Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Ashok Jain, Sukhjeet Singh, Suresh Kumar, Jagdish Tuli	NDS 108,883 (2007)	15-Jan-2007

Q(β^-)=−3.44×10^3 *6*; S(n)=5802 *24*; S(p)=4095 *11*; Q(α)=8626 *4* 2012Wa38

Note: Current evaluation has used the following Q record −3440 50 *5802* 24 *4103* 17 *8626* 4 2003Au03.

Assignment: parent of ^{217}Ra, ^{213}Rn (1970To07 and 1970Va13); ^{208}Pb(^{16}O,3n) excit (1970To07 and 1970Va13); cross bombardments (1970Va13).

See 1989De11 for calculations of B(E1)/B(E2) values.

^{221}Th Levels

See 1988Le13 for theoretical interpretation of levels, and level energy calculations by coupling states of a deformed shell model to a reflection-asymmetric rotor core. The single-particle states were obtained from a Woods-Saxon potential, including octupole deformation (octupole deformation of 0.1) as well as quadrupole deformation.

See 1991Cw01 also for deformation,level energy calculations based on the fit to the suggested parity doublet ground band. A review of the reflection asymmetric shapes may be found in 1996Bu45.

Higher-order deformations up to β_7 were included by 1989Cw03 in calculations of non-collective quasiparticle state energies for odd-A thorium isotopes in the transitional region. These higher-order equilibrium deformations lead to further fragmentation of single-particle orbitals. For K=1/2 bandhead (at g.s.), β_2=0.101, β_3=0.090, β_4=0.065, β_5=0.042, β_6=0.020 and β_7=0.027 were obtained. See 1989Cw03 for calculated deformations and energies for the K=3/2 and 5/2 bandheads.

Cross Reference (XREF) Flags

A ^{225}U α decay
B ^{208}Pb(^{16}O,3nγ) E=78-89 MeV

E(level)†	Jπ‡	$T_{1/2}$	XREF	Comments
0.0#	(7/2$^+$)	1.74 ms *3*	AB	%α=100 Only α decay was observed. From gross β^- decay theory of 1973Ta30 one estimates %ε+%β^+<1.0×10^{-4}. See 1985Po14 for calculated half-lives for decays by multiple heavy-ion emission; see 1973Ta30 for calculated $T_{1/2}$(ε decay). $T_{1/2}$: Weighted average of 1.68 ms *6*, 1.8 ms *3*, 1.9 ms *1*, 2.0 ms +3−2 and 1.73 ms *3*, 2.3 ms 4 measured by 1970To07, 1970Va13, 1993AnZS, 2000He17, 2001Ko07, and 2005Li17, respectively. Jπ: suggested by 1988Le13 from analogy to ^{219}Ra. Reflection- asymmetric rotor core-particle coupling calculations of 1988Le13 showed that the ω=1/2 orbital (of i13/2 shell) at β_2=β_3=0.1 deformation reproduces a 7/2$^+$ ground state when strong Coriolis couplings between the K=1/2, 3/2 and 5/2 orbitals are considered, and a large decoupling parameter (a≈−2) is used.
47? *20*			A	
250.9# *3*	(11/2$^+$)		AB	
488.0@ *5*	(13/2$^-$)		B	
572.8# *5*	(15/2$^+$)		B	
746.9@ *6*	(17/2$^-$)		B	
946.5# *6*	(19/2$^+$)		B	
1078.6@ *7*	(21/2$^-$)		B	
1356.0# *8*	(23/2$^+$)		B	
1472.0@ *9*	(25/2$^-$)		B	
1776.4# *9*	(27/2$^+$)		B	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{221}Th Levels (continued)

E(level)[†]	J$^{\pi}$[‡]	XREF
1935.4[@] *10*	(29/2$^-$)	B
2251.5[#] *11*	(31/2$^+$)	B
2421.5[@] *11*	(33/2$^-$)	B

[†] 1988Da15 suggested that the 250.9-keV transition, the strongest γ seen in ^{208}Pb(^{16}O,3nγ) reaction, depopulates either a 250.9−keV or possibly a 250.9+x keV level; x was estimated to be less than 50 keV from the experimental limit for observations of low-energy transitions. Therefore, as pointed out by 1988Da15, all excited-state energies might be higher by an amount of E≤50 keV.

[‡] Spins and parities of all excited states were deduced by 1988Da15 from multipolarities of deexciting γ transitions observed in ^{208}Pb(^{16}O,3nγ). If the 250.9γ feeds a low-lying level at E≤50 keV with a spin and parity different from 7/2$^+$, then J^{π}'s given here for all excited states would have to be changed by [J^{π}(level populated by 250.9γ)−7/2$^+$].

