Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	E. Browne	NDS 107,2579 (2006)	1-Nov-2004

Q(β^-)=−499 *8*; S(n)=6440.1 *11*; S(p)=7603 *14*; Q(α)=4081.6 *14* 2012Wa38
Note: Current evaluation has used the following Q record −500 8 *6440.3 11* 776E1 10 *4081.6 14* 2003Au03.
Other reactions:
^{232}Th(n,Fission): E=1 eV- 20 keV, measured cross-section (1991Na03); E<20 MeV, calculated fission cross-section (2004Ma84).
^{232}Th(γ,Fission): E=68-264 MeV (2000Sa09); E=40-100 MeV (1996Ka16); E=4.75-6.5 MeV (1996Se07); E=6.44-13.15 MeV, deduced height of fission barrier (1993Pi05); E=250-1200 MeV, measured fission cross-section (1993Bi16); E=6.73-9.72 MeV, measured γ rays (1992Ge01).
^{232}Th(γ,f) Eγ=4-7 MeV bremsstrahlung, quadrupole component in photofission deduced (1979Zh01). Others: 1978Zh03, 1978Zh04, 1977Zh06. ^{232}Th(γ,f), isomer at ≈3 MeV in third minimum decaying primarily by γ emission suggested (1978As02).
^{232}Th(pol γ,Fission): E=52 meV (1991Ta15); E=69 MeV (1991Ma22).
232Th(e,Fission), E=4.54-6.64 MeV, measured cross-sections of fission fragments (1994EnZZ).
^{232}Th(e,e′f) E(e)=20-120 MeV. Possible E2 component deduced (1977Sh15) E(e)=10-40 MeV, possible E2 component at 22 MeV (1976Kn01).
Fission following ^{232}Th(α,α') studied at E(α)=120 MeV. Small fission probability found in the region of the giant-quadrupole resonance (1980Va14). Fission mass asymmetry studied in ^{232}Th(γ,fission) for bremsstrahlung of 15-55 MeV (1980Gu12).
Three-humped fission barrier proposed. Branching=2.5×10^{-4} *15* for isomeric fission; E=2.4 MeV *2* for excitation energy of the fission shape isomer are deduced from ^{232}Th(γ,f). Eγ(bremsstrahlung)=3.25-5.75 MeV (1978Bo07,1979Be33).
^{232}Th(γ,n), (γ,2n), (γ,f) studied for Eγ=5-18.3 MeV. Deduced β(2)=0.290, Q=9.8 *4* from giant-dipole resonance parameters (1980Ca08).
^{232}Th(p,p): 2002Ig01, 2000De61.
^{232}Th(pol p,p): 1998Do16.
^{232}Th(p-bar,x): anti-proton absorption (1993Ja09,1993Wy05,1998Lu05,2001Tr19,2001Tr23).
Additional information 1.
^{232}Th(^{40}Ar,^{40}Ar), E=200 MeV (1993Ad01). Other: 1991An16.
^{232}Th(^{12}C,^{12}C) (1992An12).
Optical-model parameters deduced from (d,d) (1974Ch27).
Cluster radioactivity:
^{232}Th ^{26}Ne decay (1997Tr17,1997MiZP,1995Si05,1975ChZj,2002Sa55).
^{232}Th ^{24}Ne decay (1993Si26).
^{232}Th Double beta decay with emission of two neutrinos (2004Ra13,2002Tr04). Other: 2002Hi06.
Isotope shifts measured by LASER spectroscopy, mean square charge radii of Th isotopes determined (1989Ka29).
Deduced mean square charge radii of U and Pu isotopes from muonic x-rays relative to 232Th (1990Na22).
g-factors for g.s. band up to J^π=22$^+$ studied by 1982Ha03.

^{232}Th Levels

Additional information 2.
Band(ayz) K=0$^+$ g.s. rotational band.

Cross Reference (XREF) Flags

A	^{232}Ac β^- decay	F	^{232}Th(d,pnγ)	K	^{232}Th(n,n′γ)
B	^{232}Pa ε decay	G	Coulomb excitation: HI	L	^{232}Th(d,d′)
C	^{236}U α decay	H	Coulomb excitation: Li	M	^{232}Th(α,α'),(γ,X) E=resonance
D	^{230}Th(t,p)	I	Inelastic scattering		
E	^{232}Th(γ,γ'), ^{232}Th(e,e′)	J	Muonic atom		

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Adopted Levels, Gammas (continued)

^{232}Th Levels (continued)

E(level)[†]	J$^\pi$	T$_{1/2}$	XREF	Comments
0	0$^+$	1.40×10^{10} y *1*	ABCDEFGHI KL	%α=100; %SF=1.1×10^{-09} *4* Deformation β_4=0.050 *5* from (p,p′) (1972BrZK). Additional information 3. Q(0), giant-dipole resonance studied (1973Ve01). T$_{1/2}$: Evaluated and recommended in 1990Ho28. Weighted average of: 1.39×10^{10} y *3* (1938Ko01, 1956Pi42), 1.42×10^{10} y *7* (1956Se17), 1.45×10^{10} y *5* (1956Ma43), 1.41×10^{10} y *14* (1960Fa07), and 1.40×10^{10} y *7* (1963Le21). %SF: From T$_{1/2}$(SF)=1.2×10^{21} y *4*, evaluated and recommended in 2000Ho27, from: >0.0014×10^{21} y (1952Se67), >0.1×10^{21} y (1955Po45), >1×10^{21} y (1958Fl44), >1.0×10^{21} y *3* (1967Sp12), >0.7×10^{21} y (1975Em03), and 1.22 y *43* (1995Bo18). Others: 1997Ro12, 2004Ro01. T$_{1/2}$: T$_{1/2}$ ^{12}C,^{16}O emissions >3×10^{18} y (1975ChZJ). T$_{1/2}$: Measured T$_{1/2}$ ^{24}Ne-^{26}Ne emissions >5.06×10^{21} y (1995Bo18). Others: 1996Bo18, 1975ChZJ.
49.369 *9*	2$^+$[‡]	345 ps *15*	ABCDEFGHI KL	J$^\pi$: 49.4γ E2 to 0$^+$. T$_{1/2}$: Delayed coincidence (1960Be25). Other values: 320 ps *24* Mossbauer (1973Ca29), 345 ps *15* delayed coincidence (1960Be25), 315 ps *3* from B(E2)=9.21 *9* (1973Be44) and α=332 (reducing α by 1.5% *7* as recommended by 1987Ra01 would give T$_{1/2}$=320 ps *4*).
162.12 *2*	4$^+$[‡]	164 ps *13*	A CD FGHI KL	B(E4)↑=1.16 *5* (1976Co08) T$_{1/2}$: Doppler-shift recoil distance (1982Ow01). J$^\pi$: 112.7γ E2 to 2$^+$. T$_{1/2}$: The effect of charge-state of recoils on T$_{1/2}$ is probably <20%. μ: Studied for 4$^+$,6$^+$ levels by γ,γ precession in Fe (1971MuZN).
333.26 *8*	6$^+$[‡]	62 ps *4*	C FGHI KL	T$_{1/2}$: Weighted average of 58.4 ps *42* (1976Gu12) and 66.2 ps *51* (1975Jo07), Doppler-shift recoil distance. J$^\pi$: 171.2γ E2 to 4$^+$.
556.9 *1*	8$^+$[‡]	24 ps *1*	FGHI L	T$_{1/2}$: Weighted average of 23.8 ps *13* (Doppler-shift recoil distance, 1976Gu12), 25.1 ps *23* (Doppler-shift recoil distance, 1975Jo07), and 20 ps *3* (From B(E2)=4.0 *2*, 1982Ow01). J$^\pi$: 226.3γ E2 to 6$^+$.
714.42[&] *9*	1$^-$[‡]		A EFGHI KL	J$^\pi$: 714.4γ (E1) to 0$^+$, 665.0γ (E1) to 2$^+$. σ in ^{232}Th(d,d′).
730.6[a] *2*	0$^+$[‡]		GH KL	J$^\pi$: 730.0γ E0 to 0$^+$.
774.15[a] *14*	2$^+$[‡]	6 ps *2*	A de GH KL	J$^\pi$: 724.7γ E0+E2 to 2$^+$. T$_{1/2}$: From B(E2)=0.086 *14* (1993Mc07).
774.43[&] *7*	3$^-$[‡]		A deFGHI KL	J$^\pi$: 612.3γ (E1) to 4$^+$, 724.7γ (E1) to 2$^+$. σ in ^{232}Th(d,d′).
785.25[b] *8*	2$^+$[‡]	2.3 ps *3*	A E GH KL	J$^\pi$: 785.3γ E2 to 0$^+$. T$_{1/2}$: From B(E2)=0.145 *15* (1993Ko42).
826.8 *1*	10$^+$[‡]	10.3 ps *6*	FGHI	J$^\pi$: Weighted average of 10.4 ps *6* (Doppler-shift recoil distance, 1976Gu12), 11.2 ps *17* (Doppler-shift recoil distance, 1975Jo07), and 9.5 ps *11* (from B(E2)=3.9 *2*, 1982Ow01). J$^\pi$: 269.8γ E2 to 8$^+$.
829.6[b] *2*	(3$^+$)[‡]		GH K	J$^\pi$: 780.2γ to 2$^+$, 667.5γ to 4$^+$.
873.0[a] *3*	4$^+$[‡]		GH K	J$^\pi$: 823.6γ E2 to 2$^+$, possible 539.9γ to 6$^+$.
883.8[&] *1*	5$^-$[‡]		FGHI KL	J$^\pi$: 550.4γ (E1) to 6$^+$. σ in ^{232}Th(d,d′).
890.1[b] *2*	4$^+$[‡]		GH K	J$^\pi$: 840.5γ E2 to 2$^+$, 558.1γ E2 to 6$^+$.
960.24[b] *15*	(5$^+$)[‡]		G K	J$^\pi$: 627.2γ to 6$^+$, 797.9γ to 4$^+$.
1023.3[a] *1*	6$^+$[‡]		GH	J$^\pi$: 861.2γ E2 to 4$^+$, 466.7γ E2 to 8$^+$.

