Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	A. K. Jain (a), R. Raut (b), J. K. Tuli	NDS 110,1409 (2009)	1-Dec-2008

Q(β^-)=356 *5*; S(n)=4904 *3*; S(p)=7090 *14*; Q(α)=5097 *5* 2012Wa38
Note: Current evaluation has used the following Q record 356 5 *4904.5 29* 6950 50 *5097* 5 2003Au03.
Assignment: decay product of ^{233}U series (1947En03 and 1947Ha02); chem (1950Ha52).
Fission isomer was not observed in ^{226}Ra(n,2n) with E=0.7-10 MeV and with E=14.5 MeV (1972Ku26).
Fission barrier was deduced by 1970Ba22 as 7.0 MeV *5* from their ^{226}Ra(n,F) data.
1989Sh07: Experimental data interpreted in terms of the coexistence of reflection symmetry and reflection asymmetry. Odd particle is suggested to polarize the soft nuclei towards or away from octupole deformation.
1988Le13: Calculated level energies including octupole and quadrupole deformations with a reflection-asymmetric rotor core. Calculations of transition probabilities between parity doublet bands. See also 1986Ch43 and 1986Re04 for discussions.
1975Iv06: Calculated nonrotational states.

^{225}Ra Levels

Cross Reference (XREF) Flags

- A ^{229}Th α decay
- B ^{225}Fr β^- decay
- C ^{226}Ra(d,t), (pol d,t)
- D ^{226}Ra(^{3}He,α)

E(level)	J$^\pi$	$T_{1/2}$	XREF	Comments
0.0†	1/2$^+$	14.9 d *2*	ABC	%β^-=100 μ=−0.7338 *15* (LASER spectroscopy; 1987Ar20,1983Ah03). μ=−0.85 was calculated by 1988Le13 for octupole deformation of β_3=0.15 and quadrupole deformation of β_2=0.148. See also 1983Ra28, 1985Dz04 for calculated μ values. No α's observed: %α<0.0001 (1960Ma40). J$^\pi$: spin measured (LASER spectroscopy; 1983Ah03); the orbital assignment from measured magnetic moment. $T_{1/2}$: measured values: 15.0 d *6* (1987Mi10), 14.8 d *2* (1950Ha52). Other measurement: 14 d (1947En03).
25.41† *2*	5/2$^+$	0.88 ns *4*	ABCD	J$^\pi$: 242.4γ from 7/2$^+$ is M1; 25.39γ to 1/2$^+$ is (E2). $T_{1/2}$: from (α)(ce)(t) data in ^{229}Th α decay (1985Is03).
31.56‡ *3*	3/2$^-$	2.1 ns *5*	AB	J$^\pi$: 31.50γ to 1/2$^+$ g.s. and 148.15γ from 5/2$^+$ are E1. $T_{1/2}$: from (α)(ce)(t) data in ^{229}Th α decay (1985Is03).
42.77† *3*	3/2$^+$	<3 ns	ABCD	J$^\pi$: 42.82γ to 1/2$^+$ g.s. is M1+E2. $T_{1/2}$: from 1970Tr04 (presumably from time limit set for $\gamma\gamma$ and γce coincidence experiment).
55.16‡ *6*	(1/2$^-$)		AB	J$^\pi$: 23.6γ to 3/2$^-$ is (M1+E2); 55.11γ to 1/2$^+$ g.s.; probable 1/2 member of the K=1/2 band.
69.36‡ *6*	(7/2)$^-$		AB	J$^\pi$: 43.990γ to 5/2$^+$ is E1, 37.8γ to 3/2$^-$ is (E2).
100.50† *6*	(9/2)$^+$		A D	J$^\pi$: 75.09γ to 5/2$^+$ of g.s. band is E2; 11.1γ from 7/2$^+$ of g.s. band.
101	(3/2$^+$)		C	J$^\pi$: angular distributions in (d,t) reaction were consistent with J^π=3/2$^+$, 1/2$^+$ or 5/2$^-$; 3/2$^+$ assignment was prefered (1983Ny01).
111.60† *5*	7/2$^+$		ABCD	J$^\pi$: 86.25γ and 68.83γ to 5/2$^+$ and 3/2$^+$ of g.s. band are M1+E2 and E2, respectively; intensities of deexciting γ's.
120.36‡ *6*	5/2$^-$		AB	J$^\pi$: 147.64γ from 7/2$^+$ is E1, 77.63γ to 3/2$^+$.

