Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 108,79 (2007)	15-Oct-2006

Q(β^-)=−2.83×10^3 *3*; S(n)=8.64×10^3 *9*; S(p)=4.39×10^3 *3*; Q(α)=2.09×10^3 *3* 2012Wa38
Note: Current evaluation has used the following Q record −2830 40 *8640* 80 *4394* 28 *2086* 28 2003Au03.
Additional information 1.
Nuclear structure calculations (levels, band structures): 1989Be34, 1980Kr20, 1977Go09, 1977Ta01, 1976De50, 1976Di14, 1975Me11, 1974Ne16, 1971Na04, 1967Co06.

^{199}Tl Levels

Except for the lowest levels, the shell model is inadequate to describe observed levels. The core-coupling model extends the description. A rotational band based upon the 9/2[505] state has been observed.

Cross Reference (XREF) Flags

- A ^{199}Tl IT decay (28.4 ms)
- B ^{199}Pb ε decay (90 min)
- C ^{199}Pb ε decay (12.2 min)
- D ^{197}Au(α,2nγ)

E(level)‡	J$^\pi$†	$T_{1/2}$	XREF	Comments
0.0	1/2$^+$	7.42 h *8*	ABCD	%ε+%β^+=100 μ=+1.60 *2* (1989Ra17,1961Hu04) <r^2>$^{1/2}$=5.447 fm *4* (2004An14, evaluation). J$^\pi$: spin from atomic beam (1957Br32); parity from comparison of measured μ with that expected for $\pi s_{1/2}$ orbital. $T_{1/2}$: timing of ce(K) from a sample prepared by electromagnetic separation, (1960Ju03). μ: optical spectroscopy (1961Hu04,1961Hu08,1966Da15). Other: +1.58 *7* (atomic beam magnetic resonance,1976Ek03,1984Be40), compilation by 2005St24. See also 1984Be40.
366.89 *4*	3/2$^+$	<1.5 ns	ABCD	$T_{1/2}$: from 1959Jo21. J$^\pi$: M1+E2 γ to 1/2$^+$; $2d_{3/2}$ state.
720.35 *4*	(5/2)$^+$		AB D	J$^\pi$: M1+E2 γ to 3/2$^+$; γ from 9/2$^-$; possible $2d_{5/2}$ state.
748.87& *6*	9/2$^-$	28.4 ms *2*	A CD	%IT=100 J$^\pi$: $\gamma\gamma(\theta)$ (^{199}Tl IT decay). $T_{1/2}$: weighted av: 28.9 ms *6* (1963De38), 27 ms *4* (1963Di10), 26.6 ms 14 (1965Gr04), 29.2 ms *10* (1967Co20), 28.4 ms *2* (1977KoZH).
1118.29& *17*	11/2$^-$		CD	XREF: C(?). J$^\pi$: $\gamma(\theta)$ in (α,2nγ).
1120.90 *5*	1/2,3/2,5/2$^{(+)}$@		B	
1205.20 *21*	(7/2$^+$)		B D	XREF: B(?). J$^\pi$: ΔJ=2 γ to 3/2$^+$; excit function in (α,2nγ).
1241.64 *6*	1/2,3/2,5/2@		B	
1394.57? *21*	(11/2$^-$)		CD	
1450.46& *17*	13/2$^-$		CD	XREF: C(?). J$^\pi$: M1+E2 γ to 11/2$^-$; $\gamma(\theta)$ in (α,2nγ).
1482.39 *7*	1/2,3/2,5/2@		B	
1502.01 *5*	1/2$^{(+)}$ to 5/2$^{(+)}$@		B	J$^\pi$: (M1) γ to 3/2$^+$.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{199}Tl Levels (continued)

