Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	E. Browne	NDS 93,846 (2001)	1-May-2001

Q(β^-)=−592 *8*; S(n)=5158 *5*; S(p)=6404 *22*; Q(α)=5978.99 *21* 2012Wa38
Note: Current evaluation has used the following Q record −586 7 *5151* 5 *6401* 21 *5979.3* *3* 1995Au04.

^{223}Ra Levels

The following evidence suggests that ^{223}Ra is a nucleus with a stable octupole deformation (ε_3=0.10): Observed K=3/2, 5/2, and 1/2 parity doublet bands. Transition probabilities for E1 transitions between parity doublet bands that are about 100 times higher than for other E1 transitions. Decoupling parameters for K=1/2 bands that have opposite signs and approach a single absolute value. Magnetic moments for K=3/2 parity doublet bands that have very similar values, as predicted by theory (1988Sh34). For discussions on stable octupole deformation see 1990Ja11, 1988Le13, 1988Sh34, 1986Sh02, and 1984Le04.

Cross Reference (XREF) Flags

A ^{227}Th α decay
B ^{223}Fr β^- decay

E(level)[d]	J$^\pi$[†‡]	T$_{1/2}$	XREF	Comments
0.0[#]	3/2$^+$	11.43 d *5*	AB	%α=100; %^{14}C=8.9×10^{-8} *4* μ=+0.2705 *19*; Q=+1.254 *3* T$_{1/2}$: weighted average (lwm, χ^2/ν=10.0) of 11.444 d *46* (1987Mi10), 11.4346 d *11* (1965Ki05), 11.372 d *45* (1967JoZX), 11.685 d *56* (1954Ha60), and 11.22 d *5* (1959Ro51). J$^\pi$: J=3/2, Collinear fast-beam laser spectroscopy (1983Ah03,1988Ah02). Theoretical μ=0.45, which includes an octupole deformation, agrees better with experimental μ=+0.2705 *19* than theoretical μ=0.03 for a 3/2$^+$,3/2[631] reflection-symmetric state (no octupole deformation) (1984Le04,1988Sh34). Even parity is suggested by ^{223}Ra(3/2$^+$) α decay to the 269.48-keV level (jp=3/2$^+$) in ^{219}Rn. %^{14}C is from 1995Ho11 other values: 8.5×10^{-8} *25* (1984Ro30), 5.5×10^{-8} *20%* (1984Ga38), 7.6×10^{-8} *30%* (1984Al34), 4.7×10^{-8} *13%* (1985Ku24), 6.1×10^{-8} *10%* (1985Pr01), 6.4×10^{-8} *4* (1989Br34), 5×10^{-8} *1%* (1990We01), 7.0×10^{-8} *4%* (1991Ho15). Others: 1985Al28. Measured ^{14}C energies are: 32 MeV (1984Ro30), 29.4 MeV *12* (1984Ga38), and 29.8 MeV *2* (1985Ku24). For theoretical ^{14}C decay probabilities see: 1998Mi11, 1997Mi30, 1996Si20, 1996Mi09, 1995Si05, 1995Du05, 1994Po18, 1994Du03, 1994Bu07, 1993Gu11, 1993Go18, 1993Gu10, 1990Hu02, 1990Hu07, 1990Sh01, 1989Ma21, 1989Ci03, 1989Bu06, 1989Ma43, 1988Iv02, 1988Bl11, 1988Ba01, 1988Sh29, 1987Iv01, 1987Gu15, 1987Gu04, 1987Bl04, 1987Sh04, 1986Pi11, 1986Ka46, 1986Ir01, 1986Gr20, 1986De32, 1986Ru11, 1985Sh07, 1985Sh01, 1985Sa02, 1985Po11, and 1984Po08. μ: Collinear fast-beam laser spectroscopy. Sternheimer Polarization correction included (1989Ra17,1988Ah02,1987Ar20). Other: 1983Ah03. See 1988Sh34 and 1984Le04 for theoretical calculations (which include a stable octupole deformation) of magnetic moments. Q: Collinear fast−beam laser spectroscopy (1989Ne03). Other value: +1.19 *12* (1989Ra17,1988Ah02,1987We03). Isotope shift: 1989Ne03, 1988Ah02.
29.858[#] *8*	5/2$^+$		AB	Additional information 1. J$^\pi$: 29.9γ M1+E2 to 3/2$^+$.

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Adopted Levels, Gammas (continued)

^{223}Ra Levels (continued)

E(level)[d]	J^{π}[†‡]	$T_{1/2}$	XREF	Comments
50.128[@] *9*	3/2$^-$	0.63 ns *7*	AB	μ=+0.43 *6* J^{π}: 50γ E1 to 3/2$^+$; $\gamma\gamma(\theta)$ for the 236γ-50γ cascade is consistent with J=3/2 (1957Pi31,1960Pe13,1961Br44,1965Cl05,1970Le13). Theoretical μ=0.46, which includes an octupole deformation, agrees with experimental μ. Theoretical μ=−0.06 for a 3/2$^-$, 3/2[761] reflection-symmetric state (1984Le04,1988Sh34). $T_{1/2}$: $\alpha\gamma$(t), $\gamma\gamma$(t) (1958Va29,1961Fo08). μ: Integral perturbed angular correlations (1989Ra17,1970Le13). See 1988Sh34 and 1984Le04 for a theoretical calculation of μ including a stable octupole deformation.
61.424[#] *10*	(7/2)$^+$	≈0.6 ns	AB	J^{π}: 31.6γ M1+E2 to (5/2)$^+$. $T_{1/2}$: nuclear recoil (1971Br29).
79.708[@] *13*	(5/2)$^-$	0.24 ns *8*	AB	
104.60? *13*			A	
123.793[@] *18*	7/2$^-$	0.45 ns *+10−6*	AB	Additional information 2. J^{π}: 93.9γ E1 to (5/2)$^+$, 62.4γ E1 to (7/2)$^+$. $T_{1/2}$: nuclear recoil (1971Br29).
130.141[#] *18*	9/2$^+$	>0.3 ns	A	Additional information 3. J^{π}: 68.7γ M1+E2 to (7/2)$^+$. $T_{1/2}$: Doppler broadening (1971Br29).
174.569[@] *24*	9/2$^-$	0.20 ns *6*	A	Additional information 4. J^{π}: 113.2γ E1 to (7/2)$^+$. $T_{1/2}$: Doppler broadening (1971Br29).
174.58[#] *4*	11/2$^+$	0.14 ns *5*	A	Additional information 5. J^{π}: 44.4γ M1 to (9/2)$^+$. $T_{1/2}$: Doppler broadening (1971Br29).
234.858[&] *19*	5/2$^+$		AB	Additional information 6. J^{π}: 184.6γ E1 to 3/2$^-$, 173.4γ M1,E2 to (7/2)$^+$.
247.39[@] *4*	11/2$^-$	0.15 ns *5*	A	Additional information 7. J^{π}: 117.2γ E1 to (9/2)$^+$. $T_{1/2}$: nuclear recoil (1971Br29).
280.182[&] *22*	(7/2)$^+$	0.075 ns *25*	AB	J^{π}: 250.3γ M1+E2 to (5/2)$^+$. $T_{1/2}$: nuclear recoil (1971Br29).
286.087[b] *14*	1/2$^+$	0.77 ns *7*	AB	J^{π}: 236γ E1 to 3/2$^-$; $\gamma\gamma(\theta)$ for the 236γ-50γ cascade is consistent with J=1/2 (1957Pi31,1960Pe13,1961Br44,1965Cl05,1970Le13). Isotropic $\alpha\gamma(\theta)$ distribution for α(286)−236γ (1960Pe13,1990Br23), and for α(286)−256γ, −286γ (1990Br23) are also consistent with J=1/2. Non-isotropic $\alpha\gamma(\theta)$ distribution for α(286)−236γ measured by 1972He18 disagrees with these results. $T_{1/2}$: $\alpha\gamma$(t) (1958Va29,1961Fo08). Other value: 0.56 ns, $\alpha\gamma$(t) (1965Co22).
315.99[@] *6*	(13/2$^-$)		A	J^{π}: 141.4γ to (9/2)$^-$.
329.856[c] *14*	3/2$^-$	0.42 ns *4*	AB	J^{π}: 43.8γ E1 to 1/2$^+$, 300γ E1 to (5/2)$^+$. $T_{1/2}$: nuclear recoil (1971Br29).
334.370[b] *12*	5/2$^+$	0.28 ns *4*	AB	J^{π}: 210.6γ E1 to (7/2)$^-$, 334.4γ M1+E2 to 3/2$^+$. $T_{1/2}$: nuclear recoil (1971Br29).
342.590[b] *19*	3/2$^+$	<0.050 ns	AB	J^{π}: 56.5γ M1+E2 to 1/2$^+$, 312.6γ M1+E2 to (5/2)$^+$. $T_{1/2}$: nuclear recoil (1971Br29).
342.654[&] *21*	(9/2)$^+$	<0.10 ns	A	J^{π}: 281.3γ M1+E2 to (7/2)$^+$, 212.7γ M1+E2 to (9/2)$^+$. $T_{1/2}$: nuclear recoil (1971Br29).
350.53[c] *6*	(1/2)$^-$		A	J^{π}: 350.4γ E1 to 3/2$^-$.
369.36[a] *4*	(5/2)$^-$	0.20 ns *5*	AB	J^{π}: 319.2γ M1+E2 to 3/2$^-$. $T_{1/2}$: Doppler broadening (1971Br29).