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Adopted Levels, Gammas (continued)

^{232}Th Levels (continued)

E(level)[†]	J$^\pi$	T$_{1/2}$	XREF	Comments
1042.9[&] *1*	7$^-$[‡]		FGHI	J$^\pi$: 159.2γ E2 to 5$^-$, 486.0γ to 8$^+$.
1050.9[b] *1*	6$^+$[‡]		GH	J$^\pi$: 492.3γ E2 to 8$^+$, 888.4γ E2 to 4$^+$.
1053.9 *1*	(2$^+$)		GH KL	J$^\pi$: 891.9γ (E2) to 4$^+$, 1054.0γ (E2) to 0$^+$.
1072.4 *3*	(2$^+$)[@]		A H K	Additional information 4.
1077.9 *2*	(1$^-$)[@]		A d GH Kl	J$^\pi$: Possible K^π=1$^-$ bandhead.
1078.6 *1*	(0$^+$)		A dE H Kl	J$^\pi$: From γ-ray deexcitation.
1094.4 *2*	(2)$^+$[@]		E H K	Additional information 5.
1105.7 *1*	3$^-$		A GH KL	B(E3)↑=0.26 *5* J$^\pi$: 1056γ E1 to 2$^+$, 943γ E1 4$^+$.
1121.68 *8*	2$^+$		A GH K	J$^\pi$: 1122.0γ E2 to 0$^+$.
1137.1 *5*	12$^+$[‡]	5.5 ps *4*	FG I	T$_{1/2}$: Weighted average of 5.5 ps *4* (Doppler-shift recoil distance, 1976Gu12), and 5.8 ps *7* (From B(E2)=3.6 *2*, 1982Ow01). J$^\pi$: 310.2γ E2 to 10$^+$.
1143.3 *2*	(4$^-$)		K	J$^\pi$: 981.2γ to 4$^+$, rotational band structure (possibly K^π=2$^-$).
1146.3? *15*	(7$^+$)		G	J$^\pi$: 812.7γ to 6$^+$.
1148.3 *2*	(4$^+$)		g KL	J$^\pi$: 815.0γ to 6$^+$, 986.3γ to 4$^+$, rotational band structure, (possibly K^π=0$^+$).
1182.6 *2*	3$^-$		GH KL	J$^\pi$: 1020.5γ E1 to 4$^+$, 1133.2γ E1 to 2$^+$, (possibly K^π=3$^-$ band).
1208.8 *1*	(5$^-$)		GH KL	J$^\pi$: 434.3γ to 3$^-$, 875.6γ to 6$^+$, rotational band structure, (possibly K^π=2$^-$).
1218.1 *3*			K	
1222.1[a] *1*	(8$^+$)[‡]		GH	J$^\pi$: 888.8γ to 6$^+$, possible 395γ to 10$^+$.
1249.6[&] *1*	9$^-$[‡]		FGHI	J$^\pi$: 206.8γ E2 to 7$^-$, 422.7γ to 10$^+$. Additional information 6.
1258.7?[b] *10*	(8$^+$)[‡]		G	J$^\pi$: From Coulomb excitation cross-section.
1293.0 *3*	(5$^-$)[@]		GH L	J$^\pi$: 959.7γ to 6$^+$.
1303.2 *6*			K	
1322.3 *3*	2$^+$		G	B(E2)↑=0.00220 *22* J$^\pi$: 1322.3γ E2 to 0$^+$.
1327.4 *2*	2$^+$		GH KL	B(E2)↑=0.00113 *13* J$^\pi$: 1327.7γ E2 to 0$^+$.
1352.2 *1*			H	
≈1370[b]	(9$^+$)[‡]		G	J$^\pi$: From Coulomb excitation cross-section.
1387.1 *1*	2$^+$	0.4 ps *1*	H K	J$^\pi$: 1387.2γ E2 to 0$^+$. T$_{1/2}$: From B(E2)=0.0105 *8* (1993Mc07) and adopted Branching(1387γ)=0.075 *23*.
1413.8[c] *2*	4$^+$[‡]	2.2 ps *5*	GH	T$_{1/2}$: From Coulomb Excitation: HI (1995Ko15). Additional information 7. J$^\pi$: 584.2γ M1+E2 to 3$^+$, 524γ M1+E2 to 4$^+$, 628.5 E2 to 2$^+$.
1419? *2*			L	E(level): From ^{232}Th(d,d′). Seen only at one angle.
1450.3 *2*			K	
1466.4 *1*	4$^+$		H	J$^\pi$: 691.9γ to 3$^-$, 1133.5γ to 6$^+$.
≈1469.3?[a]	(10$^+$)[‡]		G	J$^\pi$: 912.5γ to 8$^+$.
1477.0 *2*	2$^+$		H	J$^\pi$: 1477.0γ E2 to 0$^+$.
1480.1 *2*			G K	
1482.2 *6*	14$^+$[‡]	3.1 ps *2*	G I	T$_{1/2}$: Doppler-shift recoil distance (1976Gu12). Other value: 3.1 ps *3* (From B(E2)=3.8 *2*, 1982Ow01). J$^\pi$: 345.2γ E2 to 12$^+$.
1484.9 *2*	(5$^+$)		G KL	J$^\pi$: 1323γ to 4$^+$, 524γ to (5$^+$); σ in 232Th(d,d′).
1489.4 *4*	(1,2$^+$)		K	J$^\pi$: 1489γ to 0$^+$, 1440γ to 2$^+$.
≈1490[c]	(5$^+$)[‡]		G	J$^\pi$: From Coulomb excitation cross-section.
1498.7[&] *5*	11$^-$[‡]		FG I	J$^\pi$: 249.2γ E2 to 9$^-$, 361.6γ to 12$^+$.

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Adopted Levels, Gammas (continued)

^{232}Th Levels (continued)

