Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, Sukhjeet Singh	ENSDF	08-Mar-2022

Q(β^-)=−3867 *12*; S(n)=7461 *12*; S(p)=5118 *12*; Q(α)=7299 *6* 2021Wa16
S(2n)=13350 *14*, S(2p)=8903 *10* (2021Wa16).
^{224}Th isotope identified and produced by 1949Me54 in Th(α,X) at E(α)=100-120 MeV, with an estimated half-life of ≈1 s. Later studies of ^{224}Th decay: 1958To25, 1961Ru06, 1970Va13, 1978IbZZ, 1989An13, 2000He17.
2020Cs01: theoretical structure calculations for levels, J^π, low-lying bandheads using pseudo- and proxy-SU(3) semimicroscopic algebraic quartet model (SAQM).

Theoretical calculations: 109 references extracted from the NSR database are listed in document records.
Additional information 1.

^{224}Th Levels

D_0/Q_0=electric dipole moment to electric quadrupole moment ratio deduced by 1993Ac02 from B(E1)/B(E2) ratios determined in (α,6nγ) reaction.

Cross Reference (XREF) Flags

- A ^{228}U α decay (9.1 min)
- B ^{208}Pb(^{16}O,Fγ):GDR
- C ^{208}Pb(^{18}O,2nγ)
- D ^{226}Ra(α,6nγ)

E(level)†	J^π#	$T_{1/2}$	XREF	Comments
0.0@	0^+	1.04 s *2*	A CD	%α=100 $T_{1/2}$: weighted average of 0.812 s *99* (2000He17 from α decay), 1.05 s *2* (1978IbZZ), 1.03 s *5* (1970Va13, from α decay curve), 1.05 s *5* (1958To25, detection of integral α particles with pulsed beam).
98.1@ *3*	2^+	0.590 ns *40*	A CD	J^π: E2 γ to 0^+. $T_{1/2}$: (186 ce(L2))(98 ce(L2))(t) in ^{226}Ra(α,6nγ) (1986Sc18).
251.0?& *3*	(1^-)		A D	XREF: D(?). J^π: possible member of $K^\pi=0^-$ band.
284.1@ *5*	4^+		A CD	J^π: stretched E2 γ to 2^+.
305.3& *5*	(3^-)		CD	
464.5& *5*	(5^-)		CD	
534.7@ *5*	6^+		CD	D_0/Q_0=7.3×10^{-4} fm^{-1} *11*.
699.5& *5*	(7^-)		CD	
833.9@ *6*	8^+		CD	D_0/Q_0=6.7×10^{-4} fm^{-1} *7*.
997.7& *6*	(9^-)		CD	
1173.8@ *6*	10^+		CD	D_0/Q_0=7.3×10^{-4} fm^{-1} *4*.
1347.3& *6*	(11^-)		CD	XREF: C(?). D_0/Q_0=8.8×10^{-4} fm^{-1} *6*.
1549.8@ *6*	12^+		D	D_0/Q_0=8.4×10^{-4} fm^{-1} *4*.
1738.7& *6*	(13^-)		D	D_0/Q_0=8.0×10^{-4} fm^{-1} *4*.
1958.9@ *7*	14^+		D	D_0/Q_0=9.3×10^{-4} fm^{-1} *5*.
2164.7& *7*	(15^-)		D	D_0/Q_0=8.9×10^{-4} fm^{-1} *6*.
2398.0@ *7*	16^+		D	

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Adopted Levels, Gammas (continued)

^{224}Th Levels (continued)

E(level)[†]	J$^{\pi}$[#]	$T_{1/2}$	XREF	Comments
2620.2?[&] *7*	(17$^-$)		D	D_0/Q_0=10.0×10^{-4} fm^{-1} *13*.
2864?[@]	18$^+$		D	
10.8×10^3[‡] *3*		4.4 MeV *6*	B	
14.1×10^3[‡] *6*		5.9 MeV *10*	B	

[†] From least squares fit to Eγ data.
[‡] GDR.
[#] Based on multipolarities for selected transitions in in-beam γ-ray studies, band structures and systematics of neighboring nuclides, unless specific arguments are given.
[@] Band(A): $K^{\pi}=0^+$ g.s. band.
[&] Band(B): $K^{\pi}=0^-$ band.