E(level)‡	Jπ†	XREF	Comments
1528.24# *9*	1/2,3/2,5/2@	B	
1554.11# *8*	1/2,3/2,5/2@	B	
1632.11 *12*	1/2,3/2,5/2@	B	
1658.35 *6*	1/2,3/2,5/2(+)@	B	
1695.2# *3*	1/2,3/2,5/2(+)	B	
1716.98 *23*	(13/2−)	CD	XREF: C(?). Jπ: M1+E2 γ to 11/2−; γ(θ) in (α,2nγ).
1725.27 *7*	1/2,3/2,5/2@	B	
1749.65 *6*	1/2,3/2,5/2(+)@	B	
1768.60 *7*	1/2,3/2,5/2@	B	
1866.94& *20*	(15/2−)	CD	XREF: C(?). Jπ: M1+E2 γ to 13/2−; γ(θ) in (α,2nγ).
1891.06 *8*	1/2,3/2,5/2(+)@	B	
1898.13 *9*	1/2,3/2,5/2@	B	
1930.11# *10*	1/2,3/2,5/2(+)@	B	
1943.8 *3*	(9/2−,11/2−,13/2−)	D	Jπ: (M1+E2) γ to 11/2−; γ(θ) in (α,2nγ) suggests 13/2.
1959.50 *7*	1/2,3/2,5/2@	B	
1977.48 *8*	1/2,3/2,5/2@	B	
1985.23& *22*	(17/2−)	D	Jπ: ΔJ=2 γ to 13/2−.
2031.58# *10*	1/2,3/2,5/2(+)@	B	
2080.07 *23*	(15/2+)	CD	XREF: C(?). Jπ: (E1) γ to 13/2−.
2159.57# *17*	1/2,3/2,5/2@	B	
2206.5# *3*	1/2,3/2,5/2(+)	B	
2226.48 *19*	1/2,3/2,5/2	B	
2237.39# *7*	1/2,3/2,5/2(+)@	B	
2367.38 *14*	1/2,3/2,5/2(+)@	B	
2433.63# *17*	1/2,3/2,5/2(+)@	B	
2471.69& *25*	(19/2−)	D	Jπ: γ's to (15/2−) and (17/2−).
2547.6# *4*	1/2,3/2,5/2(+)	B	
2643.2# *4*	1/2,3/2,5/2(+)	B	

† The assignments for the high spin levels are from (α,2nγ) reaction; based on γ(θ), α(K)exp, excitation function; see 1970Ne06 for detailed discussion.

‡ From least squares adjustment to adopted Eγ's, assuming Δ(Eγ)=0.2 keV if not stated.

Population of this level in ^{199}Pb ε decay (90 min) is less certain than others in that decay.

@ log *ft* from 3/2− (in ^{199}Pb ε decay (90 min)) is allowed or first-forbidden. If transition to 1/2+ g.s. is prominent, then parity for 5/2 choice is likely to Be positive.

& Band(A): 9/2[505] (oblate) band.

Adopted Levels, Gammas (continued)

γ(^{199}Tl)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[#]	α[&]	$I_{(\gamma+ce)}$	Comments
366.89	3/2$^+$	366.90 *6*	100	0.0	1/2$^+$	M1+E2[@]	+1.6[@] *2*	0.112 *10*		α(K)=0.083 *9*; α(L)=0.0214 *9*; α(M)=0.00522 *19*; α(N+..)=0.00168 *6* B(M1)(W.u.)>6.1×10^{-5}; B(E2)(W.u.)>0.49
720.35	(5/2)$^+$	353.39 *6*	100 *5*	366.89	3/2$^+$	M1+E2[@]	0.6[@] *2*	0.211 *25*		α(K)=0.169 *22*; α(L)=0.0318 *22*; α(M)=0.0075 *5*; α(N+..)=0.00240 *14*
		720.24 *6*	69 *3*	0.0	1/2$^+$	(Q)				
748.87	9/2$^-$	29 *2*		720.35	(5/2)$^+$	[M2]		6.7×10^3 *3*	9.7	B(M2)(W.u.)≈1.7×10^{-5} α(L)=4.94×10^3 *22*; α(M)=1.35×10^3 *6* E_γ: from ^{199}Tl IT decay. $I_{(\gamma+ce)}$: from ^{199}Tl IT decay: I(γ+ce)(29γ)= I(γ+ce)(720γ)+I(γ+ce)(353γ). α: given for Eγ=29.3 *3* (Eγ calculated from E(level) difference).
		381.98 *5*	100	366.89	3/2$^+$	E3		0.229		B(E3)(W.u.)≈0.0114 α(K)=0.0966; α(L)=0.101; α(M)=0.0266; α(N+..)=0.00872 I_γ,Mult.: from ^{199}Tl IT decay. E_γ: from ^{199}Tl ε decay (12.2 min). B(E3)(W.u.): compare to B(E3)(W.u.)=0.0086 *9* for the analogous transition in ^{201}Tl (1994Ra12).
1118.29	11/2$^-$	369.3	100	748.87	9/2$^-$	(M1+E2)	−0.25 *+10−30*	0.22 *3*		α(K)=0.18 *3*; α(L)=0.031 *3*; α(M)=0.0073 *6*; α(N+..)=0.0023 *2*
1120.90	1/2,3/2,5/2$^{(+)}$	400.54 *8*	81 *7*	720.35	(5/2)$^+$					
		753.92 *8*	100 *5*	366.89	3/2$^+$					
		1121.00 *7*	94 *5*	0.0	1/2$^+$					
1205.20	(7/2$^+$)	838.3	100	366.89	3/2$^+$	Q				

