Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, M. S. Basunia, Jun Chen et al. ,	NDS 192,315 (2023)	25-Sep-2023

Q(β^-)=−2302 *6*; S(n)=6715 *6*; S(p)=6246 *6*; Q(α)=6678 *4* 2021Wa16
S(2n)=12095 *9*, S(2p)=10870 *5* (2021Wa16).

Dataset by Balraj Singh, Jun Chen, and IAEA-ICTP-workshop participants: Diwanshu, S. Leblond, A. Rathi, P.S. Rawat, B. Rohila, and V. Vallet.

1948St42: ^{222}Rn identified in ^{230}U → ^{226}Th →^{222}Rn α-decay chain; ^{230}U produced in the bombardment of Th with 19-MeV deuterons and 38-MeV He ions at the Berkeley cyclotron facility. Measured half-life of the decay of ^{222}Rn from α decay. Later works on the study of ^{222}Rn decay: 1956As38 (also at Berkeley) and 1958To25 (at Gustaf Werner cyclotron facility in Uppsala).

Theoretical structure calculations:

2023Zh13: calculated $T_{1/2}$ and branching ratios for α, 2α, and ^{14}C cluster decays, quadrupole, octupole and hexadecupole deformation-energy surfaces using relativistic Hartree-Bogoliubov model with the DD-PC1 functional and a separable pairing force.

2022Ta16: calculated neutron and proton energy gaps, quadrupole and octupole deformation parameters using Hartree-Fock-Bogolyubov approximation with Skyrme forces.

2022Uz01: calculated quadrupole and octupole deformation parameters, rms proton matter radii, the total energy, and ^{14}C cluster decay rate using Skyrme Hartree−Fock+BCS theory with SLy4 and SkM* interactions.

2021Ku31: calculated energy differences, neutron and proton energy gaps, deformation parameters using Hartree-Fock-Bogoliubov theory with an effective Skyrme interaction.

2020No13: calculated potential energy surfaces in (β_2,β_3) plane using self-consistent mean-field (SCMF), and interacting boson model (IBM), energies of yrast positive-parity and negative-parity states, and relative energy splitting between positive- and negative-parity yrast bands, B(E1), B(E2), B(E3), transition quadrupole and octupole moments using Hartree-Fock-Bogoliubov approximation, based on Gogny-D1M energy density functional, and *sdf* interacting boson model (IBM) Hamiltonian for quadrupole-octupole coupling and collective excitations.

2019Zh50: calculated empirical proton-neutron interaction, B(E2), B(E3), binding energy, contour plot of total energy in (β_2,β_3) plane, neutron and proton single-particle levels by using the covariant density functional theory and the quadrupole-octupole collective Hamiltonian approach.

2015Bo05: calculated levels, J^π, B(E1), Be(2), B(E3) using analytic quadrupole octupole axially (AQOA) symmetric model using Davidson potential. Bohr collective Hamiltonian, and quadrupole plus octupole deformation.

2013De12: calculated β_2 and deformation parameter, CSM parameter, α-core QQ coupling parameter, Iα to 2^+, 4^+ and 6^+ states from ^{222}Ra decay in daughter nuclei, B(E2), rigidity parameter, E(4^+)/E(2^+) and E(6^+)/E(4^+) ratios, effective charge, hindrance factors using coherent state model.

2001Ch02: calculated rotational bands energy vs spin using reflection-asymmetric shell model for octupole-deformed nuclei.

1998Ra05: calculated high-spin levels, J^π, ground state and K^π=0^- bands using phenomenological model.

1997Bu07, 1997Bu28: calculated levels, J^π, B(λ), deformation parameters, using mixed Saxon-Woods plus cubed Saxon-Woods cluster-core interaction.

1993Yo02, 1986Le05: calculations of B(E1)/B(E2) transition probabilities from the K^π=0^- band.

1989Eg02: calculated octupole barrier energies, pairing energy, deformation parameters β_2, β_4 and β_6, dipole moment vs constrained quadrupole moment using microscopic model.

1988Ro02, 1987Ro08: calculated E1, E3 transition probabilities and the 0^+, 1^- energy splitting, barrier heights, single particle and pairing energies vs octupole deformation, dipole vs octupole moments, B(E1)/B(E2) using constrained HF plus BCS method.

1988Ba48: calculated rotational band wave functions, quadrupole, and octupole deformations, energy splitting between the even- and odd-parity rotational bands using a collective Hamiltonian.

1987Na10: calculated levels, J^π, routhians, rotational bands, B(E1)/B(E2) ratios, shape dependence using cranking model.

1986Bo19: calculated quadrupole-octupole deformation energy surface, nonzero octupole moment using self-consistent Hartree-Fock plus BCS calculations.

Theoretical calculations for decay characteristics:

2023Zh13: calculated $T_{1/2}$ and branching ratios for α, 2α and ^{14}C cluster decays using relativistic Hartree-Bogoliubov model with the DD-PC1 functional and a separable pairing force, and proximity potential model for deformed nuclei.

2022Ka09: calculated $T_{1/2}$ for bare nuclei and He-like ions using adiabatic approach.

2020Ni01: calculated α-branching ratio to vibrational states, and α-decay half-life using multichannel cluster model.