[#] Band(A): K=1/2 g.s. band (1988Le13). See 1988Da15 and 1988Le13 for discussions.

[@] Band(B): K=1/2 parity doublet of g.s. band (1988Le13). See 1988Da15 and 1988Le13 for discussions.

γ(^{221}Th)

E$_i$(level)	J$_i^{\pi}$	E$_{\gamma}$	I$_{\gamma}$	E$_f$	J$_f^{\pi}$	Mult.	α[‡]
250.9	(11/2$^+$)	250.9 *3*	100.0	0.0	(7/2$^+$)	E2	0.304
488.0	(13/2$^-$)	237.1 *3*	100.0	250.9	(11/2$^+$)	E1	0.0640
572.8	(15/2$^+$)	84.8 *3*	58 *7*	488.0	(13/2$^-$)	E1	0.184
		321.9 *3*	100 *5*	250.9	(11/2$^+$)	E2	0.139
746.9	(17/2$^-$)	174.1 *3*	100 *4*	572.8	(15/2$^+$)	E1	0.132
		258.9[#] *3*	7.3 *11*	488.0	(13/2$^-$)	[E2]	0.274
946.5	(19/2$^+$)	199.6 *3*	100 *6*	746.9	(17/2$^-$)	E1	0.0957
		373.6 *5*	27 *9*	572.8	(15/2$^+$)	E2	0.0911
1078.6	(21/2$^-$)	132.1 *3*	100 *3*	946.5	(19/2$^+$)	E1	0.257
		332.1[†] *3*	36 *6*	746.9	(17/2$^-$)	[E2]	0.127
1356.0	(23/2$^+$)	277.4 *3*	100 *6*	1078.6	(21/2$^-$)	E1	0.0447
		409.5[#] *3*	9 *4*	946.5	(19/2$^+$)	[E2]	0.0713
1472.0	(25/2$^-$)	116.0 *3*	100 *7*	1356.0	(23/2$^+$)	E1	0.352
		393.3 *3*	87 *7*	1078.6	(21/2$^-$)	E2	0.0793
1776.4	(27/2$^+$)	304.4 *3*	100 *9*	1472.0	(25/2$^-$)	E1	0.0363
		420.3[#] *10*	<13.64	1356.0	(23/2$^+$)	[E2]	0.0666
1935.4	(29/2$^-$)	159.0 *3*	93 *15*	1776.4	(27/2$^+$)	E1	0.165
		463.5 *5*	100 *15*	1472.0	(25/2$^-$)	E2	0.0521
2251.5	(31/2$^+$)	316.1 *3*	100 *17*	1935.4	(29/2$^-$)	E1	0.0334
		475.0[#] *11*	<16.67	1776.4	(27/2$^+$)	[E2]	0.0491
2421.5	(33/2$^-$)	170.4 *3*	26 *4*	2251.5	(31/2$^+$)	[E1]	0.1396
		485.7 *3*	100 *12*	1935.4	(29/2$^-$)	[E2]	0.0465

[†] γ was doublet (1988Da15).