E(level)[†]	J$^{\pi}$	T$_{1/2}$	XREF	Comments
				Additional information 8.
≈1511.9[b]	(10^{+})[‡]		G	J$^{\pi}$: From Coulomb excitation cross-section.
1519.8 *2*			K	
1553.8 *1*	2^{+}	110 fs *10*	E H K	T$_{1/2}$: From B(E2)=0.0279 *20* (1993Mc07) and branching(1554γ) from Coulomb Excitation: Li. J$^{\pi}$: 1554.0γ E2 to 0^{+}. T$_{1/2}$: from B(E2).
1561.4 *5*	(1,2^{+})		KL	J$^{\pi}$: 1561.4γ to 0^{+}.
1573.0 *15*	(1,2^{+})		K	J$^{\pi}$: 1572.8γ to 0^{+}, 1523.8γ to 2^{+}.
1573.7[c] *7*	(6^{+})[‡]		G	J$^{\pi}$: 614γ M1+E2 to (5^{+}), 683γ (E2) to 4^{+}, 550γ to 6^{+}.
1578.5 *4*	(2^{+})		K	J$^{\pi}$: 1578.3γ to 0^{+}, 1527.4γ to 2^{+}, 1417.0γ to 4^{+}.
1609.1 *5*			K	
1618.0 *7*			KL	
≈1640?[b]	(11^{+})[‡]		g	J$^{\pi}$: From Coulomb excitation cross-section.
1647.6 *8*			K	
1690.9 *10*			KL	
1727.6 *7*			K	
1738.1 *10*	(1,2^{+})		KL	J$^{\pi}$: 1738γ to 0^{+}.
≈1755[a]	(12^{+})[‡]		G	J$^{\pi}$: From Coulomb excitation cross-section.
1783[c] *1*	(8)$^{+}$[‡]		G	J$^{\pi}$: 760γ E2 to 6^{+}, 637γ to (7^{+}).
1784.7[&] *6*	13^{-}[‡]		G I	J$^{\pi}$: 286.0γ E2 to 11^{-}, 302.5γ to 14^{+}.
1791 *2*			L	E(level): From ^{232}Th(d,d′). ΔE estimated by evaluator.
≈1801[b]	(12^{+})[‡]		G	J$^{\pi}$: From Coulomb excitation cross-section.
1858.5 *7*	16^{+}[‡]	2.3 ps *2*	G I	T$_{1/2}$: Weighted average of 2.2 ps *2* (Doppler-shift recoil distance, 1976Gu12), and 2.7 ps *6* (From B(E2)=3.5 *2*, 1982Ow01). J$^{\pi}$: 376.3γ E2 to 14^{+}.
2043.2 *15*	1^{+}[#]	6.1 fs *4*	E	T$_{1/2}$: From B(M1)=1.48 *9* and branching(2043γ)=0.650 *8* in ^{232}Th(γ,γ') (1988He02).
≈2080[a]	(14^{+})[‡]		G	J$^{\pi}$: From Coulomb excitation cross-section.
2101.6[&] *7*	15^{-}[‡]		G I	J$^{\pi}$: 316.9γ E2 to 13^{-}, 243.1γ to 16^{+}.
≈2117[b]	(14^{+})[‡]		G	J$^{\pi}$: From Coulomb excitation cross-section.
2248.2 *15*	1^{+}[#]	13 fs *2*	E	B(M1)↑=0.55 *7* T$_{1/2}$: From B(M1)=0.55 *7* and branching(2248γ)=0.70 *12* in ^{232}Th(γ,γ') (1988He02).
2262.4 *9*	18^{+}[‡]	1.4 ps *2*	G I	T$_{1/2}$: Weighted average of 1.3 ps *2* (Doppler-shift recoil distance, 1976Gu12), and 1.6 ps *4* (From B(E2)=3.7 *6*, 1980Ow01). J$^{\pi}$: 403.9γ E2 to 16^{+}.
2274 *4*	1^{+}[#]	25 fs *6*	E	B(M1)↑=0.25 *3* T$_{1/2}$: From B(M1)=0.25 *3* and branching(2274γ)=0.62 *12* in ^{232}Th(γ,γ') (1988He02).
2296 *4*	1^{+}[#]	19 fs *9*	E	B(M1)↑=0.32 *6* T$_{1/2}$: From B(M1)=0.31 *6* and branching(2296γ)=0.59 *25* in ^{232}Th(γ,γ') (1988He02).
≈2441[a]	(16^{+})[‡]		G	J$^{\pi}$: From Coulomb excitation cross-section.
2445.3[&] *9*	17^{-}[‡]		G I	J$^{\pi}$: 343.7γ E2 to 15^{-}.
2445.7[b]	(16^{+})[‡]		G	J$^{\pi}$: From Coulomb excitation cross-section.
≈2446[b]	(16^{+})[‡]		G	
2691 *1*	20^{+}[‡]	1.2 ps *2*	G I	J$^{\pi}$: From B(E2)=3.4 *4* (1982Ow01). J$^{\pi}$: 428.9γ E2 to 18^{+}.
≈2767[b]	(18^{+})[‡]		G	

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Adopted Levels, Gammas (continued)

^{232}Th Levels (continued)

E(level)†	Jπ	$T_{1/2}$	XREF	Comments
2813& *1*	19−‡		G I	Jπ: 367.8γ E2 to 17−.
≈2832a	(18+)‡		G	Jπ: From Coulomb excitation cross-section.
3144 *1*	22+‡	0.8 ps *1*	G I	Jπ: From B(E2)=3.9 *6* (1982Ow01). Jπ: 452.7γ E2 to 20+.
3204& *2*	21−‡		G I	Jπ: 390.6γ E2 to 19−.
≈3249a	(20+)‡		G	Jπ: From Coulomb excitation cross-section.
3616& *2*	23−‡		G I	Jπ: 412.6γ E2 to 21−.
3620.0 *15*	24+‡	1.1 ps *3*	G	Jπ: From B(E2)=2.1 *7* (1982Ow01). Jπ: 476γ E2 to 22+.
4050& *2*	25−‡		G I	Jπ: 433.8γ E2 to 23−.
4117 *2*	26+‡	0.6 ps *2*	G I	Jπ: From B(E2)=3.3 *13* (1982Ow01). Jπ: 497γ E2 to 24+.
4506& *3*	27−‡		G I	Jπ: 456γ E2 to 25−.
4633 *2*	(28+)‡	≈0.2 ps	G I	Jπ: From B(E2)≈7 (1982Ow01). Jπ: 516γ (E2) to 26+.
5164 *3*	(30+)‡		G I	Jπ: 530.5γ (E2) to (28+).

† Deduced by evaluator from a least-squares fit to γ-ray energies, unless given otherwise.
‡ From rotational band structure. Additional arguments are given with individual levels.
# From M1 excitation in ^{232}Th(γ,γ′) and ^{232}Th(e,e′).
@ Coulomb excited by light ions, γ(θ), and ratios of γ-ray reduced transition probabilities (1993Mc07).
& Band(A): $K^\pi=0^-$ Octupole vibrational band.
a Band(B): $K^\pi=0^+$ Beta vibrational band.
b Band(C): $K^\pi=2^+$ Gamma vibrational band.
c Band(D): $K^\pi=4^+$ Two-phonon gamma vibrational band.

Adopted Levels, Gammas (continued)

$\gamma(^{232}Th)$

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.[a]	δ	α[b]	Comments
49.369	2+	49.369[&] 9	100[&]	0	0+	E2[&]		332	α(L)=244; α(M)=66.4 B(E2)(W.u.)=198 11 E_γ: From ^{232}Ac β^- decay.
162.12	4+	112.75[†] 2	100[†]	49.369	2+	E2[†]		6.82	α(K)=0.234; α(L)=4.78; α(M)=1.31; α(N+..)=0.490 B(E2)(W.u.)=286 24
333.26	6+	171.2[‡] 1	100[‡]	162.12	4+	E2[‡]		1.21	α(K)=0.208; α(L)=0.729; α(M)=0.199; α(N+..)=0.0738 B(E2)(W.u.)=326 22
556.9	8+	223.6[‡] 1	100[‡]	333.26	6+	E2[‡]		0.450	α(K)=0.131; α(L)=0.233; α(M)=0.0633; α(N+..)=0.0234 B(E2)(W.u.)=344 15
714.42	1−	665.0[†] 2	100[†] 2	49.369	2+	(E1)[†]		0.00729	α(K)=0.00594; α(L)=0.00102
		714.4[†] 2	16[†] 2	0	0+	(E1)[†]		0.00637	α(K)=0.00520; α(L)=0.00088
730.6	0+	681.1[‡] 3	100[‡]	49.369	2+				
		≈730.4[#]		0	0+	E0			
774.15	2+	612.0[&] 3	≈43[&]	162.12	4+	[E2][&]		0.0273	α(K)=0.0187; α(L)=0.00646 B(E2)(W.u.)≈3.3
		724.7[&] 2	≈1.8[&]	49.369	2+	E0+E2[&]			B(E2)(W.u.)≈0.52 Additional information 9.
		774.1[&] 4	100[&]	0	0+	E2[&]		0.0167	α(K)=0.0122; α(L)=0.00339 B(E2)(W.u.)=2.8 12
774.43	3−	612.3[&] 1	100[&]	162.12	4+	(E1)[&]		0.0085	α(K)=0.00694; α(L)=0.00120
		724.7[&] 5	≈9[&]	49.369	2+	(E1)[&]		0.00620	α(K)=0.00506; α(L)=0.00086 Additional information 10.
785.25	2+	623.1[‡] 1	≈0.8[‡]	162.12	4+	(E2)[‡]		0.0262	α(K)=0.0181; α(L)=0.00613 B(E2)(W.u.)≈0.13
		735.9[‡] 2	100[‡] 4	49.369	2+	E2+M1[‡]	23 10	0.0186 3	α(K)=0.0134 2; α(L)=0.00389 4 B(M1)(W.u.)=2.4×10^{-5} 22; B(E2)(W.u.)=7.2 7
		785.3[‡] 2	56[‡] 5	0	0+	E2[‡]		0.0162	α(K)=0.0118; α(L)=0.00327 B(E2)(W.u.)=2.9 4 Additional information 11.
826.8	10+	269.8[‡] 1	100[‡]	556.9	8+	E2[‡]		0.240	α(K)=0.091; α(L)=0.109; α(M)=0.0293; α(N+..)=0.0108 B(E2)(W.u.)=363 21
829.6	(3+)	667.5[#] 4	25[#] 6	162.12	4+				
		780.2[#] 2	100[#] 6	49.369	2+				
873.0	4+	539.9[†c] 10	100[†]	333.26	6+	[†]			Not seen in ^{232}Th(n,n′γ).
		823.6[‡] 3		49.369	2+	E2		0.0147	α(K)=0.0109; α(L)=0.00289
883.8	5−	550.4[†] 5		333.26	6+	(E1)		0.0105	α(K)=0.0085; α(L)=0.00149