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Adopted Levels, Gammas (continued)

^{225}Ra Levels (continued)

E(level)	J^π	XREF	Comments
149.96[#] *6*	$3/2^+$	ABCD	J^π: 150.04γ to $1/2^+$ is M1+E2.
179.75[#] *2*	$5/2^+$	AB	J^π: 179.757γ to $1/2^+$ is E2.
≈203.5?[‡]	$(9/2^-)$	A	J^π: 134.2γ to $(7/2)^-$ is (M1); α-hindrance factor.
≈215.8?		A	This level could possibly be the $13/2^+$ member of the K=1/2 g.s. band.
220.55 *7*	$(7/2^+,9/2^+)$	A CD	J^π: 63.7γ from $(7/2)^+$ is possibly M1+E2; Iγ's of transitions to $(9/2)^+$, $7/2^+$ states.
225.2[@] *1*	$3/2^-$	B	J^π: 169.9γ to $1/2^-$ is M1+E2.
226.9[†] *3*	$(11/2^+)$	A	J^π: 126.4γ to $9/2^+$ member of the g.s. band; α-hindrance factor. $J^\pi=(13/2^+)$ was proposed by 1986He06.
236.25[&] *2*	$5/2^+$	ABCD	J^π: favored α decay from 5/2[633] ^{229}Th g.s..
243.56[#] *4*	$7/2^+$	A CD	J^π: 218.154γ and 142.962γ to the $5/2^+$ and $9/2^+$ members of the g.s. band are M1.
≈248.5?		A	
260.2[@] *1*	$(5/2)^-$	B	J^π: 139.8γ to $5/2^-$ is M1+E2, 190.8γ to $(7/2)^-$ is M1, 110.3γ to $3/2^+$ level.
267.92[&] *5*	$7/2^+$	A CD	J^π: 156.409γ to $7/2^+$ is M1, gammas to $3/2^+$ and $9/2^+$ levels; α hindrance factor.
272.15 *15*		A	Level could be the $9/2^+$ member of the K=3/2 band based at 149.96 keV.
284.49 *5*	$7/2^+$	A	J^π: 127.926 and 183.928 γ's to $7/2^+$ and $9/2^+$ levels are M1, 134.2γ to $3/2^+$ level.
293 *8*		C	
321.76[&] *8*	$(9/2^+)$	A CD	J^π: α hindrance factor; level's energy spacing from the $5/2^+$ and $7/2^+$ members of the band; γ deexcitation mode.
≈328		A	
≈335?		A	
≈347?		A	
390.0[&] *4*	$(11/2^+)$	A CD	J^π: α hindrance factor; level's energy spacing from other members of the band.
394.2 *1*	$3/2^-,5/2$	B	J^π: γ transitions to $3/2^+$, $3/2^-$, $5/2^+$ and $7/2^-$ levels.
394.72 *13*	$(3/2,5/2,7/2)^+$	A	J^π: 158.42γ to $5/2^+$ is M1.
400 *8*		C	
≈417?		A	
448 *10*		D	
478.4 *1*	(3/2)	AB	J^π: from γ transitions to $1/2^+$, $5/2^+$ and $5/2^-$ levels $J^\pi= 3/2\pm, 5/2^+$. Transition to the $1/2^+$ state being the strongest suggests J=3/2.
484 *8*		CD	Level seen in (d,t) at 484-keV was possibly doublet (1983Ny01). J^π: $(5/2^+)$ was proposed by 1983Ny01 from (d,t) data.
487[&] *3*	$(13/2^+)$	A C	J^π: α hindrance factor; level energy spacing from other members of the band.
535 *8*		CD	
546 *8*		C	
603 *3*		A C	
609 *3*		A CD	
630 *8*		C	J^π: $(1/2^+),(5/2^+)$ was suggested by 1983Ny01 from (d,t) data.
675 *8*		C	J^π: $(3/2^+)$ was suggested by 1983Ny01 from (d,t) data.
724.1 *1*	(3/2,5/2)	B	J^π: intensities of gammas to $3/2^+$, $3/2^-$ and $5/2^-$ levels.
815 *8*	$(5/2^-)$	CD	J^π: (d,t) data.
851 *8*		C	
898[a] *8*	$(1/2^-)$	CD	J^π: from (d,t) data.
956[a] *8*	$(5/2^-)$	CD	J^π: from (d,t) data.
967[a] *8*	$(3/2^-)$	CD	J^π: from (d,t) data.
1009 *8*		CD	
1025 *8*		CD	
1056 *8*		C	
1070 *8*		CD	
1091 *8*		CD	
1156 *8*		CD	
1184 *10*		D	
1225 *8*	$(5/2^-)$	CD	J^π: from (d,t) data 1983Ny01 proposed 5/2[503] assignment.
1258 *8*		C	

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Adopted Levels, Gammas (continued)

^{225}Ra Levels (continued)

E(level)	J^π	XREF	Comments
1272 *10*		D	
1334 *8*		CD	
1377 *10*		D	
1441 *8*		CD	
1479 *8*		CD	
1553 *8*		C	
1766 *8*		C	
1792 *8*		C	
1872 *10*		D	
1912 *10*		D	
1972 *10*		D	
2138 *10*	(13/2$^+$)	D	J^π: 13/2$^+$, 3/2[606] assignment was proposed by 1986Lo01 from their (^{3}He,α) data.