γ(^{224}Th)

E$_i$(level)	J$_i^{\pi}$	E$_{\gamma}$[†]	I$_{\gamma}$[†]	E$_f$	J$_f^{\pi}$	Mult.[‡]	α[@]	Comments
98.1	2$^+$	98.1 *3*	100	0.0	0$^+$	E2[#]	12.33 *25*	B(E2)(W.u.)=96 *7*
251.0?	(1$^-$)	152.9 *3*	50 *13*	98.1	2$^+$	[E1]	0.179	I$_{\gamma}$: from ^{228}U α decay.
		246 *3*	100 *25*	0.0	0$^+$	[E1]	0.059	E$_{\gamma}$,I$_{\gamma}$: γ seen in ^{228}U α decay only.
284.1	4$^+$	186.0 *3*	100	98.1	2$^+$	E2[#]	0.863	
305.3	(3$^-$)	207.2 *3*	100	98.1	2$^+$	(E1)	0.0868	
464.5	(5$^-$)	180.4 *3*	100	284.1	4$^+$	(E1)	0.1204	
534.7	6$^+$	70.2 *3*	85 *25*	464.5	(5$^-$)	[E1]	0.299 *6*	
		250.6 *3*	100	284.1	4$^+$	(E2)	0.299	
699.5	(7$^-$)	164.8 *3*		534.7	6$^+$	(E1)	0.151	
		235.0 *3*		464.5	(5$^-$)			
833.9	8$^+$	134.4 *3*	100	699.5	(7$^-$)	(E1)	0.243	
		299.2 *3*	50 *10*	534.7	6$^+$	[E2]	0.170	
997.7	(9$^-$)	163.8 *3*		833.9	8$^+$			
		298.2 *3*		699.5	(7$^-$)			
1173.8	10$^+$	176.1 *3*	100	997.7	(9$^-$)	(E1)	0.1276	
		339.9 *3*	36 *4*	833.9	8$^+$	[E2]	0.1166	
1347.3	(11$^-$)	173.4 *3*	100	1173.8	10$^+$	(E1)	0.1323	
		349.6 *3*	30 *4*	997.7	(9$^-$)	[E2]	0.1076	
1549.8	12$^+$	202.5 *3*	100	1347.3	(11$^-$)	[E1]	0.0916	
		376.0 *3*	29 *3*	1173.8	10$^+$	[E2]	0.0880	
1738.7	(13$^-$)	188.9 *3*	100	1549.8	12$^+$	[E1]	0.1080	
		391.4 *3*	50 *5*	1347.3	(11$^-$)	[E2]	0.0790	
1958.9	14$^+$	220.2 *3*	100	1738.7	(13$^-$)	[E1]	0.0753	
		409.0 *3*	29 *3*	1549.8	12$^+$	[E2]	0.0703	
2164.7	(15$^-$)	205.8 *3*	100	1958.9	14$^+$	[E1]	0.0882	
		426.1 *3*	45 *6*	1738.7	(13$^-$)	[E2]	0.0633	
2398.0	16$^+$	233.3 *3*		2164.7	(15$^-$)			
		439.1 *3*		1958.9	14$^+$			
2620.2?	(17$^-$)	222.3[&]	100	2398.0	16$^+$	[E1]	0.0737	
		455.4[&] *3*	42 *11*	2164.7	(15$^-$)	[E2]	0.0535	
2864?	18$^+$	466[&]		2398.0	16$^+$			

[†] From ^{226}Ra(α,6nγ), where data are more extensive and generally given with uncertainties. The Eγ and γ branching ratios

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Adopted Levels, Gammas (continued)

$\gamma(^{224}Th)$ (continued)

available from $^{208}Pb(^{18}O,2n\gamma)$ are in agreement with those from $(\alpha,6n\gamma)$ reaction but are less complete. The only exception is 251,(1^-) level, where energy of one γ ray and intensities are taken from α decay.

‡ From $\gamma(\theta)$ data in $(^{18}O,2n\gamma)$, unless otherwise stated.

Intensities of L1, and L2+L3 peaks in $(^{18}O,2n\gamma)$ displayed in spectral figure 1 of 1986Sc12 are consistent with E2.

@ 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.

& Placement of transition in the level scheme is uncertain.