$^{232}_{90}Th_{142}$-6

γ(^{232}Th) (continued)

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.[a]	δ	α[b]	Comments
883.8	5⁻	≈722[†c]		162.12	4⁺	(E1)		0.00625	α(K)=0.00510; α(L)=0.00087
890.1	4⁺	558.1[†c] *10*	5.0[†] *16*	333.26	6⁺	E2[†]		0.0335	α(K)=0.0222; α(L)=0.0085 Not seen in ^{232}Th(n,n′γ).
		728.0[†] *2*	100[†] *4*	162.12	4⁺	[†]			
		840.5[†] *4*	18[†] *4*	49.369	2⁺	E2[†]		0.0141	α(K)=0.0105; α(L)=0.00275
960.24	(5⁺)	627.2[#] *2*	52[#] *5*	333.26	6⁺	[#]			
		797.9[#] *2*	100[#] *5*	162.12	4⁺	[#]			
1023.3	6⁺	466.7[‡] *2*	2.0[‡] *3*	556.9	8⁺	E2[‡]		0.0512	α(K)=0.0311; α(L)=0.0148; α(M)=0.00386; α(N+..)=0.00142
		690.0[‡] *1*	30[‡] *5*	333.26	6⁺				
		861.2[‡] *10*	100[‡] *17*	162.12	4⁺	E2[‡]		0.0135	α(K)=0.0100; α(L)=0.00258
1042.9	7⁻	159.2[‡] *1*	100[‡] *14*	883.8	5⁻	E2[‡]		1.61	α(K)=0.230; α(L)=1.01; α(M)=0.275; α(N+..)=0.102
		486.0[‡] *1*	65[‡] *10*	556.9	8⁺				
		≈710[c]	0.6 *6*	333.26	6⁺				
1050.9	6⁺	492.3[†] *10*		556.9	8⁺	E2		0.0450	α(K)=0.0281; α(L)=0.0125; α(M)=0.00324; α(N+..)=0.00119
		717.7[‡] *1*	100[‡] *15*	333.26	6⁺				
		888.4[‡] *5*	25[‡] *4*	162.12	4⁺	E2[‡]		0.0127	α(K)=0.0095; α(L)=0.00239
1053.9	(2⁺)	268.4[‡]	<33[‡]	785.25	2⁺				
		279.5[‡] *3*	81[‡] *29*	774.15	2⁺				
		323.2[‡] *2*	100[‡] *14*	730.6	0⁺				
		891.9[‡] *3*		162.12	4⁺	(E2)		0.0126	α(K)=0.0094; α(L)=0.00237
		1004.6[‡] *3*		49.369	2⁺	(M1+E2)	2.6 *4*	0.0133 *11*	α(K)=0.0103 *9*; α(L)=0.00222 *15*
		1054.0[‡] *3*		0	0⁺	(E2)		0.0091	α(K)=0.00702; α(L)=0.00159
1072.4	(2⁺)	1023.0[‡] *3*	100[‡]	49.369	2⁺	[‡]			
1077.9	(1⁻)	1028.5[‡] *3*		49.369	2⁺				
		1078.0[‡] *3*		0	0⁺				
1078.6	(0⁺)	364.2[‡] *1*		714.42	1⁻				
		1029.2[‡]		49.369	2⁺				
1094.4	(2)⁺	932.3[‡] *3*		162.12	4⁺				
		1045.0[‡] *3*	[‡]	49.369	2⁺	M1+E2[‡]	−3.7 +*34*−*17*	0.011 *20*	α(K)=0.008 *16*; α(L)=0.002 *3*
1105.7	3⁻	331.3[‡] *1*	38[‡] *6*	774.43	3⁻				
		391.3[‡] *3*	5[‡] *1*	714.42	1⁻				
		943.5[‡] *1*	100[‡] *15*	162.12	4⁺	E1[‡]		0.00384	α(K)=0.00315; α(L)=0.00052
		1056.4[‡] *3*		49.369	2⁺	E1		0.00315	α(K)=0.00258; α(L)=0.00043

$\gamma(^{232}Th)$ (continued)

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.[a]	δ	α[b]	Comments
1121.68	2^+	347.2[‡] 1	30[‡] 5	774.43	3^-	E1[‡]		0.0272	α(K)=0.0219; α(L)=0.00402; α(M)=0.00096; α(N+..)=0.00034
		407.3[‡] 1	37[‡] 6	714.42	1^-				
		959.3[‡] 2	100[‡] 15	162.12	4^+	E2[‡]		0.0109	α(K)=0.00829; α(L)=0.00199
		1072.6[‡] 3		49.369	2^+	M1+E2	1.45 16	0.0156 11	α(K)=0.0123 9; α(L)=0.00245 16
		1122.0[‡] 3		0	0^+	E2		0.00812	α(K)=0.00629; α(L)=0.00138
1137.1	12^+	310.2[†] 5	100[†]	826.8	10^+	E2[†]		0.155	α(K)=0.0691; α(L)=0.0631; α(M)=0.0169; α(N+..)=0.00625 B(E2)(W.u.)=3.7×10^2 3
1143.3	(4^-)	981.2[#] 2	100[#]	162.12	4^+				
1146.3?	(7^+)	812.7[†c] 10		333.26	6^+				
1148.3	(4^+)	815.0[#] 2	47[#] 18	333.26	6^+				
		986.3[#] 2	100[#] 18	162.12	4^+				
1182.6	3^-	408.2[‡] 3		774.15	2^+	E1		0.0192	α(K)=0.0155; α(L)=0.00280; α(M)=0.00067; α(N+..)=0.00024
		1020.5[‡] 3		162.12	4^+	E1		0.00335	α(K)=0.00274; α(L)=0.00045
		1133.2[‡] 3		49.369	2^+	E1		0.00279	α(K)=0.00229; α(L)=0.00038
1208.8	(5^-)	325.0[‡] 1	9.6[‡] 15	883.8	5^-				
		434.3[‡] 2	3.4[‡] 11	774.43	3^-				
		875.6[‡] 2	1.9[‡] 6	333.26	6^+				
		1046.7[‡] 1	100[‡] 15	162.12	4^+				
1218.1		884.8[#] 3	100[#]	333.26	6^+				
1222.1	(8^+)	≈395.3[†]		826.8	10^+				
		888.8[†] 10		333.26	6^+				
1249.6	9^-	206.8[‡] 1	71[‡] 12	1042.9	7^-	E2[‡]		0.595	α(K)=0.151; α(L)=0.323; α(M)=0.088; α(N+..)=0.0325
		422.7[‡] 1	100[‡] 15	826.8	10^+				
1293.0	(5^-)	959.7[‡] 3	100[‡]	333.26	6^+				
1303.2		1303.2[#] 6	100[#]	0	0^+				
1322.3	2^+	1322.3[#] 3	100[#]	0	0^+	E2		0.00598	α(K)=0.00470; α(L)=0.00096
1327.4	2^+	1165.1[‡] 3		162.12	4^+	E2		0.00757	α(K)=0.00588; α(L)=0.00127
		1277.8[‡] 3		49.369	2^+	(M1+E2)		0.013 7	α(K)=0.010 6; α(L)=0.0019 9
		1327.7[‡] 3		0	0^+	E2		0.00594	α(K)=0.00467; α(L)=0.00096
1352.2		637.8[‡] 1	100[‡]	714.42	1^-				
1387.1	2^+	612.7[‡] 3	100[‡] 21	774.43	3^-				
		656.7[‡c] 11		730.6	0^+	E2		0.0234	α(K)=0.0164; α(L)=0.00528
		672.6[‡] 1	55[‡] 8	714.42	1^-	E1[‡]		0.00713	α(K)=0.00581; α(L)=0.00099 B(E1)(W.u.)=0.00011 3

