; α(L)=0.00262 *4*; α(M)=0.000580 *8* α(N)=0.0001358 *19*; α(O)=1.960×10^{-5} *27*; α(P)=1.080×10^{-6} *15* %Iγ=0.0049 *2* I_γ: 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}[@] *13*	633.292	5/2$^+$	0.0	1/2$^+$	[E2]	0.00959 *13*	α(K)=0.00778 *11*; α(L)=0.001410 *20*; α(M)=0.000320 *4* α(N)=7.44×10^{-5} *10*; α(O)=1.018×10^{-5} *14*; α(P)=4.35×10^{-7} *6* %Iγ=6.9×10^{-6} *5*
642.873 *9*	2.13×10^{-4} *5*	781.796	(5/2)$^+$	138.93316	7/2$^+$			%Iγ=7.66×10^{-5} *18* I_γ: 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=1.93×10^{-4} *6* I_γ: weighted average of 0.000528 *17* (1990Wa28), 0.00062 *25* (1976Ge21), 0.000565 *28* (1972Bb13).
693.46 *8*	2.42×10^{-5}[@] *12*	832.42	(9/2$^+$)	138.93316	7/2$^+$			%Iγ=8.7×10^{-6} *4*
710.354 *15*	9.5×10^{-5} *7*	718.786	(7/2$^+$)	8.41017	3/2$^+$			%Iγ=3.4×10^{-5} *3* I_γ: 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}[@] *6*	878.35	(7/2$^+$)	138.93316	7/2$^+$			%Iγ=1.8×10^{-6} *2*
760.24 *24*	2.3×10^{-6}[@] *6*	878.35	(7/2$^+$)	118.18945	5/2$^+$			%Iγ=8.3×10^{-7} *22*
773.386 *14*	5.81×10^{-4} *9*	781.796	(5/2)$^+$	8.41017	3/2$^+$			%Iγ=2.09×10^{-4} *3* I_γ: weighted average of 0.000578 *10* (1990Wa28), 0.00062 *28* (1976Ge21), 0.000607 *28* (1972Bb13).
781.64 *8*	8.4×10^{-6}[@] *7*	781.796	(5/2)$^+$	0.0	1/2$^+$			%Iγ=3.0×10^{-6} *3*

From ENSDF

$^{169}_{69}Tm_{100}$-17

^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02 (continued)

γ(^{169}Tm) (continued)

† Eγ quoted to 0.01 eV are from the evaluation by 2000He14, except where otherwise noted, (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, 1990WaZZ, 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.

‡ From 1993BaZQ only; uncertainty unstated by authors.

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 (same 1986Me10), 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 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, 1976Ge21, 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 1990Wa28.

& 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.

a Eγ (from level energy differences) 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.

b 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).

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

d Comparison to RUL shows calculated strength within recommended limit.

e From Adopted Gammas.

f Additional information 5.

g For absolute intensity per 100 decays, multiply by 0.3594 *12*.

h Placement of transition in the level scheme is uncertain.

x γ ray not placed in level scheme.

