Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	ENSDF	08-Dec-2015

Q(β^-)=1881 *6*; S(n)=6235 *5*; S(p)=6944 *5*; Q(α)=260 *30* 2012Wa38
S(2n)=13721 *6*, S(2p)=15710 *50* (2012Wa38).
Nuclear structure theory references:
1994No15: analyzed Gallagher-Moszkowski splitting energy, Newby shifts.
1988Fr16: analyzed rotational bands data.
1973Na27: calculated level energies.
Additional information 1.
Hyperfine structure measurement: 1988Al04, 1987Mi31.

^{172}Tm Levels

Band assignments are from 1972Ba01 and 1976MeZC.

Cross Reference (XREF) Flags

A ^{172}Er β^- decay (49.3 h)
B ^{170}Er(^{7}Li,αnγ)

E(level)[†]	J$^\pi$	T$_{1/2}$	XREF	Comments
0.0[‡]	2$^-$	63.6 h *3*	AB	%β^-=100 Evaluated rms charge radius=5.2411 fm *52* (2013An02). Δ<r^2>(^{172}Tm,^{169}Tm)=0.154 fm^2 *30* (1988Al04). J$^\pi$: first forbidden unique β transitions to 0$^+$ and 4$^+$ levels in ^{172}Yb with log $f^{1u}t$=9.8 and 11.0, respectively. T$_{1/2}$: weighted average of 63.6 h *3* (1956Ne08), 63.5 h *5* (1961Ha42), 63.7 h *5* (1961Or01), 63.8 h *5* (1967Ot03).
62.529[‡] *4*	(3)$^-$		AB	J$^\pi$: M1+E2 γ to 2$^-$ and possible band member.
145.84[‡] *6*	(4$^-$)		AB	J$^\pi$: possible band member.
239.92[&] *5*	(3$^-$)		AB	J$^\pi$: possible bandhead with K^π=3$^-$ and configuration=π1/2[411]$\otimes\nu$5/2[512] (1974LaZQ).
249.8[‡] *2*	(5$^-$)		B	
330.0[&] *2*	(4$^-$)		B	
374.4[‡] *2*	(6$^-$)		B	
407.338[#] *2*	(1)$^-$	1.07 ns *5*	A	J$^\pi$: M1(+E2) γ to 2$^-$ and M1 γ from (0)$^-$. T$_{1/2}$: from (K x ray)(407γ)(t) (1968Ha08).
441.7[&] *2*	(5$^-$)		B	
446.036[#] *4*	(2)$^-$		A	J$^\pi$: M1+E2 γ to (1)$^-$, (M1) γs to 2$^-$ and (3)$^-$.
475.446[@] *2*	(0)$^-$		A	J$^\pi$: E2 γ to (2)$^-$, M1 γ from (1)$^-$ and possible bandhead.
476.2 *2*	(6$^+$)	132 μs *7*	B	%IT=100 T$_{1/2}$: from γ(t) (2008Hu05), using chopper beam. Configuration=π7/2[523]$\otimes\nu$5/2[512], K^π=6$^+$. The antiparallel coupling of this configuration gives a level at 1$^+$, 610.1 which is populated only in β decay studies. The 6$^+$ bandhead of parallel coupling being lower than the 1$^+$ bandhead of the antiparallel coupling is consistent with predictions of Gallagher-Moszkowski rules.
479.68 *9*	(1$^-$,2$^-$)		A	J$^\pi$: log *ft*=9.3 from 0$^+$ and γ to (3)$^-$.
496.34? *12*			A	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{172}Tm Levels (continued)

E(level)[†]	J$^\pi$	T$_{1/2}$	XREF	Comments
519.3[‡] *5*	(7$^-$)		B	
526.23 *5*	(0$^-$,1,2$^-$)		A	J$^\pi$: log *ft*=9.1 from 0$^+$; γs to 2$^-$ and (1)$^-$. J^π=0$^-$ and 1$^+$ are less likely if 463.7γ to (3)$^-$ exists.
535.140[@] *3*	(1)$^-$	1.22 ns *5*	A	J$^\pi$: M1+E2 γ to (1)$^-$, M1 γ to (0)$^-$ and log *ft*=5.89 from 0$^+$. T$_{1/2}$: from β(K x ray)(t) (1968Ha08).
574.7[&] *7*	(6$^-$)		B	
610.062 *2*	1$^+$	≤0.3 ns	A	J$^\pi$: log *ft*=5.56 from 0$^+$. T$_{1/2}$: from β(610γ)(t) (1968Ha08).
685.3?[‡] *9*	(8$^-$)		B	
714.50 *9*	(0$^-$,1)		A	J$^\pi$: log *ft*=8.4 from 0$^+$ and γ to 2$^-$.
719.5[&] *11*	(7$^-$)		B	
797.42 *10*	(0$^-$,1)		A	J$^\pi$: log *ft*=7.7 from 0$^+$; γ to 2$^-$. J^π=0$^-$ and 1$^+$ less likely if 734.9γ to (3)$^-$ exists.
871.3?[‡] *10*	(9$^-$)		B	