Adopted Levels, Gammas (continued)

$\gamma(^{232}Th)$ (continued)

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.[a]	δ	α[b]	Comments
1387.1	2+	1225.1[‡] 3	64[‡] 19	162.12	4+	E2[‡]		0.00689	α(K)=0.00538; α(L)=0.00114 B(E2)(W.u.)=0.51 18
		1337.8[‡] 3	40 8	49.369	2+	M1+E2	−1.5 5	0.0092 21	α(K)=0.0073 18; α(L)=0.0014 3 I_γ: From $^{232}Th(n,n'\gamma)$.
		1387.2[‡] 3	21 6	0	0+	E2		0.00548	α(K)=0.00432; α(L)=0.00087 I_γ: From $^{232}Th(n,n'\gamma)$.
1413.8	4+	≈524[†]		890.1	4+	M1+E2	1.4	≈0.092	α(K)=0.0699; α(L)=0.0168
		584.2[†] 2	29[†] 5	829.6	(3+)	M1+E2[†]	<5	0.09 6	α(K)=0.07 5; α(L)=0.015 7 B(M1)(W.u.)>0.00028; B(E2)(W.u.)<12
		628.5[†] 2	100[†] 15	785.25	2+	E2[†]		0.0257	α(K)=0.0178; α(L)=0.00598 B(E2)(W.u.)=23 7
1450.3		1400.9 2		49.369	2+				
1466.4	4+	582.6[‡] 1	87 13	883.8	5−				
		691.9[‡] 2	34 5	774.43	3−				
		1133.5[‡] 2	100 19	333.26	6+				
		1304.3[‡c]	<85	162.12	4+				
≈1469.3?	(10+)	≈912.5[†c]	100[†]	556.9	8+				
1477.0	2+	702.6[‡] 3		774.15	2+	M1+E2	2.0 5	0.034 8	α(K)=0.026 7; α(L)=0.0062 10
		1427.6[‡] 3		49.369	2+				
		1477.0[‡] 3		0	0+	E2		0.00488	α(K)=0.00387; α(L)=0.00076
1480.1		1430.7[#] 2	100[#]	49.369	2+				
1482.2	14+	345.2[†] 5	100[†]	1137.1	12+	E2[†]		0.114	α(K)=0.0559; α(L)=0.0423; α(M)=0.0113; α(N+..)=0.00417 B(E2)(W.u.)=3.9×10^2 3
1484.9	(5+)	523.8[#] 10		960.24	(5+)				
		≈1150.9[†]		333.26	6+				
		1322.8[#] 2	100[#]	162.12	4+				
1489.4	(1,2+)	530.3[#] 16		960.24	(5+)				
		1440.0[#] 5	100[#] 13	49.369	2+				
		1489.3[#] 5	89[#] 13	0	0+				
1498.7	11−	249.2[†] 5		1249.6	9−	E2		0.311	α(K)=0.106; α(L)=0.149; α(M)=0.0404; α(N+..)=0.0149
		361.6[†] 5		1137.1	12+				
1519.8		1470.4[#] 2	100[#]	49.369	2+				
1553.8	2+	681.0[‡c] 3		873.0	4+	E2		0.0217	α(K)=0.0153; α(L)=0.00478
		768.5[‡c] 3		785.25	2+	M1+E2	≈6	≈0.0184	α(K)=0.0135; α(L)=0.00365
		779.6[‡] 3		774.15	2+	M1+E2	2.5 5	0.024 4	α(K)=0.018 3; α(L)=0.0043 5

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Adopted Levels, Gammas (continued)

γ(^{232}Th) (continued)

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.[a]	δ	α[b]	Comments
1553.8	2^+	823.5[‡c] 3		730.6	0^+	E2		0.0147	α(K)=0.0109; α(L)=0.00289
		839.4[‡] 1		714.42	1^-	E1		0.00474	α(K)=0.00387; α(L)=0.00065
		1391.9[‡c] 3		162.12	4^+	E2		0.00544	α(K)=0.00429; α(L)=0.00086
		1504.6[‡c] 3		49.369	2^+	M1+E2	−2.7 +26−12	0.004 6	α(K)=0.004 6
		1554.0[‡c] 3		0	0^+	E2		0.00354	α(K)=0.00354
1561.4	$(1,2^+)$	1561.4[#] 5	100[#]	0	0^+				
1573.0	$(1,2^+)$	1523.8[#] 2	45[#] 17	49.369	2^+				
		1572.8[#] 2	100[#] 17	0	0^+				
1573.7	(6^+)	550[†]	32	1023.3	6^+				
		614[†]	100[†]	960.24	(5^+)	M1+E2[†]	<6	0.08 5	α(K)=0.06 5; α(L)=0.013 7
		≈683[†]	37[†]	890.1	4^+	(E2)[†]		≈0.0216	α(K)=0.0153; α(L)=0.00474
1578.5	(2^+)	1417.0[#] 5	100[#] 17	162.12	4^+				
		1527.4[#] 8	86[#] 17	49.369	2^+				
		1578.3[#] 14	92[#] 17	0	0^+				
1609.1		1447.0[#] 5	100[#]	162.12	4^+				
1618.0		1568.6[#] 7	100[#]	49.369	2^+				
1647.6		1485.5[#] 8	100[#]	162.12	4^+				
1690.9		1641.5[#] 10	100[#]	49.369	2^+				
1727.6		1679.1[#] 15	100[#]	49.369	2^+				
		1727.3[#] 8	61[#] 20	0	0^+				
1738.1	$(1,2^+)$	1738.1[#] 10	100[#]	0	0^+				
1783	$(8)^+$	637[†]	100[†]	1146.3?	(7^+)				
		760[†]	59[†]	1023.3	6^+	E2[†]		0.0173	α(K)=0.0126; α(L)=0.00356
1784.7	13^-	286.0[†] 5		1498.7	11^-	E2		0.199	α(K)=0.0812; α(L)=0.086; α(M)=0.0232; α(N+..)=0.0086
		302.5[†] 5		1482.2	14^+				
1858.5	16^+	376.3[†] 5	100[†]	1482.2	14^+	E2[†]		0.089	α(K)=0.0472; α(L)=0.0310; α(M)=0.00819; α(N+..)=0.00303 B(E2)(W.u.)=3.9×10^2 4
2043.2	1^+	1994[@] 2	53[@] 2	49.369	2^+				
		2043[@] 2	100[@]	0	0^+	M1[#@]			B(M1)(W.u.)=0.2849 9
2101.6	15^-	243.1[†] 5		1858.5	16^+				
		316.9[†] 5		1784.7	13^-	E2		0.146	α(K)=0.0662; α(L)=0.0582; α(M)=0.0156; α(N+..)=0.00576
2248.2	1^+	2199[@] 2	42[@] 7	49.369	2^+				
		2248[@] 2	100[@]	0	0^+	M1[#@]			B(M1)(W.u.)=0.1107 3

Adopted Levels, Gammas (continued)

γ(^{232}Th) (continued)