2010Ro08: calculated HFB mean-field energies and octupole collective inertial parameters as function of octupole moment, particle-particle correlation energies, B(E1) and B(E3) probabilities, and dipole moments using Hartree-Fock-Bogoliubov

Adopted Levels, Gammas (continued)

approximation, and Barcelona-Catania-Paris energy density functionals.

Additional information 1.

Consult the NSR database for about 120 references for theoretical structure calculations, and about 230 theory references for α, 2α and ^{14}C decays, and other cluster decay characteristics of ^{222}Ra.

^{222}Ra Levels

B(E1)(W.u.) and B(E2)(W.u.) deduced by evaluators from measured matrix elements in Coulomb excitation, except as noted.
The $K^\pi=0^+$ g.s. band and the $K^\pi=0^-$ band at 242.11 keV have been interpreted as octupole parity-doublet bands.

Cross Reference (XREF) Flags

- A ^{222}Fr β^- decay (14.2 min)
- B ^{226}Th α decay (30.72 min)
- C $^{232}Th(^{136}Xe,X\gamma)$
- D Coulomb excitation

E(level)†	J^π	$T_{1/2}$‡	XREF	Comments
0.0#	0^+	33.6 s *4*	ABCD	$\%\alpha=100$; $\%^{14}C=3.0\times10^{-8}$ *10* Evaluated rms charge radius $<r^2>^{1/2}=5.687$ fm *24* (2013An02). Evaluated $\delta<r^2>(^{222}Ra-^{214}Ra)=+0.8950$ fm^2 *2* (2013An02). $T_{1/2}$: from 2012Po13, from analysis of 42 α-decay curves, and with detailed discussion of uncertainties. Others: 36.17 s *10* (1995Ko54); 43 s *4* (1982Bo04); 39 s *4* (1958To25); 37.5 s *5* (1956As38); 38.0 s (1948St42). ^{14}C branching from measured values of $I(^{14}C)/I(\alpha)=3.7\times10^{-10}$ *6* (1985Pr01), 3.1×10^{-10} *10*(1985Ho21), and 2.3×10^{-10} *3* (1991Hu02). 1991Hu02 searched also for any ^{14}C branching to the 3^- state in ^{208}Pb at 2614 keV and deduced an upper limit of 2×10^{-10}% for its branch. Measured change in rms radius: $\delta<r^2>(^{214}Ra,^{222}Ra)=+1.0449$ fm^2 *2*(stat) *524*(syst) (2018Ly01). Measured isotope shifts: $\delta\nu(^{214}Ra,^{222}Ra)=-29260$ MHz *4*; $\delta\nu(^{226}Ra,^{222}Ra)=+12483$ MHz *3* (2018Ly01). Isotope shifts and change in rms charge radius deduced from the measurement of hyperfine-structure spectra of the $7s^2S^0\rightarrow7s7p^3P_1$ atomic transition using Collinear Resonance Ionization Spectroscopy at ISOLDE-CERN (2018Ly01). The isotope shift relative to ^{214}Ra was measured by 1988Ah02; the change in the nuclear mean square charge radius and the change in the quadrupole deformation parameter were deduced as $\Delta<r^2>=-0.198$, and $\Delta<\beta^2>^{1/2}=0.191$. See also 1987We03, 1985Ne09.
111.137# *20*	2^+	0.52 ns *4*	ABCD	Q=−0.75 *29* J^π: E2 γ to 0^+. $T_{1/2}$: from (α)(ce 111γ)(t) in ^{226}Th α decay. Q: from diagonal E2 matrix element $(111,2^+\rightarrow111,2^+)=-1.3$ *5* (2020Bu01) in Coulomb excitation.
242.157@ *17*	1^-	9.5 ps *+21−16*	AB D	J^π: E1 γ to 0^+. $T_{1/2}$: other: <1.2 ns from (α)(242γ)(t) in ^{226}Th α decay.
301.495# *34*	4^+	135 ps *+17−14*	ABCD	Q=−1.59 *29* J^π: E2 γ to 2^+; band member. $T_{1/2}$: other: <1.4 ns from (α)(190γ)(t) in ^{226}Th α decay. Q: from diagonal E2 matrix element $(301,4^+\rightarrow301,4^+)=-1.3$ *5* (2020Bu01) in Coulomb excitation.
317.330@ *22*	$(3)^-$	4.7 ps *+26−14*	AB D	J^π: E1 206γ to 2^+; 75γ to 1^-; band member.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{222}Ra Levels (continued)