[†] From least-squares fit to Eγ values.
[‡] Band(A): π1/2[411]⊗ν5/2[512],K^π=2$^-$.
[#] Band(B): π1/2[411]⊗ν1/2[521],K^π=1$^-$.
[@] Band(C): π1/2[411]⊗ν1/2[521],K^π=0$^-$.
[&] Band(D): π1/2[411]⊗ν5/2[521],K^π=3$^-$.

Adopted Levels, Gammas (continued)

γ(^{172}Tm)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.[†]	δ[†]	α[‡]	Comments
62.529	(3)$^-$	62.524 *4*	100 *2*	0.0	2$^-$	M1+E2	0.29 *8*	12.6 *4*	α(K)=9.3 *4*; α(L)=2.5 *6*; α(M)=0.59 *14* α(N)=0.14 *3*; α(O)=0.018 *4*; α(P)=0.000584 *23*
145.84	(4$^-$)	83.24 *20*	100 *14*	62.529	(3)$^-$	[M1+E2]		5.8 *6*	α(K)=3.0 *15*; α(L)=2.2 *15*; α(M)=0.52 *38* α(N)=0.119 *84*; α(O)=0.0142 *92*; α(P)=1.7×10^{-4} *11*
		145.86 *15*	37 *10*	0.0	2$^-$	[E2]		0.769	α(K)=0.400 *6*; α(L)=0.283 *5*; α(M)=0.0686 *10* α(N)=0.01564 *23*; α(O)=0.00186 *3*; α(P)=1.744×10^{-5} *25*
239.92	(3$^-$)	177.25 *15*	8.5 *26*	62.529	(3)$^-$	[M1+E2]		0.50 *12*	α(K)=0.37 *15*; α(L)=0.100 *23*; α(M)=0.0233 *62* α(N)=0.0054 *14*; α(O)=0.00070 *12*; α(P)=2.1×10^{-5} *11* I_γ: from β^- decay. Other: 28 *9* from (^{7}Li,αnγ).
		239.9 *2*	100 *7*	0.0	2$^-$	[M1+E2]		0.204 *61*	α(K)=0.160 *63*; α(L)=0.0345 *13*; α(M)=0.0079 *6* α(N)=0.00184 *11*; α(O)=0.000245 *6*; α(P)=9.2×10^{-6} *45*
249.8	(5$^-$)	103.9 *2*	100	145.84	(4$^-$)	[M1+E2]		2.72 *8*	α(K)=1.64 *69*; α(L)=0.82 *48*; α(M)=0.20 *12* α(N)=0.045 *27*; α(O)=0.0055 *29*; α(P)=9.2×10^{-5} *52*
		187.2 *2*	90 *5*	62.529	(3)$^-$	[E2]		0.325	α(K)=0.198 *3*; α(L)=0.0973 *15*; α(M)=0.0234 *4* α(N)=0.00535 *8*; α(O)=0.000648 *10*; α(P)=9.13×10^{-6} *13*
330.0	(4$^-$)	90.0 *5*	100 *32*	239.92	(3$^-$)	[M1+E2]		4.40 *23*	α(K)=2.4 *11*; α(L)=1.5 *10*; α(M)=0.37 *25* α(N)=0.084 *57*; α(O)=0.0101 *62*; α(P)=1.36×10^{-4} *81*
		267.4 *4*	78 *27*	62.529	(3)$^-$	[M1+E2]		0.150 *48*	α(K)=0.119 *48*; α(L)=0.0241 *8*; α(M)=0.00553 *9* α(N)=0.001281 *20*; α(O)=0.000173 *13*; α(P)=6.8×10^{-6} *33*