† Band(A): K^π=1/2$^+$ band, largely includes 1/2[631] band. Coriolis coupled with the 3/2[631] band.
‡ Band(B): K^π=1/2$^-$ band, largely includes 1/2[501] band.
# Band(C): K^π=3/2$^+$ band, largely includes 3/2[631] band. Coriolis coupled with the 1/2[631] band.
@ Band(D): K^π=3/2$^-$ band.
& Band(E): 5/2[633] band.
a Band(F): K=1/2.

Adopted Levels, Gammas (continued)

$\gamma(^{225}Ra)$

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[@]	δ	α[&]	Comments
25.41	$5/2^+$	25.39 *2*	100[#]	0.0	$1/2^+$	(E2)		7377	B(E2)(W.u.)=102 *6*
31.56	$3/2^-$	31.50 *5*	100[#]	0.0	$1/2^+$	E1		2.44	B(E1)(W.u.)=0.00081 *20*
42.77	$3/2^+$	17.36 *3*	110 *60*	25.41	$5/2^+$	(M1)		140.6	B(M1)(W.u.)>0.0064
		42.82 *5*	100 *7*	0.0	$1/2^+$	(M1+E2)	0.28 *7*	77 *20*	B(M1)(W.u.)>0.00027; B(E2)(W.u.)>2.0
55.16	$(1/2^-)$	23.6	46 *4*	31.56	$3/2^-$	(M1+E2)	0.034 *34*	241 *12*	
		55.11 *3*	100 *16*	0.0	$1/2^+$				
69.36	$(7/2)^-$	37.8 *1*	0.50 *25*	31.56	$3/2^-$	(E2)		1040	
		43.990 *10*	100 *5*	25.41	$5/2^+$	E1		1.002	
100.50	$(9/2)^+$	31.10 *5*	100 *10*	69.36	$(7/2)^-$				
		75.09 *7*	72 *16*	25.41	$5/2^+$	E2		37.6	
111.60	$7/2^+$	11.1 *1*		100.50	$(9/2)^+$				
		42.3 *1*	6.2 *7*	69.36	$(7/2)^-$				
		68.83 *3*	10.2 *10*	42.77	$3/2^+$	E2		57.0	
		86.25 *4*	100 *8*	25.41	$5/2^+$	M1+E2	0.27 *9*	6.0 *7*	
120.36	$5/2^-$	50.99 *4*	39 *10*	69.36	$(7/2)^-$				
		77.63 *5*	100 *14*	42.77	$3/2^+$				
		94.92 *8*	30 *7*	25.41	$5/2^+$				
149.96	$3/2^+$	94.73 *2*	33 *3*	55.16	$(1/2^-)$				
		107.108 *8*	100 *6*	42.77	$3/2^+$	M1+E2	0.3 *3*	13.1 *6*	
		124.55 *5*	85 *8*	25.41	$5/2^+$	(M1)		8.84	
		150.04 *3*	7.3 *19*	0.0	$1/2^+$	M1+E2	0.4 *4*	4.7 *5*	
179.75	$5/2^+$	30.3 *1*	<3.5	149.96	$3/2^+$	(M1+E2)		≈223	
		68.09 *4*	5.8 *9*	111.60	$7/2^+$	M1+E2	0.32 *16*	15 *5*	
		110.332 *8*	10.5 *11*	69.36	$(7/2)^-$				
		136.990 *4*	100 *3*	42.77	$3/2^+$	M1(+E2)		6.91	
		148.15 *4*	75 *6*	31.56	$3/2^-$	E1		0.1877	
		154.336 *10*	65 *2*	25.41	$5/2^+$	M1+E2	0.4 *4*	4.4 *4*	
		179.757 *7*	16.7 *14*	0.0	$1/2^+$	E2		0.884	
≈203.5?	$(9/2^-)$	134.2 *1*		69.36	$(7/2)^-$	(M1)		7.14	
220.55	$(7/2^+,9/2^+)$	109.2	86 *16*	111.60	$7/2^+$				
		119.98 *2*	100 *40*	100.50	$(9/2)^+$				
		194.3 *3*	60 *40*	25.41	$5/2^+$				
225.2	$3/2^-$	45.2 *2*	5.6 *10*	179.75	$5/2^+$				
		75.1 *1*	45 *4*	149.96	$3/2^+$				
		169.9 *1*	20 *2*	55.16	$(1/2^-)$	M1+E2		2.4 *13*	
		182.3 *1*	100	42.77	$3/2^+$				
		193.5 *3*	15 *3*	31.56	$3/2^-$				
		199.7 *1*	35 *3*	25.41	$5/2^+$				
		225.1 *1*	55 *4*	0.0	$1/2^+$				
226.9	$(11/2^+)$	126.4 *2*	100[#]	100.50	$(9/2)^+$	[M1,E2]		5.8 *23*	
236.25	$5/2^+$	56.518 *5*	6.5 *5*	179.75	$5/2^+$	M1+E2	0.11 *11*	18.9 *16*	

