^{209}Bi(^{14}C,3nγ) 1991Sc19

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. Browne, J. K. Tuli	NDS 112, 1115 (2011)	31-Oct-2010

^{220}Ac Levels

E=72 MeV; measured: Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma(\theta)$.
Preliminary results published in 1990Sc06.
Other: 1987FuZT: ^{208}Pb(^{15}N,3nγ), E=78 MeV; measured Eγ, Iγ, $\gamma\gamma$, $\gamma(\theta)$.

Bands A and B, C and D, and E and F form three sets of alternating parity bands.
The authors suggest that J^π of the level at x keV is relatively high, and thus that the x-keV level is not the g.s. of ^{220}Ac. This suggestion is based on the observation that the difference between the highest and lowest observed states is only 18 spin units, whereas much higher spins have been reached with this reaction in other nuclei. Also the γ rays seen in ^{224}Pa α decay were not seen in this study.

E(level)†	Jπ‡#	E(level)†	Jπ‡#	E(level)†	Jπ‡#	E(level)†	Jπ‡#
0.0+x@	J	887.0+x[c] 4	J+6	1678.1+x& 4	J+11	2637.0+x[c] 5	J+(14)
59.0+x[a] 2	J+1	914.1+x& 3	J+7	1704.3+x[c] 4	J+10	2649.2+x& 4	J+(15)
136.2+x@ 3	J+2	973.7+x[a] 3	J+7	1790.2+x[a] 4	J+11	2686.9+x[a] 4	J+(15)
305.1+x[a] 3	J+3	1103.4+x[b] 3	J+8	1883.6+x[d] 4	J+11	2822.3+x[d] 5	J+(15)
401.3+x@ 3	J+4	1113.0+x@ 3	J+8	1935.1+x[b] 4	J+12	2909.9+x@ 4	J+(16)
507.1+x[b] 3	J+4	1120.1+x[d] 4	J+7	1974.0+x@ 4	J+12	2916.5+x[b] 4	J+(16)
554.6+x[c] 3	J+4	1266.1+x& 3	J+9	2145.9+x& 4	J+13	3175.9+x[a] 4	J+(17)
614.0+x[a] 3	J+5	1267.8+x[c] 4	J+8	2164.8+x[c] 4	J+(12)	3180.6+x& 4	J+(17)
625.3+x& 3	J+5	1372.9+x[a] 3	J+9	2223.6+x[a] 4	J+13	3405.6+x@ 4	J+(18)
731.1+x@ 3	J+6	1485.2+x[d] 4	J+9	2339.6+x[d] 5	J+(13)		
774.0+x[b] 3	J+6	1488.9+x[b] 4	J+10	2416.2+x[b] 4	J+14		
779.1+x[d] 4	J+5	1534.5+x@ 4	J+10	2431.3+x@ 4	J+14		

† From least squares fit to γ-ray energies.
‡ Assignments based on $\gamma\gamma$ coincidences, γ-ray multipolarity and band structure.
# Parity: the parity of the level at x keV, bandhead of band A, is not known. Bands C and E are of the same parity as band A, while bands B, D, and F are of opposite parity.
@ Band(A): band A parity=π.
& Band(B): band B, parity=$-\pi$.
[a] Band(C): band C, parity=π.
[b] Band(D): band D, parity=$-\pi$.
[c] Band(E): band E, parity=π.
[d] Band(F): band F, parity=$-\pi$.

γ(^{220}Ac)

E_i(level)	J_i^π	E_γ	I_γ†	E_f	J_f^π	Mult.‡
59.0+x	J+1	59.0 2		0.0+x	J	M1@
136.2+x	J+2	77.3 2		59.0+x	J+1	M1@
305.1+x	J+3	168.9 2	36.1 8	136.2+x	J+2	M1+E2

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^{209}Bi(^{14}C,3nγ) 1991Sc19 (continued)

$\gamma(^{220}Ac)$ (continued)