374.4	(6$^-$)	124.6 *2*	100	249.8	(5$^-$)	[M1+E2]		1.50 *16*	α(K)=1.00 *39*; α(L)=0.39 *18*; α(M)=0.093 *46* α(N)=0.021 *11*; α(O)=0.0026 *11*; α(P)=5.5×10^{-5} *30*
		228.5 *2*	56.5 *22*	145.84	(4$^-$)	[E2]		0.1678	α(K)=0.1116 *16*; α(L)=0.0432 *7*; α(M)=0.01031 *15* α(N)=0.00236 *4*; α(O)=0.000292 *5*; α(P)=5.40×10^{-6} *8*
407.338	(1)$^-$	167.40 *7*	0.017 *2*	239.92	(3$^-$)	[E2]		0.475	B(E2)(W.u.)=0.0112 *15* α(K)=0.272 *4*; α(L)=0.1559 *22*; α(M)=0.0377 *6* α(N)=0.00860 *13*; α(O)=0.001032 *15*; α(P)=1.223×10^{-5} *18*
		344.817 *17*	1.49 *4*	62.529	(3)$^-$	(E2)		0.0473	B(E2)(W.u.)=0.0264 *16* α(K)=0.0353 *5*; α(L)=0.00927 *13*; α(M)=0.00217 *3* α(N)=0.000499 *7*; α(O)=6.44×10^{-5} *9*; α(P)=1.85×10^{-6} *3*
		407.338 *3*	100.0 *20*	0.0	2$^-$	M1(+E2)	<0.6	0.060 *5*	α(K)=0.050 *5*; α(L)=0.0076 *4*; α(M)=0.00170 *8* α(N)=0.000397 *19*; α(O)=5.7×10^{-5} *4*; α(P)=3.0×10^{-6} *3* B(M1)(W.u.)=0.00020 *1*; B(E2)(W.u.)<0.22
441.7	(5$^-$)	111.7 *1*	91 *29*	330.0	(4$^-$)	[M1+E2]		2.14 *13*	α(K)=1.35 *55*; α(L)=0.61 *33*; α(M)=0.146 *82* α(N)=0.033 *19*; α(O)=0.0041 *20*; α(P)=7.5×10^{-5} *42*
		201.7 *2*	21 *7*	239.92	(3$^-$)	[E2]		0.253	α(K)=0.1597 *23*; α(L)=0.0715 *11*; α(M)=0.0172 *3* α(N)=0.00392 *6*; α(O)=0.000479 *7*; α(P)=7.50×10^{-6} *11*
		295.8 *3*	100 *35*	145.84	(4$^-$)	[M1+E2]		0.113 *38*	α(K)=0.090 *37*; α(L)=0.0174 *14*; α(M)=0.00398 *21* α(N)=0.00092 *6*; α(O)=0.000126 *16*; α(P)=5.2×10^{-6} *25*
446.036	(2)$^-$	38.66 *5*	0.24 *7*	407.338	(1)$^-$	M1+E2	0.6 *1*	57 *12*	α(L)=44 *10*; α(M)=10.6 *23* α(N)=2.4 *6*; α(O)=0.28 *6*; α(P)=0.00199 *15*
		206.09 *10*	0.10 *1*	239.92	(3$^-$)	[M1+E2]		0.319 *84*	α(K)=0.244 *94*; α(L)=0.058 *8*; α(M)=0.0135 *23* α(N)=0.0031 *5*; α(O)=0.00041 *3*; α(P)=1.39×10^{-5} *68*

$^{172}_{69}Tm_{103}$-3

Adopted Levels, Gammas (continued)