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Adopted Levels, Gammas (continued)

γ(^{199}Tl) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[#]	α[&]	Comments
1241.64	1/2,3/2,5/2	120.54[b] *15*	3.4 *10*	1120.90	1/2,3/2,5/2$^{(+)}$				
		521.28 *7*	26 *5*	720.35	$(5/2)^+$				
		874.77 *9*	100 *5*	366.89	$3/2^+$				
1394.57?	$(11/2^-)$	645.7	100	748.87	$9/2^-$	E2+M1	−0.9 *+5−8*	0.036 *12*	
1450.46	$13/2^-$	332.1	100	1118.29	$11/2^-$	M1+E2	−0.34 *9*	0.286 *12*	α(K)=0.232 *11*; α(L)=0.0409 *10*; α(M)=0.00957 *20*; α(N+..)=0.00306 *7*
		701.7	97	748.87	$9/2^-$	E2		0.0132	α(K)=0.0101; α(L)=0.00233
1482.39	1/2,3/2,5/2	240.8 *2*	7.0 *5*	1241.64	1/2,3/2,5/2				
		361.4 *6*	15 *5*	1120.90	1/2,3/2,5/2$^{(+)}$				
		761.98 *7*	100 *5*	720.35	$(5/2)^+$				
		1115.1 *4*	28 *3*	366.89	$3/2^+$				
		1481.2 *6*	6.0 *10*	0.0	$1/2^+$				
1502.01	$1/2^{(+)}$ to $5/2^{(+)}$	781.48 *7*	23.7 *14*	720.35	$(5/2)^+$				
		1135.04 *8*	100 *5*	366.89	$3/2^+$	(M1)[@]		0.0126	α(K)=0.0103; α(L)=0.00168
		1502.04 *8*	27.4 *11*	0.0	$1/2^+$				
1528.24	1/2,3/2,5/2	1161.27 *9*	100	366.89	$3/2^+$				
1554.11	1/2,3/2,5/2	312.3[b] *7*	6 *2*	1241.64	1/2,3/2,5/2				
		433.2 *3*	36 *10*	1120.90	1/2,3/2,5/2$^{(+)}$				
		833.83 *10*	40 *6*	720.35	$(5/2)^+$				
		1187.23 *10*	100 *10*	366.89	$3/2^+$				
		1553.3 *3*	18 *4*	0.0	$1/2^+$				
1632.11	1/2,3/2,5/2	390.3 *4*	45 *8*	1241.64	1/2,3/2,5/2				
		510.90[b] *10*		1120.90	1/2,3/2,5/2$^{(+)}$				
		911.80 *15*	100 *15*	720.35	$(5/2)^+$				
		1265.4 *3*	48 *5*	366.89	$3/2^+$				
		1631.8 *3*	24 *5*	0.0	$1/2^+$				
1658.35	1/2,3/2,5/2$^{(+)}$	937.89 *8*	37.7 *20*	720.35	$(5/2)^+$				
		1291.50 *10*	5.5 *5*	366.89	$3/2^+$				
		1658.43 *9*	100	0.0	$1/2^+$				
1695.2	1/2,3/2,5/2$^{(+)}$	1328.3 *3*	55 *8*	366.89	$3/2^+$				
		1695.28[b] *10*	100 *8*	0.0	$1/2^+$				
1716.98	$(13/2^-)$	598.8	100	1118.29	$11/2^-$	M1+E2	−2.4 *+6−7*	0.025 *4*	α(K)=0.020 *4*; α(L)=0.0044 *5*
1725.27	1/2,3/2,5/2	222.83 *10*	5.0 *21*	1502.01	$1/2^{(+)}$ to $5/2^{(+)}$				
		1005.13 *8*	100 *5*	720.35	$(5/2)^+$				
		1358.6 *3*	26 *3*	366.89	$3/2^+$				
		1725.3 *5*	5.0 *17*	0.0	$1/2^+$				
1749.65	1/2,3/2,5/2$^{(+)}$	267.6 *2*	14 *8*	1482.39	1/2,3/2,5/2				
		1029.21 *9*	57 *3*	720.35	$(5/2)^+$				
		1382.71 *9*	100 *4*	366.89	$3/2^+$				
		1749.70 *10*	81 *4*	0.0	$1/2^+$				