E_i(level)	J_i^π	E_γ	I_γ †	E_f	J_f^π	Mult.‡	Comments
305.1+x	J+3	246.0 *2*	63.9 *8*	59.0+x	J+1	E2	
401.3+x	J+4	96.3 *2*	17.7 *17*	305.1+x	J+3	M1(+E2)	
		265.0 *2*	82.3 *17*	136.2+x	J+2	E2	
507.1+x	J+4	202.1 *2*		305.1+x	J+3	E1@	
554.6+x	J+4	249.5 *2*	46 *4*	305.1+x	J+3	M1&	
		418.5 *2*	54 *4*	136.2+x	J+2	[E2]	
614.0+x	J+5	106.9 *2*	55.2 *7*	507.1+x	J+4	E1@	
		212.7 *2*	13.2 *5*	401.3+x	J+4	M1(+E2)@	
		309.0 *2*	31.6 *7*	305.1+x	J+3	E2	
625.3+x	J+5	224.0 *2*		401.3+x	J+4	E1@	
731.1+x	J+6	105.9 *2*	37.5 *18*	625.3+x	J+5	E1@	
		117.1 *2*	7 *4*	614.0+x	J+5	M1&	
		329.7 *2*	55.4 *25*	401.3+x	J+4	E2	
774.0+x	J+6	159.9 *2*	85.0 *10*	614.0+x	J+5	E1@	
		266.9 *2*	15.0 *10*	507.1+x	J+4	E2	
779.1+x	J+5	224.5 *2*		554.6+x	J+4	[E1]	
887.0+x	J+6	107.9 *2*	58.7 *23*	779.1+x	J+5	E1@	
		332.4 *2*	41.3 *23*	554.6+x	J+4	E2	
914.1+x	J+7	140.2 *2*	4.5 *14*	774.0+x	J+6	M1&	
		183.1 *2*	78.6 *22*	731.1+x	J+6	E1@	
		288.7 *2*	16.9 *19*	625.3+x	J+5	[E2]	
973.7+x	J+7	199.7 *2*	70.5 *14*	774.0+x	J+6	E1@	
		242.7[b] *2*	<11	731.1+x	J+6	[M1]	
		359.7 *2*	29.5 *14*	614.0+x	J+5	E2	
1103.4+x	J+8	129.7 *2*	64 *3*	973.7+x	J+7	E1@	
		189.3[a] *2*	11.9[a#] *18*	914.1+x	J+7	[M1]	
		329.4 *2*	24 *4*	774.0+x	J+6	E2	
1113.0+x	J+8	140.2 *3*	1.8 *8*	973.7+x	J+7	M1&	
		199.8 *2*	74.0 *17*	914.1+x	J+7	E1@	
		382.9 *2*	24.2 *14*	731.1+x	J+6	E2	
1120.1+x	J+7	233.0 *2*		887.0+x	J+6	E1@	
1266.1+x	J+9	152.2 *2*	64.6 *19*	1113.0+x	J+8	E1@	
		162.7 *2*	6.4 *12*	1103.4+x	J+8	(M1)@	
		351.9 *2*	29.0 *19*	914.1+x	J+7	E2	
1267.8+x	J+8	147.7 *2*	51 *3*	1120.1+x	J+7	E1@	
		380.8 *2*	49 *3*	887.0+x	J+6	E2	
1372.9+x	J+9	259.2 *2*	6.6 *14*	1113.0+x	J+8	M1&	
		269.6 *2*	80.9 *19*	1103.4+x	J+8	(E1)	Mult.: D from DCO; E1 from position in level scheme.
		399.1 *2*	12.5 *14*	973.7+x	J+7	E2	
1485.2+x	J+9	217.4 *2*	84 *7*	1267.8+x	J+8	E1@	
		365.0 *2*	16 *7*	1120.1+x	J+7	[E2]	
1488.9+x	J+10	116.0 *2*	30.4 *19*	1372.9+x	J+9	E1@	
		222.8 *2*	15.7 *25*	1266.1+x	J+9	(M1)&	
		385.5 *2*	53.9 *25*	1103.4+x	J+8	E2	
1534.5+x	J+10	268.4 *2*	85 *4*	1266.1+x	J+9	E1@	
		420.6 *2*	15 *4*	1113.0+x	J+8	(E2)	
1678.1+x	J+11	143.6 *2*	44.1 *22*	1534.5+x	J+10	E1@	
		189.3[a] *2*	6.3[a#] *20*	1488.9+x	J+10	M1+E2@	

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^{209}Bi(^{14}C,3nγ) 1991Sc19 (continued)

γ(^{220}Ac) (continued)