γ(^{172}Tm) (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.[†]	δ[†]	α[‡]	Comments
446.036	(2)$^-$	300.19 *6*	0.70 *3*	145.84	(4$^-$)	[E2]		0.0713	α(K)=0.0516 *8*; α(L)=0.01522 *22*; α(M)=0.00359 *5* α(N)=0.000824 *12*; α(O)=0.0001047 *15*; α(P)=2.64×10^{-6} *4*
		383.501 *4*	79.5 *16*	62.529	(3)$^-$	(M1)		0.0754	α(K)=0.0634 *9*; α(L)=0.00935 *13*; α(M)=0.00208 *3* α(N)=0.000486 *7*; α(O)=7.01×10^{-5} *10*; α(P)=3.83×10^{-6} *6*
		446.025 *9*	100.0 *23*	0.0	2$^-$	(M1)		0.0508	α(K)=0.0428 *6*; α(L)=0.00627 *9*; α(M)=0.001393 *20* α(N)=0.000326 *5*; α(O)=4.70×10^{-5} *7*; α(P)=2.58×10^{-6} *4*
475.446	(0)$^-$	29.37 *5*	0.23 *6*	446.036	(2)$^-$	E2		755 *13*	α(L)=579 *10*; α(M)=140.8 *23* α(N)=31.8 *6*; α(O)=3.60 *6*; α(P)=0.001301 *22*
		68.107 *4*	100.0 *20*	407.338	(1)$^-$	M1		9.38	α(K)=7.84 *11*; α(L)=1.200 *17*; α(M)=0.268 *4* α(N)=0.0626 *9*; α(O)=0.00899 *13*; α(P)=0.000485 *7*
		475.445 *2*	31.6 *6*	0.0	2$^-$	(E2)		0.0195	α(K)=0.01534 *22*; α(L)=0.00323 *5*; α(M)=0.000743 *11* α(N)=0.0001719 *24*; α(O)=2.29×10^{-5} *4*; α(P)=8.41×10^{-7} *12*
476.2	(6$^+$)	34.6 *3*	17.9 *27*	441.7	(5$^-$)	E1		1.10 *3*	α(L)=0.857 *25*; α(M)=0.193 *6* α(N)=0.0434 *13*; α(O)=0.00515 *14*; α(P)=0.000152 *4* B(E1)(W.u.)=3.6×10^{-9} *6*
		101.8 *1*	100.0 *23*	374.4	(6$^-$)	E1		0.318	α(K)=0.264 *4*; α(L)=0.0426 *6*; α(M)=0.00949 *14* α(N)=0.00218 *4*; α(O)=0.000289 *5*; α(P)=1.178×10^{-5} *17* B(E1)(W.u.)=8.0×10^{-10} *6*
		226.3 *2*	26.6 *26*	249.8	(5$^-$)	E1		0.0390	α(K)=0.0328 *5*; α(L)=0.00488 *7*; α(M)=0.001082 *16* α(N)=0.000250 *4*; α(O)=3.46×10^{-5} *5*; α(P)=1.630×10^{-6} *23* B(E1)(W.u.)=1.93×10^{-11} *23*
479.68	(1$^-$,2$^-$)	239.5 *2*	37 *7*	239.92	(3$^-$)	[M1,E2]		0.205 *62*	α(K)=0.161 *64*; α(L)=0.0346 *14*; α(M)=0.0080 *6* α(N)=0.00185 *12*; α(O)=0.000247 *6*; α(P)=9.2×10^{-6} *45*
		416.8 *5*	78 *26*	62.529	(3)$^-$				
		479.76 *10*	100 *11*	0.0	2$^-$				
496.34?		496.3[@] *3*	100	0.0	2$^-$				
519.3	(7$^-$)	145[#@] *1*		374.4	(6$^-$)				
		269.5 *4*		249.8	(5$^-$)				
526.23	(0$^-$,1,2$^-$)	80.19 *5*	100 *50*	446.036	(2)$^-$	[D,E2]		3.2 *27*	α(K)=2.7 *22*; α(L)=0.41 *34*; α(M)=0.092 *74* α(N)=0.022 *18*; α(O)=0.0031 *26*; α(P)=1.6×10^{-4} *14*
		118.9 *2*	20 *10*	407.338	(1)$^-$	[D,E2]		1.05 *84*	α(K)=0.88 *71*; α(L)=0.13 *11*; α(M)=0.030 *24* α(N)=0.0069 *56*; α(O)=9.9×10^{-4} *81*; α(P)=5.3×10^{-5} *45*
		463.7[@]	<50	62.529	(3)$^-$				
		526.2 *4*	70 *50*	0.0	2$^-$				
535.140	(1)$^-$	59.692 *6*	100 *3*	475.446	(0)$^-$	M1		14.2	B(M1)(W.u.)=0.0049 *3*
		89.09 *4*	0.17 *2*	446.036	(2)$^-$	[M1,E2]		4.56 *25*	α(K)=2.5 *12*; α(L)=1.6 *11*; α(M)=0.39 *27* α(N)=0.088 *60*; α(O)=0.0106 *65*; α(P)=1.40×10^{-4} *83* Additional information 2.
		127.805 *3*	78.9 *17*	407.338	(1)$^-$	M1+E2	0.6 *3*	1.46 *6*	B(M1)(W.u.)=0.00029 *8*; B(E2)(W.u.)=2.9 *22* α(K)=1.10 *14*; α(L)=0.28 *6*; α(M)=0.065 *15* α(N)=0.015 *4*; α(O)=0.0019 *4*; α(P)=6.5×10^{-5} *10*
		295.3[@] *3*	0.09 *6*	239.92	(3$^-$)	[E2]		0.0750	B(E2)(W.u.)=0.00019 *13*