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Adopted Levels, Gammas (continued)

^{223}Ra Levels (continued)

E(level)[d]	Jπ[†‡]	$T_{1/2}$	XREF	Comments
376.296[c] *11*	7/2⁻	<0.03 ns	AB	Additional information 8. Jπ: 296.5γ M1+E2 to (5/2)⁻, 314.8γ E1 to (7/2)⁺. $T_{1/2}$: Doppler broadening (1971Br29).
405.07[a] *3*	(7/2)⁻		A	Jπ: 324.9γ M1+E2 to (5/2)⁻.
424.12[&] *5*	(11/2⁺)		A	Jπ: 249.6γ to (9/2)⁻, 362.5γ to (7/2)⁺.
432.24[c] *3*	(5/2)⁻		AB	Jπ: 308.4γ M1+E2 to (7/2)⁻, 432.3γ to 3/2⁺.
442.35[b] *8*	(7/2⁺)		A	Jπ: 318.5γ to (7/2)⁻, 268.0γ to (9/2)⁻. Other assignment: Jπ=9/2⁻ member of Kπ=5/2⁻ band (1988Le13,1986Sh02,1988Sh34).
445.071[b] *19*	9/2⁺		A	Additional information 9. Jπ: 383γ M1+E2 to (7/2)⁺, 315γ M1 to (9/2)⁺.
459.93[a] *5*	(9/2)⁻		A	Jπ: 117.2γ E1 to (9/2)⁺. Other assignment: Jπ=(7/2⁺) member of Kπ=1/2⁺ band (1988Le13,1986Sh02,1988Sh34).
514.25[a] *8*	(11/2⁻)		A	Jπ: 54.2γ (M1) to (9/2)⁻, 267.1 to (11/2)⁻, 339.8γ to (11/2)⁺. Other assignment: Jπ=11/2⁻ member of Kπ=1/2−band (1988Le13,1988Sh02,1988Sh34).
537.16 *11*			A	
568 *2*			A	
590.3 *10*			A	
593.58[e] *12*			B	
641 *3*			A	
685 *3*			A	
712.7 *4*			AB	
729 *4*			A	
782.54[e] *17*	(1/2,3/2,5/2)		B	Jπ: 440γ to 3/2⁺, 453γ to 3/2⁻.
784.02 *17*			AB	
786.90 *17*			AB	
792.6 *6*			AB	
803.44 *9*			AB	
805.38[e] *10*	(1/2,3/2,5/2)		B	Jπ: 475.4γ to 3/2⁻.
818.18 *18*			AB	
823.03 *9*			AB	
826.7 *3*	(3/2⁺)		AB	Jπ: 540γ to 1/2⁺, 766γ to (7/2)⁺, log *ft*=5.9 from 3/2⁽⁻⁾.
842.05 *8*			AB	
846.41[e] *4*	(5/2)		B	Jπ: 723γ to (7/2⁻), 796γ to 3/2⁻.
859.07 *11*			A	
867.5 *4*	(3/2,5/2⁺)		AB	Jπ: 581γ to 1/2⁺, 533γ to 5/2⁺.
879.41 *17*	(7/2⁺)		AB	Jπ: 644γ to (5/2)⁺, 748.8γ to (9/2)⁺.
884.2? *5*			A	
891? *1*			AB	
904.4? *12*			A	
905.9[e] *4*			B	
908.03 *22*			AB	
926.48 *16*	(3/2,5/2⁻)		AB	Jπ: 576γ to (1/2)⁻, 896γ to 5/2⁺.
940.79[e] *13*	(3/2⁻,5/2)		B	Jπ: 816γ to (7/2)⁻, 941γ to 3/2⁺.
943.1 *10*	(3/2,5/2)		AB	Jπ: 893γ to 3/2⁻, 914γ to (5/2)⁺.
957.73 *11*	(3/2⁻,5/2⁺)		AB	Jπ: 672γ to 1/2⁺, 834γ to (7/2)⁻.
971.31 *25*			AB	
999.85 *17*			AB	
1015.2? *7*			A	
1020.1 *3*			AB	
1025.0 *10*			AB	
1028.94[e] *25*			B	

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Adopted Levels, Gammas (continued)

^{223}Ra Levels (continued)

† Spin and parity assignments are based on rotational structure, γ-ray multipolarities, $\gamma\gamma(\theta)$, and $\alpha\gamma(\theta)$, unless otherwise specified. Specific arguments are given with individual levels. Parity doublet rotational band assignments are from 1986Sh02, 1988Sh34, 1988Le13, 1990Ja11, 1990Br23, and 1993Ab01.

‡ Although octupole deformations are small in this region, nuclear states are no longer fully characterized by single Nilsson orbitals. This terminology, however, is used throughout this evaluation to label states rather than to accurately describe their nature.

Band(A): 3/2(631) parity doublet rotational band. Rotational parameter: A=6.0 (1990Ja11).

@ Band(B): 3/2(761) parity doublet rotational band. Rotational parameter: A=5.9 (1990Ja11).

& Band(C): 5/2(633) parity doublet rotational band. Rotational parameter: A=6.5 (1990Ja11).

[a] Band(D): 5/2(752) parity doublet rotational band. Rotational parameter: A=5.1 (1990Ja11).

[b] Band(E): 1/2(640) parity doublet rotational band. Rotational parameters: A=8.6, a=1.35 (1990Br23); a(theory)=1.33 (1988Sh34).

[c] Band(F): 1/2(770) parity doublet rotational band. Rotational parameters: A=6.8, a=−2.0 (1990Br23); a(theory)=−2.3 (1988Sh34).

[d] From ^{227}Th α decay, unless otherwise specified.

[e] Observed in ^{223}Fr β^- decay only.

Adopted Levels, Gammas (continued)

γ(^{223}Ra)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	δ	α[#]	Comments
29.858	5/2+	29.86 1	100.0	0.0	3/2+	M1+E2	0.41 10	5.4×10^2 15	
50.128	3/2−	20.25 5	2.8 3	29.858	5/2+	[E1]		7.73	B(E1)(W.u.)=0.00050 9
		50.13 1	100 5	0.0	3/2+	E1		0.707	B(E1)(W.u.)=0.00119 16
61.424	(7/2)+	31.58 1	76 12	29.858	5/2+	M1+E2	0.28 6	272 75	B(M1)(W.u.)≈0.0027; B(E2)(W.u.)≈70
		61.441 20	100 12	0.0	3/2+	E2		98.4	B(E2)(W.u.)≈44
79.708	(5/2)−	29.60 3	≈0.3	50.128	3/2−	[M1+E2]		≈2078	
		49.82 5	22 5	29.858	5/2+	E1		0.716	
		79.69 2	100 4	0.0	3/2+	E1		0.205	
104.60?		43.8[a] 5	1.0×10^2 4	61.424	(7/2)+				
		75.01[a] 5	49 19	29.858	5/2+				
123.793	7/2−	44.22 12	3.5 9	79.708	(5/2)−	M1+E2	0.52 4	132 12	B(M1)(W.u.)=0.0025 11; B(E2)(W.u.)=1.1×10^2 5
		62.45[@] 5	13.4[@] 17	61.424	(7/2)+	E1		0.393	B(E1)(W.u.)=2.0×10^{-5} +22−5
		73.63 5	0.9 4	50.128	3/2−	E2		41.3	B(E2)(W.u.)=10 6
		93.88 5	100.0 22	29.858	5/2+	E1		0.132	B(E1)(W.u.)=7.9×10^{-5} 24
130.141	9/2+	6.5 3	1.0×10^2 3	123.793	7/2−	[E1]		41.2	
		68.74[@] 3	64[@] 12	61.424	(7/2)+	M1+E2	0.45	17.8	
		100.27 3	93 18	29.858	5/2+	E2		9.61	
174.569	9/2−	44.40[&] 5	0.7[&] 8	130.141	9/2+	[E1]		0.978	
		50.85 5	2.9 12	123.793	7/2−	M1+E2	0.4 1	54 14	
		69.8[a] 3	1.9 8	104.60?					
		94.97[@] 5	5[@] 3	79.708	(5/2)−	E2		12.4	
		113.11[&] 5	100.0[&]	61.424	(7/2)+	E1		0.362	
174.58	11/2+	44.40[&] 5	8[&] 6	130.141	9/2+	M1		35.2	B(M1)(W.u.)=0.015 13
		113.11[&] 5	100.0[&]	61.424	(7/2)+	E2		5.78	B(E2)(W.u.)=2.8×10^2 12
234.858	5/2+	111.05[‡] 3	0.18[‡] 4	123.793	7/2−				
		155.5[‡] 5	0.1[‡]	79.708	(5/2)−				
		173.45 3	3.9 6	61.424	(7/2)+	M1,E2			
		184.65 5	8.0 9	50.128	3/2−	E1		0.110	
		204.98 10	36 6	29.858	5/2+	M1+E2	−0.12 7	2.13 4	
		234.76 10	100 12	0.0	3/2+	M1(+E2)	−0.07 2	1.47	
247.39	11/2−	72.85 5	12 10	174.569	9/2−				
		117.20 5	100 8	130.141	9/2+	E1		0.332	
		123.58 10	7 3	123.793	7/2−				
280.182	(7/2)+	105.2 1		174.569	9/2−				Populates either or both 174.569 ((9/2)−) and 174.58 ((11/2)+).
		150.14 20	10 3	130.141	9/2+				
		175.8[a] 3	19 5	104.60?					
		200.5 1	12 9	79.708	(5/2)−				