E_i(level)	J_i^π	E_γ	I_γ[†]	E_f	J_f^π	Mult.[‡]	Comments
1678.1+x	J+11	412.0 *2*	49.6 *23*	1266.1+x	J+9	E2	
1704.3+x	J+10	219.1 *2*	67 *4*	1485.2+x	J+9	E1[@]	
		436.5 *2*	33 *4*	1267.8+x	J+8	[E2]	
1790.2+x	J+11	256[b]		1534.5+x	J+10		γ not listed in tables. However, it is shown dashed in the level scheme of 1991Sc19.
		301.2 *2*	85.7 *24*	1488.9+x	J+10	(E1)	Mult.: D from DCO; E1 from position in level scheme.
		417.3 *2*	14.3 *24*	1372.9+x	J+9	[E2]	
1883.6+x	J+11	179.3 *2*	58 *4*	1704.3+x	J+10	E1[@]	
		398.4 *2*	42 *4*	1485.2+x	J+9	[E2]	
1935.1+x	J+12	144.9 *2*	31.1 *17*	1790.2+x	J+11	E1[@]	
		257.2 *2*	11.5 *14*	1678.1+x	J+11	M1[&]	
		446.2 *2*	57.3 *20*	1488.9+x	J+10	E2	
1974.0+x	J+12	295.8 *2*	81 *3*	1678.1+x	J+11	E1[@]	
		439.4 *2*	19 *3*	1534.5+x	J+10	[E2]	
2145.9+x	J+13	171.9 *2*	37.3 *23*	1974.0+x	J+12	E1[@]	
		210.8 *3*	<13.3	1935.1+x	J+12	[M1]	
		467.8 *2*	62.7 *23*	1678.1+x	J+11	E2	
2164.8+x	J+(12)	281.0 *2*	69 *9*	1883.6+x	J+11	[E1]	
		460.6 *2*	31 *9*	1704.3+x	J+10	[E2]	
2223.6+x	J+13	288.5 *2*	82 *4*	1935.1+x	J+12	E1[@]	
		433.5 *2*	18 *4*	1790.2+x	J+11	[E2]	
2339.6+x	J+(13)	174.8 *2*	40 *10*	2164.8+x	J+(12)		
		456.1 *2*	60 *10*	1883.6+x	J+11		
2416.2+x	J+14	192.6 *2*	45 *4*	2223.6+x	J+13	E1[@]	
		270.0 *5*	<10	2145.9+x	J+13	[M1]	
		481.1 *2*	56 *4*	1935.1+x	J+12	E2	
2431.3+x	J+14	285.4 *2*	38 *12*	2145.9+x	J+13	E1[@]	
		457.2 *2*	62 *12*	1974.0+x	J+12	[E2]	
2637.0+x	J+(14)	297.4 *2*		2339.6+x	J+(13)		
		472.0 *2*		2164.8+x	J+(12)		
2649.2+x	J+(15)	217.8 *2*	45 *4*	2431.3+x	J+14		
		233.2 *3*	12 *4*	2416.2+x	J+14		
		503.3 *2*	42 *4*	2145.9+x	J+13		
2686.9+x	J+(15)	270.7 *2*	83 *4*	2416.2+x	J+14		
		463.3 *2*	17 *4*	2223.6+x	J+13		
2822.3+x	J+(15)	185.0 *3*		2637.0+x	J+(14)		
		482.9 *2*		2339.6+x	J+(13)		
2909.9+x	J+(16)	260.8 *2*	64 *10*	2649.2+x	J+(15)	(E1)	
		478.5 *2*	35 *10*	2431.3+x	J+14		
2916.5+x	J+(16)	229.5 *2*	50 *8*	2686.9+x	J+(15)		
		500.3 *2*	50 *8*	2416.2+x	J+14	(E2)	
3175.9+x	J+(17)	259.3 *2*		2916.5+x	J+(16)		
		489.1 *2*		2686.9+x	J+(15)		
3180.6+x	J+(17)	270.3 *5*		2909.9+x	J+(16)		
		531.4 *2*		2649.2+x	J+(15)		
3405.6+x	J+(18)	224.7 *4*		3180.6+x	J+(17)		
		495.8 *2*		2909.9+x	J+(16)		

[†] Relative branching from the level.