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Adopted Levels, Gammas (continued)

γ(^{199}Tl) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[#]	α[&]	Comments
1768.60	1/2,3/2,5/2	1048.09 *9*	29 *4*	720.35	$(5/2)^+$				
		1401.94 *10*	100 *6*	366.89	$3/2^+$				
		1768.48 *15*	22 *6*	0.0	$1/2^+$				
1866.94	$(15/2^-)$	416.6	100	1450.46	$13/2^-$	M1+E2	−0.40 *+12−18*	0.151 *14*	α(K)=0.123 *13*; α(L)=0.0215 *14*; α(M)=0.0050 *3*; α(N+..)=0.00161 *10*
		748.5	100	1118.29	$11/2^-$	E2		0.0115	α(K)=0.00888; α(L)=0.00197
1891.06	$1/2,3/2,5/2,5/2^{(+)}$	1170.70 *9*	76 *7*	720.35	$(5/2)^+$				
		1524.10 *15*	40 *10*	366.89	$3/2^+$				
		1891.3 *3*	100 *7*	0.0	$1/2^+$				
1898.13	1/2,3/2,5/2	344.0 *7*	7 *3*	1554.11	1/2,3/2,5/2				
		777.20 *15*	59 *5*	1120.90	$1/2,3/2,5/2,5/2^{(+)}$				
		1531.23 *10*	100 *7*	366.89	$3/2^+$				
		1898.7 *6*	16 *5*	0.0	$1/2^+$				
1930.11	$1/2,3/2,5/2,5/2^{(+)}$	1209.60 *10*	100 *7*	720.35	$(5/2)^+$				
		1930.69 *20*	43 *11*	0.0	$1/2^+$				
1943.8	$(9/2^-,11/2^-,13/2^-)$	825.5	100	1118.29	$11/2^-$	(M1+E2)	−1.9 *3*	0.0135 *12*	α(K)=0.0108 *11*; α(L)=0.00203 *15*
1959.50	1/2,3/2,5/2	430.9 *3*	9.3 *21*	1528.24	1/2,3/2,5/2				
		476.9 *3*	8.5 *21*	1482.39	1/2,3/2,5/2				
		838.68 *10*	42 *8*	1120.90	$1/2,3/2,5/2,5/2^{(+)}$				
		1239.12 *10*	100 *4*	720.35	$(5/2)^+$				
		1592.58 *15*	12.4 *13*	366.89	$3/2^+$				
		1959.50 *20*	3.2 *5*	0.0	$1/2^+$				
1977.48	1/2,3/2,5/2	319.2 *4*	16 *5*	1658.35	$1/2,3/2,5/2,5/2^{(+)}$				
		494.89 *10*	65 *10*	1482.39	1/2,3/2,5/2				
		1610.67 *10*	100 *7*	366.89	$3/2^+$				
		1978.5 *3*	12 *2*	0.0	$1/2^+$				E_γ: level-energy difference=1977.5.
1985.23	$(17/2^-)$	118.2	23	1866.94	$(15/2^-)$				
		534.8	100	1450.46	$13/2^-$	Q			
2031.58	$1/2,3/2,5/2,5/2^{(+)}$	503.15 *20*	27 *9*	1528.24	1/2,3/2,5/2				
		1311.28 *10*	100 *14*	720.35	$(5/2)^+$				
		2031.4 *5*	60 *11*	0.0	$1/2^+$				
2080.07	$(15/2^+)$	363.2	25	1716.98	$(13/2^-)$	(E1)		0.0185	α(K)=0.0153; α(L)=0.00251; α(M)=0.000581; α(N+..)=0.000185
		629.5	100	1450.46	$13/2^-$	E1(+M2)	−0.07 *+7−5*	0.00580	α(K)=0.00480; α(L)=0.00075
2159.57	1/2,3/2,5/2	605.8[ab] *6*	<18[a]	1554.11	1/2,3/2,5/2				
		1793.10 *20*	100 *18*	366.89	$3/2^+$				
		2158.6 *3*	20 *5*	0.0	$1/2^+$				E_γ: level-energy difference=2159.6.
2206.5	$1/2,3/2,5/2,5/2^{(+)}$	574.98[b] *15*	120 *20*	1632.11	1/2,3/2,5/2				
		724.5[b] *4*	133 *27*	1482.39	1/2,3/2,5/2				
		1840.0[b] *4*	93 *13*	366.89	$3/2^+$				