$^{172}_{69}Tm_{103}$-4

Adopted Levels, Gammas (continued)

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

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.[†]	α[‡]	Comments
								α(K)=0.0540 *8*; α(L)=0.01617 *24*; α(M)=0.00381 *6* α(N)=0.000876 *13*; α(O)=0.0001111 *16*; α(P)=2.76×10^{-6} *4*
535.140	(1)$^-$	472.71 *4*	1.16 *6*	62.529	(3)$^-$	[E2]	0.0198	α(K)=0.01556 *22*; α(L)=0.00328 *5*; α(M)=0.000757 *11* α(N)=0.0001750 *25*; α(O)=2.33×10^{-5} *4*; α(P)=8.52×10^{-7} *12* B(E2)(W.u.)=0.000232 *17*
		535.143 *9*	10.9 *3*	0.0	2$^-$	(M1,E2)	0.0231 *87*	α(K)=0.0191 *77*; α(L)=0.00308 *82*; α(M)=6.9×10^{-4} *18* α(N)=1.61×10^{-4} *42*; α(O)=2.27×10^{-5} *66*; α(P)=1.12×10^{-6} *49* Additional information 3.
574.7	(6$^-$)	133 *1*		441.7	(5$^-$)			
		245 *1*		330.0	(4$^-$)			
610.062	1$^+$	74.940 *8*	0.27 *1*	535.140	(1)$^-$	E1	0.710	α(K)=0.582 *9*; α(L)=0.0999 *14*; α(M)=0.0223 *4* α(N)=0.00509 *8*; α(O)=0.000660 *10*; α(P)=2.50×10^{-5} *4*
		113.71 *13*	0.003 *2*	496.34?		[D,E2]	1.19 *96*	α(K)=1.00 *80*; α(L)=0.15 *12*; α(M)=0.034 *27* α(N)=0.0079 *63*; α(O)=0.00113 *92*; α(P)=6.0×10^{-5} *51*
		134.68 *6*	0.024 *1*	475.446	(0)$^-$	[E1]	0.1517	α(K)=0.1265 *18*; α(L)=0.0197 *3*; α(M)=0.00438 *7* α(N)=0.001009 *15*; α(O)=0.0001361 *20*; α(P)=5.88×10^{-6} *9*
		164.013 *5*	1.52 *6*	446.036	(2)$^-$	E1	0.0902	α(K)=0.0754 *11*; α(L)=0.01151 *17*; α(M)=0.00256 *4* α(N)=0.000590 *9*; α(O)=8.04×10^{-5} *12*; α(P)=3.60×10^{-6} *5*
		202.724 *5*	2.33 *8*	407.338	(1)$^-$	(E1)	0.0518	α(K)=0.0435 *6*; α(L)=0.00652 *10*; α(M)=0.001447 *21* α(N)=0.000335 *5*; α(O)=4.60×10^{-5} *7*; α(P)=2.13×10^{-6} *3*
		370.3 *2*	0.0028 *6*	239.92	(3$^-$)	[M2]	0.302	α(K)=0.244 *4*; α(L)=0.0448 *7*; α(M)=0.01025 *15* α(N)=0.00241 *4*; α(O)=0.000342 *5*; α(P)=1.760×10^{-5} *25*
		547.54[@]	<0.0007	62.529	(3)$^-$	[M2]	0.0907	α(K)=0.0744 *11*; α(L)=0.01261 *18*; α(M)=0.00286 *4* α(N)=0.000670 *10*; α(O)=9.57×10^{-5} *14*; α(P)=5.04×10^{-6} *7*
		610.062 *2*	100.0 *23*	0.0	2$^-$	E1	0.00379	α(K)=0.00322 *5*; α(L)=0.000449 *7*; α(M)=9.91×10^{-5} *14* α(N)=2.31×10^{-5} *4*; α(O)=3.28×10^{-6} *5*; α(P)=1.724×10^{-7} *25*
685.3?	(8$^-$)	166[@] *1*		519.3	(7$^-$)			
		311[@] *2*		374.4	(6$^-$)			
714.50	(0$^-$,1)	179.6 *4*	10 *4*	535.140	(1)$^-$			
		307.15 *10*	100 *21*	407.338	(1)$^-$			
		714.45 *25*	17 *13*	0.0	2$^-$			
719.5	(7$^-$)	145[#] *1*		574.7	(6$^-$)			
		277 *2*		441.7	(5$^-$)			
797.42	(0$^-$,1)	187.4[@] *4*	8 *8*	610.062	1$^+$			
		734.9[@]	<0.012	62.529	(3)$^-$			
		797.42 *10*	100 *4*	0.0	2$^-$			
871.3?	(9$^-$)	186[@] *2*		685.3?	(8$^-$)			
		352[@] *1*		519.3	(7$^-$)			

