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^-)=−1.56×10^3 *5*; S(n)=5378 *10*; S(p)=5808 *6*; Q(α)=6880.4 *20* 2012Wa38

Note: Current evaluation has used the following Q record \$ −1560 50 *5380* 10 *5808* 6 *6880.4 20* 2003Au03.

^{221}Ra Levels

Cross Reference (XREF) Flags

A ^{225}Th α decay
B ^{210}Pb(^{14}C,3nγ)

E(level)†	J$^\pi$‡	T$_{1/2}$	XREF	Comments
0.0#	5/2$^+$	28 s *2*	A	%α=100 μ=−0.1799 *17* (1988Ah02,2005St24); Q=1.98 *11* (1989Ne03,2005St24) μ,Q: LASER. Other Q measurement: 1.90 *20* (1988Ah02). J$^\pi$: spin was measured (1988Ah02; LASER spectroscopy). Parity from measured magnetic dipole moment. Magnetic dipole moment and electric quadrupole moment were calculated by 1988Ah02 for the 5/2[633] orbital, and by 1988Le13 for K=5/2, including octupole deformation with $\beta_2 \approx \beta_3 \approx 0.1$, by using the reflection-asymmetric rotor model. T$_{1/2}$: from 1958To25. Other measurement: 30 s *2* (1951Me10). ^{14}C decay was not observed: <1.2×10^{-11} % (1986Ba26,1985Pr01). See 1991Cw01 for level energy calculations. For calculated heavy-ion emission rates, see 1985Po14, 1986De32, 1986Gr20, 1986Ir01, 1986Pi11, 1986Po15, 1987Sh04, 1988Ba01, 1988Bl11, 1988Sh29, 1989Bu06, 1989Ci03 and 1990Sh01. Isotope shifts were measured by 1987We03, 1988Ah02, 1989Ne03.
53.14# *8*	(7/2)$^+$		A	J$^\pi$: 53.2γ to 5/2$^+$ g.s. is M1; α hindrance factor and level are consistent with its being the 7/2 member of the g.s. rotational band.
103.61@ *11*	(5/2)$^-$		A	J$^\pi$: 103.5γ to 5/2$^+$ g.s. is E1; 50.5γ to (7/2)$^+$ level.
121.95# *10*	(9/2$^+$)		A	J$^\pi$: 68.8γ to (7/2)$^+$ is (M1).
146.81@ *20*	(7/2)$^-$		A	J$^\pi$: 146.8γ to 5/2$^+$ g.s. is E1. Assignment as the 7/2$^-$ member of the K=5/2 band was proposed by 1989Ac01.
174? *5*			A	
210.9@ *4*	(11/2$^+$)		B	
299.16 *8*	(7/2)$^+$		A	J$^\pi$: 299.2 and 246.0 γ's to 5/2$^+$ and (7/2)$^+$ levels are M1. From the low hindrance factor for the α decay from 3/2$^+$ ^{225}Th, 1989Ac01 suggested that this level contains a large K=3/2 amplitude, and suggested the possibility of octupole deformation.
318.9# *5*	(13/2$^+$)		B	
321.39& *9*	(3/2)$^+$		A	J$^\pi$: 321.4γ to 5/2$^+$ is M1. K=3/2 orbital with octupole deformation was suggested by 1989Ac01.
341.5@ *5*	(13/2$^-$)		B	
359.02& *8*	(5/2)$^+$		A	J$^\pi$: 305.9 and 359.0 γ's to 5/2$^+$ and (7/2)$^+$ levels are M1; α hindrance factor is consistent with the assignment.
438.0@ *5*	(15/2$^+$)		B	
440.4# *5*	(15/2$^-$)		B	
450.33 *16*	(5/2$^-$)		A	J$^\pi$: 151.2γ to (7/2)$^+$ level is (E1); 128.9γ to (3/2)$^+$ level.
485.41 *11*	(3/2$^-$,5/2$^-$)		A	J$^\pi$: 164.0 and 126.4 γ's to (3/2)$^+$ and (5/2)$^+$ levels are (E1).
566.0@ *5*	(17/2$^-$)		B	

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Adopted Levels, Gammas (continued)

^{221}Ra Levels (continued)

E(level)†	Jπ‡	XREF	E(level)†	Jπ‡	XREF	E(level)†	Jπ‡	XREF
573.1# 5	(17/2+)	B	866.9# 5	(21/2+)	B	1197.4# 6	(25/2+)	B
688.4# 5	(19/2−)	B	990.4# 5	(23/2−)	B	1344.4# 6	(27/2−)	B
711.6@ 5	(19/2+)	B	1025.9@ 5	(23/2+)	B	1375.8@ 6	(27/2+)	B
849.6@ 5	(21/2−)	B	1180.5@ 6	(25/2−)	B			

† From least-squares adjustment of Eγ.

