Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. Browne, J. K. Tuli	NDS 108,681 (2007)	1-Jun-2006

Q(β^-)=274 *4*; S(n)=6191 *4*; S(p)=7983 *14*; Q(α)=3673 *11* 2012Wa38

Note: Current evaluation has used the following Q record 273 3 6190 *3* 8170 syst 3672 *13* 2003Au03.

Theory/Calculations:

2006De05: Systematics of α decay to rotational states.

2005La04: Binding energies, radii rel mean-field interaction.

2005Po01,2004Mo06,2003Po15,1995Ba47: Fission phenomena.

For calculated and deduced fission-barrier parameters, see 1971Pa31, 1974Ba28, 1976Sh22, 1978Ma48, 1978Pr05 and 1980Ku14, for example.

2003Bu11,2003Bu27: Band comparisons.

2002Gi11: Super-deformed states.

2000Bu02,200bu32,1998Bu18,1983Ia01: Cluster models.

1992So10: Intrinsic structures and rotational bands.

1988Bh04: g.s. bands, anharmonic vibrator model.

1988Ri07,1986Da03: interacting boson model.

1988Bh04: B(E2) value for deexcitation of the 2^+ state was calculated using an anharmonic vibrational description of the nuclear collective motion.

1987Be43: α decay.

1986Da03: The (p,t) cross section for population of excited 0^+ state relative to that for population of g.s. was calculated by utilizing an interacting boson model of α-like clustering in nuclei. The g.s. band level energies and the B(E2) value for excitation of the 2^+ state of g.s. band were calculated.

1972Va20: calculations of low-lying 0^+ states, and (p,t) strengths for their populations.

1970Ga12, 1983Ro14: Calculated quadrupole and hexadecapole moments corresponding to equilibrium deformations.

1970Ne08: Energies of octupole-vibrational bands and B(E3) values for excitation of 3^- states were calculated by using a modified octupole-octupole force and by including the Coriolis interaction between the states of the intrinsic octupole quadruplet (K^π=0^-,1^-,2^-,3^-).

γ-vibrational state energy and B(E2) value for excitation of 2^+ state were calculated by 1965Be40 within the framework of the Nilsson single-particle model, the quasiparticle and quasiboson approximations.

1967So04, 1970Ga12, 1982Le19, 1982Du16, 1983Ro14: calculations of equilibrium deformation parameters.

1965So04: Quadrupole (K^π=0^+,2^+) and octupole (K^π=0^-,1^-,2^-) collective bandheads were calculated by using the superfluid nuclear model.

^{234}Th Levels

Cross Reference (XREF) Flags

A	^{238}U α decay	D	^{238}U(d,^{6}Li)
B	^{234}Ac β^- decay	E	^{232}Th(^{18}O,^{16}Oγ)
C	^{232}Th(^{136}Xe,Xγ)	F	^{232}Th(t,p) E=20 MeV

E(level)[#]	J$^\pi$[†]	$T_{1/2}$	XREF	Comments
0.0[@]	0^+	24.10 d *3*	ABCDEF	%β^-=100 α decay was not observed: %α<1×10^{-4} (1955De47). α-decay Γ was calculated by 1978Pi14 and by 1987Be43 as 1.82×10^{-39} MeV and 9.65×10^{-39} MeV, respectively. α and ^{22}O decay probabilities were calculated by 1986Ru11 as 4.7×10^{-29}/sec and 3.4×10^{-5}/sec, respectively. Probability of decay by heavy-ion emission was calculated also by 1986Pi11, and ^{26}Ne decay was suggested as the most probable decay mode. $T_{1/2}$: 24.5 d (1931Cu01), 24.1 d *2* (1939Sa11), 24.101 d *25* (1948Kn23).