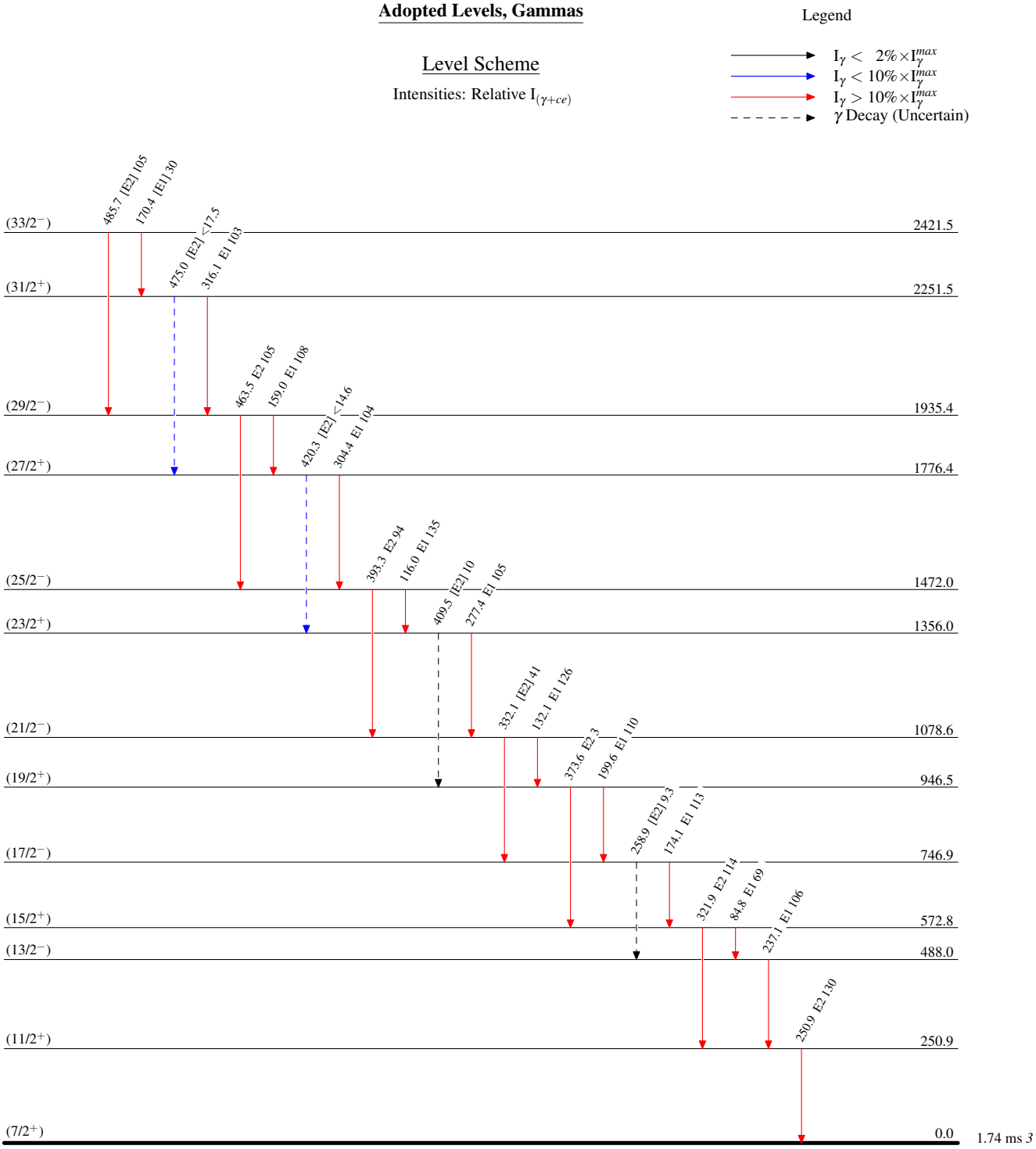
[‡] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

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

Adopted Levels, Gammas

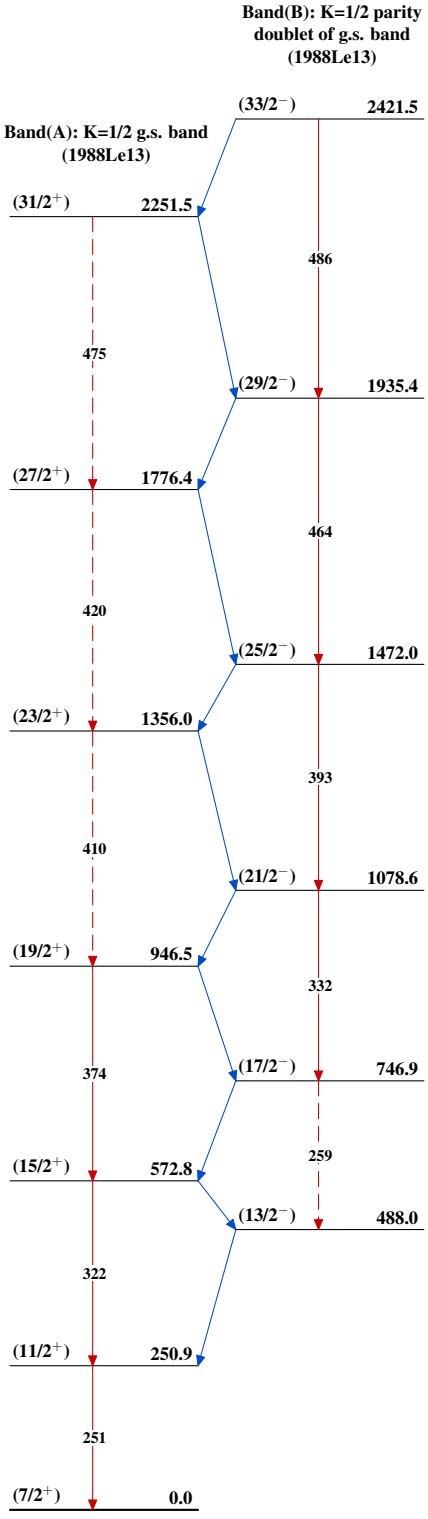
Level Scheme

Intensities: Relative $I_{(\gamma+ce)}$



$^{221}_{90}Th_{131}$

Adopted Levels, Gammas



$^{221}_{90}Th_{131}$