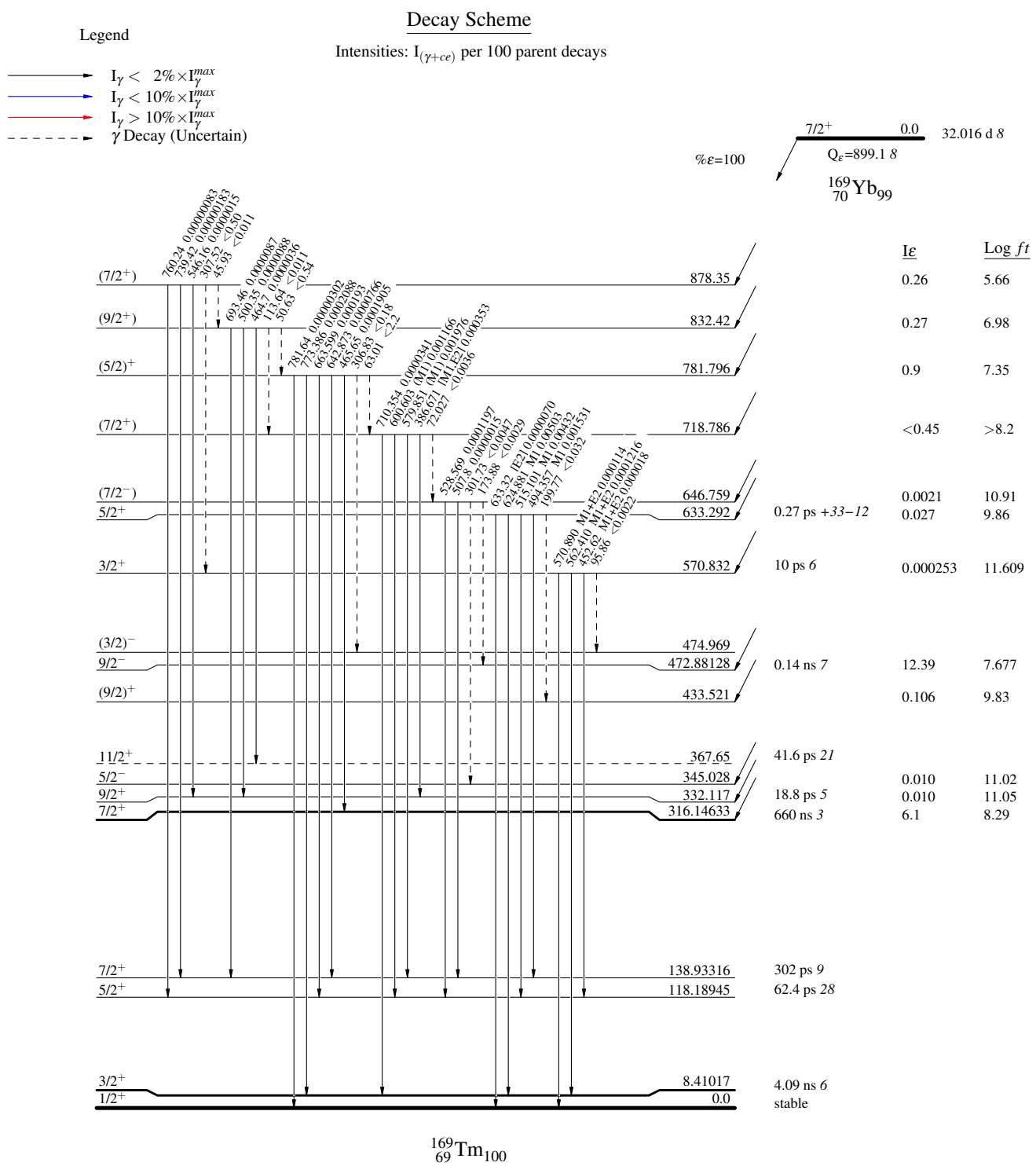
From ENSDF

$^{169}_{69}Tm_{100}$-18

^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02

Decay Scheme

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

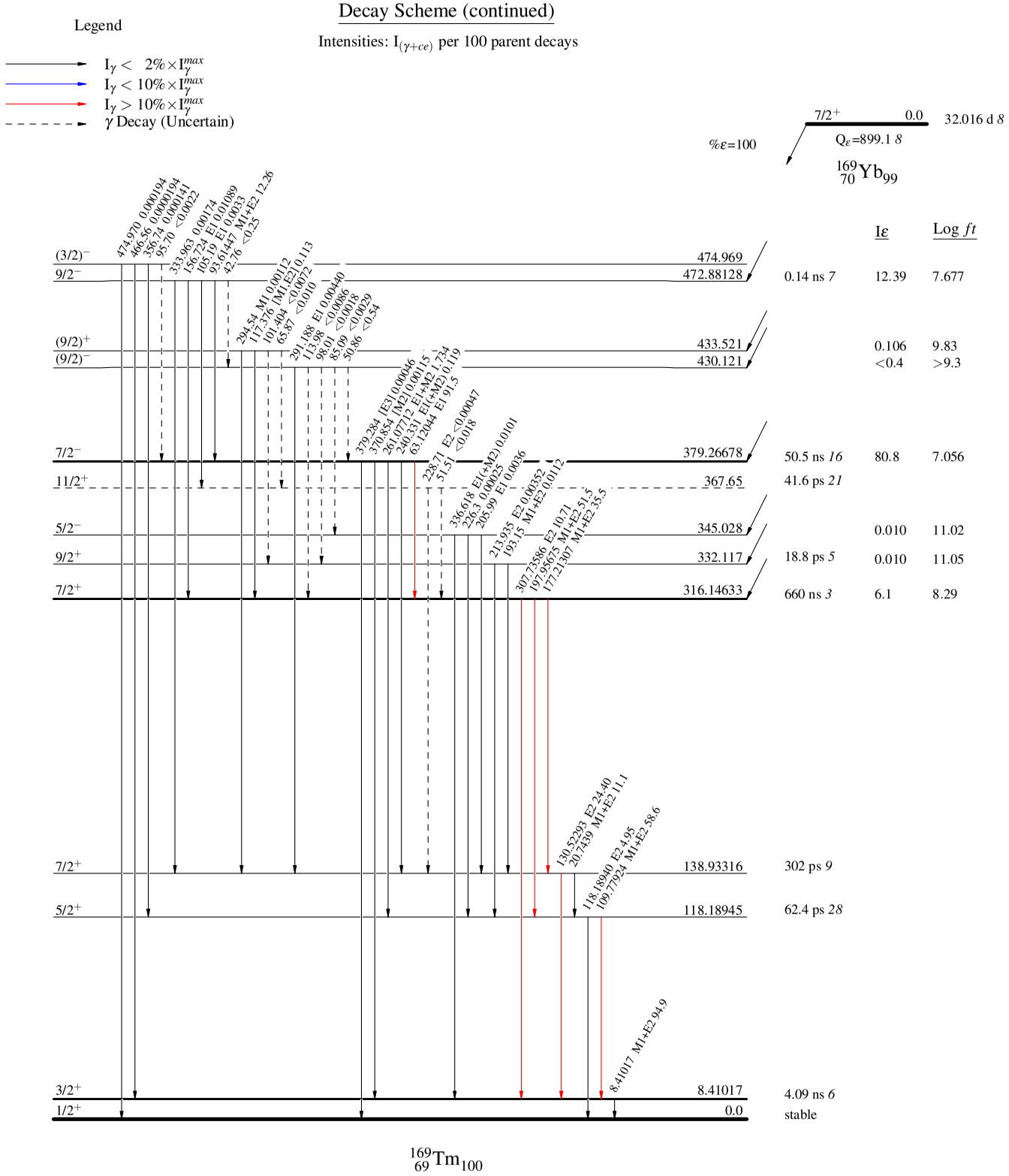


$^{169}_{69}Tm_{100}$

^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02