[‡] D, Q, or D+Q multipolarities of the γ-ray transitions are deduced from Directional Correlation of Oriented Nuclei (DCO) measurements. Since no delayed transitions were observed, all Q transitions are assumed to be E2.

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^{209}Bi(^{14}C,3nγ) 1991Sc19 (continued)

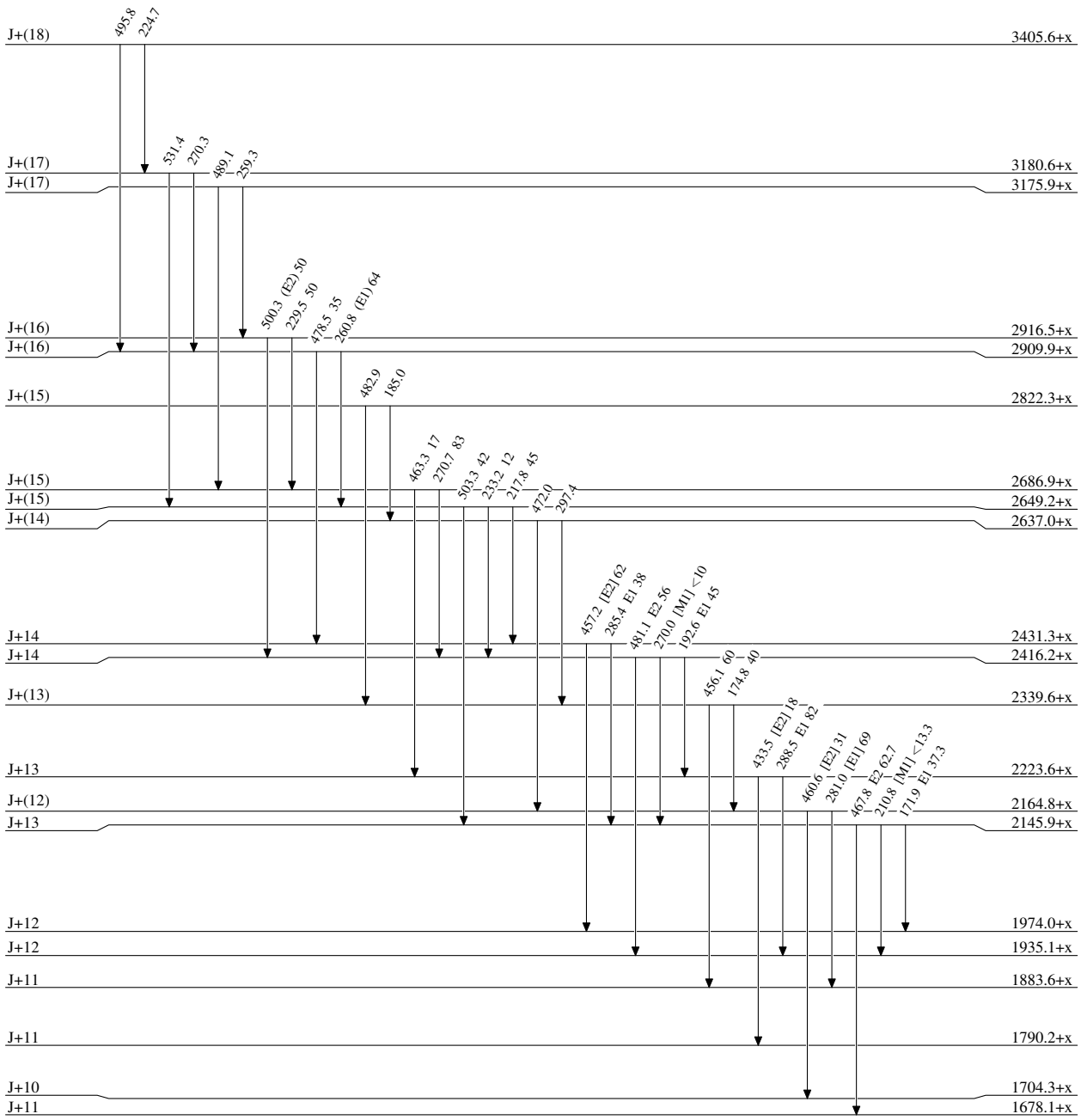
$\gamma(^{220}Ac)$ (continued)

The division of intensity is based on intensity balance and the assumption that the 189.3γ ray from the 1103.4+x level has M1 multipolarity.
@ The electric or magnetic character of the dipole γ-ray transition is inferred from the total decay transition intensity balance.
& Deduced from γ-ray transition intensity balance.
a Multiply placed with intensity suitably divided.
b Placement of transition in the level scheme is uncertain.