$^{199}_{81}Tl_{118}$-5

Adopted Levels, Gammas (continued)

γ(^{199}Tl) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[#]
2206.5	1/2,3/2,5/2$^{(+)}$	2206.5 *3*	100 *20*	0.0	$1/2^+$		
2226.48	1/2,3/2,5/2	1506.2 *4*	100 *11*	720.35	$(5/2)^+$		
		1859.3 *3*	61 *13*	366.89	$3/2^+$		
		2226.7 *3*	13 *8*	0.0	$1/2^+$		
2237.39	1/2,3/2,5/2$^{(+)}$	605.8[ab] *6*	<6[a]	1632.11	1/2,3/2,5/2		
		735.4[a] *3*	<18[a]	1502.01	$1/2^{(+)}$ to $5/2^{(+)}$		
		995.6[b] *4*	19 *4*	1241.64	1/2,3/2,5/2		
		1517.12 *10*	75 *5*	720.35	$(5/2)^+$		
		2237.29 *10*	100 *6*	0.0	$1/2^+$		
2367.38	1/2,3/2,5/2$^{(+)}$	641.3 *4*	33 *6*	1725.27	1/2,3/2,5/2		
		735.4[ab] *3*	<61[a]	1632.11	1/2,3/2,5/2		
		1647.2 *6*	61 *12*	720.35	$(5/2)^+$		
		2000.61 *15*	100 *9*	366.89	$3/2^+$		
		2367.0 *5*	45 *9*	0.0	$1/2^+$		
2433.63	1/2,3/2,5/2$^{(+)}$	2066.95 *20*	44 *4*	366.89	$3/2^+$		
		2433.1 *3*	100 *7*	0.0	$1/2^+$		
2471.69	$(19/2^-)$	486.4		1985.23	$(17/2^-)$	D(+Q)	+0.1 *3*
		604.8		1866.94	$(15/2^-)$		
2547.6	1/2,3/2,5/2$^{(+)}$	2180.2[b] *4*	154 *40*	366.89	$3/2^+$		
		2547.6 *4*	100 *40*	0.0	$1/2^+$		
2643.2	1/2,3/2,5/2$^{(+)}$	984.4[b] *5*	167 *67*	1658.35	1/2,3/2,5/2$^{(+)}$		
		2643.2 *4*	100 *33*	0.0	$1/2^+$		

[†] From ^{199}Pb ε decay (90 min) and from (α,2nγ) for gammas from high spin levels above the 749.7-keV isomeric state.
[‡] ^{199}Pb ε (90 min) and (α,2nγ).
[#] From (α,2nγ), unless otherwise noted.
[@] From ^{199}Pb ε decay (90 min).
[&] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[a] Multiply placed with undivided intensity.
[b] Placement of transition in the level scheme is uncertain.