‡ Based on suggested band assignments and other arguments given. Jπ for levels seen only in (^{14}C,3nγ) are from 1991Fe07 based on DCO-deduced multipolarities and band assignments. Similar band structure has been observed in ^{223}Th isotone (1991Fe07).

\# Band(A): 5/2[633].

@ Band(B): 5/2[752].

& Band(C): K=3/2.

γ(^{221}Ra)

E_i(level)	J^π_i	Eγ	Iγ†	E_f	J^π_f	Mult.‡	δ	α#
53.14	(7/2)+	53.2 2		0.0	5/2+	M1(+E2)	0.22 +10−22	29 8
103.61	(5/2)−	50.5 2	13 4	53.14	(7/2)+			
		103.5 2	100 20	0.0	5/2+	E1		0.1022
121.95	(9/2+)	68.8 2	100 10	53.14	(7/2)+	(M1)		9.77
		121.9 2	24 6	0.0	5/2+			
146.81	(7/2)−	146.8 2		0.0	5/2+	E1		0.1919
210.9	(11/2+)	89.0 3	100	121.95	(9/2+)			
299.16	(7/2)+	177.2 1	19.1 9	121.95	(9/2+)			
		246.0 1	100 3	53.14	(7/2)+	M1		1.294
		299.2 1	16 3	0.0	5/2+	M1		0.753
318.9	(13/2+)	108.0 3	100	210.9	(11/2+)			
321.39	(3/2)+	217.7 2	1.7 3	103.61	(5/2)−	(E1)		0.0744
		321.4 1	100	0.0	5/2+	M1		0.619
341.5	(13/2−)	130.6 3	100	210.9	(11/2+)	E1		
359.02	(5/2)+	212.0	4.4 22	146.81	(7/2)−			
		305.9 1	100 10	53.14	(7/2)+	M1		0.709
		359.0 1	100 12	0.0	5/2+	M1		0.458
438.0	(15/2+)	96.5 3	100	341.5	(13/2−)	E1		
440.4	(15/2−)	121.5 3	100	318.9	(13/2+)	E1		
450.33	(5/2−)	128.9 2	22 5	321.39	(3/2)+			
		151.2 2	100 8	299.16	(7/2)+	(E1)		0.179
485.41	(3/2−,5/2−)	126.4 2	45 10	359.02	(5/2)+	(E1)		0.277
		164.0 2	100 36	321.39	(3/2)+	(E1)		0.1471
		381.8 2	88 18	103.61	(5/2)−			
		485.4 2	18 6	0.0	5/2+			
566.0	(17/2−)	128.0 3	100	438.0	(15/2+)	E1		
		224.5@ 3	21	341.5	(13/2−)			
573.1	(17/2+)	132.7 3	100	440.4	(15/2−)			
		254.2 3	48	318.9	(13/2+)			
688.4	(19/2−)	115.3 3	100	573.1	(17/2+)	E1		
		248.0 3	28	440.4	(15/2−)	E2		
711.6	(19/2+)	145.6 3	100	566.0	(17/2−)	E1		
		273.6 3	43	438.0	(15/2+)			
849.6	(21/2−)	138.0 3	100	711.6	(19/2+)	E1		
		161.2 3	32	688.4	(19/2−)			
		283.6 3	25	566.0	(17/2−)	E2		

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Adopted Levels, Gammas (continued)

$\gamma(^{221}Ra)$ (continued)