$^{223}_{88}Ra_{135}$-5

Adopted Levels, Gammas (continued)

$\gamma(^{223}Ra)$ (continued)

E_i(level)	J^{π}_i	E_γ†	I_γ†	E_f	J^{π}_f	Mult.†	δ	α#	Comments
280.182	(7/2)$^+$	218.90@ *5*	100@ *10*	61.424	(7/2)$^+$	M1		1.79	
		250.15 *5*	8.1 *16*	29.858	5/2$^+$	M1		1.23	
		280.7‡ *5*	6.3‡	0.0	3/2$^+$				
286.087	1/2$^+$	235.96 *2*	100.0 *20*	50.128	3/2$^-$	E1		0.0615	
		256.23 *2*	54.3 *10*	29.858	5/2$^+$	E2		0.253	
		286.09 *20*	13.5 *12*	0.0	3/2$^+$	M1+E2			
315.99	(13/2$^-$)	141.42@ *5*	100.0@	174.569	9/2$^-$				
329.856	3/2$^-$	43.77 *5*	7.2 *5*	286.087	1/2$^+$	E1		1.014	B(E1)(W.u.)=0.000160 *20*
		94.97@ *5*	0.8@ *5*	234.858	5/2$^+$				
		206.08 *5*	8.6 *9*	123.793	7/2$^-$	E2		0.535	B(E2)(W.u.)=1.65 *24*
		250.27 *8*	15.4 *14*	79.708	(5/2)$^-$	M1+E2	−2.1 *4*	0.45 *5*	B(M1)(W.u.)=4.1×10^{-5} *14*; B(E2)(W.u.)=0.91 *15*
		279.80 *5*	1.8 *5*	50.128	3/2$^-$	M1+E2	0.12 *11*	0.90 *3*	B(M1)(W.u.)=1.8×10^{-5} *6*; B(E2)(W.u.)=0.0011 *+20−11*
		299.98 *3*	75.0 *22*	29.858	5/2$^+$	E1		0.0354	B(E1)(W.u.)=5.2×10^{-6} *6*
		329.85 *2*	100 *6*	0.0	3/2$^+$	(E1)		0.0286	B(E1)(W.u.)=5.2×10^{-6} *6*
334.370	5/2$^+$	48.30 *3*	1.1 *5*	286.087	1/2$^+$	E2		313	
		54.19@ *4*	0.52@ *11*	280.182	(7/2)$^+$	(M1)		19.7	
		99.58 *10*	2.1 *6*	234.858	5/2$^+$				
		204.14 *10*	18.1 *21*	130.141	9/2$^+$	E2		0.553	
		210.62 *5*	100 *8*	123.793	7/2$^-$	E1		0.0805	
		254.63 *3*	57 *11*	79.708	(5/2)$^-$	E1		0.0515	
		272.91 *5*	40.6 *7*	61.424	(7/2)$^+$	M1+E2			
		284.24 *10*	3.2 *11*	50.128	3/2$^-$				
		304.50 *2*	92 *11*	29.858	5/2$^+$	M1+E2(+E0)	0.26 *4*	1.1 *1*	
		334.37 *2*	91 *7*	0.0	3/2$^+$	M1+E2	−0.61 *4*	0.435 *12*	
342.590	3/2$^+$	56.42 *14*	1.8 *15*	286.087	1/2$^+$	M1+E2	0.47 *2*	40.8 *16*	
		107.76@ *7*	1.5@ *5*	234.858	5/2$^+$	(M1)		13.4	
		262.87 *5*	20.8 *15*	79.708	(5/2)$^-$	E1		0.0479	
		281.42@ *5*	34.5@ *23*	61.424	(7/2)$^+$				
		292.41 *5*	12.8 *15*	50.128	3/2$^-$	E1		0.0375	
		312.69 *3*	100 *8*	29.858	5/2$^+$	M1+E2	0.16 *3*	0.654 *6*	
		342.55 *4*	68 *18*	0.0	3/2$^+$	M1+E2	1.29 *2*	0.261	
342.654	(9/2)$^+$	62.45@ *5*	256@ *33*	280.182	(7/2)$^+$	M1+E2	0.29 *5*	19.0 *21*	
		107.76@ *7*	10@ *3*	234.858	5/2$^+$	[E2]		7.16	
		168.36 *10*	19 *3*	174.569	9/2$^-$				
		212.70 *4*	100 *13*	130.141	9/2$^+$	M1+E2	−0.4 *1*	1.74 *9*	
		218.90@ *5*	138@ *13*	123.793	7/2$^-$				
		281.42@ *5*	226@ *15*	61.424	(7/2)$^+$	M1+E2	0.53 *2*	0.738	
350.53	(1/2)$^-$	8.15 *20*	7.1 *24*	342.590	3/2$^+$				

From ENSDF

$^{223}_{88}Ra_{135}$-6

γ(^{223}Ra) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[†]	δ	α[#]	Comments
350.53	(1/2)⁻	64.35 *10*	24 *4*	286.087	1/2⁺	[E1]		0.363	
		300.50 *16*	12.9 *24*	50.128	3/2⁻	(M1+E2)			
		350.54 *7*	100 *17*	0.0	3/2⁺	E1		0.0251	
369.36	(5/2)⁻	89.08[‡] *10*	11.3[‡] *6*	280.182	(7/2)⁺				
		134.6 *1*	100 *24*	234.858	5/2⁺	[E1]		0.238	
		245.60[‡] *5*	5.4[‡] *10*	123.793	7/2⁻				
		289.59 *10*		79.708	(5/2)⁻				
		307.78[&‡] *14*	≤03[&‡]	61.424	(7/2)⁺				
		319.24 *5*	100 *24*	50.128	3/2⁻	M1+E2	0.18 *3*	0.615	
		339.50[‡] *5*	12.7[‡] *11*	29.858	5/2⁺				
		369.35 *5*	19 *4*	0.0	3/2⁺				
376.296	7/2⁻	33.39 *8*	1.6 *6*	342.654	(9/2)⁺	[E1]		2.09	
		41.93 *5*	6 *3*	334.370	5/2⁺	[E1]		1.12	
		46.45 *5*		329.856	3/2⁻				
		96.03 *5*	14 *3*	280.182	(7/2)⁺	(E1)		0.124	
		141.42[@] *5*	24[@] *5*	234.858	5/2⁺	E1		0.210	
		201.64 *10*	4.8 *6*	174.569	9/2⁻	M1+E2	1.59 *9*	1.05 *4*	
		246.12 *10*	2.50 *19*	130.141	9/2⁺				
		252.50 *5*	23 *4*	123.793	7/2⁻	M1		1.20	
		296.50 *5*	89 *8*	79.708	(5/2)⁻	M1+E2	−0.13 *2*	0.762 *4*	
		314.85[@] *4*	100[@] *8*	61.424	(7/2)⁺	E1		0.0318	
		325.99 *18*	1.3 *6*	50.128	3/2⁻				
		346.45 *1*	2.4 *3*	29.858	5/2⁺				
		376.27 *10*	1.1 *3*	0.0	3/2⁺				
405.07	(7/2)⁻	62.68 *3*	70 *25*	342.654	(9/2)⁺	[E1]		0.40	
		124.44 *20*	40 *22*	280.182	(7/2)⁺				
		169.95 *10*	54 *22*	234.858	5/2⁺				
		229.9 *5*	38 *13*	174.58	11/2⁺				
		280.7 *3*	25 *13*	123.793	7/2⁻				
		324.88 *20*	100 *25*	79.708	(5/2)⁻	M1+E2			
		374.80 *20*	15.00	29.858	5/2⁺				
424.12	(11/2⁺)	109.2[a] *4*	10 *3*	315.99	(13/2⁻)				
		249.6[@a] *5*	15[@] *5*	174.569	9/2⁻				Populates either or both 174.569 ((9/2)⁻) and 174.58 ((11/2)⁺).
		249.6[@a] *5*	15[@] *5*	174.58	11/2⁺				Populates either or both 174.569 ((9/2)⁻) and 174.58 ((11/2)⁺).
		362.63 *10*	100 *3*	61.424	(7/2)⁺				
432.24	(5/2)⁻	56.00 *6*	29.01	376.296	7/2⁻	M1		17.9	
		89.6 *4*	23 *8*	342.590	3/2⁺				

Adopted Levels, Gammas (continued)