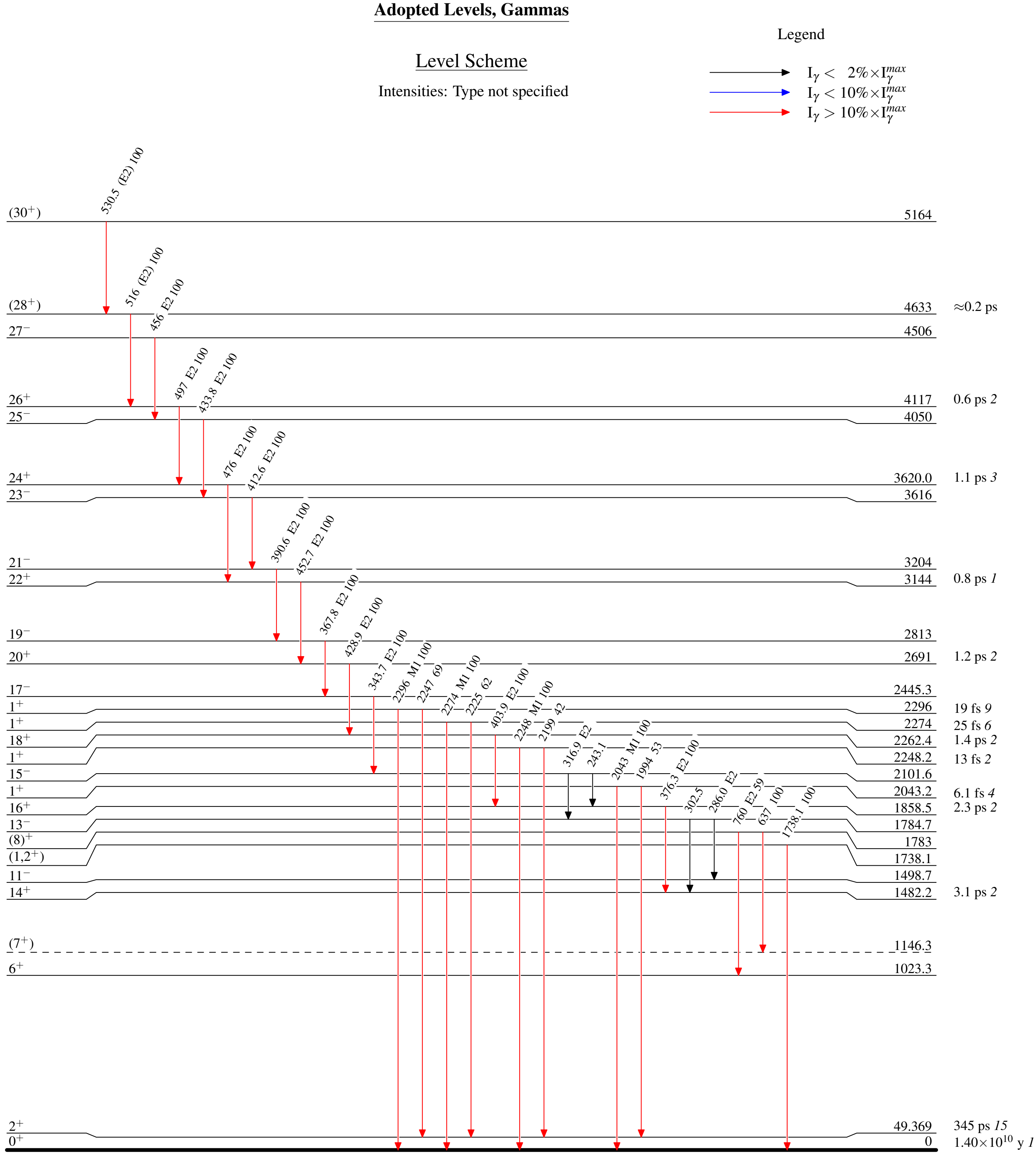
E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.[a]	α[b]	Comments
2262.4	18+	403.9[†] 5	100[†]	1858.5	16+	E2[†]	0.0739	α(K)=0.0411; α(L)=0.0241; α(M)=0.00635; α(N+..)=0.00235 B(E2)(W.u.)=4.5×10^2 7
2274	1+	2225[@] 5	62[@] 13	49.369	2+			
		2274[@] 5	100[@]	0	0+	M1[#@]		B(M1)(W.u.)=0.0431 3
2296	1+	2247[@] 5	69[@] 29	49.369	2+			
		2296[@] 5	100[@]	0	0+	M1[#@]		B(M1)(W.u.)=0.0590 4
2445.3	17−	343.7[†] 5	100[†]	2101.6	15−	E2[†]	0.115	α(K)=0.0564; α(L)=0.0430; α(M)=0.0114; α(N+..)=0.00423
2691	20+	428.9[†] 5	100[†]	2262.4	18+	E2[†]	0.0633	α(K)=0.0366; α(L)=0.0197; α(M)=0.00515; α(N+..)=0.00190 B(E2)(W.u.)=3.6×10^2 6
2813	19−	367.8[†] 10	100[†]	2445.3	17−	E2[†]	0.095	α(K)=0.0493; α(L)=0.0336; α(M)=0.0089; α(N+..)=0.00329
3144	22+	452.7[†] 5	100[†]	2691	20+	E2[†]	0.0552	α(K)=0.0330; α(L)=0.0164; α(M)=0.00428; α(N+..)=0.00158 B(E2)(W.u.)=4.2×10^2 11
3204	21−	390.6[†] 10	100[†]	2813	19−	E2[†]	0.0808	α(K)=0.0438; α(L)=0.0271; α(M)=0.00716; α(N+..)=0.00265
3616	23−	412.6[†] 10	100[†]	3204	21−	E2[†]	0.0699	α(K)=0.0394; α(L)=0.0224; α(M)=0.00589; α(N+..)=0.00218
3620.0	24+	476[†] 1	100[†]	3144	22+	E2[†]	0.0488	α(K)=0.0300; α(L)=0.0139; α(M)=0.00362; α(N+..)=0.00133 B(E2)(W.u.)=2.4×10^2 7
4050	25−	433.8[†] 10	100[†]	3616	23−	E2[†]	0.0615	α(K)=0.0358; α(L)=0.0189; α(M)=0.00495; α(N+..)=0.00183
4117	26+	497[†] 1	100[†]	3620.0	24+	E2[†]	0.0440	α(K)=0.0276; α(L)=0.0121; α(M)=0.00314; α(N+..)=0.00115 B(E2)(W.u.)=3.5×10^2 12
4506	27−	456[†] 2	100[†]	4050	25−	E2[†]	0.0543	α(K)=0.0325; α(L)=0.0160; α(M)=0.00418; α(N+..)=0.00154
4633	(28+)	516[†] 1	100[†]	4117	26+	(E2)[†]	0.0401	α(K)=0.0257; α(L)=0.0108 B(E2)(W.u.)≈7.0×10^2
5164	(30+)	530.5[†] 20	100[†]	4633	(28+)	(E2)[†]	0.0376	α(K)=0.0244; α(L)=0.0099

[†] From Coulomb Excitation: HI.
[‡] From Coulomb Excitation: Li.
[#] From ^{232}Th(n,n′γ).
[@] From ^{232}Th(γ,γ′).
[&] From ^{232}Ac β^- decay.
[a] From γ(θ) and γγ(θ) in light-ion and heavy-ion Coul. ex., unless otherwise specified.
[b] 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.
[c] Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Level Scheme

Intensities: Type not specified



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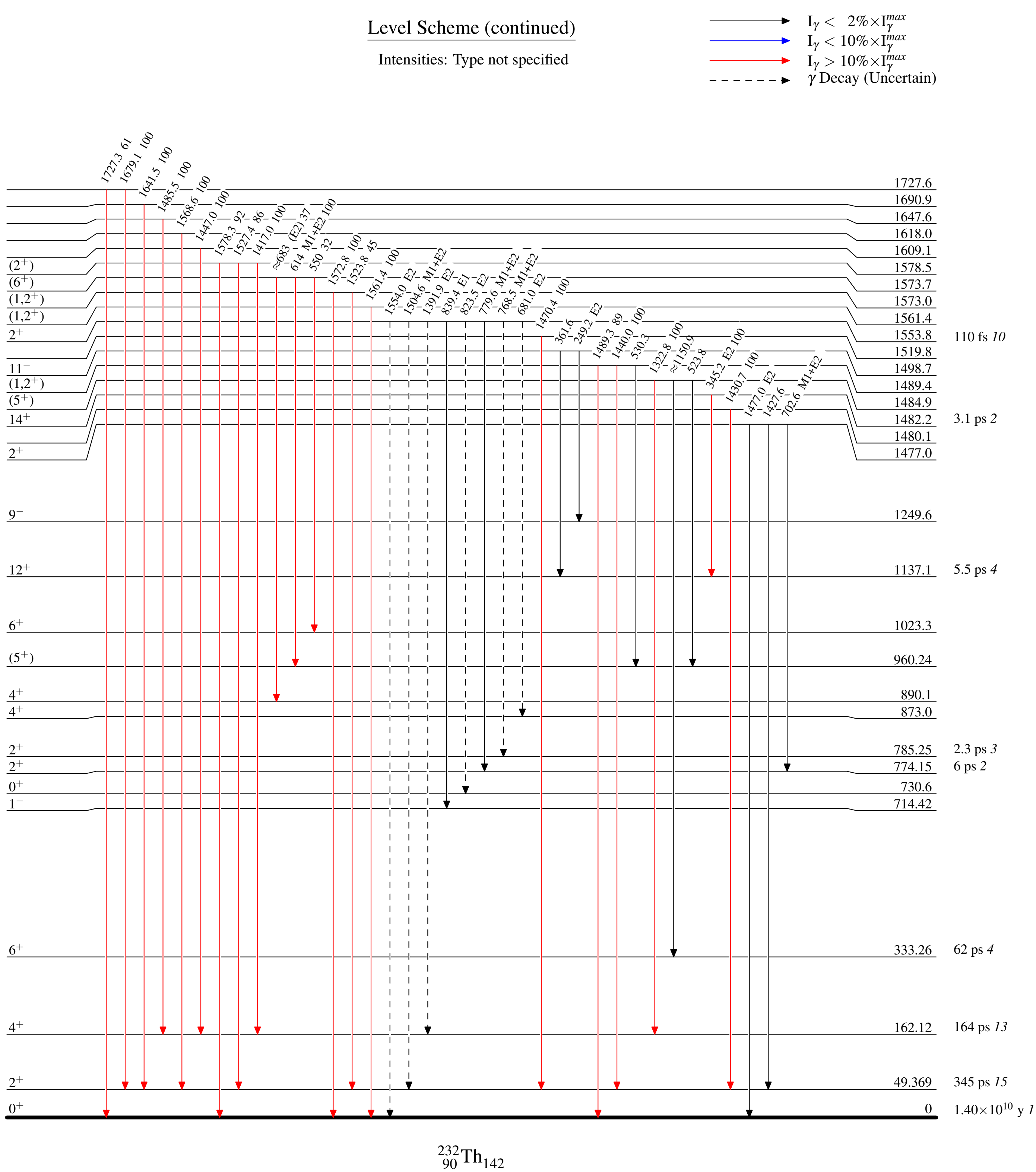
Adopted Levels, Gammas