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Adopted Levels, Gammas (continued)

γ(^{225}Ra) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[@]	α[&]
236.25	5/2$^+$	86.40 *5*	58 *3*	149.96	3/2$^+$	M1	5.03
		115.98 *10*	0.40 *7*	120.36	5/2$^-$		
		124.65 *5*	16.7 *14*	111.60	7/2$^+$	(M1)	8.82
		166.976 *7*	4.7 *3*	69.36	(7/2)$^-$		
		193.509 *4*	100	42.77	3/2$^+$	M1	2.53
		204.690 *5*	13.5 *7*	31.56	3/2$^-$	(E1)	0.0861
		210.853 *3*	63 *7*	25.41	5/2$^+$	M1	1.98
		236.249 *8*	3.95 *21*	0.0	1/2$^+$	E2	0.333
243.56	7/2$^+$	123.193 *13*	37.3 *18*	120.36	5/2$^-$		
		131.926 *5*	83 *3*	111.60	7/2$^+$	M1	7.49
		142.962 *5*	100 *3*	100.50	(9/2)$^+$	M1	5.97
		174.82 *2*	<8	69.36	(7/2)$^-$		
		200.807 *16*	17.0 *8*	42.77	3/2$^+$		
		218.154 *17*	46 *6*	25.41	5/2$^+$	M1	1.81
≈248.5?		68.8[ab]		179.75	5/2$^+$		
260.2	(5/2)$^-$	80.3 *1*	10.8 *21*	179.75	5/2$^+$		
		110.3 *1*	83 *13*	149.96	3/2$^+$	(E1)	0.385
		139.8 *1*	46 *4*	120.36	5/2$^-$	M1+E2	4.6 *21*
		190.8 *1*	100 *9*	69.36	(7/2)$^-$	M1	2.63
		217.5 *1*	37 *4*	42.77	3/2$^+$		
		228.6 *1*	13.7 *17*	31.56	3/2$^-$		
		234.8 *1*	60 *5*	25.41	5/2$^+$		
267.92	7/2$^+$	31.57 *9*	5.7 *9*	236.25	5/2$^+$		
		117.99 *15*	1.1 *4*	149.96	3/2$^+$		
		147.64 *5*	17.2 *18*	120.36	5/2$^-$	E1	0.1893
		156.409 *9*	100 *3*	111.60	7/2$^+$	M1	4.62
		167.45 *5*	4.3 *9*	100.50	(9/2)$^+$		
		225.149 *19*	6.0 *9*	42.77	3/2$^+$		
		242.4 *2*	7.9 *13*	25.41	5/2$^+$	M1	1.35
272.15		30.3[a]		243.56	7/2$^+$		
		68.8[ab]		≈203.5?	(9/2$^-$)		
		160.6		111.60	7/2$^+$		
		171.75 *2*		100.50	(9/2)$^+$		
284.49	7/2$^+$	63.7 *2*	3.6 *15*	220.55	(7/2$^+$,9/2$^+$)		
		104.6[b] *2*	6 *2*	179.75	5/2$^+$		
		134.2[a]	≤2.2	149.96	3/2$^+$		
		172.926 *18*	80 *8*	111.60	7/2$^+$	M1	3.47
		183.928 *8*	100 *5*	100.50	(9/2)$^+$	M1(+E2)	2.92
		215.100 *10*	97 *8*	69.36	(7/2)$^-$		
		259.08 *4*	24 *4*	25.41	5/2$^+$		
321.76	(9/2$^+$)	49.75 *8*	11.1 *11*	272.15			

$^{225}_{88}Ra_{137}$-5

Adopted Levels, Gammas (continued)