γ(^{223}Ra) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.[†]	δ	α[#]	Comments
432.24	(5/2)$^-$	102.50 10	6.870	329.856	3/2$^-$				
		308.40 3	100 16	123.793	7/2$^-$	M1+E2			
		352.61 10	60 13	79.708	(5/2)$^-$	M1+E2			
		370.93 8	24 16	61.424	(7/2)$^+$				
		382.2 3	38 8	50.128	3/2$^-$				
		402.2 3	5×10^1 3	29.858	5/2$^+$				
		432.33 10	24 3	0.0	3/2$^+$				
442.35	(7/2$^+$)	99.6 2	100.0	342.590	3/2$^+$				
		162.19 10	60 20	280.182	(7/2)$^+$				
		267.86 20	55 20	174.569	9/2$^-$				
		318.46 20	52 17	123.793	7/2$^-$				
445.071	9/2$^+$	20.94 5	0.5 14	424.12	(11/2$^+$)				
		40.20 3	3.2 8	405.07	(7/2)$^-$				
		68.74[@] 3	11.8[@] 21	376.296	7/2$^-$				
		110.65 5	0.7 5	334.370	5/2$^+$	E2		6.37	
		197.56 10	2.6 8	247.39	11/2$^-$				
		270.56 20	5.8 19	174.569	9/2$^-$				Populates either or both 174.569 ((9/2)$^-$) and 174.58 ((11/2)$^+$).
		314.85[@] 4	100[@] 8	130.141	9/2$^+$	M1		0.655	
		383.51 4	5 5	61.424	(7/2)$^+$	M1+E2	−0.46 12	0.33 2	
		415.11 10	0.29 14	29.858	5/2$^+$				
459.93	(9/2)$^-$	117.20 5		342.654	(9/2)$^+$	E1		0.332	
		212.7[a] 3	44 12	247.39	11/2$^-$				
		225.5[a] 3	21 6	234.858	5/2$^+$				
		285.52 10	1.0×10^2 3	174.58	11/2$^+$				Populates either or both 174.569 ((9/2)$^-$) and 174.58 ((11/2)$^+$).
		398.6 3	3.2 9	61.424	(7/2)$^+$				
514.25	(11/2$^-$)	54.19[@] 10	6.3[@] 13	459.93	(9/2)$^-$	(M1)		19.7	
		267.05 20	100 25	247.39	11/2$^-$				
		339.76 10	38 13	174.58	11/2$^+$				Populates either or both 174.569 ((9/2)$^-$) and 174.58 ((11/2)$^+$).
537.16		289.77 10	100.0	247.39	11/2$^-$				
590.3		466.8[a] 2	100.0	123.793	7/2$^-$				
593.58		307.78[&‡] 14	100[&‡] 12	286.087	1/2$^+$				
		469.3[&‡] 2	8.889[&‡]	123.793	7/2$^-$				
712.7		632.3 7	100 19	79.708	(5/2)$^-$				
		662.8 4	42 13	50.128	3/2$^-$				
782.54	(1/2,3/2,5/2)	439.6 3	37 10	342.590	3/2$^+$				
		452.9[&‡] 2	100.0[&‡]	329.856	3/2$^-$				

$^{223}_{88}Ra_{135}$-8

Adopted Levels, Gammas (continued)

γ(^{223}Ra) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f
784.02		722.1 *6*	1.0×10^2 *4*	61.424	(7/2)$^+$
		734.4 *5*	28 *11*	50.128	3/2$^-$
		754.1[@] *2*	7×10^1[@] *4*	29.858	5/2$^+$
		784.2 *5*	27 *7*	0.0	3/2$^+$
786.90		444.5[‡] *3*	40[‡] *8*	342.590	3/2$^+$
		452.9[&a] *6*	1.1×10^2[&] *3*	334.370	5/2$^+$
		457.5[a] *1*	30	329.856	3/2$^-$
		506.9[‡] *2*	80[‡] *16*	280.182	(7/2)$^+$
		552.4 *5*	100 *22*	234.858	5/2$^+$
		663.7[‡] *3*	40[‡] *8*	123.793	7/2$^-$
		707.2 *7*	17 *6*	79.708	(5/2)$^-$
		738.4[a] *10*	30 *8*	50.128	3/2$^-$
		756.9 *2*	83 *22*	29.858	5/2$^+$
		787.4[@] *5*	17[@] *10*	0.0	3/2$^+$
792.6		792.6[a] *6*	100.0	0.0	3/2$^+$
803.44		434.4[‡] *1*	4[‡] *1*	369.36	(5/2)$^-$
		469.3[&‡] *2*	2[&‡]	334.370	5/2$^+$
		569.0[a] *3*	92 *14*	234.858	5/2$^+$
		723.5 *1*	42 *16*	79.708	(5/2)$^-$
		742.4[‡] *3*	2.0[‡] *5*	61.424	(7/2)$^+$
		754.1[@] *2*	38[@] *22*	50.128	3/2$^-$
		803.9 *4*	1.0×10^2 *8*	0.0	3/2$^+$
805.38	(1/2,3/2,5/2)	475.4[&‡] *1*	100.0[&‡]	329.856	3/2$^-$
		806.0[‡] *2*	50[‡] *10*	0.0	3/2$^+$
818.18		756.9[a] *2*	1.0×10^2 *3*	61.424	(7/2)$^+$
		787.4[@a] *5*	21[@] *12*	29.858	5/2$^+$
		818[@a] *1*	9×10^1[@] *4*	0.0	3/2$^+$
823.03		480[a] *1*	12 *4*	342.590	3/2$^+$
		493.1 *2*	21 *3*	329.856	3/2$^-$
		536.9 *1*	43 *7*	286.087	1/2$^+$
		589.0[a] *6*	2.3 *6*	234.858	5/2$^+$
		773.4 *4*	6.0 *15*	50.128	3/2$^-$
		792.6[a] *6*	1.6 *4*	29.858	5/2$^+$
		823.4 *4*	100 *10*	0.0	3/2$^+$
826.7	(3/2$^+$)	475.4[&‡] *1*	0.7[&‡]	350.53	(1/2)$^-$
		539.8[‡] *2*	1.4[‡] *3*	286.087	1/2$^+$

From ENSDF

$^{223}_{88}$Ra$_{135}$-9

Adopted Levels, Gammas (continued)

γ(^{223}Ra) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Comments
826.7	(3/2+)	545.4[‡] 4	0.07[‡] 2	280.182	(7/2)+	
		746.4 7	6.7 25	79.708	(5/2)−	
		766.3 5	19 5	61.424	(7/2)+	
		775.8 5	100 9	50.128	3/2−	
		826.7 5	11 4	0.0	3/2+	
842.05		507.5 1	39 16	334.370	5/2+	
		556.1 2	22 10	286.087	1/2+	
		607.7 3	10.8 23	234.858	5/2+	
		718.5[a] 10	1.8 7	123.793	7/2−	
		762.2 5	16 3	79.708	(5/2)−	
		781.0 5	19 4	61.424	(7/2)+	
		792.2[‡] 3	2.9[‡] 3	50.128	3/2−	
		812.6 4	100 16	29.858	5/2+	
		842.5 3	53 8	0.0	3/2+	
846.41	(5/2)	516.7[‡] 2	8.3[‡] 14	329.856	3/2−	
		723.1[‡] 4	100[‡] 14	123.793	7/2−	
		765.8[‡] 9	56[‡] 6	79.708	(5/2)−	
		784.93[‡] 5	35[‡] 14	61.424	(7/2)+	
		796.22[‡] 5	24[‡] 4	50.128	3/2−	
		846.86[‡] 10	<13.79[‡]	0.0	3/2+	
859.07		482[a] 1	15 5	376.296	7/2−	
		516.6 3	31 12	342.590	3/2+	Populates 342.590 (3/2+) or 342.654 ((9/2)+).
		524.5 4	21 5	334.370	5/2+	
		579.0 2	5×10[1] 4	280.182	(7/2)+	
		735.4 2	18 6	123.793	7/2−	
		797.3 5	100 13	61.424	(7/2)+	
		808.6[a] 4	8 3	50.128	3/2−	
		828.5[@a] 5	21[@] 6	29.858	5/2+	
		858.9 2	28 5	0.0	3/2+	
867.5	(3/2,5/2+)	524.8[‡] 2	57[‡] 11	342.590	3/2+	
		533.1[‡] 3	25[‡] 21	334.370	5/2+	
		537.2[‡] 2	25[‡]	329.856	3/2−	
		581.3[‡] 4	18[‡] 4	286.087	1/2+	
		632.7[‡] 3	29[‡] 7	234.858	5/2+	
		787.6[@‡] 2	36[@‡] 7	79.708	(5/2)−	
		837.8 5	100 22	29.858	5/2+	
		867.3 5	6×10[1] 5	0.0	3/2+	

From ENSDF

$^{223}_{88}Ra_{135}$-10

γ(^{223}Ra) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Comments
879.41	(7/2$^+$)	644.3 3	22 10	234.858	5/2$^+$	
		704.3[a] 5	19 4	174.569	9/2$^-$	Populates either or both 174.569 ((9/2)$^-$) and 174.58 ((11/2)$^+$).
		748.8[a] 4	1.0×10^2 3	130.141	9/2$^+$	
		818.1[@] 2	41[@] 19	61.424	(7/2)$^+$	
		848.3[a] 6	66 19	29.858	5/2$^+$	
884.2?		854.3[a] 5	100.0	29.858	5/2$^+$	
891?		891[a] 1	100.0	0.0	3/2$^+$	
904.4?		534.6[a] 4	100.0	369.36	(5/2)$^-$	
905.9		576.1[‡] 4	100.0[‡]	329.856	3/2$^-$	
908.03		448.0 6	6 4	459.93	(9/2)$^-$	
		621.4 5	2.5 7	286.087	1/2$^+$	
		828.5[@a] 5	8.1[@] 22	79.708	(5/2)$^-$	
		857.3 7	2.5 8	50.128	3/2$^-$	
		878.2 4	5.9 17	29.858	5/2$^+$	
		908.6 4	100 14	0.0	3/2$^+$	
926.48	(3/2,5/2$^-$)	576.0 2	1.0×10^2 6	350.53	(1/2)$^-$	
		592.3[‡] 4	3.2[‡] 8	334.370	5/2$^+$	
		596[a] 1	3.2 16	329.856	3/2$^-$	
		692.0 7	12 4	234.858	5/2$^+$	
		846.7 5	46 10	79.708	(5/2)$^-$	
		876.3 4	72 24	50.128	3/2$^-$	
		896.1 5	34 9	29.858	5/2$^+$	
		927 1	2.0 8	0.0	3/2$^+$	
940.79	(3/2$^-$,5/2)	816.5[‡] 2	45[‡] 9	123.793	7/2$^-$	
		911.3[‡] 2	27[‡] 9	29.858	5/2$^+$	
		941.2[‡] 3	100[‡] 19	0.0	3/2$^+$	
943.1	(3/2,5/2)	600.7[‡] 4	17[‡] 4	342.590	3/2$^+$	
		613.6[‡] 4	33[‡] 8	329.856	3/2$^-$	
		863[a] 1	1.0×10^2 4	79.708	(5/2)$^-$	
		893 1	67 20	50.128	3/2$^-$	
		913.6[‡] 3	13[‡] 4	29.858	5/2$^+$	
957.73	(3/2$^-$,5/2$^+$)	671.9[‡] 4	4.3[‡] 11	286.087	1/2$^+$	
		833.9[‡] 2	10.6[‡] 22	123.793	7/2$^-$	
		878.1[‡] 2	26[‡] 5	79.708	(5/2)$^-$	
		907.61[‡] 20	100[‡] 15	50.128	3/2$^-$	
		958.0[‡] 7	2.8[‡] 7	0.0	3/2$^+$	
971.31		641.0 5	27 9	329.856	3/2$^-$	