^{209}Bi(^{14}C,3nγ) 1991Sc19

Level Scheme

Intensities: % photon branching from each level



$^{220}_{89}Ac_{131}$

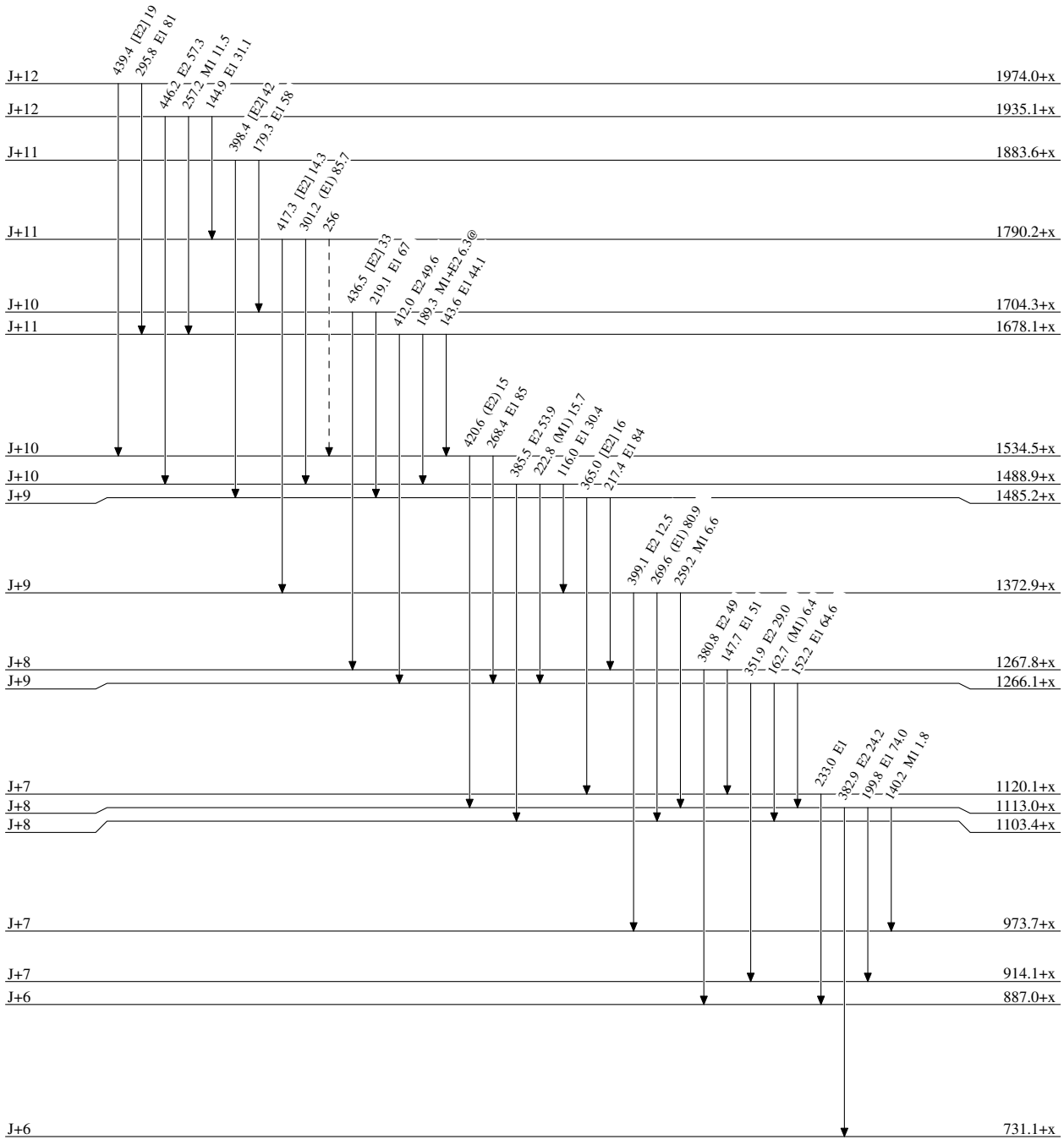
^{209}Bi(^{14}C,3nγ) 1991Sc19

Legend

Level Scheme (continued)