Level Scheme (continued)

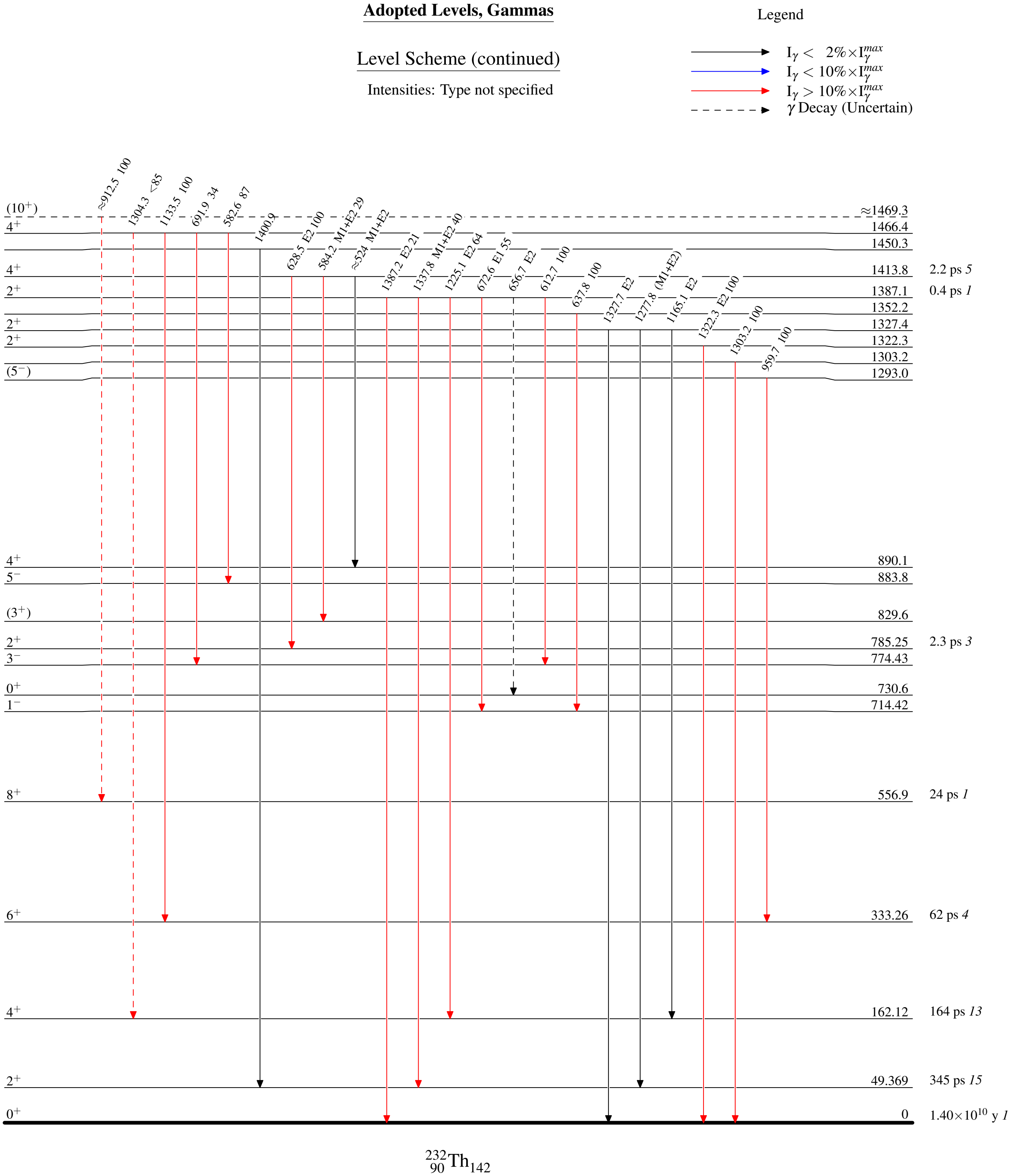
Intensities: Type not specified



Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified



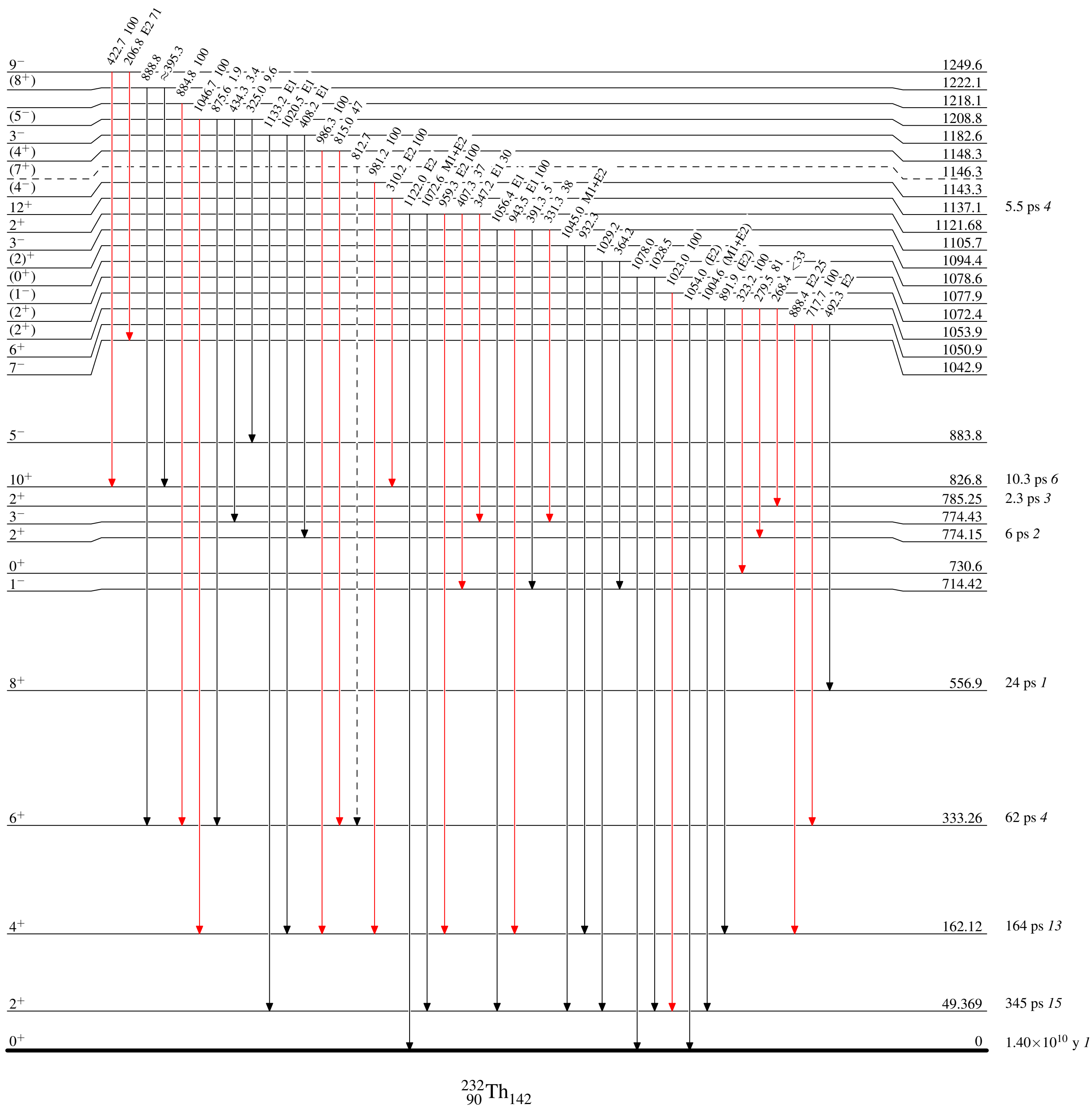
Adopted Levels, Gammas

Level Scheme (continued)