E(level)†	J^π	$T_{1/2}$‡	XREF	Comments
				The nuclear electric dipole moment was deduced by 1992Ru01 as 0.036 *6* fm from the branching ratio for E1, E2 transitions deexciting the level. The electric quadrupole moment of 6.74 b *28* for both the g.s. and the K^π=0$^-$ band was assumed.
473.87@ *4*	(5$^-$)	24 ps *+5−9*	ABCD	J^π: γ to 4$^+$; no β feeding from 2$^-$ parent; band member.
549.97# *19*	(6$^+$)	34 ps *+6−5*	CD	J^π: gammas to 4$^+$ and (5$^-$); band member.
702.92@ *27*	(7$^-$)	15 ps *5*	CD	J^π: gammas to (6$^+$) and (5$^-$); band member.
842.93# *25*	(8$^+$)	11.1 ps *+31−24*	CD	J^π: gammas to (6$^+$) and (7$^-$); band member.
914.174& *26*	(0$^+$)		B	J^π: gammas to 2$^+$ and 1$^-$; analogy to the 916, 0$^+$ level in ^{224}Ra.
992.12@ *33*	(9$^-$)	5.1 ps *+17−13*	CD	J^π: gammas to (8$^+$) and (7$^-$); band member.
1024.920& *23*	(2$^+$)		AB	J^π: gammas to 0$^+$ and 4$^+$.
1170.99 *4*	(3$^-$,4$^+$)		A	J^π: gammas to (3)$^-$, 4$^+$ and (5$^-$); log *ft*=8.25 *+39−22* from 2$^-$ parent.
1171.55 *4*	(1,2$^+$)		A	J^π: γ to 0$^+$.
1173.02# *30*	(10$^+$)	5.0 ps *+24−17*	CD	J^π: gammas to (8$^+$) and (9$^-$); band member.
1225.23 *5*	(1,2$^+$)		A	J^π: γ to 0$^+$.
1265.05 *4*	(2$^+$,3)		A	J^π: gammas to 2$^+$ and 4$^+$; log *ft*=7.40 *9* from 2$^-$ parent.
1310.24 *8*	(0$^+$,1,2,3$^-$)		A	J^π: gamma to 1$^-$; log *ft*=8.52 *13* from 2$^-$ parent.
1330.5@ *4*	(11$^-$)	3.6 ps *+18−12*	CD	J^π: gammas to (10$^+$) and (9$^-$); band member.
1360.88 *9*	(1$^-$,2,3)		A	J^π: gammas to 2$^+$ and (3)$^-$; log *ft*=8.03 *10* from 2$^-$ parent.
1375.77 *8*	(1,2,3$^-$)		A	J^π: gamma to 1$^-$; log *ft*=8.15 *11* from 2$^-$ parent.
1402.596 *31*	(2$^+$,3$^-$)		A	J^π: gammas to 1$^-$ and 4$^+$.
1432.73 *6*	(1,2,3$^-$)		A	J^π: gammas to 2$^+$ and 1$^-$; log *ft*=7.42 *9* from 2$^-$ parent.
1439.994 *34*	(3$^-$)		A	J^π: gammas to 1$^-$ and (5$^-$); log *ft*=7.05 *10* from 2$^-$ parent.
1499.49 *5*	(1$^-$,2,3$^-$)		A	J^π: gammas to 1$^-$ and (3)$^-$; log *ft*=7.34 *9* from 2$^-$ parent.
1536.8# *5*	(12$^+$)	4.6 ps *+26−16*	CD	J^π: gammas to (10$^+$) and (11$^-$); band member.
1556.04 *7*	(2$^+$)		A	J^π: gammas to 0$^+$ and 4$^+$.
1619.62 *9*	(1,2,3$^-$)		A	J^π: gammas to 2$^+$ and 1$^-$; log *ft*=7.38 *12* from 2$^-$ parent.
1644.88 *4*	(2$^+$,3$^-$)		A	J^π: gammas to 1$^-$ and 4$^+$; log *ft*=6.91 *+34−22* from 2$^-$ parent.
1710.0@ *5*	(13$^-$)		C	J^π: gammas to (12$^+$) and (11$^-$); band member.
1754.36 *5*	(3$^-$)		A	J^π: gammas to 2$^+$, 4$^+$, and (5$^-$); log *ft*=6.55 *12* from 2$^-$ parent.
1821.56 *20*	(1,2,3$^-$)		A	J^π: γ to 1$^-$; log *ft*=7.0 *+19−16* from 2$^-$ parent.
1841.20 *6*	(1,2,3$^-$)		A	J^π: γ to 1$^-$; log *ft*=6.09 *+37−25* from 2$^-$ parent. If J^π(1645 level)=3$^-$, then J^π(1841)≠1$^+$.
1932.9# *6*	(14$^+$)		C	J^π: gamma to (12$^+$); band member.
2125.0@ *6*	(15$^-$)		C	J^π: gammas to (14$^+$) and (13$^-$); band member.
2358.4# *7*	(16$^+$)		C	J^π: gamma to (14$^+$); band member.
2569.8@ *7*	(17$^-$)		C	J^π: gammas to (16$^+$) and (15$^-$); band member.
2810.7# *9*	(18$^+$)		C	J^π: gamma to (16$^+$); band member.
3040.6@ *9*	(19$^-$)		C	J^π: gamma to (17$^-$); band member.
3287.4# *10*	(20$^+$)		C	J^π: gamma to (18$^+$); band member.

† From a least-squares fit to Eγ values. Uncertainties of some Eγ values have been increased (as specified under comment at each γ) in the fitting due to poor fit and the resulting reduced χ^2=2.2, compared to 4.9 without those ΔEγ adjustments.

‡ For levels above 111.1, half-lives have been deduced by evaluators from measured matrix elements in Coulomb excitation, and adopted γ-ray branching ratios.

Band(A): K^π=0$^+$ g.s. band.

@ Band(B): K^π=0$^-$ octupole vibrational band. Weighted averaged of D_0/Q_0=0.00402 b$^{1/2}$ *11* (1999Co02). Average electric dipole moment D_0=0.027 eb$^{1/2}$ *4* from J=7-15 (1999Co02).

& Band(C): K^π=(0$^+$) band.