Adopted Levels, Gammas (continued)

$\gamma(^{223}Ra)$ (continued)

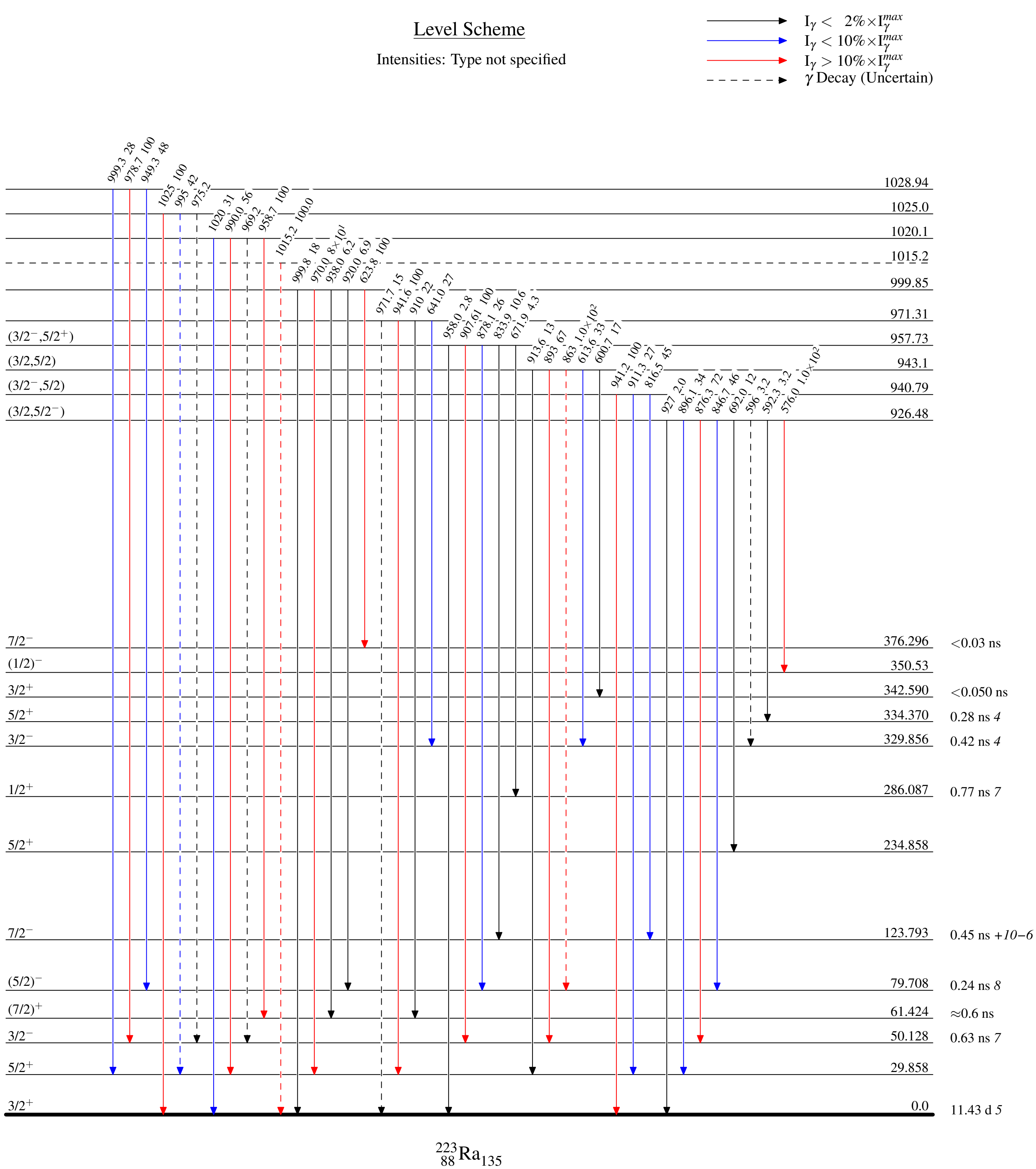
E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f
971.31		910 *1*	22 *9*	61.424	$(7/2)^+$
		941.6 *3*	100 *15*	29.858	$5/2^+$
		971.7[a] *10*	15 *8*	0.0	$3/2^+$
999.85		623.8 *5*	100 *23*	376.296	$7/2^-$
		920.0 *5*	6.9 *16*	79.708	$(5/2)^-$
		938.0 *8*	6.2 *23*	61.424	$(7/2)^+$
		970.0 *2*	8×10^1 *7*	29.858	$5/2^+$
		999.8 *5*	18 *5*	0.0	$3/2^+$
1015.2?		1015.2[a] *7*	100.0	0.0	$3/2^+$
1020.1		958.7 *3*	100 *21*	61.424	$(7/2)^+$
1020.1		969.2[‡a] *4*	‡	50.128	$3/2^-$
		990.0 *7*	56 *15*	29.858	$5/2^+$
		1020 *1*	31 *11*	0.0	$3/2^+$
1025.0		975.2[‡a] *5*	‡	50.128	$3/2^-$
		995[a] *1*	42 *25*	29.858	$5/2^+$
		1025 *1*	100 *25*	0.0	$3/2^+$
1028.94		949.3[‡] *4*	48[‡] *12*	79.708	$(5/2)^-$
		978.7[‡] *4*	100[‡] *20*	50.128	$3/2^-$
		999.3[‡] *5*	28[‡] *8*	29.858	$5/2^+$

† From ^{227}Th α decay, unless otherwise specified.
‡ Observed in ^{223}Fr β^- decay only.
# 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.
@ Multiply placed with undivided intensity.
& Multiply placed with intensity suitably divided.
a Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Level Scheme

Intensities: Type not specified

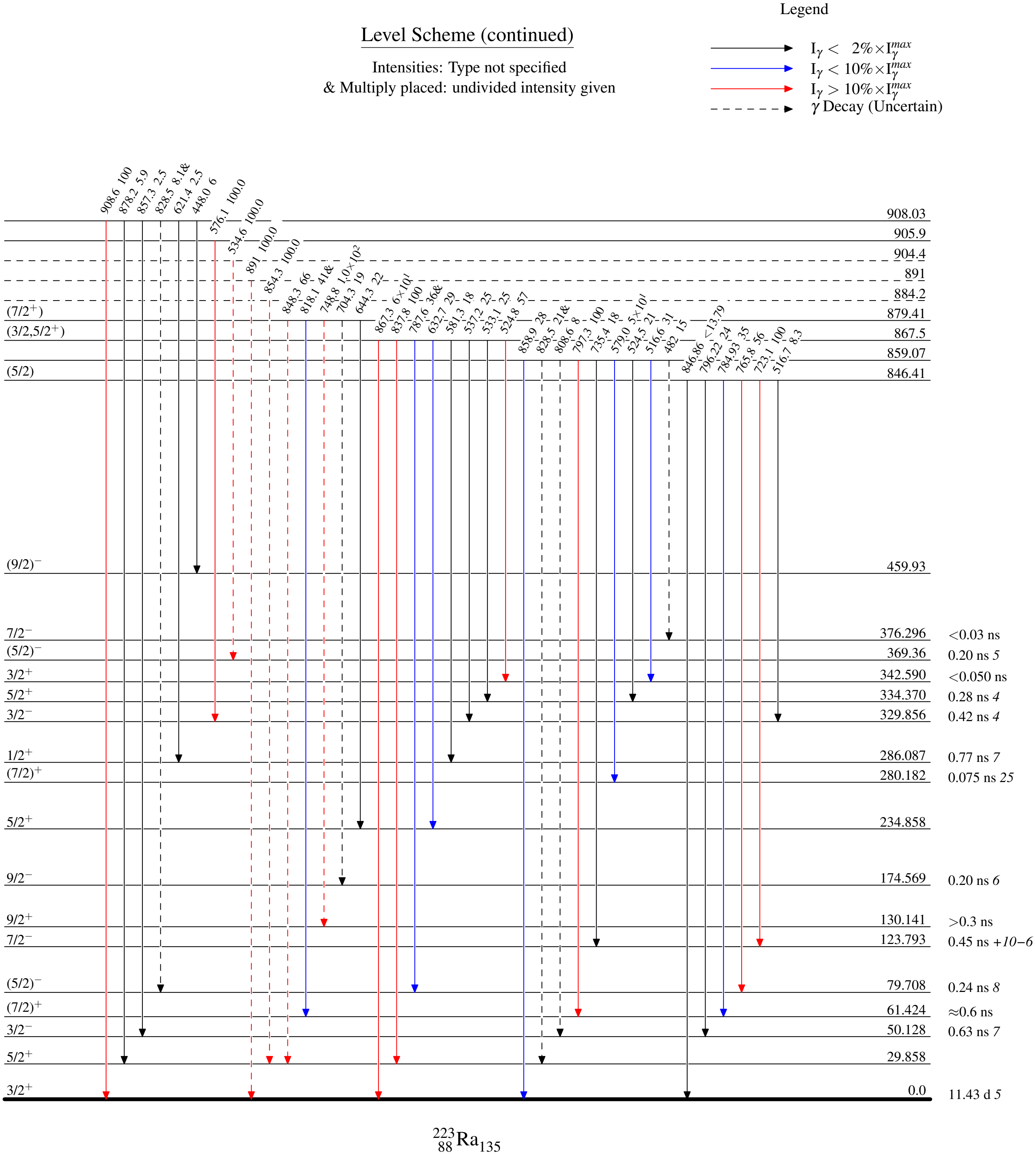


Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified

& Multiply placed: undivided intensity given



Adopted Levels, Gammas

Level Scheme (continued)