γ(^{225}Ra) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[@]	δ	α[&]
321.76	(9/2$^+$)	53.75 *20*	5.8 *16*	267.92	7/2$^+$			
		78.3 *2*	4.2 *11*	243.56	7/2$^+$			
		101.1 *2*	9.5 *16*	220.55	(7/2$^+$,9/2$^+$)			
		142.0 *1*	5.8 *16*	179.75	5/2$^+$			
		210.15 *8*	100 *22*	111.60	7/2$^+$			
		221.22 *5*	12 *4*	100.50	(9/2)$^+$			
		252.43 *3*	49 *7*	69.36	(7/2)$^-$			
		296.2 *2*	≈6	25.41	5/2$^+$			
390.0	(11/2$^+$)	163.34 *17*		226.9	(11/2$^+$)			
		169.09 *3*		220.55	(7/2$^+$,9/2$^+$)			
		174.22[a] *22*		≈215.8?				
394.2	3/2$^-$,5/2	134.0 *1*	45 *15*	260.2	(5/2)$^-$			
		157.9 *1*	65 *15*	236.25	5/2$^+$			
		169.0 *3*	100 *50*	225.2	3/2$^-$			
		244.2 *1*	35 *10*	149.96	3/2$^+$			
		324.7 *2*	20 *5*	69.36	(7/2)$^-$			
		368.8 *2*	40 *15*	25.41	5/2$^+$			
394.72	(3/2,5/2,7/2)$^+$	126.5 *3*	23 *11*	267.92	7/2$^+$			
		151.6 *3*	≈53	243.56	7/2$^+$			
		158.42 *12*	100 *11*	236.25	5/2$^+$	M1(+E2)	<0.9	4.5 *14*
		174.22[a] *11*		220.55	(7/2$^+$,9/2$^+$)			
478.4	(3/2)	242.1 *1*	24 *3*	236.25	5/2$^+$			
		253.4 *1*	29 *5*	225.2	3/2$^-$			
		328.6 *1*	20 *5*	149.96	3/2$^+$			
		358.1 *3*	8 *4*	120.36	5/2$^-$			
		435.6 *1*	71 *8*	42.77	3/2$^+$			
		453.0 *1*	50 *7*	25.41	5/2$^+$			
		478.3 *1*	100 *10*	0.0	1/2$^+$			
724.1	(3/2,5/2)	464.1 *1*	36 *7*	260.2	(5/2)$^-$			
		499.0 *2*	100 *16*	225.2	3/2$^-$			
		574.1 *2*	43 *7*	149.96	3/2$^+$			

[†] From ^{229}Th α decay and ^{225}Fr β$^-$ decay.
[‡] Relative photon intensity deexciting each level.
[#] Set 100 (β. Singh).
[@] From ce work in ^{229}Th α decay and γ-x ray coincidence data in ^{225}Fr β$^-$ decay.
[&] 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] Multiply placed.
[b] Placement of transition in the level scheme is uncertain.

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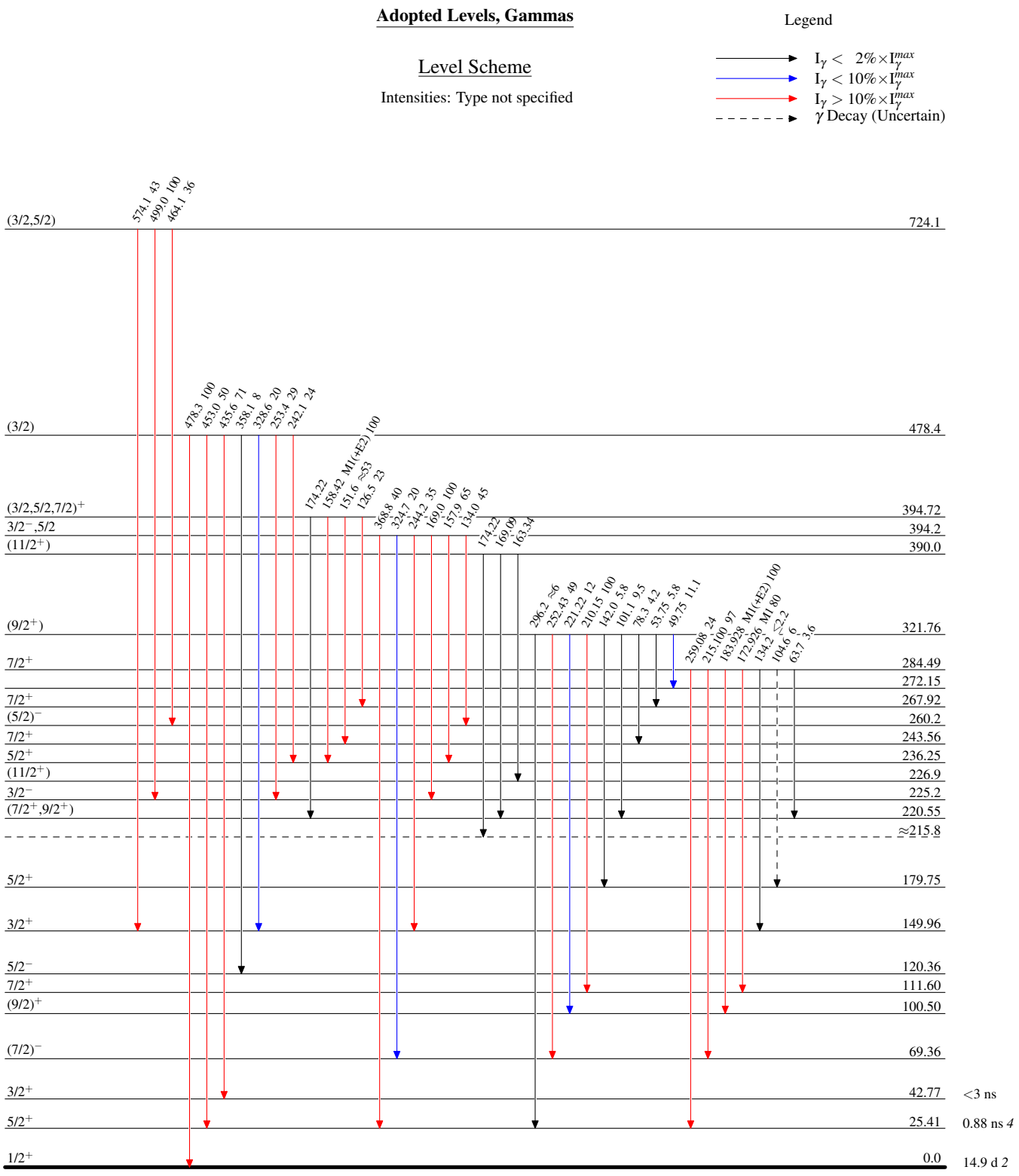
Adopted Levels, Gammas