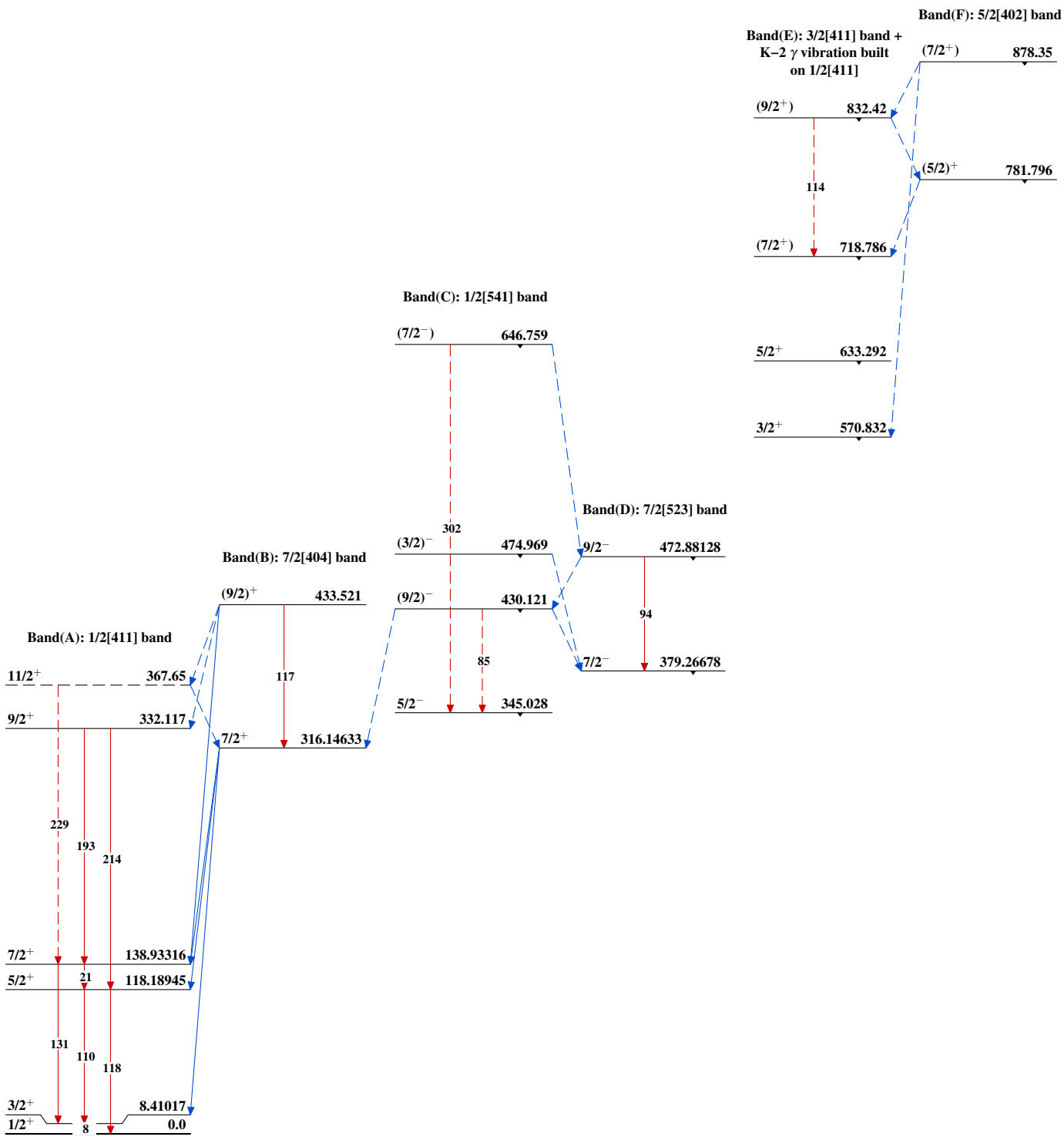
Decay Scheme (continued)

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



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

^{169}Yb ε decay (32.016 d) 1986Ad07,1990Wa28,2000Mo02



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