Adopted Levels, Gammas (continued)

γ(^{222}Ra)

E_i(level)	J^π_i	E_γ‡	I_γ‡	E_f	J^π_f	Mult.#	α&	Comments
111.137	2+	111.15 *3*	100	0.0	0+	E2	6.12 *9*	B(E2)(W.u.)=112.8 *+96−82* E_γ: unweighted average of 111.11 *1* from ^{222}Fr β^- decay, 111.15 *1* from ^{226}Th α decay, and 111.2 *2* from (^{136}Xe,Xγ).
242.157	1−	131.01 *3*	31.2 *15*	111.137	2+	(E1)	0.2500 *35*	B(E1)(W.u.)=0.00186 *+40−34* E_γ: unweighted average of 130.98 *1* from ^{222}Fr β^- decay and 131.04 *1* from ^{226}Th α decay. I_γ: from ^{226}Th α decay. Other: 31.8 *31* from ^{222}Fr β^- decay. Mult.: from intensity balance in ^{226}Th α decay.
		242.13 *2*	100.0 *30*	0.0	0+	E1	0.0575 *8*	B(E1)(W.u.)=0.00095 *+19−17* E_γ: unweighted average of 242.11 *1* from ^{222}Fr β^- decay and 242.14 *1* from ^{226}Th α decay. I_γ: from ^{226}Th α decay. Other: 100 *10* from ^{222}Fr β^- decay.
301.495	4+	190.42 *14*	100	111.137	2+	E2	0.700 *10*	B(E2)(W.u.)=123 *14* E_γ: unweighted average of 190.24 *2* from ^{222}Fr β^- decay, 190.31 *1* from ^{226}Th α decay, and 190.7 *2* from (^{136}Xe,Xγ).
317.330	(3)−	75.13 *2*	0.017 *4*	242.157	1−	[E2]	36.8 *5*	B(E2)(W.u.)=98 *+49−40*
		206.22 *4*	100.0 *32*	111.137	2+	E1	0.0839 *12*	B(E1)(W.u.)=0.0041 *+17−14* E_γ: unweighted average of 206.18 *2* from ^{222}Fr β^- decay and 206.25 *1* from ^{226}Th α decay. I_γ: from ^{226}Th α decay. Other: 100 *10* from ^{222}Fr β^- decay.
473.87	(5−)	(156.5 *1*)	4.3 *23*	317.330	(3)−	[E2]	1.480 *21*	B(E2)(W.u.)=109 *+30−26* E_γ: from level-energy difference. I_γ: from B(E2,157γ)/B(E1,172γ) ratio in Coulomb excitation; this γ has not been observed.
		172.37 *2*	100	301.495	4+	[E1]	0.1288 *18*	B(E1)(W.u.)=0.00123 *+60−24* E_γ: others: 172.3 *2* from ^{226}Th α decay and 172.2 *5* from (^{136}Xe,Xγ).
549.97	(6+)	77	29 *4*	473.87	(5−)	[E1]	0.2211 *31*	B(E1)(W.u.)=0.00211 *+44−40* E_γ,I_γ: from Coulomb excitation.
		248.4@ *2*	100	301.495	4+	[E2]	0.276 *4*	B(E2)(W.u.)=135 *+24−21* I_γ: from Coulomb excitation.
702.92	(7−)	153.1@ *5*	100@ *32*	549.97	(6+)	[E1]	0.1715 *28*	B(E1)(W.u.)=0.0024 *+12−7*
		229.3@ *5*	18@ *6*	473.87	(5−)	[E2]	0.362 *6*	B(E2)(W.u.)=95 *+74−38*
842.93	(8+)	140.1@ *2*	100@ *18*	702.92	(7−)	[E1]	0.2126 *31*	B(E1)(W.u.)=0.00265 *+75−66*
		292.9@ *2*	92@ *8*	549.97	(6+)	[E2]	0.1636 *23*	B(E2)(W.u.)=119 *+36−28*
914.174	(0+)	672.02 *2*	100 *7*	242.157	1−			
		802.7† *1*	13 *8*	111.137	2+			E_γ: uncertainty multiplied by a factor of 2 in the fitting; level-energy difference=803.036.
992.12	(9−)	149.3@ *5*	100@ *16*	842.93	(8+)	[E1]	0.1822 *30*	B(E1)(W.u.)=0.0049 *+18−14*
		289.0@ *5*	88@ *10*	702.92	(7−)	[E2]	0.1705 *26*	B(E2)(W.u.)=2.7×10^2 *+10−7*

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Adopted Levels, Gammas (continued)

γ(^{222}Ra) (continued)