$^{199}_{81}Tl_{118}$-6

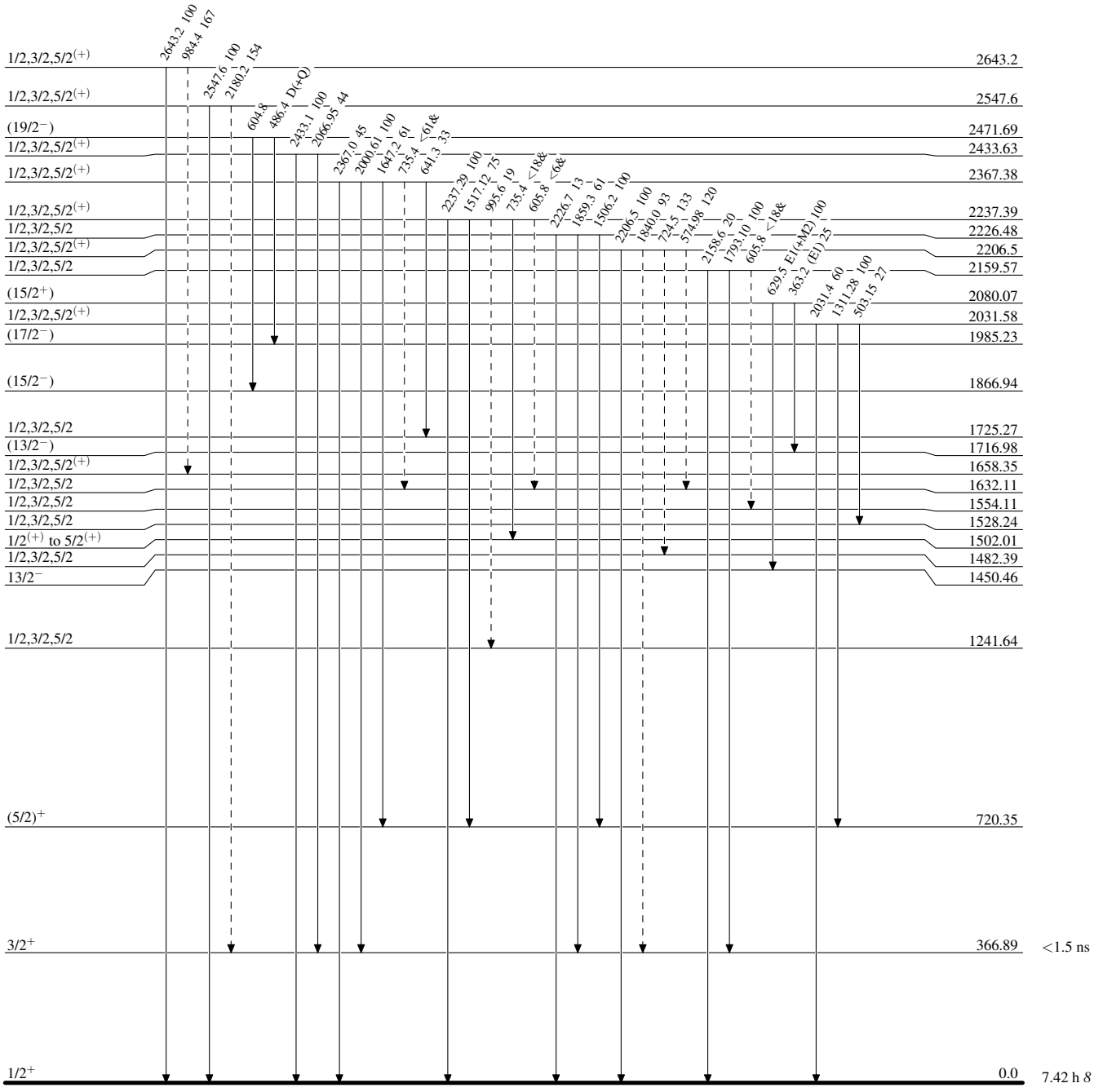
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given

– – – – – – ► γ Decay (Uncertain)