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Adopted Levels, Gammas (continued)

^{234}Th Levels (continued)

E(level)[#]	Jπ[†]	$T_{1/2}$	XREF	Comments
				$T_{1/2}(2\beta)>4.5\times10^3$ y for 2ν mode and $>4.1\times10^4$ y for 0ν mode (2005Tr01).
49.55[@] *6*	2^+	0.37 ns *3*	ABCDEF	Jπ: 49.55-keV γ to 0^+ is E2. $T_{1/2}$: by $\alpha\gamma$(t) in ^{238}U decay (1960Be25).
163.05[@] *12*	4^+		ABCDEF	Jπ: 113.5γ to 2^+; α hindrance factor.
336.45[@] *24*	6^+		CDE	Jπ: 173.5γ to 4^+ is E2; energy fit to the band.
564.7[@] *3*	8^+		CDE	Jπ: 228.3γ to 6^+ is E2; energy fit to the band.
688.38 *22*	(1^-)		B	Jπ: 688.5- and 638.7-keV gammas to 0^+ and 2^+ levels; systematics of 1^- states.
810 *30*	(0^+)[‡]		D	
842.5[@] *4*	10^+		C E	Jπ: 278.2γ to 8^+ is E2; energy fit to the band.
995.0[&] *5*	(7^-)		C	
1150 *40*	(0^+)[‡]		D	
1164.9[@] *6*	(12^+)		C E	Jπ: 317.2γ to 10^+; energy fit to the band.
1194.8[&] *5*	(9^-)		C	
1441.9[&] *5*	(11^-)		C	
1470 *40*	(0^+)[‡]		D	
1526.6[@] *7*	(14^+)		C	
1731.0[&] *6*	(13^-)		C	
1896.3 *15*	$(1,2^+)$		B	Jπ: γ rays to 0^+ and 2^+ states.
1913.0 *15*	$(1,2^+)$		B	Jπ: γ rays to 0^+ and 2^+.
1923.4[@] *8*	(16^+)		C	
2059.2[&] *7*	(15^-)		C	
2351.0[@] *9*	(18^+)		C	
2422.9[&] *8*	(17^-)		C	
2805.1[@] *11*	(20^+)		C	
2816.6[&] *9*	(19^-)		C	
3238.3[&] *11*	(21^-)		C	
3281.4[@] *12*	(22^+)		C	
3684.3[&] *12*	(23^-)		C	
3775.1[@] *13*	(24^+)		C	

[†] Mostly from (^{136}Xe,Xγ) based on $\gamma\gamma(\theta)$ and band assignments, unless stated explicitly.
[‡] From (d,^{6}Li) reaction data, based on systematics of 0^+ states, and on angular distributions for transitions to the unresolved 0^+, 2^+ states within the bands.
[#] From least squares fit to Eγ.
[@] Band(A): g.s. band.
[&] Band(B): octupole band.

$\gamma(^{234}Th)$

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	α[&]	Comments
49.55	2^+	49.55 *6*		0.0	0^+	E2	326	B(E2)(W.u.)=183 *16*
163.05	4^+	113.5 *1*		49.55	2^+	E2		
336.45	6^+	173.4 *2*	100.0	163.05	4^+	E2	1.149	
564.7	8^+	228.3 *2*	100.0	336.45	6^+	E2	0.419	
688.38	(1^-)	638.7 *3*	59 *12*	49.55	2^+			
		688.5 *3*	100 *14*	0.0	0^+			

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Adopted Levels, Gammas (continued)