E_i(level)	J^π_i	E_γ[‡]	I_γ[‡]	E_f	J^π_f	Mult.[#]	α[&]	Comments
1024.920	(2$^+$)	707.54 *3*	100 *5*	317.330	(3)$^-$			E_γ: other: 707.52 *9* from ^{226}Th α decay. I_γ: other: 100 *9* from ^{226}Th α decay.
		723.45 *6*	3.4 *5*	301.495	4$^+$			E_γ: weighted average of 723.45 *4* from ^{222}Fr β^- decay and 722.9 *4* from ^{226}Th α decay. I_γ: other: 15 *6* from ^{226}Th α decay is discrepant.
		782.77 *3*	98 *9*	242.157	1$^-$			E_γ: other: 783.0 *5* from ^{226}Th α decay. I_γ: other: 112 *25* from ^{226}Th α decay.
		913.69 *5*	16.9 *23*	111.137	2$^+$			E_γ: other: 913.9 *4* from ^{226}Th α decay. I_γ: other: 66 *33* from ^{226}Th α decay is discrepant.
		1025.02 *8*	6.7 *11*	0.0	0$^+$			
1170.99	(3$^-$,4$^+$)	696.88[†] *5*	29 *5*	473.87	(5$^-$)			E_γ: uncertainty multiplied by a factor of 2 in the fitting; level-energy difference=697.13.
		853.78 *8*	100 *6*	317.330	(3)$^-$			
		869.6 *2*	81 *25*	301.495	4$^+$			
1171.55	(1,2$^+$)	929.47 *8*	15 *2*	242.157	1$^-$			
		1060.33 *5*	100 *8*	111.137	2$^+$			
		1171.69 *8*	53 *6*	0.0	0$^+$			
1173.02	(10$^+$)	180.9[@] *2*	100[@] *23*	992.12	(9$^-$)	[E1]	0.1147 *16*	B(E1)(W.u.)=0.0032 *+16−11*
		330.1[@] *2*	75[@] *7*	842.93	(8$^+$)	[E2]	0.1147 *16*	B(E2)(W.u.)=139 *+76−48*
1225.23	(1,2$^+$)	982.90 *8*	97 *19*	242.157	1$^-$			
		1114.26 *8*	100 *19*	111.137	2$^+$			
		1225.24 *8*	38 *7*	0.0	0$^+$			
1265.05	(2$^+$,3)	963.61 *6*	26 *4*	301.495	4$^+$			
		1153.87 *5*	100 *10*	111.137	2$^+$			
1310.24	(0$^+$,1,2,3$^-$)	1068.08 *8*		242.157	1$^-$			
1330.5	(11$^-$)	157.4[@] *5*	64[@] *10*	1173.02	(10$^+$)	[E1]	0.1604 *26*	B(E1)(W.u.)=0.0046 *+24−16*
		338.3[@] *5*	100[@] *10*	992.12	(9$^-$)	[E2]	0.1069 *16*	B(E2)(W.u.)=2.4×10^2 *+13−8*
1360.88	(1$^-$,2,3)	1043.60 *9*	100 *12*	317.330	(3)$^-$			
		1249.1[†] *1*	60 *11*	111.137	2$^+$			E_γ: uncertainty multiplied by a factor of 3 in the fitting; level-energy difference=1249.74.
1375.77	(1,2,3$^-$)	1133.61 *8*		242.157	1$^-$			
1402.596	(2$^+$,3$^-$)	231.7 *2*	15.2 *16*	1170.99	(3$^-$,4$^+$)			
		377.64 *4*	24 *2*	1024.920	(2$^+$)			
		1085.20 *5*	92 *12*	317.330	(3)$^-$			
		1101.09 *5*	100 *10*	301.495	4$^+$			
		1160.52 *8*	14.4 *14*	242.157	1$^-$			
		1291.61 *8*	9.6 *16*	111.137	2$^+$			
1432.73	(1,2,3$^-$)	1190.4 *1*	8.5 *15*	242.157	1$^-$			
		1321.65 *6*	100 *8*	111.137	2$^+$			
1439.994	(3$^-$)	268.99 *4*	13 *3*	1170.99	(3$^-$,4$^+$)			
		415.05 *4*	11 *2*	1024.920	(2$^+$)			
		966.24 *9*	23 *5*	473.87	(5$^-$)			
		1122.41[†] *9*	40 *7*	317.330	(3)$^-$			E_γ: uncertainty multiplied by a

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Adopted Levels, Gammas (continued)

$\gamma(^{222}Ra)$ (continued)