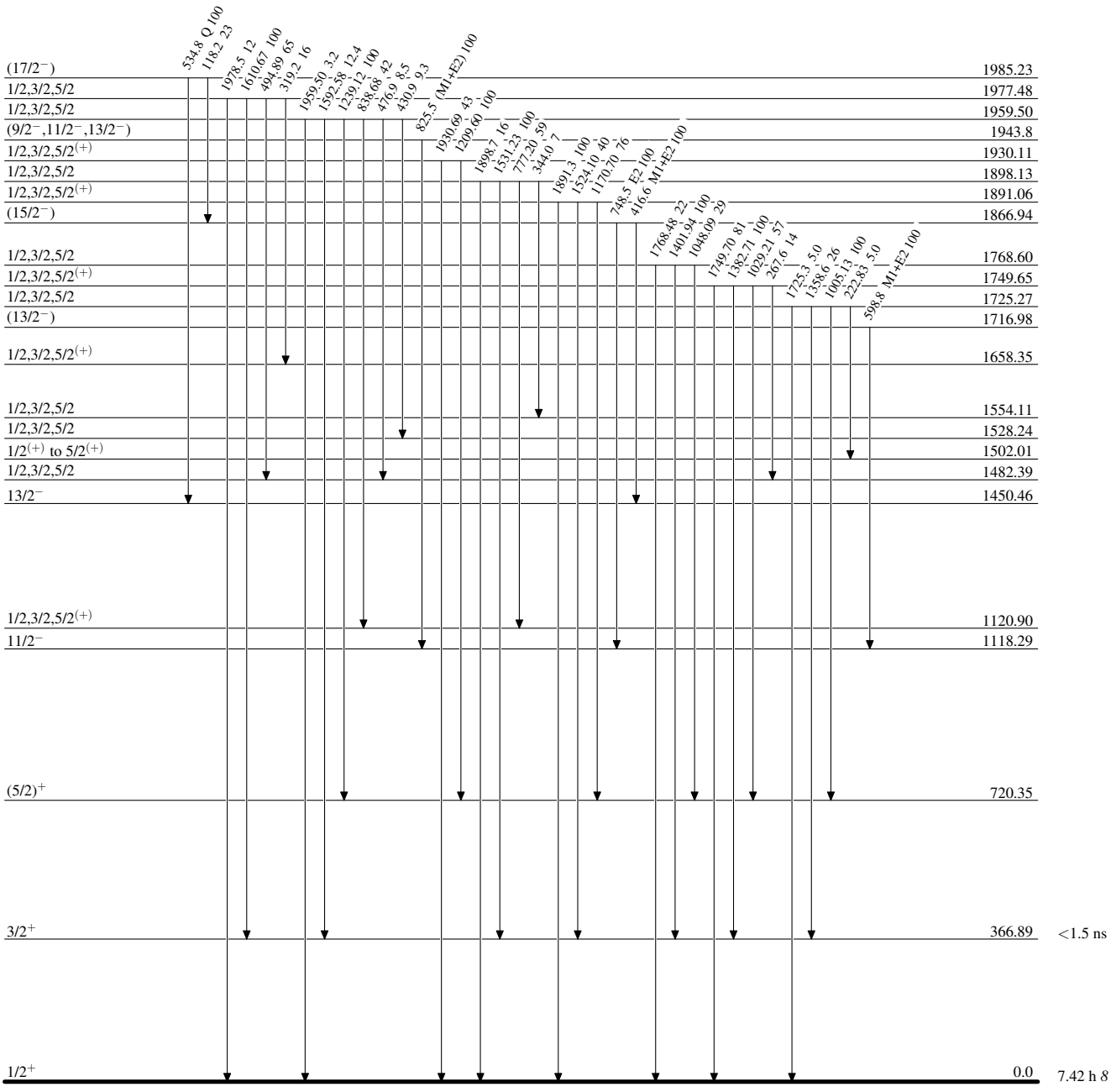


$^{199}_{81}Tl_{118}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given



$^{199}_{81}Tl_{118}$

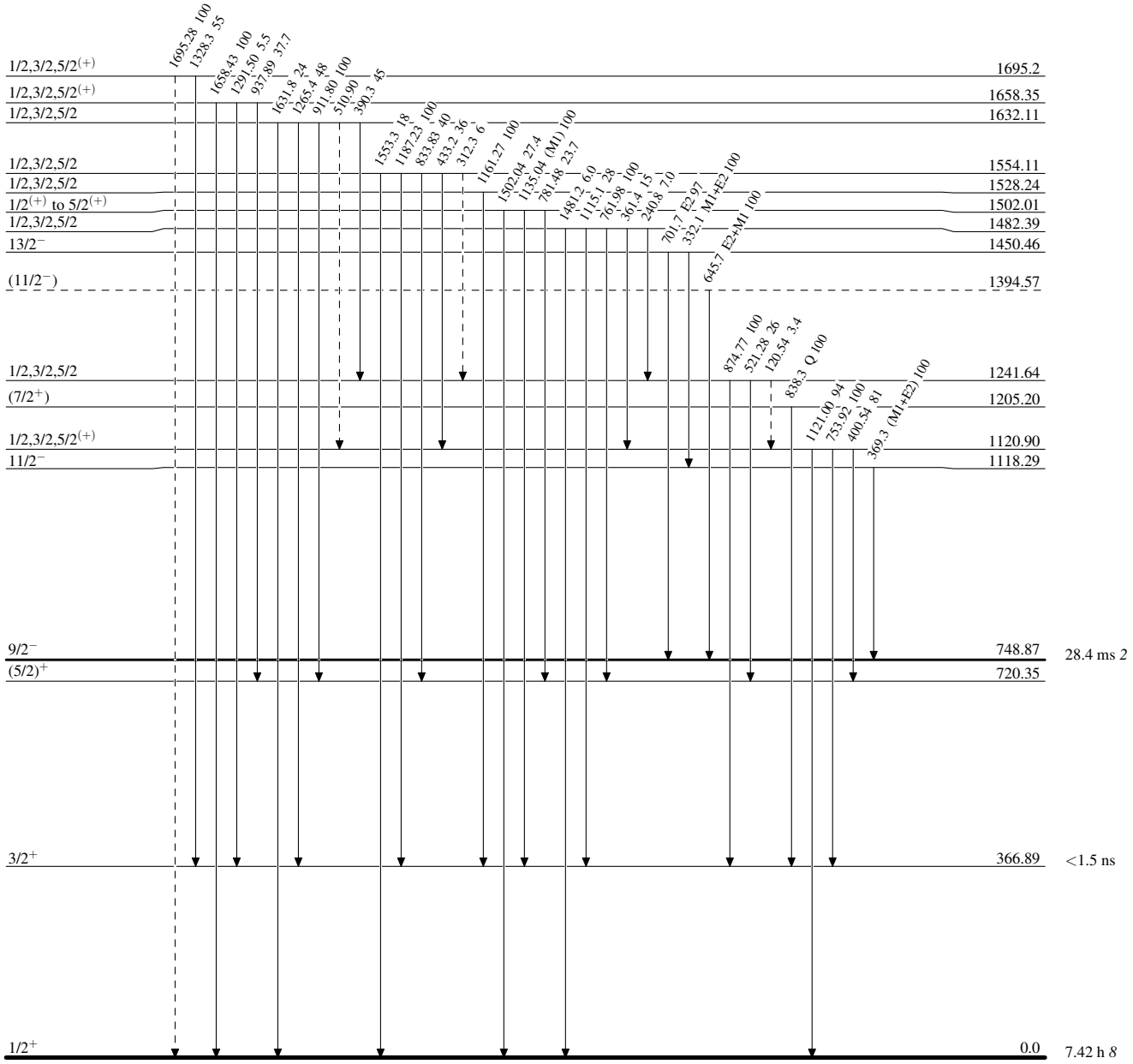
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given

- - - - - - ► γ Decay (Uncertain)

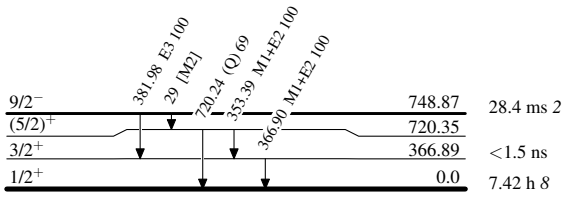


$^{199}_{81}Tl_{118}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given



$^{199}_{81}Tl_{118}$

Adopted Levels, Gammas

Band(A): 9/2[505] (oblate) band

$^{199}_{81}Tl_{118}$