Level Scheme

Intensities: Type not specified

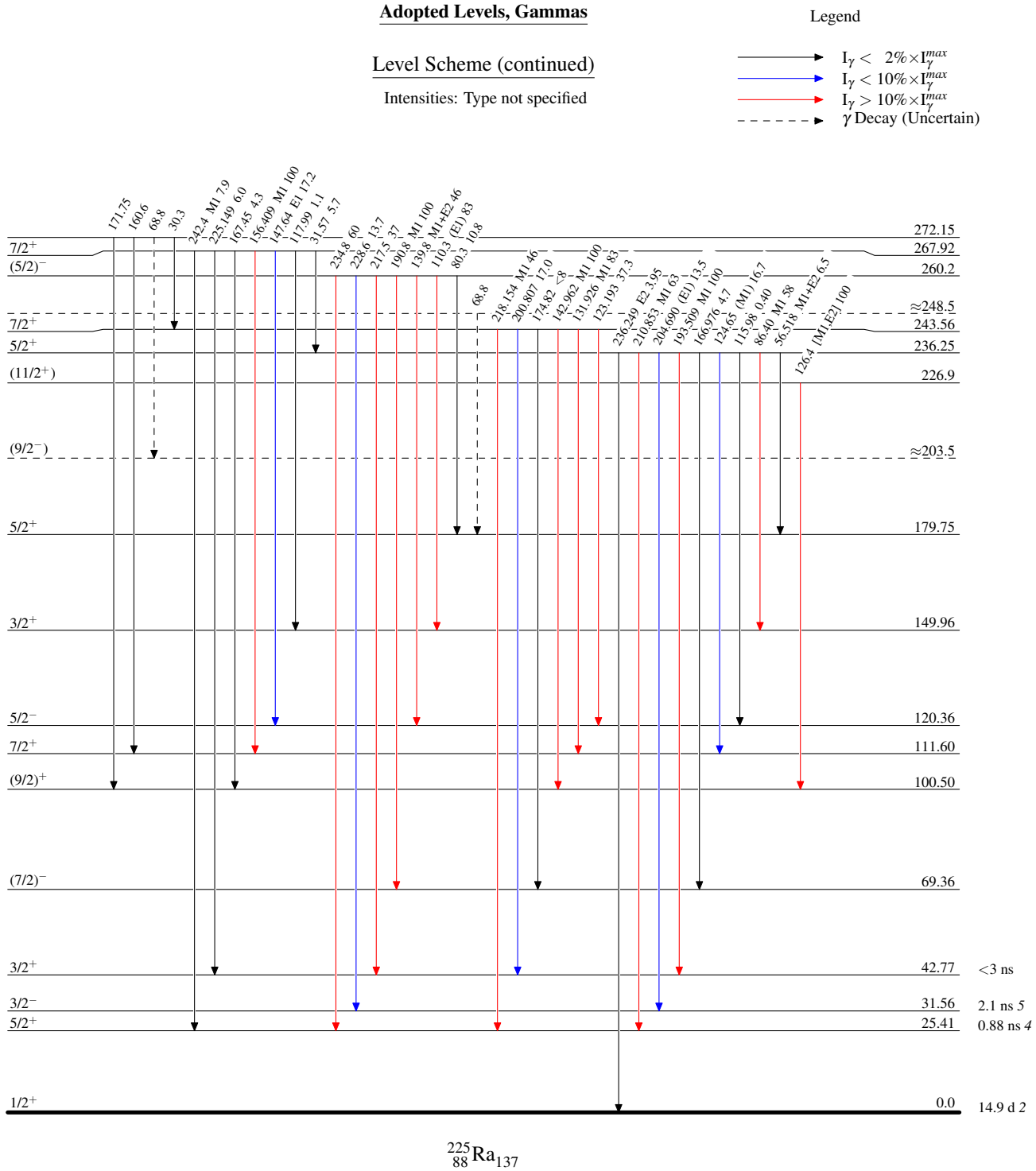


$^{225}_{88}Ra_{137}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified

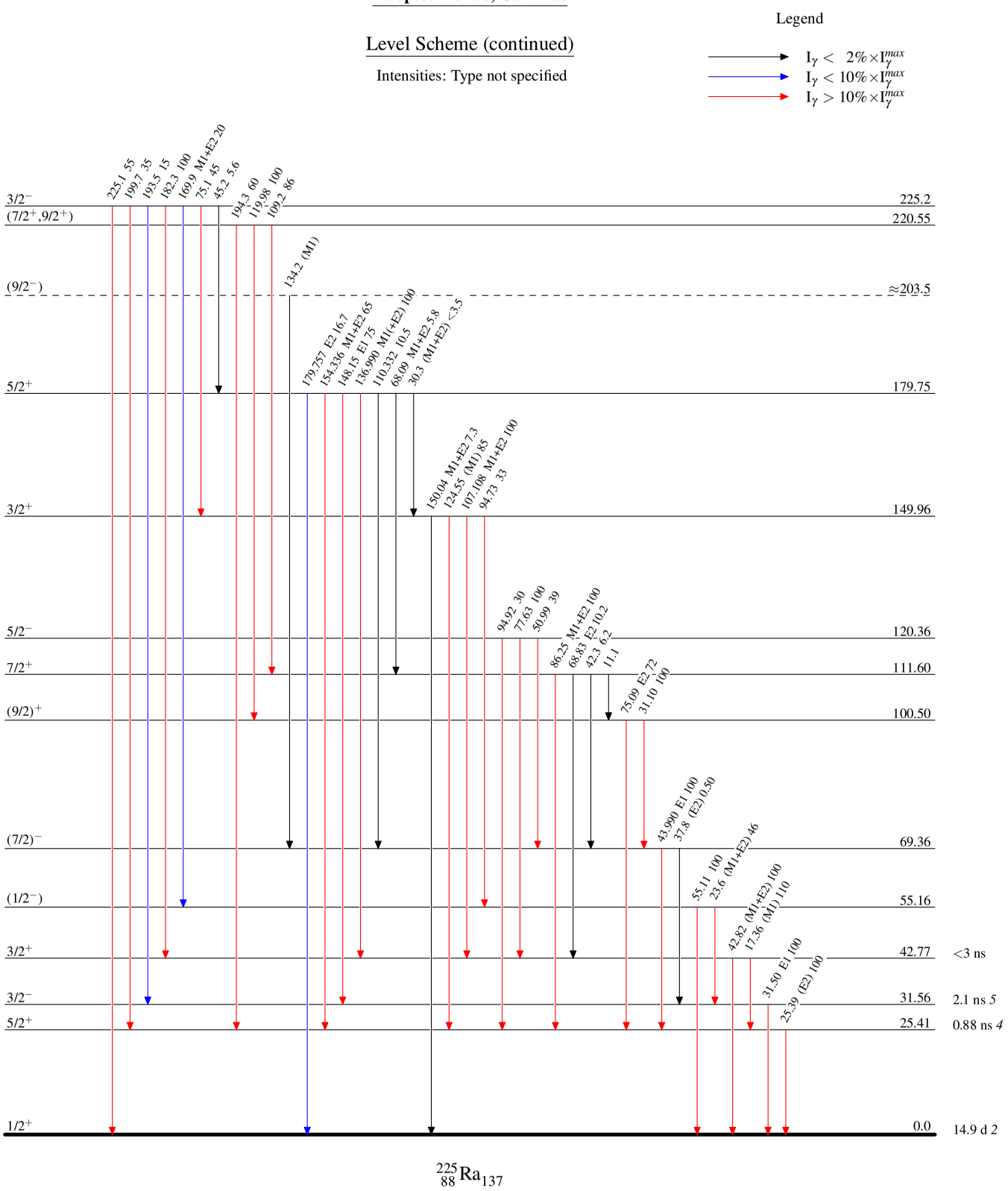


$^{225}_{88}Ra_{137}$

Adopted Levels, Gammas

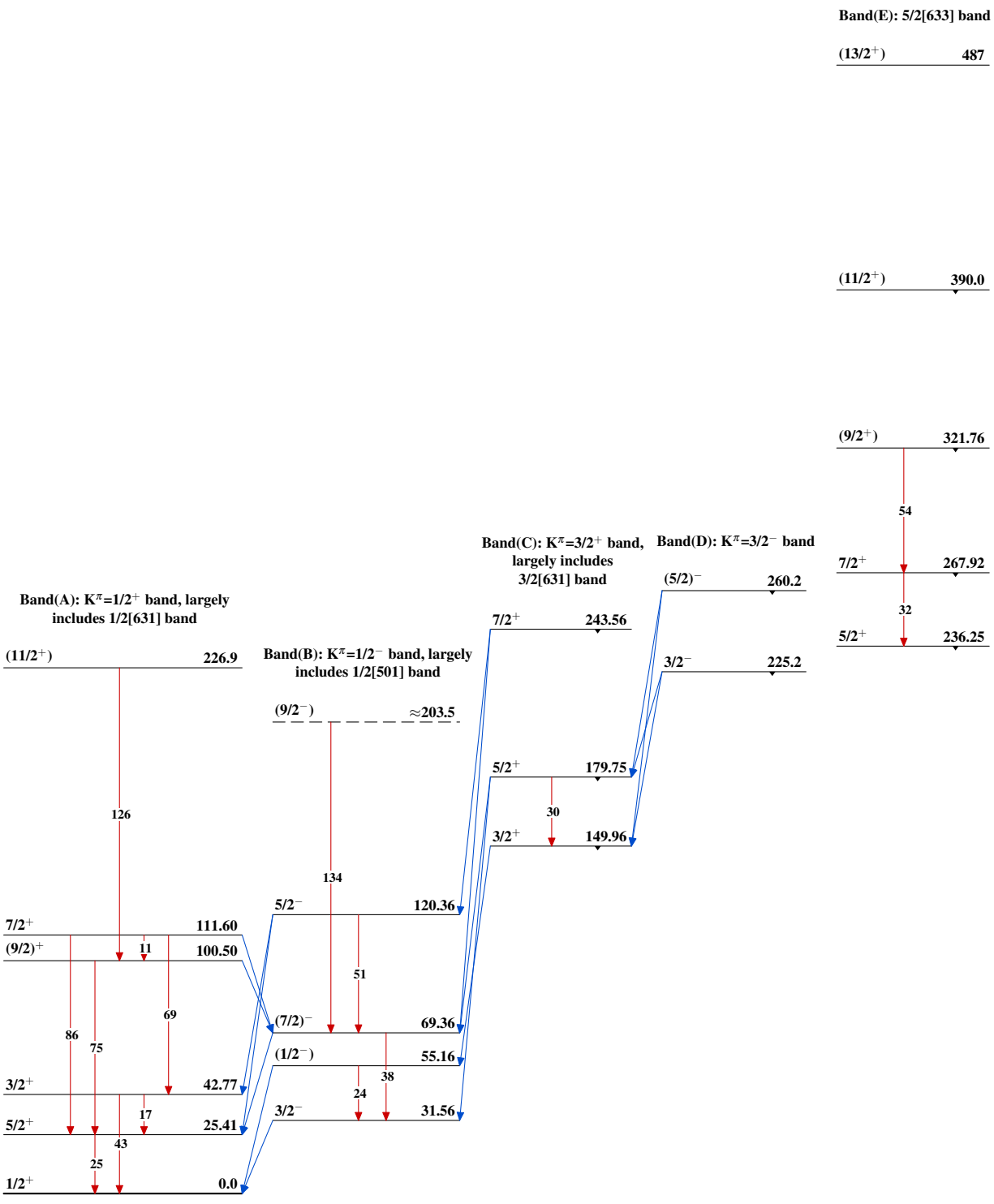
Level Scheme (continued)

Intensities: Type not specified



$^{225}_{88}Ra_{137}$

Adopted Levels, Gammas



$^{225}_{88}Ra_{137}$

Adopted Levels, Gammas (continued)

Band(F): K=1/2

$(3/2^-)$ **967**

$(5/2^-)$ **956**

$(1/2^-)$ **898**

$^{225}_{88}Ra_{137}$