E_i(level)	J^π_i	E_γ‡	I_γ‡	E_f	J^π_f	Mult.#	α&	Comments
								factor of 2 in the fitting; level-energy difference=1122.661.
1439.994	(3^-)	1138.47 *5*	100 *10*	301.495	4^+			
		1197.99 *8*	30 *5*	242.157	1^-			
1499.49	$(1^-,2,3^-)$	474.45 *9*	100 *10*	1024.920	(2^+)			
		1182.05 *8*	87 *10*	317.330	$(3)^-$			
		1257.5 *1*	33 *6*	242.157	1^-			
		1388.5 *1*	76 *10*	111.137	2^+			
1536.8	(12^+)	206.2@ *5*	64@ *12*	1330.5	(11^-)	[E1]	0.0839 *13*	B(E1)(W.u.)=0.00164 *+93−62*
		363.9@ *5*	100@ *10*	1173.02	(10^+)	[E2]	0.0871 *13*	B(E2)(W.u.)=136 *+78−48*
1556.04	(2^+)	1238.60 *8*	100 *13*	317.330	$(3)^-$			
		1254.4 *2*	26 *3*	301.495	4^+			
		1445.2 *2*	69 *11*	111.137	2^+			
		1556.5 *2*	59 *11*	0.0	0^+			
1619.62	$(1,2,3^-)$	1377.4 *1*	100 *15*	242.157	1^-			
		1508.7 *2*	24 *7*	111.137	2^+			
1644.88	$(2^+,3^-)$	619.95 *4*	31 *4*	1024.920	(2^+)			
		1327.58 *6*	100 *9*	317.330	$(3)^-$			
		1343.3 *1*	10.4 *17*	301.495	4^+			
		1402.5 *2*	27 *3*	242.157	1^-			
		1534.1 *2*	17 *3*	111.137	2^+			
1710.0	(13^-)	173.1@ *5*	82@ *12*	1536.8	(12^+)	[E1]	0.1275 *20*	
		379.6@ *5*	100@ *9*	1330.5	(11^-)	[E2]	0.0776 *11*	
1754.36	(3^-)	351.75 *4*	52 *11*	1402.596	$(2^+,3^-)$			
		1280.99† *9*	34 *7*	473.87	(5^-)			E_γ: uncertainty multiplied by a factor of 3 in the fitting; level-energy difference=1280.49.
		1436.4† *1*	100 *10*	317.330	$(3)^-$			E_γ: uncertainty multiplied by a factor of 3 in the fitting; level-energy difference=1437.03.
		1453.4† *1*	45 *9*	301.495	4^+			E_γ: uncertainty multiplied by a factor of 3 in the fitting; level-energy difference=1452.86.
		1643.9† *2*	44 *11*	111.137	2^+			E_γ: uncertainty multiplied by a factor of 2 in the fitting; level-energy difference=1643.22.
1821.56	$(1,2,3^-)$	1579.4 *2*	100	242.157	1^-			
1841.20	$(1,2,3^-)$	196.31 *4*	100 *13*	1644.88	$(2^+,3^-)$			
		1599.6† *2*	16 *5*	242.157	1^-			E_γ: uncertainty multiplied by a factor of 2 in the fitting; level-energy difference=1599.04.
1932.9	(14^+)	396.0@ *5*	100	1536.8	(12^+)	[E2]	0.0693 *10*	
2125.0	(15^-)	192.1@ *5*	68@ *30*	1932.9	(14^+)	[E1]	0.0993 *15*	
		415.0@ *5*	100@ *12*	1710.0	(13^-)	[E2]	0.0613 *9*	
2358.4	(16^+)	425.5@ *5*	100	1932.9	(14^+)	[E2]	0.0575 *8*	
2569.8	(17^-)	211.4@ *5*		2358.4	(16^+)			
		444.8@ *5*	100@	2125.0	(15^-)	[E2]	0.0514 *7*	
2810.7	(18^+)	452.3@ *5*	100	2358.4	(16^+)	[E2]	0.0493 *7*	
3040.6	(19^-)	470.8@ *5*	100	2569.8	(17^-)	[E2]	0.0447 *6*	
3287.4	(20^+)	476.7@ *5*	100	2810.7	(18^+)	[E2]	0.0434 *6*	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

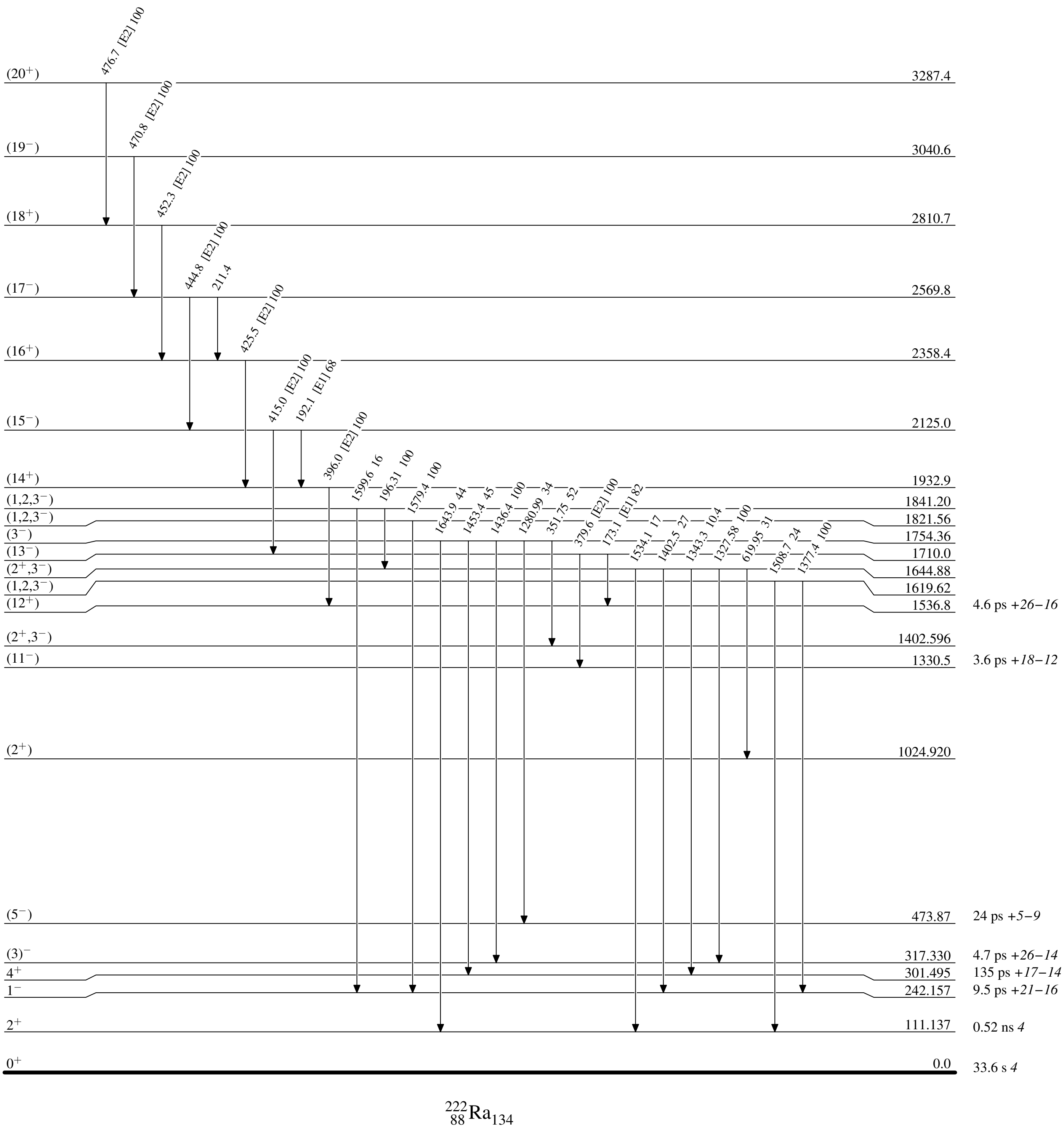
$\gamma(^{222}Ra)$ (continued)