E_i(level)	J^π_i	E_γ	I_γ†	E_f	J^π_f	Mult.‡
866.9	(21/2$^+$)	178.5 *3*	100	688.4	(19/2$^-$)	E1
		293.8 *3*	28	573.1	(17/2$^+$)	E2
990.4	(23/2$^-$)	123.5 *3*	100	866.9	(21/2$^+$)	
		140.8 *3*	39	849.6	(21/2$^-$)	
		302.0 *3*	78	688.4	(19/2$^-$)	E2
1025.9	(23/2$^+$)	176.3 *3*	100	849.6	(21/2$^-$)	E1
		314.3 *3*	43	711.6	(19/2$^+$)	
1180.5	(25/2$^-$)	154.6 *3*	100	1025.9	(23/2$^+$)	
		330.9 *3*	84	849.6	(21/2$^-$)	E2
1197.4	(25/2$^+$)	207.0 *3*	100	990.4	(23/2$^-$)	E1
		330.5 *3*	53	866.9	(21/2$^+$)	
1344.4	(27/2$^-$)	147.0 *3*	74	1197.4	(25/2$^+$)	
		354.0@ *3*	100	990.4	(23/2$^-$)	
1375.8	(27/2$^+$)	195.2 *3*	100	1180.5	(25/2$^-$)	
		349.8@ *3*	47	1025.9	(23/2$^+$)	

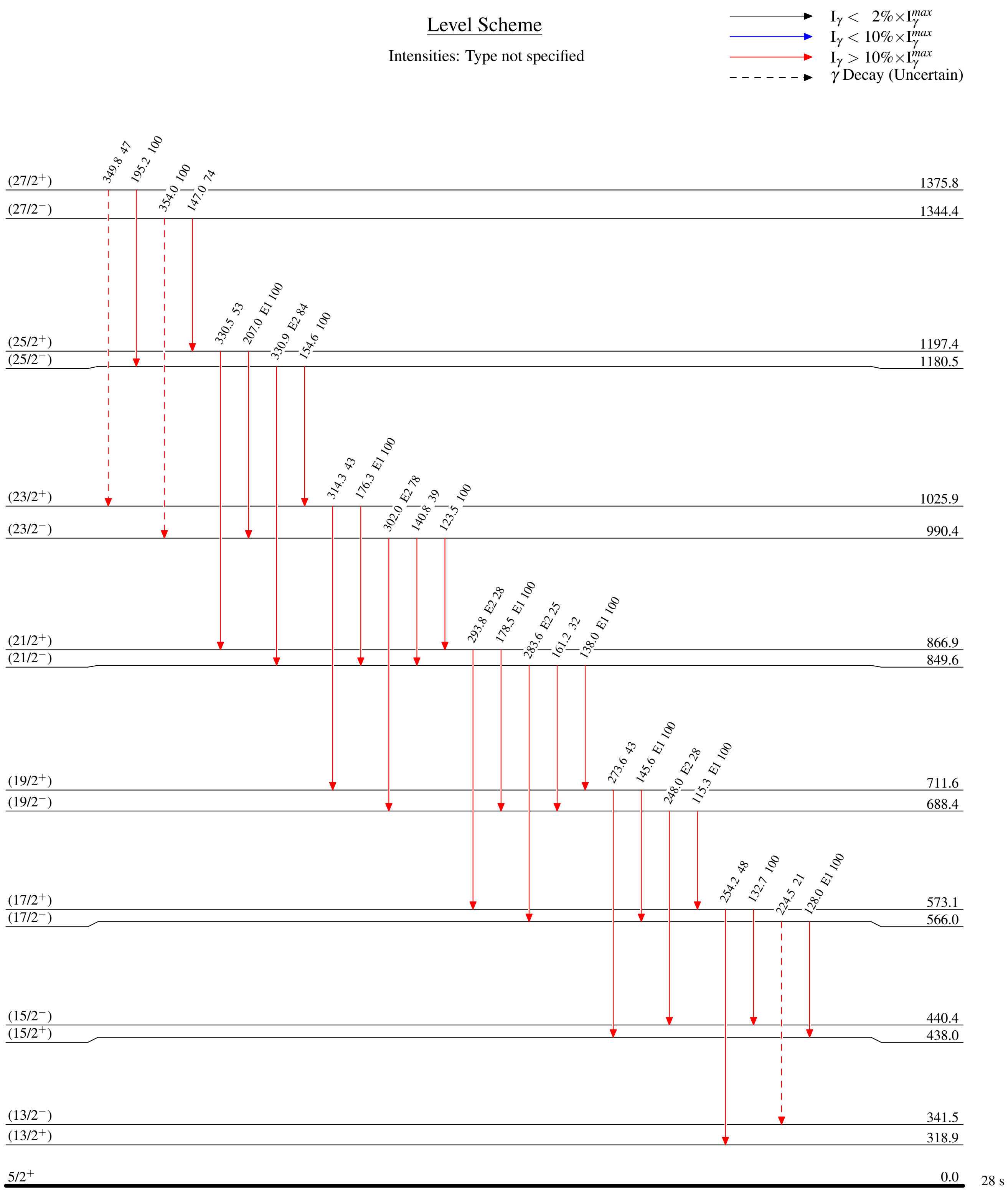
† Relative photon intensities deexciting each level.