$^{172}_{69}Tm_{103}$-5

Adopted Levels, Gammas (continued)

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

† From ce data in ^{172}Er β^- decay.
‡ From BrIcc v2.3b (16-Dec-2014) 2008Ki07, "Frozen Orbitals" appr. When no δ value given, value overlaps listed multipolarities.
# Multiply placed.
@ Placement of transition in the level scheme is uncertain.

$^{172}_{69}Tm_{103}$-6

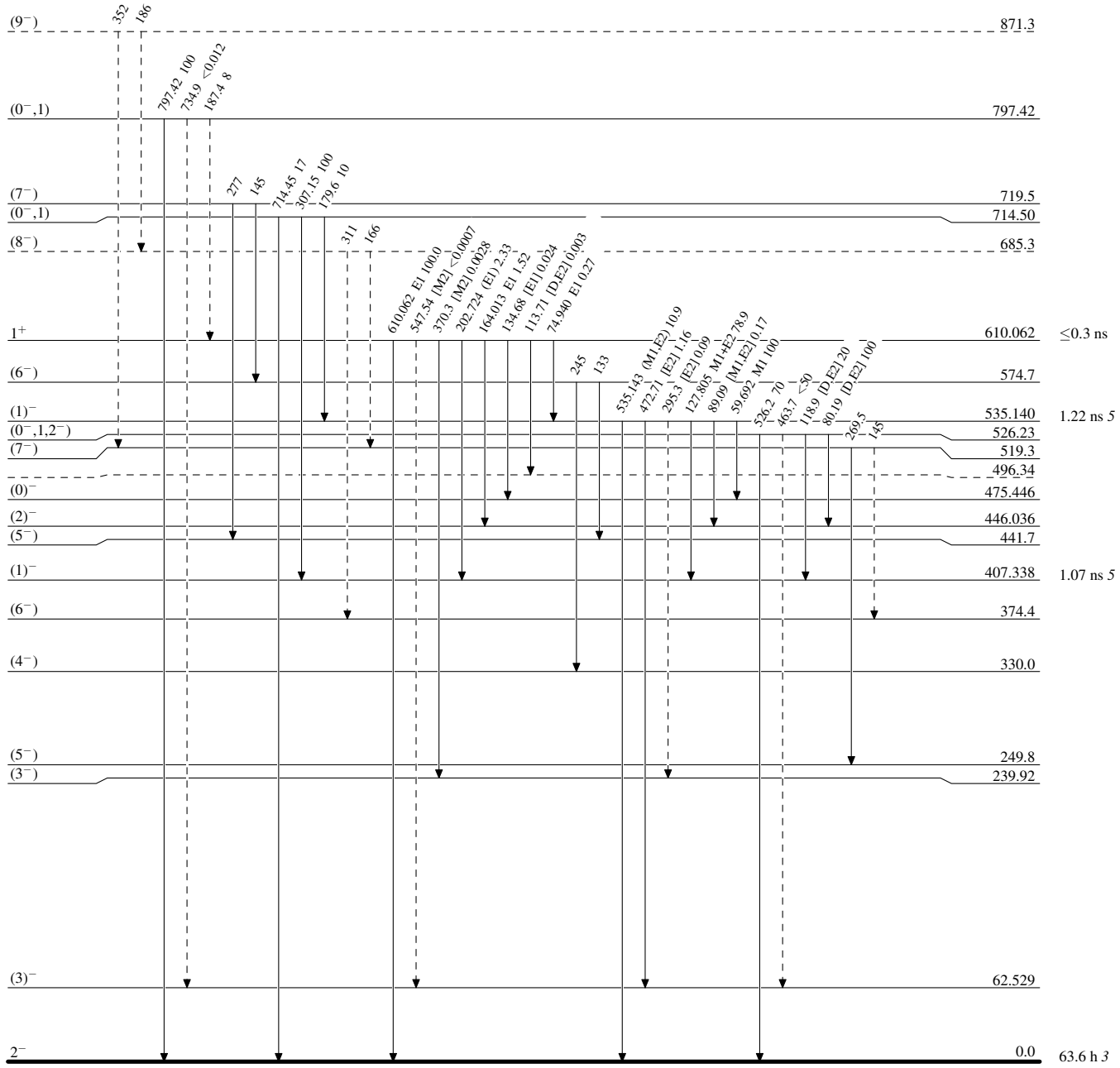
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{172}_{69}Tm_{103}$