Intensities: % photon branching from each level
@ Multiply placed: intensity suitably divided

– – – – – – ► γ Decay (Uncertain)



$^{220}_{89}Ac_{131}$

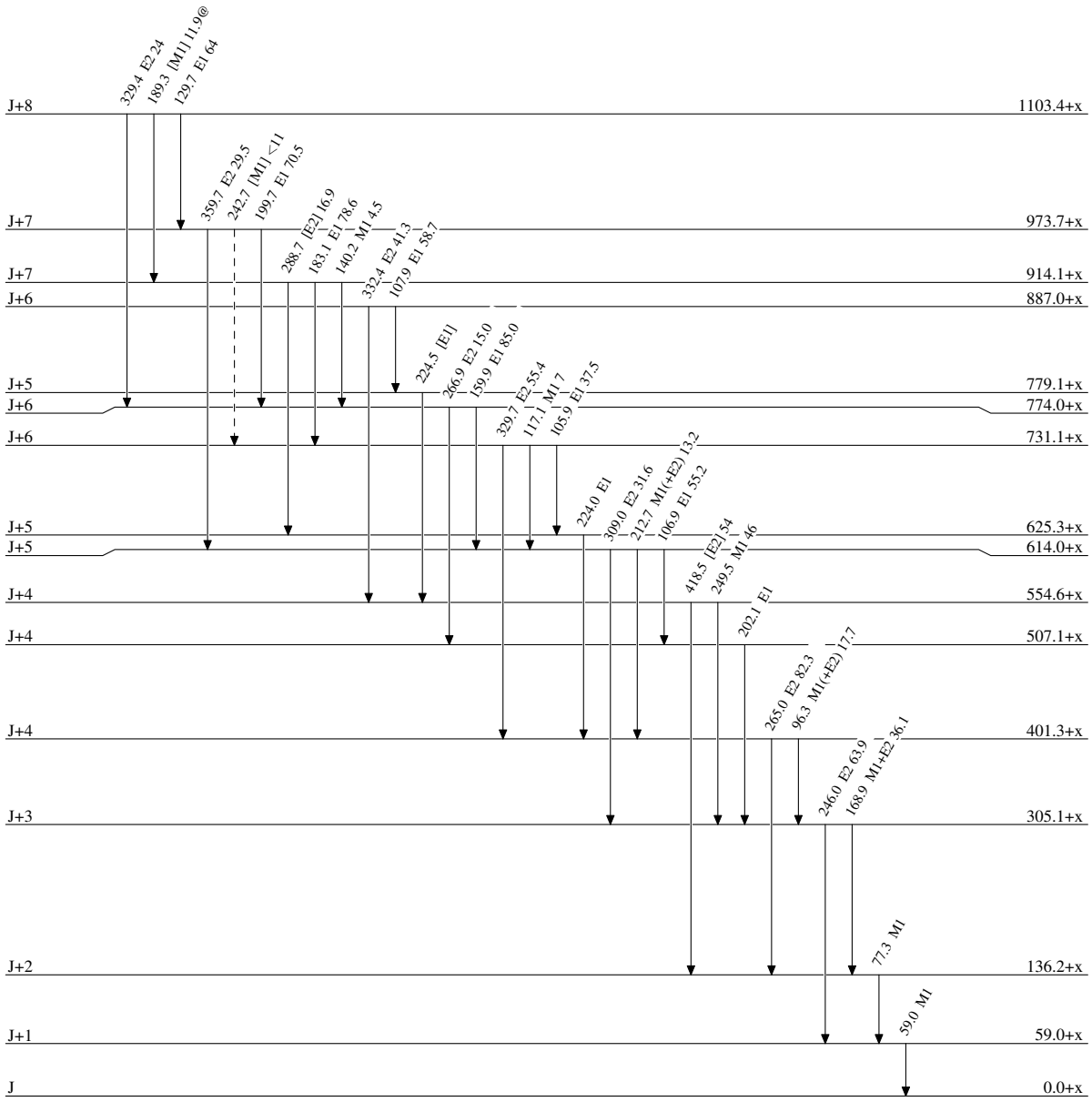
^{209}Bi(^{14}C,3nγ) 1991Sc19

Legend

Level Scheme (continued)