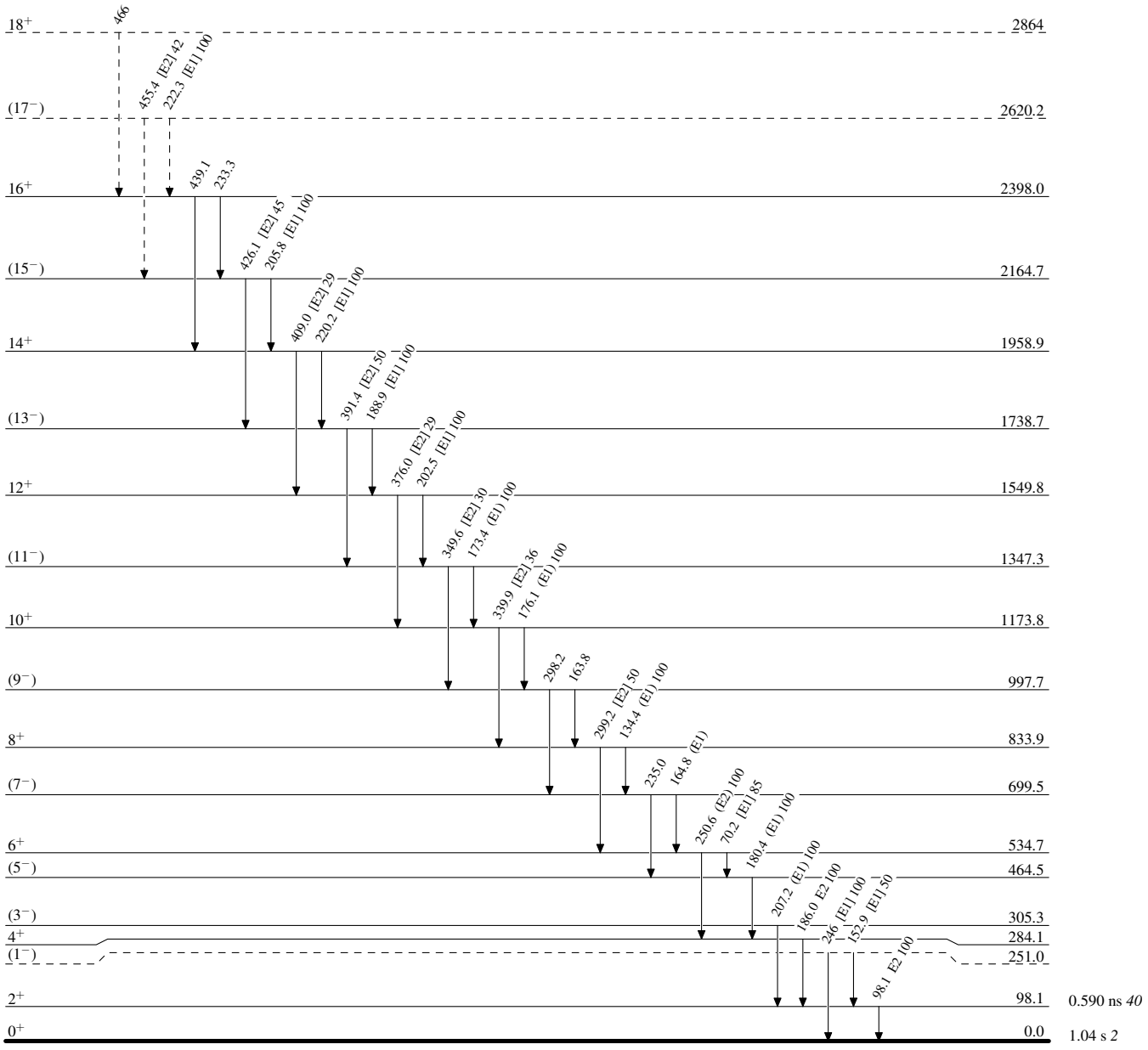
Adopted Levels, Gammas

Legend

Level Scheme

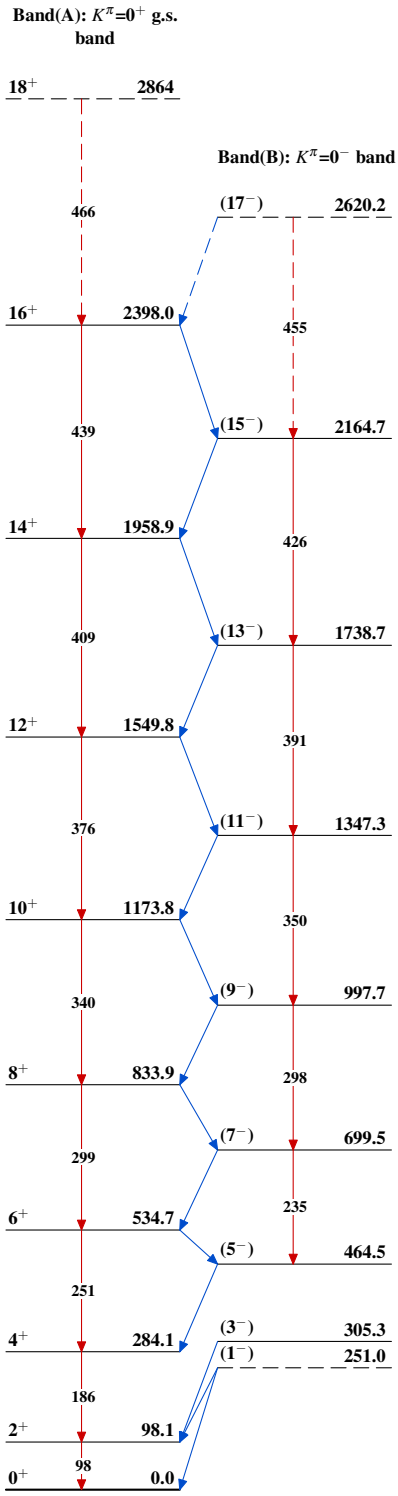
Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{224}_{90}Th_{134}$

Adopted Levels, Gammas



$^{224}_{90}Th_{134}$