† Poor fit; uncertainty multiplied by a factor in the fitting.
‡ From ^{222}Fr β^- decay, unless otherwise noted.
# From ce data in ^{226}Th α decay, unless otherwise noted.
@ From $^{232}Th(^{136}Xe,X\gamma)$.
& 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.

Adopted Levels, Gammas

Level Scheme

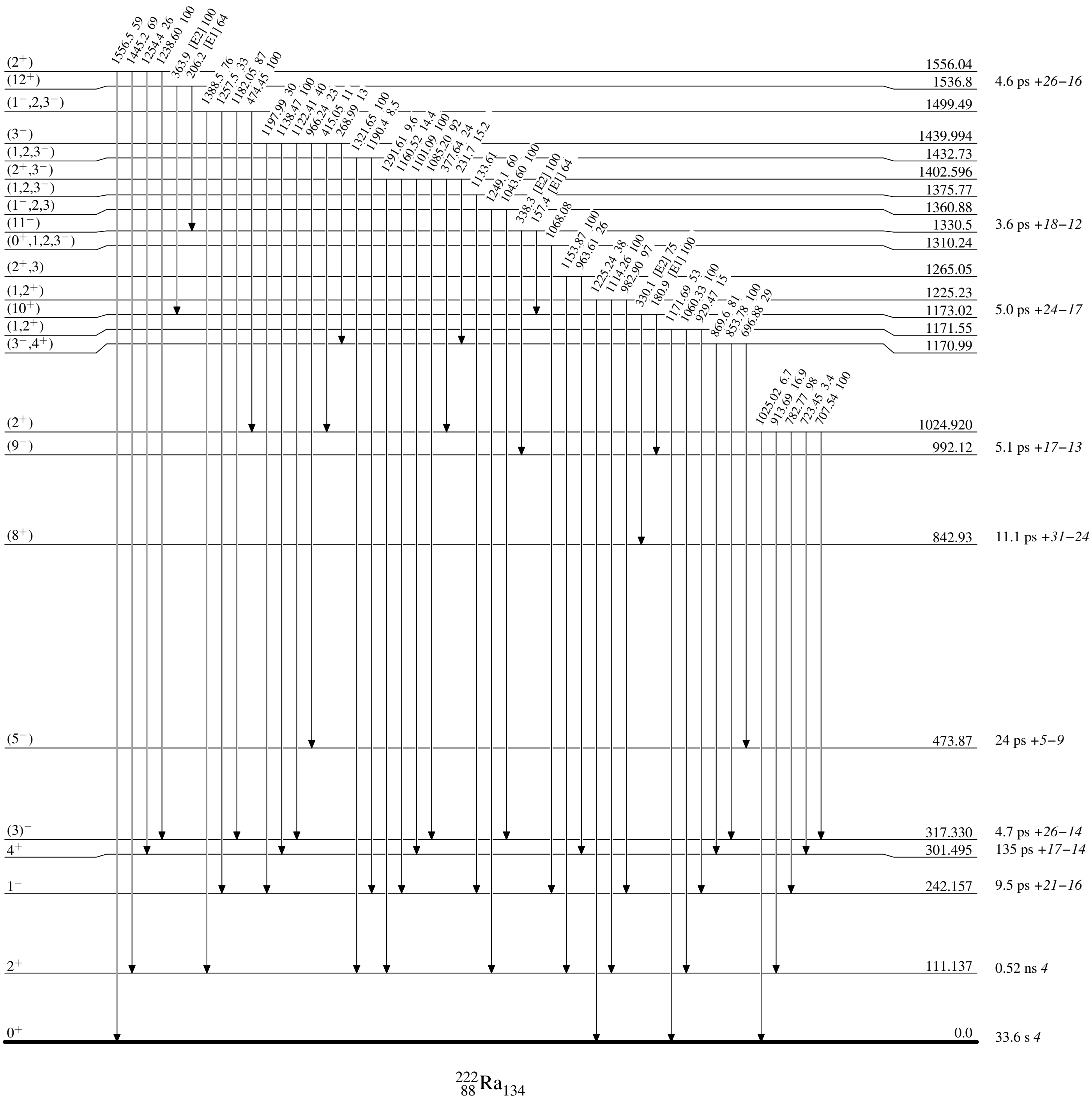
Intensities: Relative photon branching from each level