‡ From α decay, (^{14}C,3nγ). Multipolarities for transitions in (^{14}C,3nγ) are based on DCO ratios. See (^{14}C,3nγ) for multipolarities suggested by 1991Fe07 but not adopted here.

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

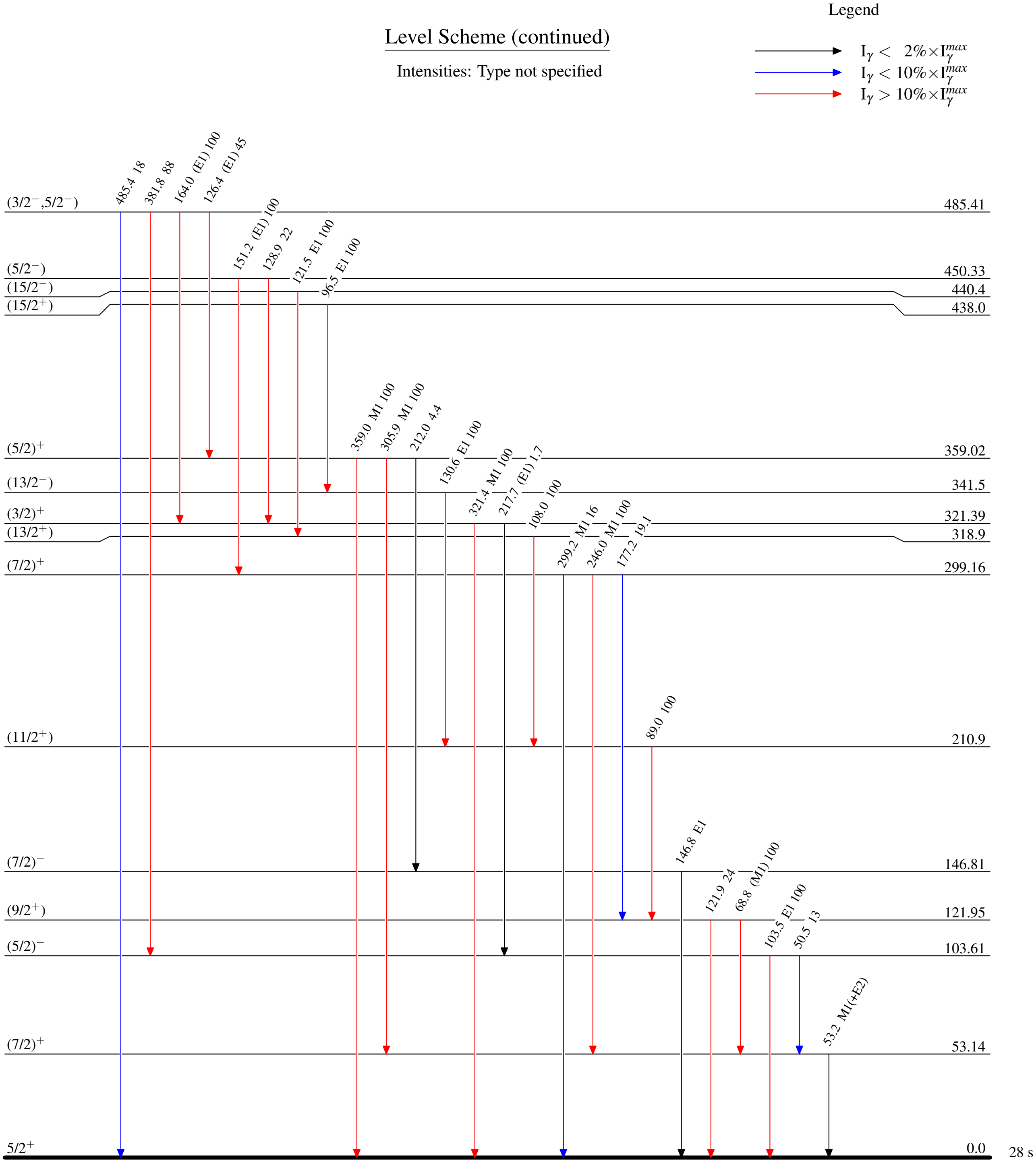


$^{221}_{88}Ra_{133}$

Adopted Levels, Gammas

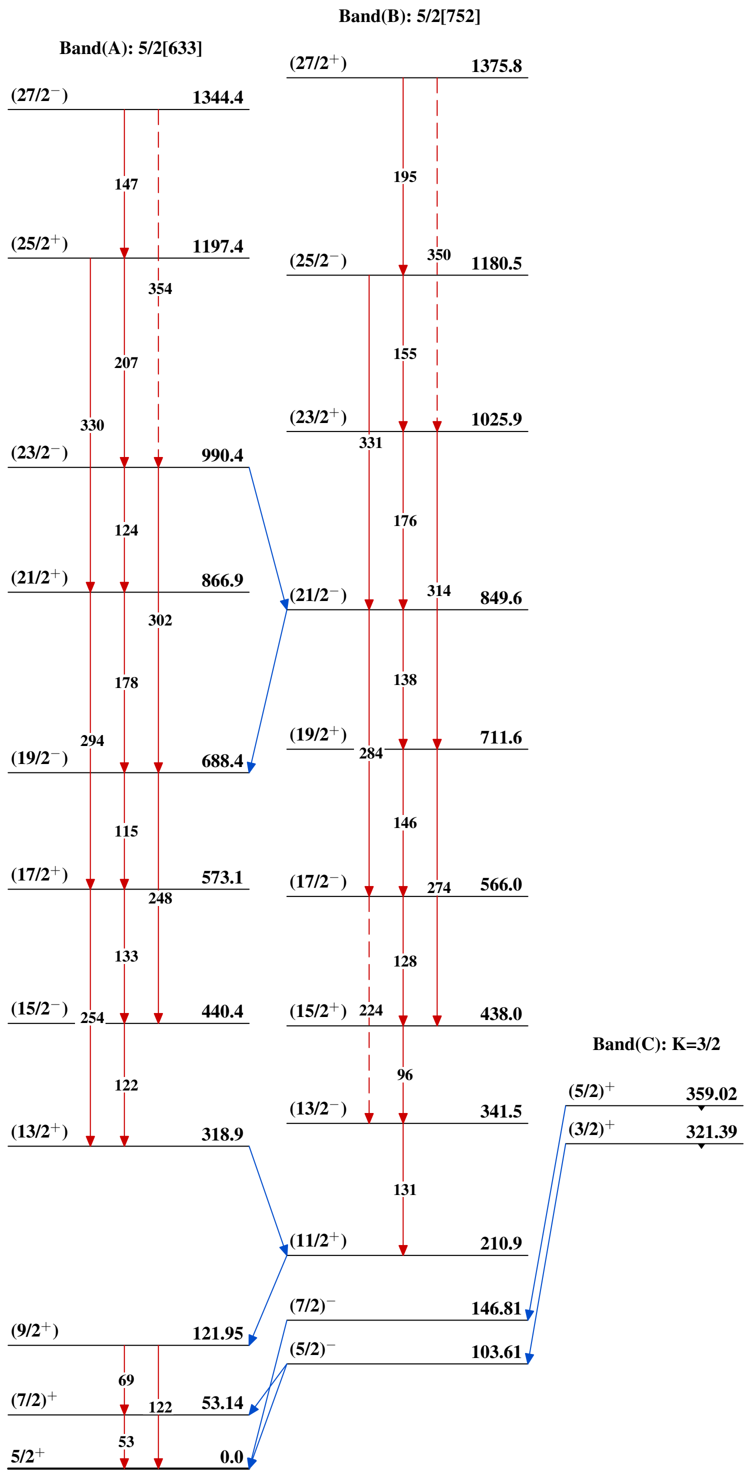
Level Scheme (continued)

Intensities: Type not specified



$^{221}_{88}Ra_{133}$

Adopted Levels, Gammas



$^{221}_{88}Ra_{133}$