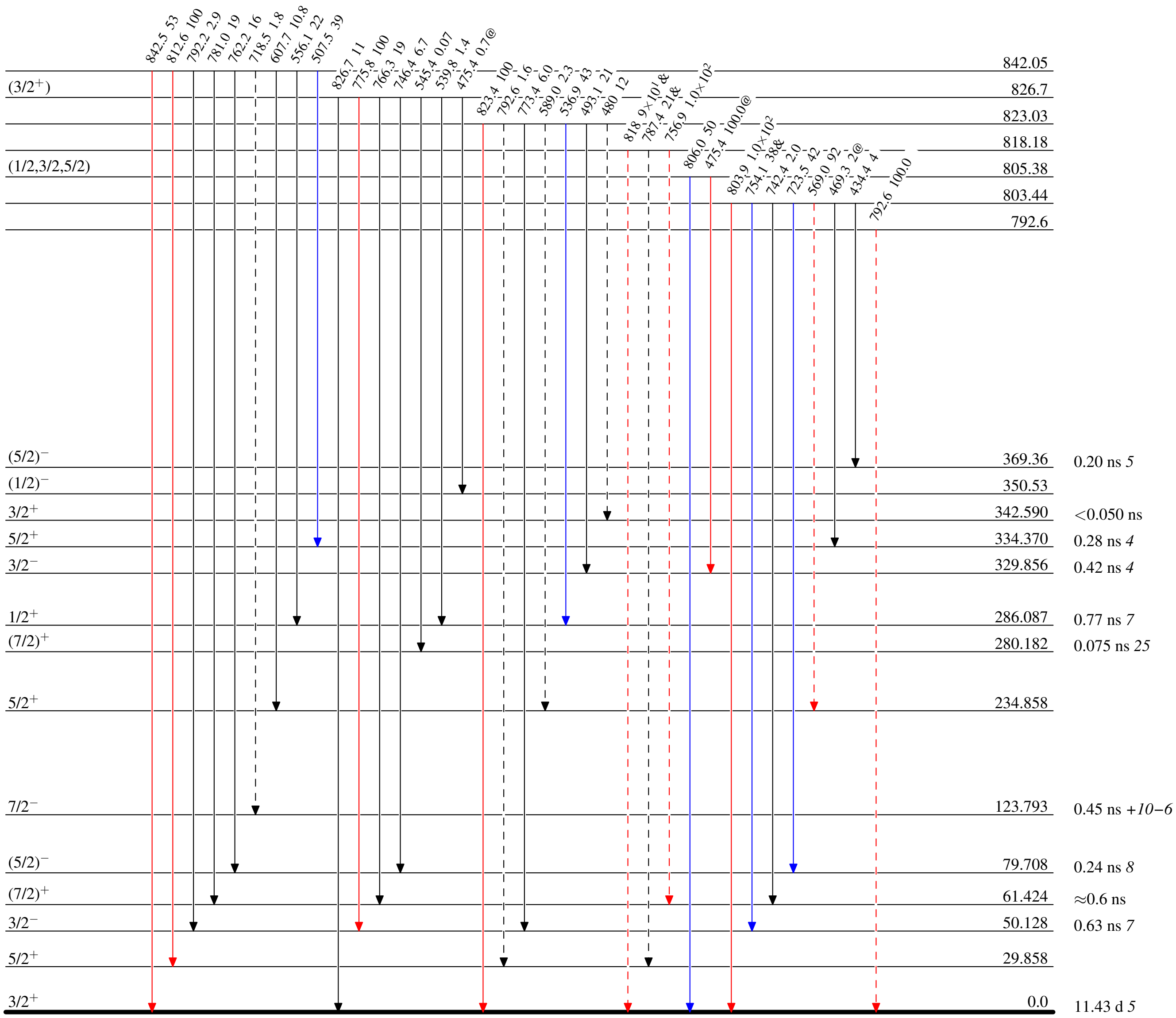
Intensities: Type not specified

& Multiply placed: undivided intensity given

@ Multiply placed: intensity suitably divided

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)