Adopted Levels, Gammas

Level Scheme (continued)

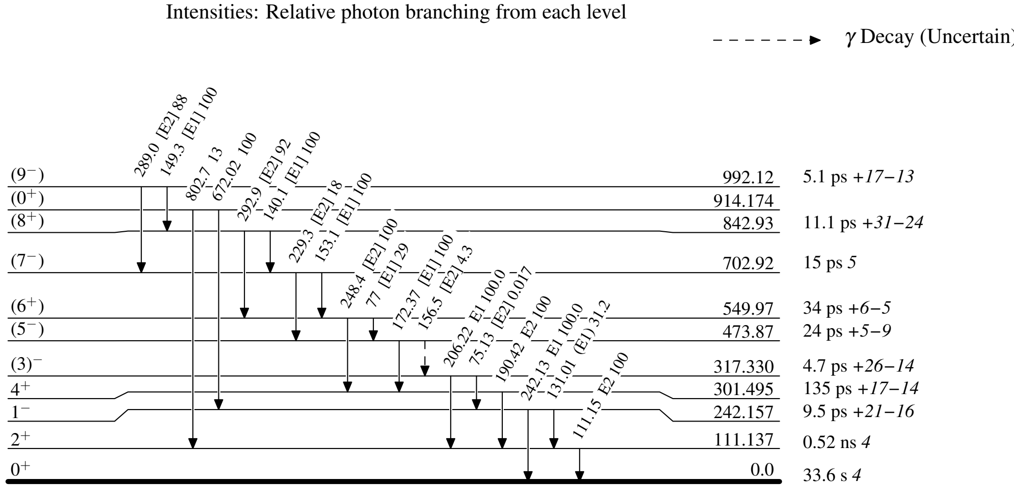
Intensities: Relative photon branching from each level



Adopted Levels, Gammas

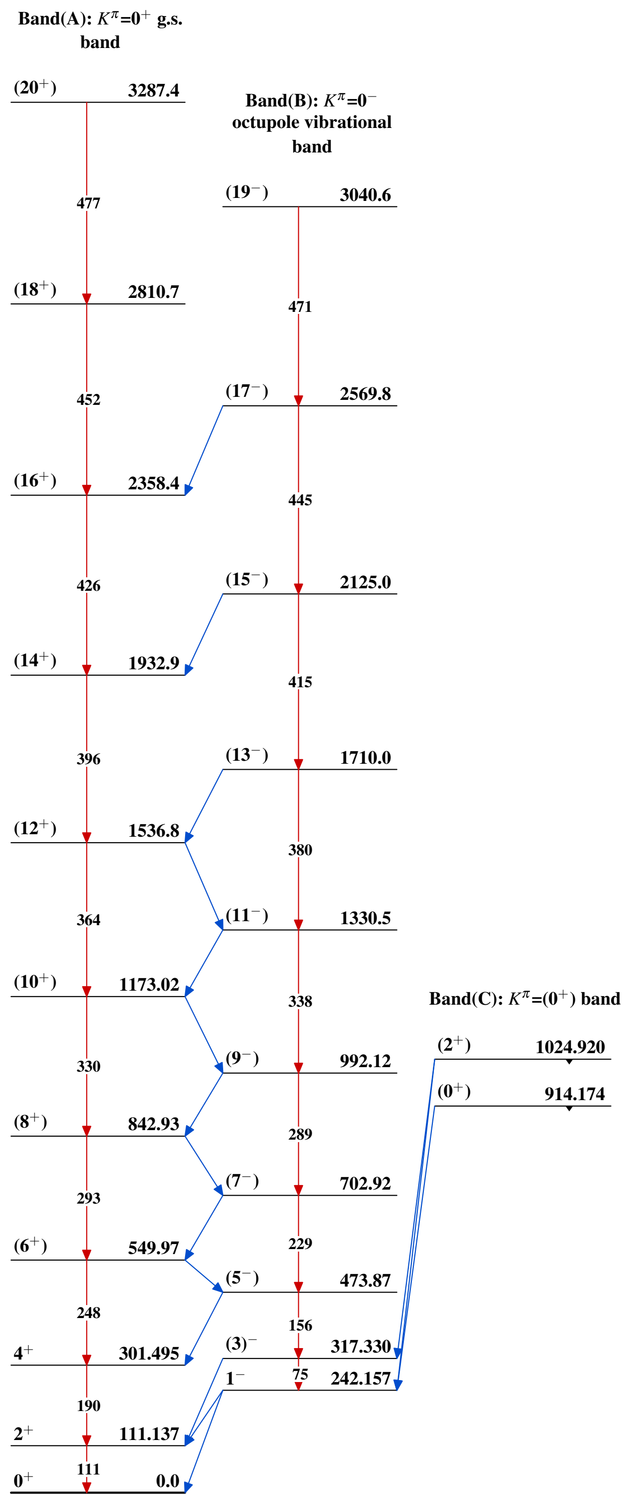
Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{222}_{88}Ra_{134}$

Adopted Levels, Gammas



$^{222}_{88}Ra_{134}$