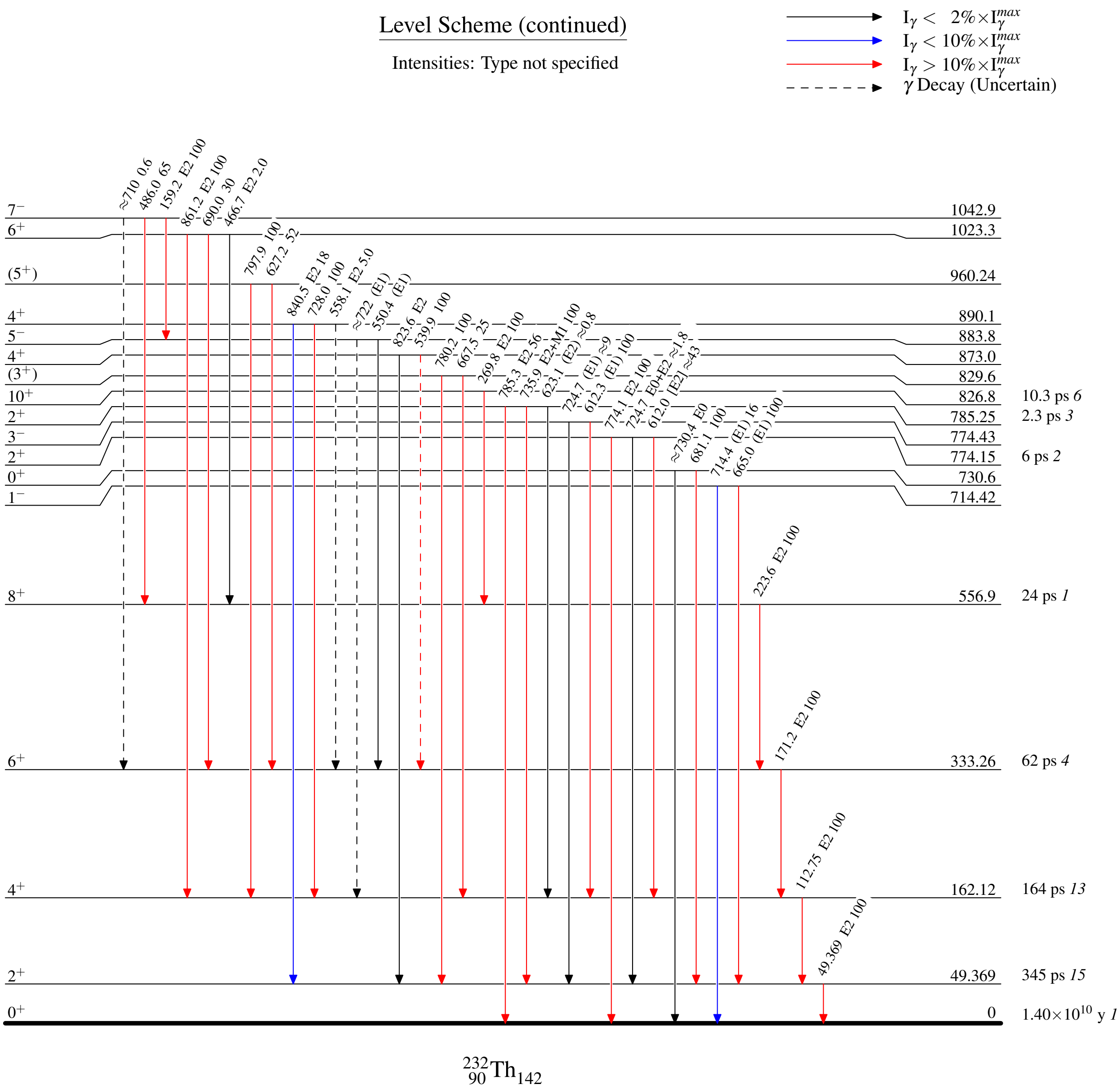
Intensities: Type not specified

Legend

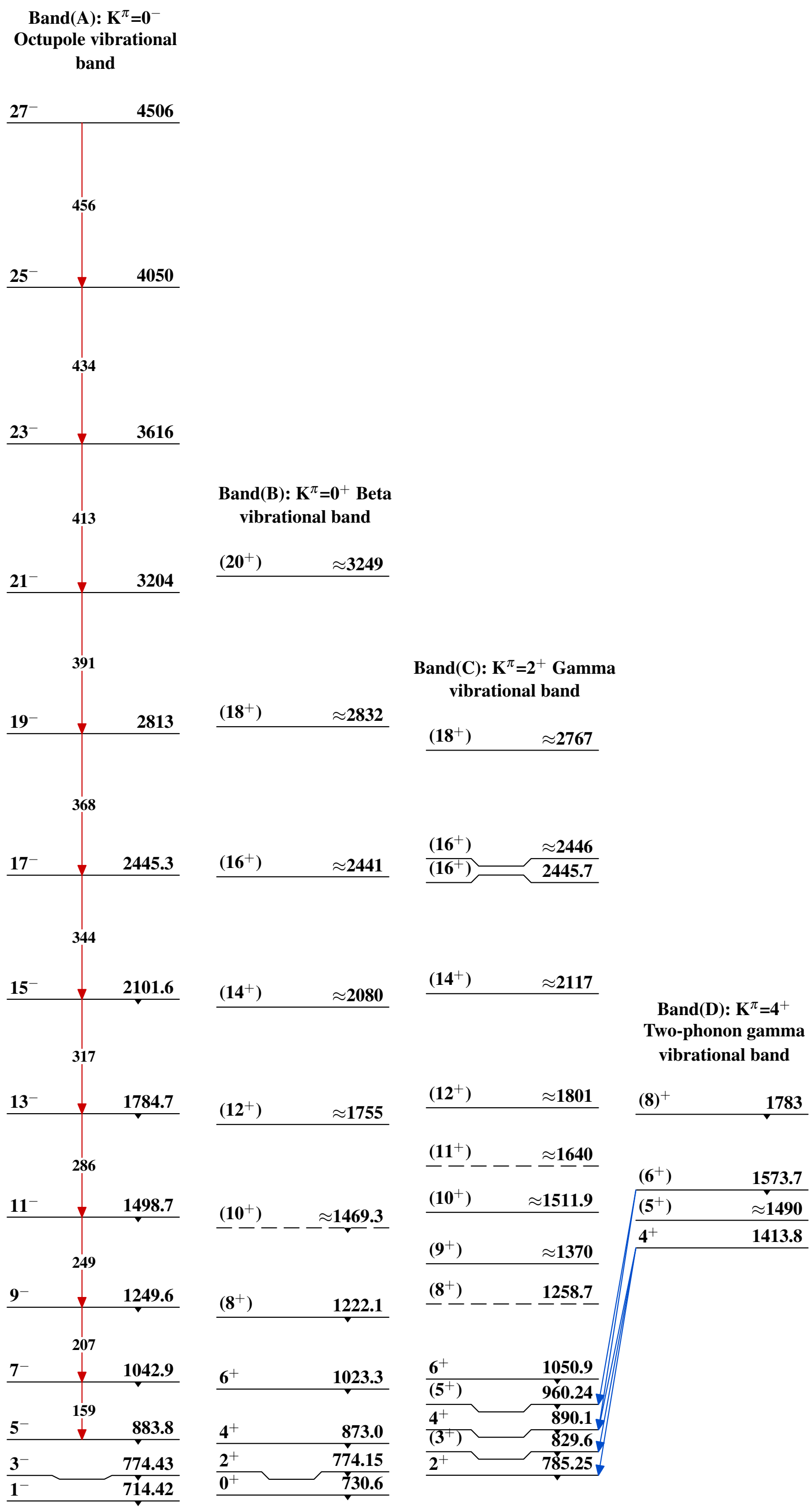
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)



Adopted Levels, Gammas



Adopted Levels, Gammas



$^{232}_{90}Th_{142}$