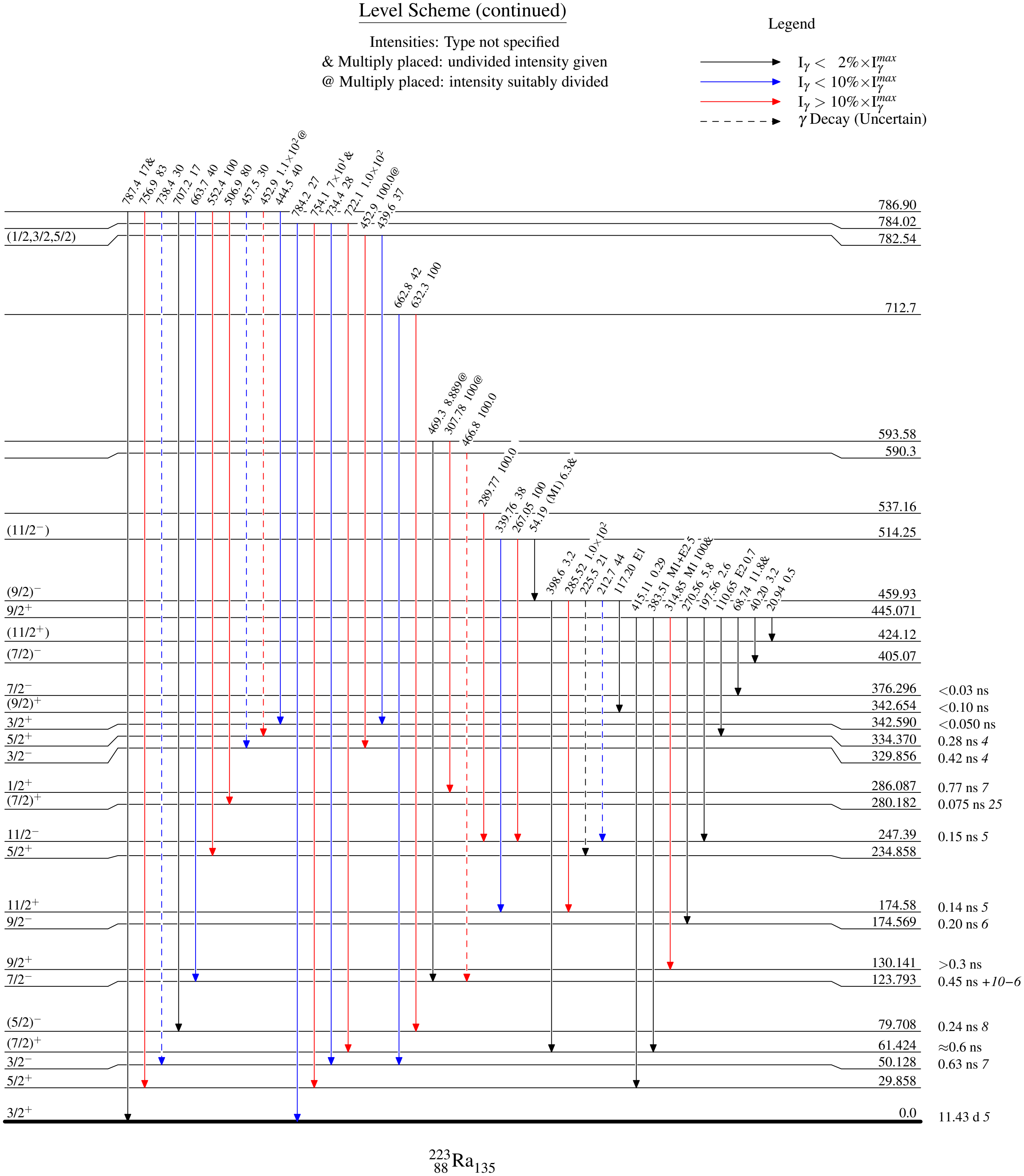


$^{223}_{88}Ra_{135}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided



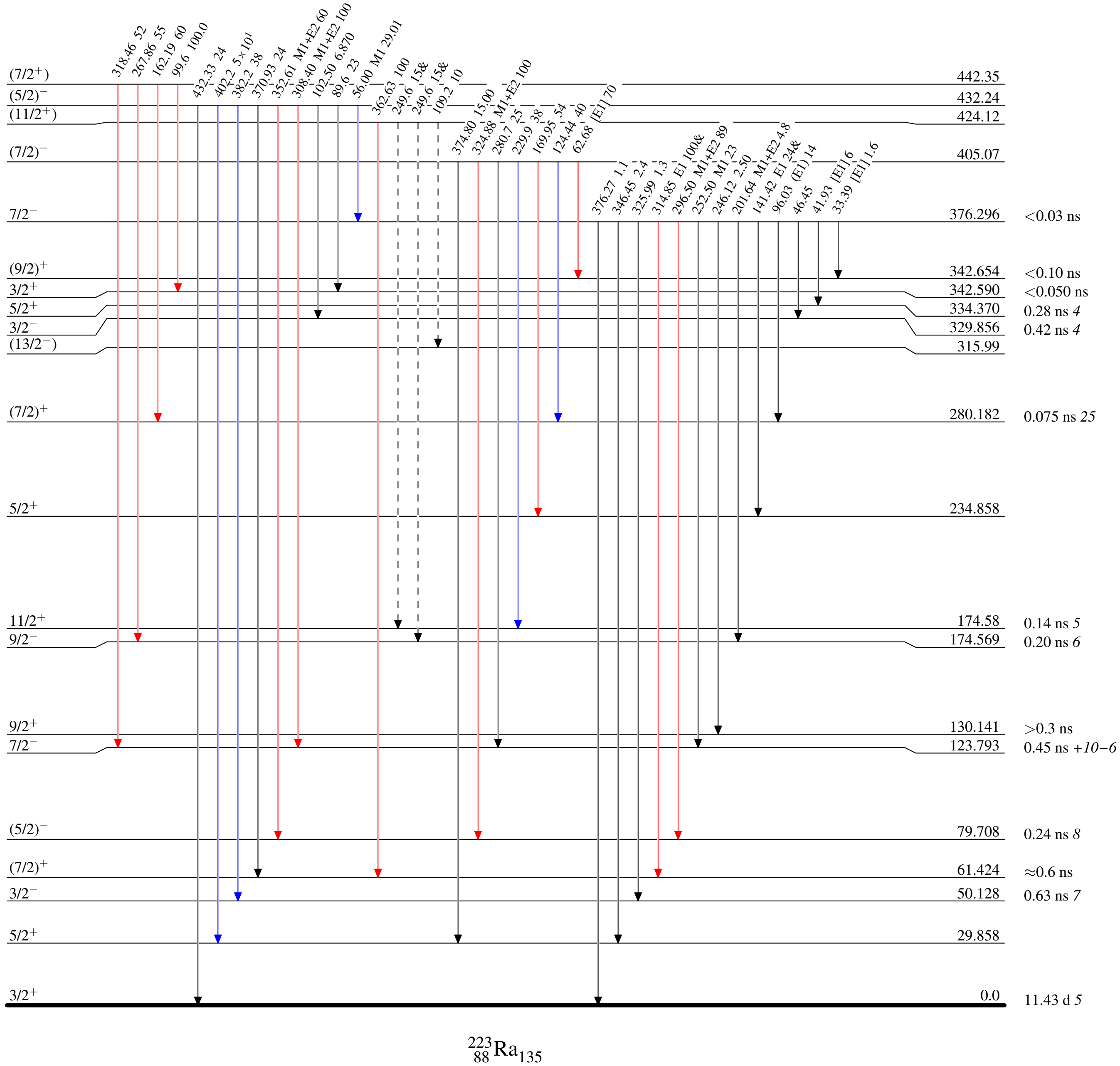
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

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)



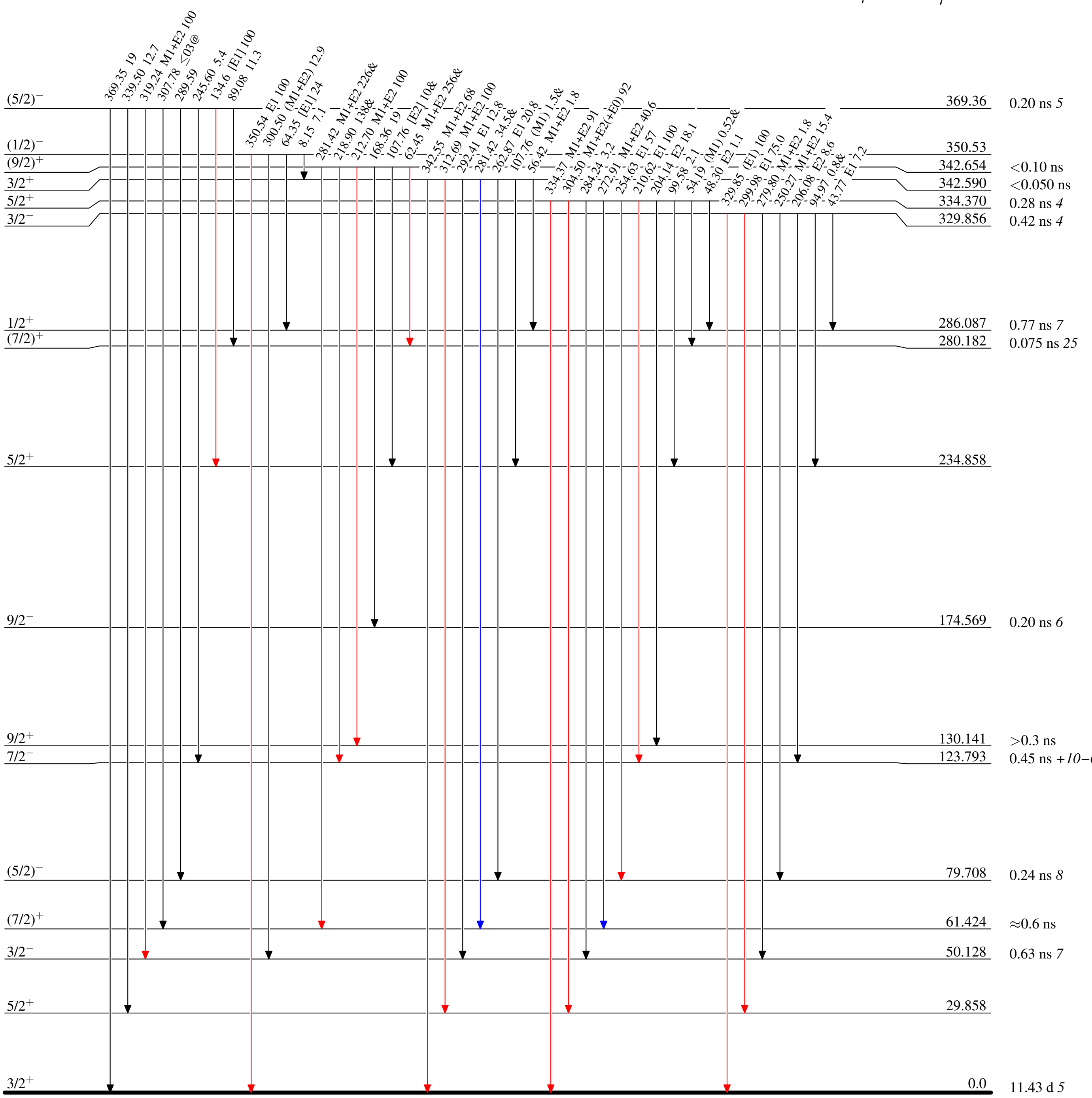
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$