γ(^{234}Th) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	α[&]	$I_{(\gamma+ce)}$
842.5	10^+	277.8 *2*	100.0	564.7	8^+	E2	0.217	
995.0	(7^-)	658.4 *5*	100	336.45	6^+			
1164.9	(12^+)	322.3 *5*	100.0	842.5	10^+	E2[@]		
1194.8	(9^-)	199.7 *5*	$6.\times10^1$ *3*	995.0	(7^-)	E2[@]		59 *28*
		630.1 *5*	100 *12*	564.7	8^+	E1[@]		64 *7*
1441.9	(11^-)	247.1 *5*	100 *19*	1194.8	(9^-)	E2[@]		112 *21*
		599.4 *5*	72 *9*	842.5	10^+	E1[@]		62 *7*
1526.6	(14^+)	361.8 *5*	100.0	1164.9	(12^+)	E2[@]		584 *13*
1731.0	(13^-)	289.1 *5*	1.0×10^2 *4*	1441.9	(11^-)	E2[@]		67 *23*
		566.0 *5*	41 *13*	1164.9	(12^+)	E1[@]		23 *7*
1896.3	$(1,2^+)$	1847 *2*	100 *17*	49.55	2^+			
		1896 *2*	64 *15*	0.0	0^+			
1913.0	$(1,2^+)$	1751 *2*	64 *16*	163.05	4^+			
		1912 *2*	100 *20*	0.0	0^+			
1923.4	(16^+)	396.8 *5*	100.0	1526.6	(14^+)	E2[@]		341 *14*
2059.2	(15^-)	328.2 *5*	100 *16*	1731.0	(13^-)	E2[@]		59 *9*
		532.7 *5*	10 *4*	1526.6	(14^+)	E1[@]		5 *2*
2351.0	(18^+)	427.6 *5*	100.0	1923.4	(16^+)	E2[@]		178 *14*
2422.9	(17^-)	363.7 *5*	100 *24*	2059.2	(15^-)	E2[@]		33 *8*
		499.4 *5*	10 *4*	1923.4	(16^+)	E1[@]		3 *1*
2805.1	(20^+)	454.1 *5*	100.0	2351.0	(18^+)	E2[@]		81 *14*
2816.6	(19^-)	393.7 *5*	1.0×10^2 *3*	2422.9	(17^-)	E2[@]		23 *6*
		465.8[a] *5*		2351.0	(18^+)			
3238.3	(21^-)	421.7 *5*	100.0	2816.6	(19^-)	E2[@]		9 *6*
3281.4	(22^+)	476.3 *5*	100.0	2805.1	(20^+)	E2[@]		4 *2*
3684.3	(23^-)	446.0 *5*	100.0	3238.3	(21^-)	E2[@]		34 *7*
3775.1	(24^+)	493.7 *5*	100.0	3281.4	(22^+)	E2[@]		19 *7*

[†] From ^{238}U α decay, ^{234}Ac β^- decay and ^{234}Th(^{136}Xe,Xγ).

[‡] Relative photon intensity deexciting each level.

[#] E2 multipolarity for the 49.55 and 113.5 γ rays are from ^{238}U α decay; quadrupole character for the 173.5-, 228.3- 278.2-keV γ rays were deduced by 1989Ge01 from particle-γ angular correlation measurements in ^{232}Th(^{18}O,^{16}Oγ) reaction.

[@] From γγ(θ) in ^{232}Th(^{136}Xe,Xγ).