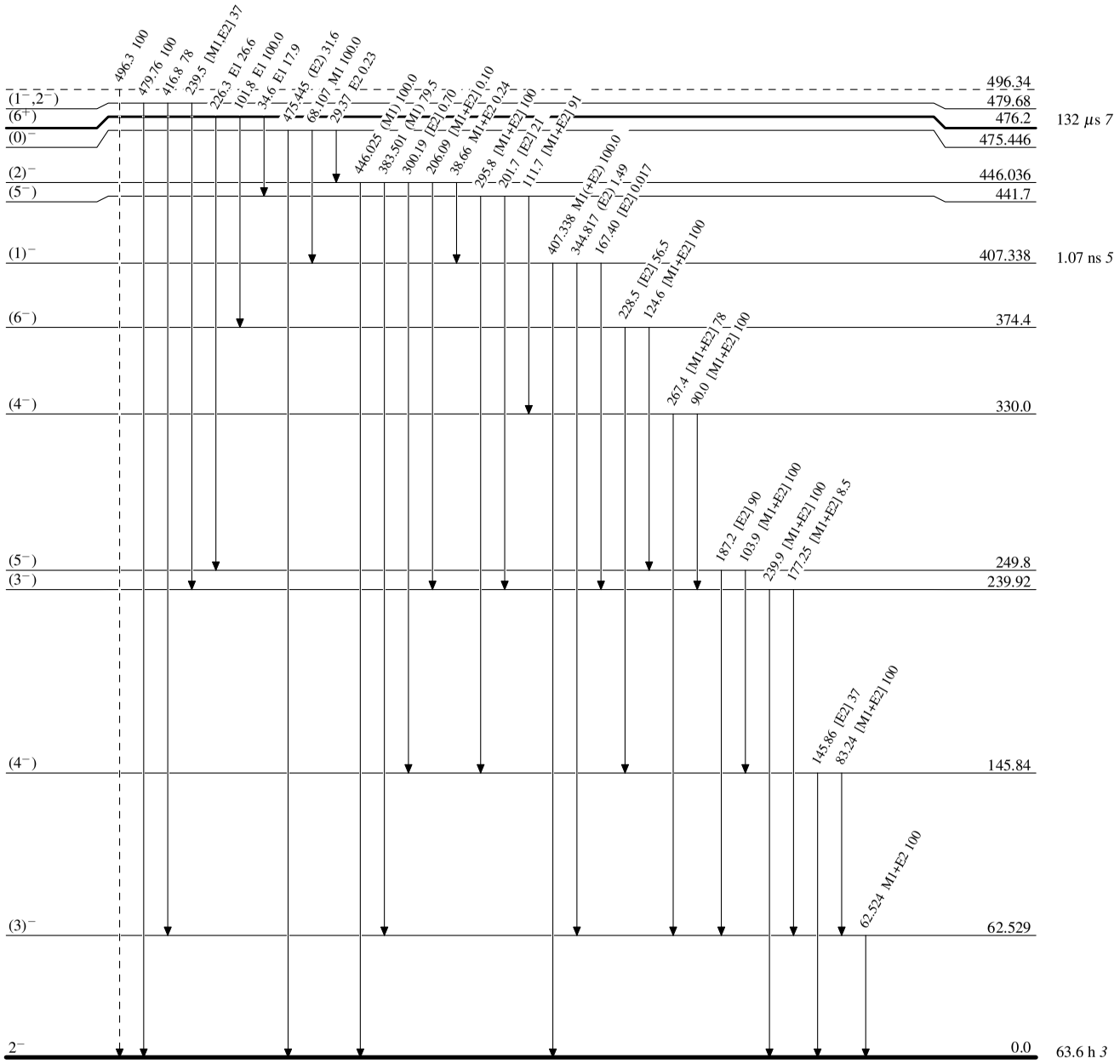
Adopted Levels, Gammas

Legend

Level Scheme (continued)