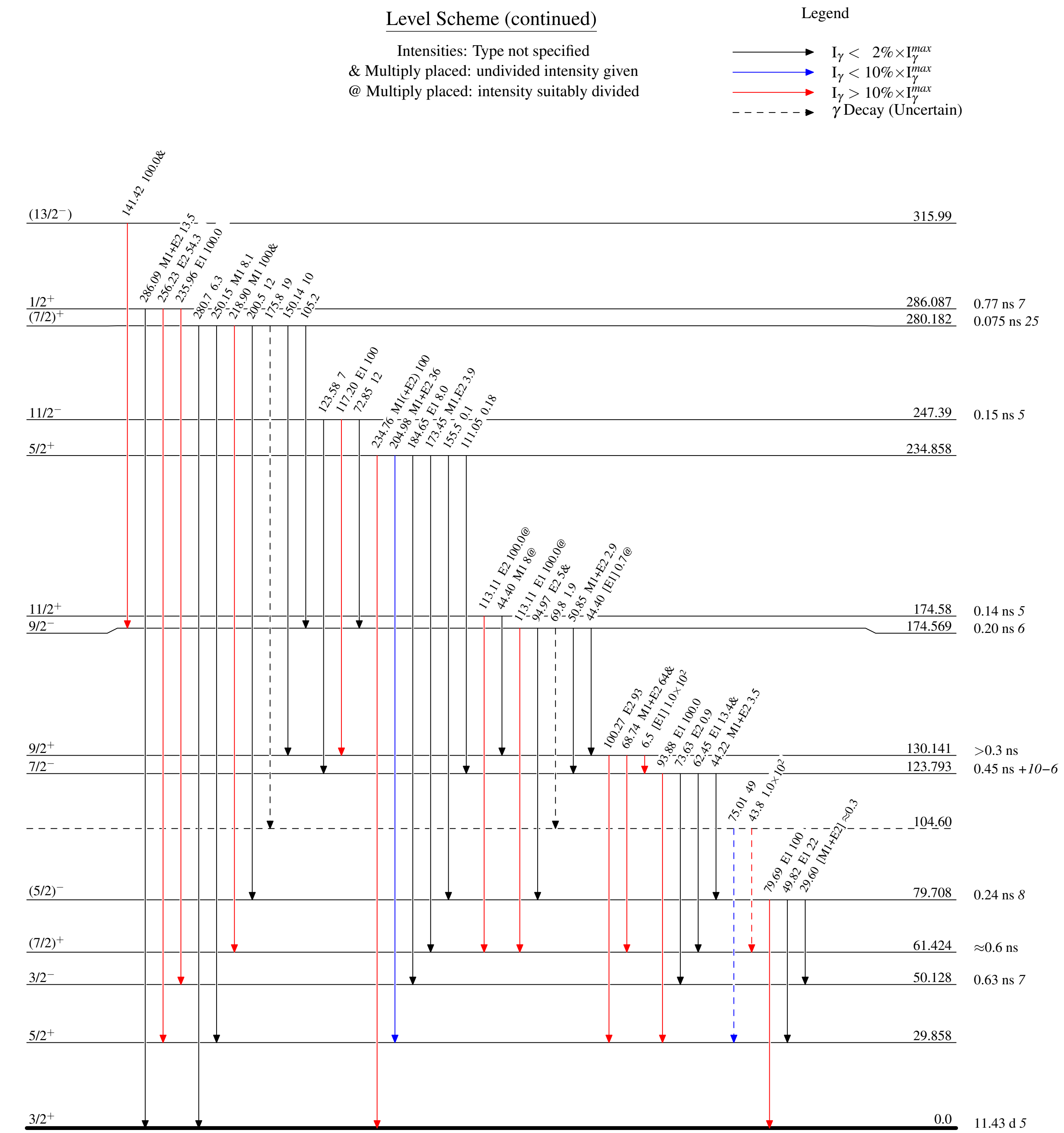


$^{223}_{88}Ra_{135}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

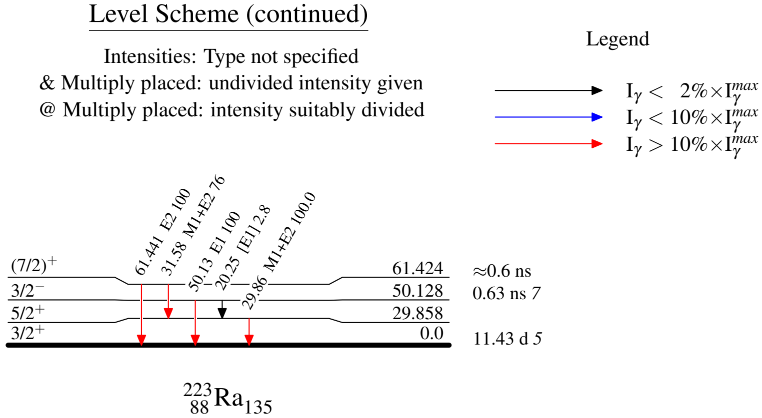


$^{223}_{88}Ra_{135}$

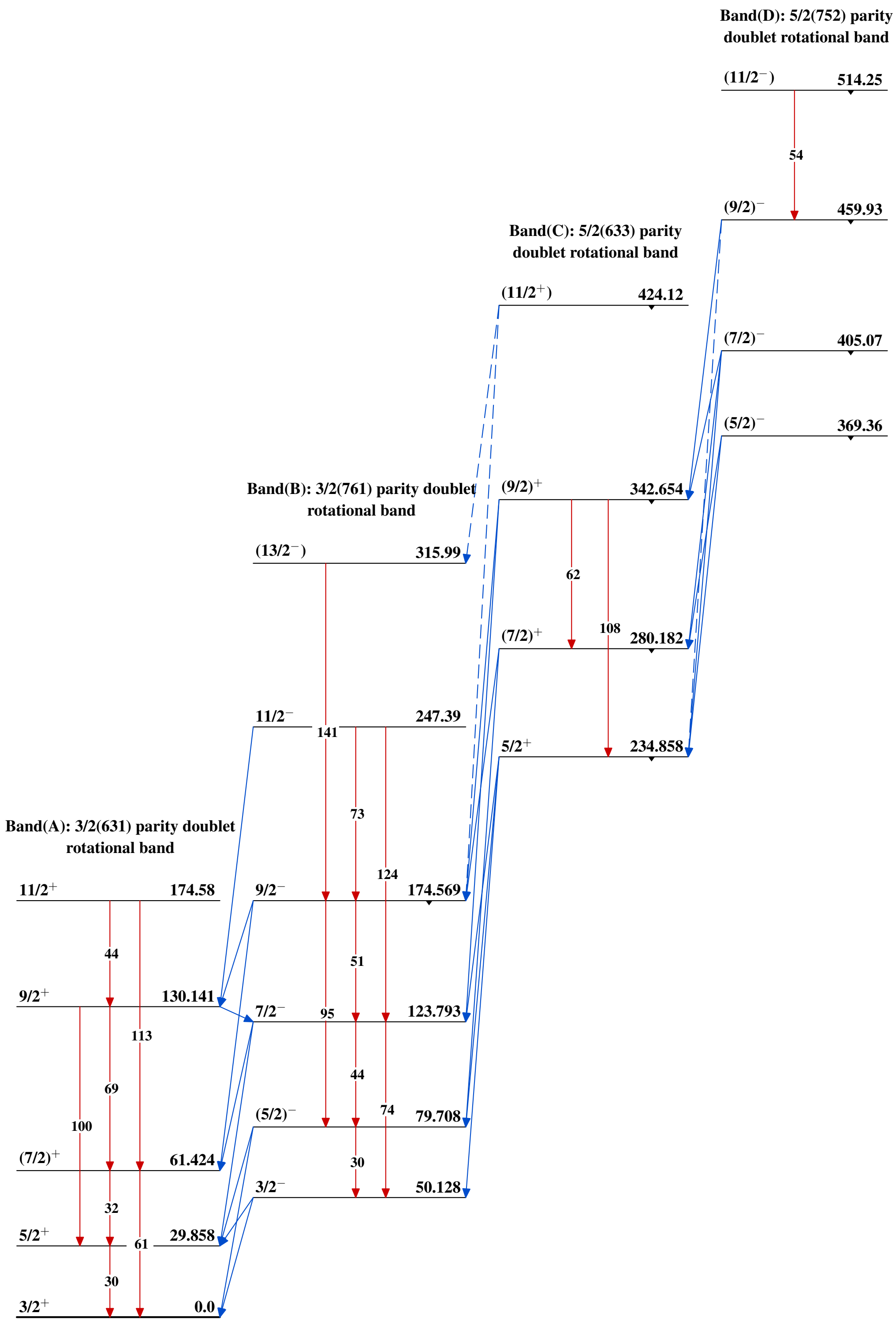
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

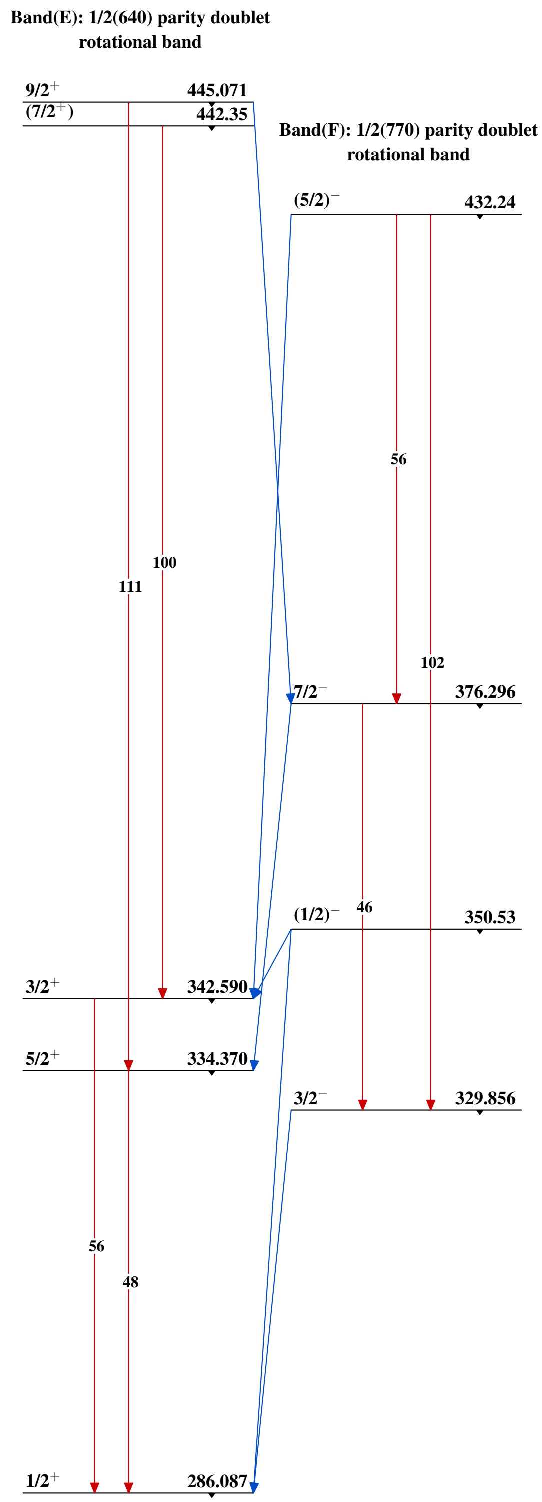


Adopted Levels, Gammas



$^{223}_{88}Ra_{135}$

Adopted Levels, Gammas (continued)



$^{223}_{88}Ra_{135}$