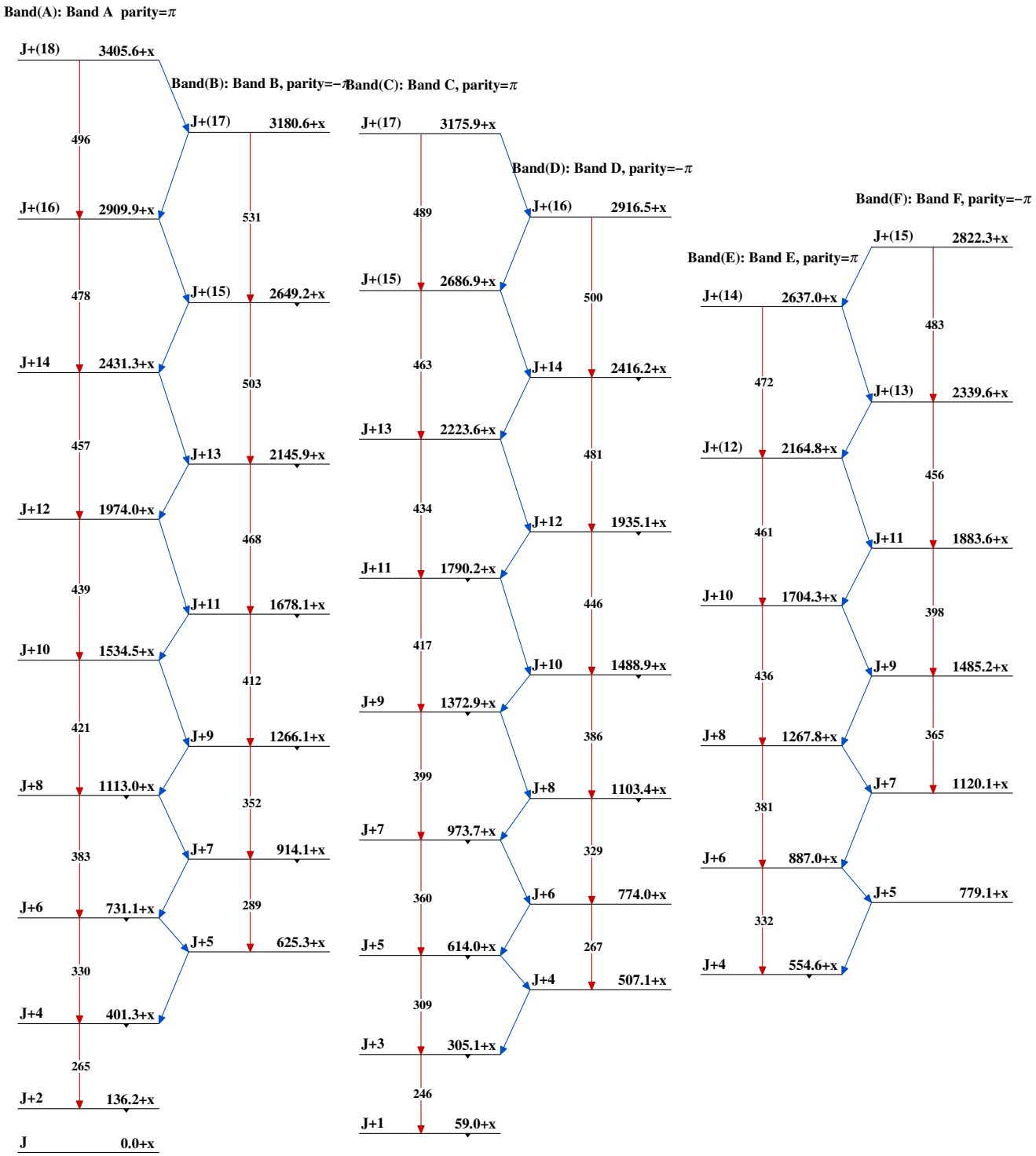
Intensities: % photon branching from each level
@ Multiply placed: intensity suitably divided

γ Decay (Uncertain)



$^{220}_{89}Ac_{131}$

^{209}Bi(^{14}C,3nγ) 1991Sc19



$^{220}_{89}Ac_{131}$