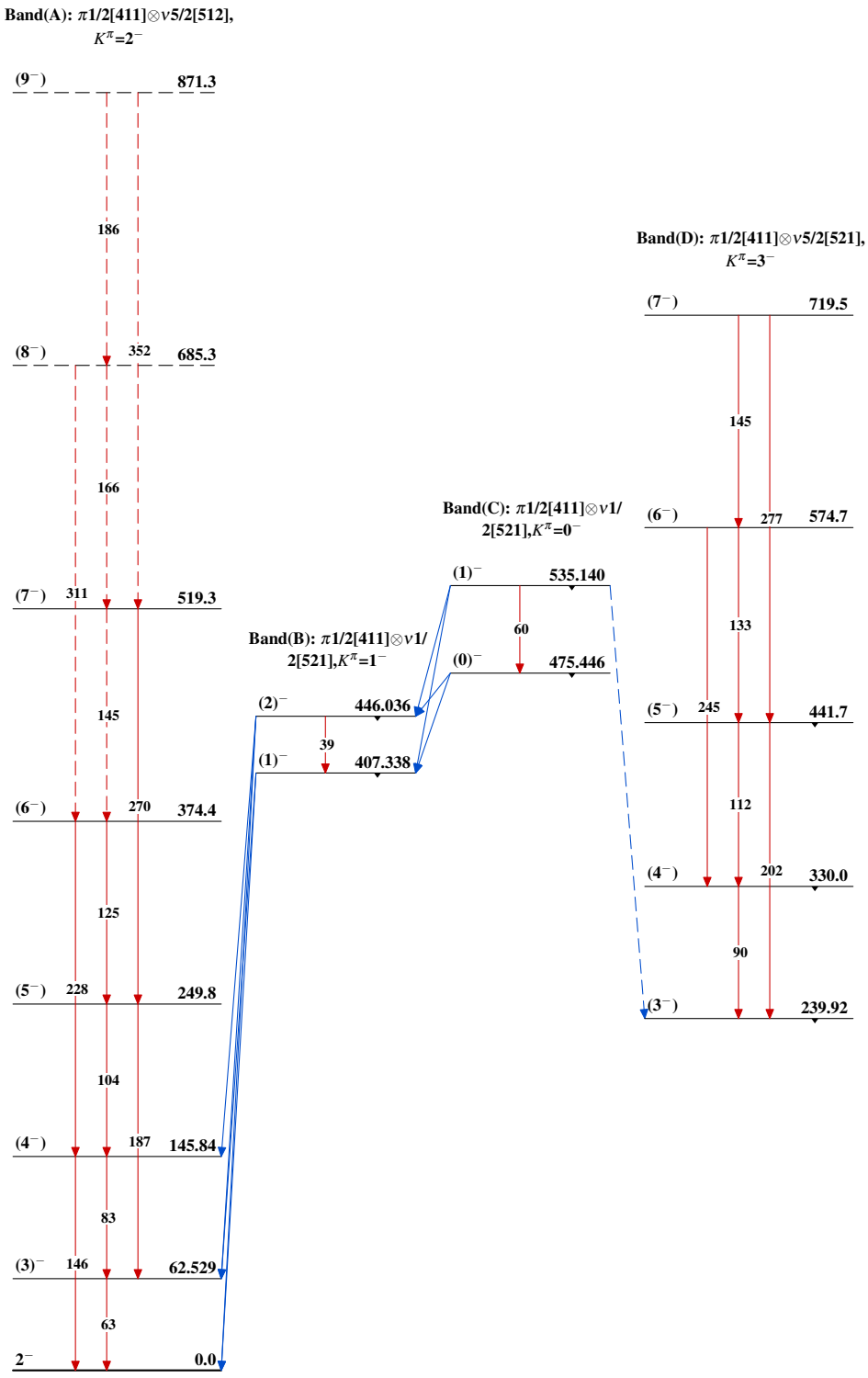
Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{172}_{69}Tm_{103}$

Adopted Levels, Gammas



$^{172}_{69}Tm_{103}$