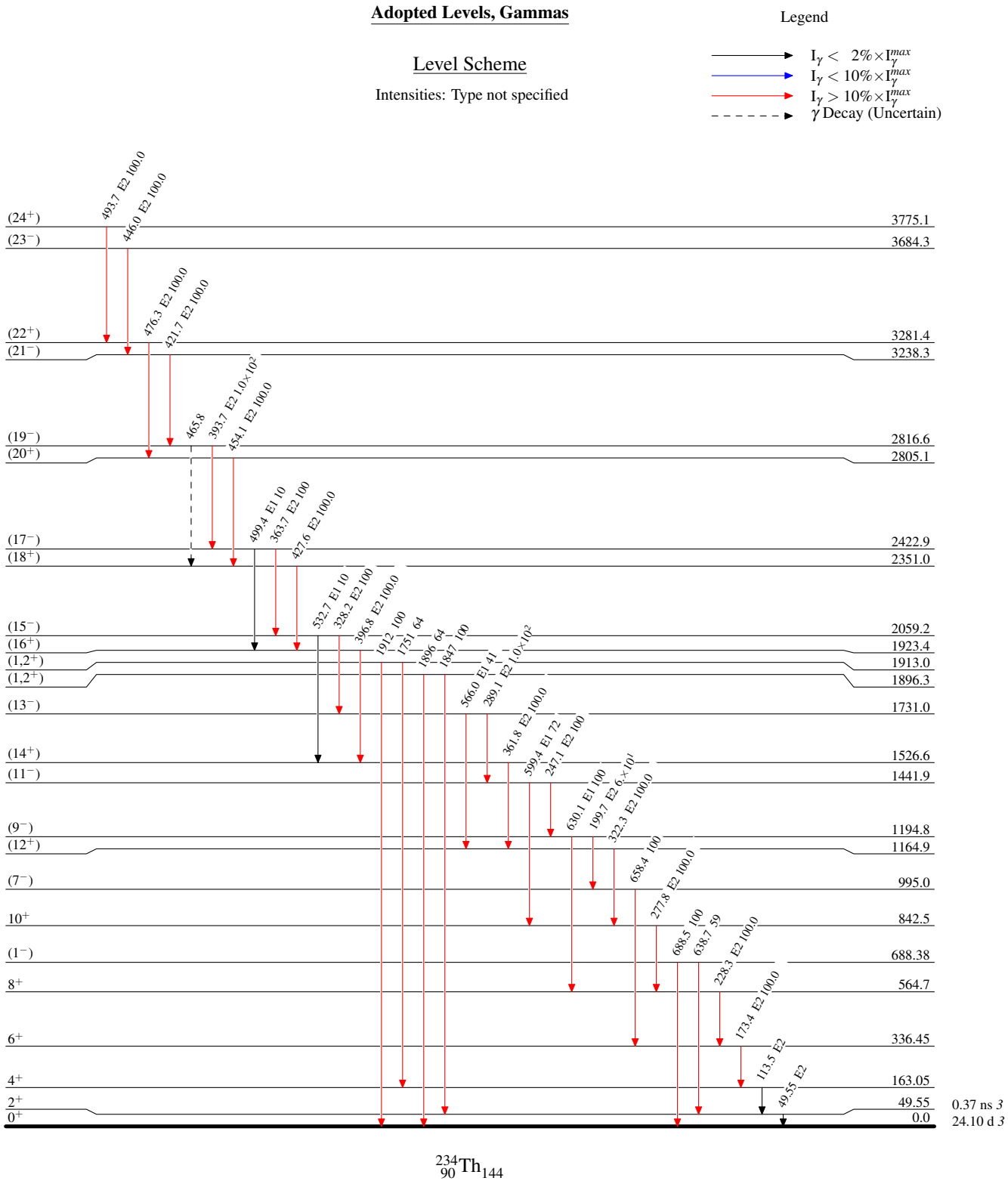
[&] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

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

Adopted Levels, Gammas

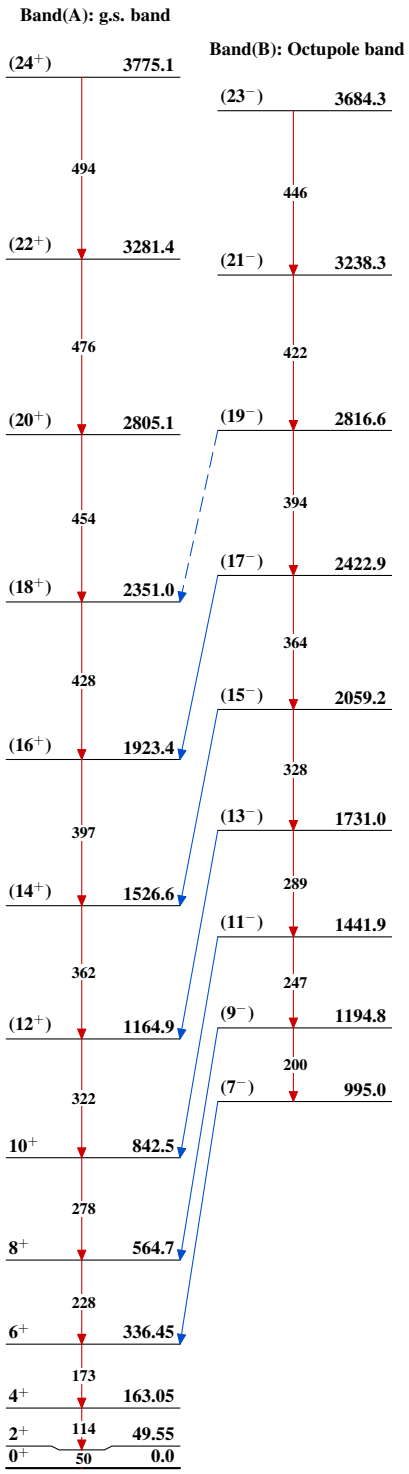
Level Scheme

Intensities: Type not specified



$^{234}_{90}Th_{144}$

Adopted Levels, Gammas



$^{234}_{90}Th_{144}$