^{220}Ac α decay 1997Sh09

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	S. -c. Wu	NDS 108, 1057 (2007)	1-Mar-2007

Parent: ^{220}Ac: E=0; $T_{1/2}$=26.4 ms *2*; Q(α)=8348 *4*; %α decay=100.0

^{216}Fr Levels

1997Sh09: measured: Eα, Iα, Eγ, Iγ, ce, $\alpha\gamma$, α(ce), γ(ce). Source: ^{224}Pa + ^{220}Ac in secular equilibrium produced by ^{209}Bi(^{18}O,2n). Ge, Ge(Li), Si(Li) detectors.
1971EpZY: measured: α, $\alpha\gamma$, $\gamma\gamma$, $\alpha\gamma$(t).
1970Bo13: measured: α.

E(level)†	J$^\pi$‡	$T_{1/2}$	Comments
0#	1$^-$		
133.3# *1*	3$^-$	71 ns *5*	%α>50 $T_{1/2}$: from 1971EpZY. %α: From intensity balance at the 133.3-keV level (evaluator).
141.6# *2*	(0)$^-$		
191.2# *2*	(5)$^-$		
212.0@ *2*	2,3		
226.1# *2*	(4)$^-$		
247.8?@	0,1,2		
249.4@ *2*	3,4$^-$		
254.4# *2*	(2)		
290.4@ *2*	3,4,5		
344.2& *2*	4,5$^-$		
349.3& *3*	2,3,4		
409.3& *2*	2,3,4,5$^-$		
493.4& *2*	3,4,5$^-$		
532.1& *2*	3,4,5		
539.4& *4*	3,4,5$^-$		
550.9& *2*	(3)$^-$		
568.8& *4*	4,5$^-$		
581.5& *3*	(3)		

† From least squares fit to Eγ.
‡ Assignments of J^π and configuration are those suggested by 1997Sh09. The J^π assignments are based on γ multipolarities, on HF in α decay, and on proposed configuration assignments; all levels have been assigned negative parity.
# Band(A): Configuration=((π $h_{9/2}$9/2$^-$)(ν $g_{9/2}$9/2$^+$)).
@ Band(B): Configuration=((π $h_{9/2}$0)(π $f_{7/2}$7/2$^-$)(ν $g_{9/2}$9/2$^+$)).
& Band(C): Configuration=((π $h_{9/2}$9/2$^-$)(ν $g_{9/2}$0)(ν $i_{11/2}$11/2$^+$)).

^{220}Ac α decay 1997Sh09 (continued)

α radiations

All data are from 1997Sh09, unless otherwise noted.

Eα	E(level)	Iα[‡]	HF[†]	Comments
7622	581.5	4	55	Eα=7610 *20*, Iα=9 *4* (1970Bo13).
7635	568.8	4	61	
7652	550.9	9	31	
7664	539.4	4	75	
7670	532.1	8	40	Eα=7680 *20*, Iα=21 *5* (1970Bo13).
7709	493.4	11	38	
7792	409.3	10	76	Eα=7790 *10*, Iα=13 *2* (1970Bo13).
7850	349.3	5	231	
7855	344.2	26	46	Eα=7850 *10*, Iα=24 *2*.
7944	254.4	≈2	≈1110	
7971	226.1	4	673	Eα=7985 *10*, Iα=4 *2* (1970Bo13).
8006	191.2	3	1135	Eα=8005 *10*, Iα=5 *3* (1970Bo13).
8055	141.6	4	1186	Eα=8060 *10*, Iα=6 *1* (1970Bo13).
8063	133.3	2	2507	
8194	0	4	3005	Eα=8195 *10*, Iα=3 *1* (1970Bo13).

† $r_0(^{216}Fr)$=1.556 *6*, unweighted average of $r_0(^{214}Rn)$=1.563 *4*, $r_0(^{216}Rn)$=1.554 *6*, $r_0(^{216}Ra)$=1.566 *9*, $r_0(^{218}Ra)$=1.539 *9*.
‡ Absolute intensity per 100 decays.

$\gamma(^{216}Fr)$

All data are from 1997Sh09.

Eγ	Iγ[†#]	Ei(level)	J_i^π	Ef	J_f^π	Mult.[‡]	α[@]	Comments
34.9 *3*	≈2	226.1	(4)⁻	191.2	(5)⁻	(M1)	61.5 *18*	α(L)=46.6 *14*; α(M)=11.1 *4*; α(N+..)=3.68 *11* α(N)=2.92 *9*; α(O)=0.653 *20*; α(P)=0.105 *3*; α(Q)=0.00587 *18* Mult.: from intensity balance E2 and higher multipolarities are ruled out.
37.4 *3*	≈2	249.4	3,4⁻	212.0	2,3			Mult.: from intensity balance γ is not E2. Mult.: M1 gives I(γ+ce)≈106, E2 gives I(γ+ce)≈2000, E1 gives I(γ+ce)≈3.
42.5 *2*	≈3	254.4	(2)	212.0	2,3			
53.6 *2*	≈3	344.2	4,5⁻	290.4	3,4,5			
57.9 *1*	6.6 *20*	191.2	(5)⁻	133.3	3⁻	E2	118.3 *20*	α(L)=87.2 *15*; α(M)=23.5 *4*; α(N+..)=7.60 *13* α(N)=6.16 *10*; α(O)=1.274 *21*; α(P)=0.163 *3*; α(Q)=0.000257 *4* Mult.: α(L)exp=50 *20*.
64.3 *1*	18 *3*	290.4	3,4,5	226.1	(4)⁻			Mult.: from intensity balance, not E2 (I(γ+ce)=1307); M1 gives I(γ+ce)=212.
78.6 *2*	5 *2*	212.0	2,3	133.3	3⁻			
92.8 *1*	37 *5*	226.1	(4)⁻	133.3	3⁻	M1	3.50	α(L)=2.66 *4*; α(M)=0.634 *9*; α(N+..)=0.210 *3* α(N)=0.1661 *24*; α(O)=0.0371 *6*; α(P)=0.00596 *9*; α(Q)=0.000333 *5* Mult.: α(L)exp=2.3 *5*.
94.8 *1*	25 *4*	344.2	4,5⁻	249.4	3,4⁻			
ˣ112.7 *3*	5.7 *20*							
118.2 *2*	13.5 *35*	344.2	4,5⁻	226.1	(4)⁻	(M1)	8.90	α(K)=7.16 *11*; α(L)=1.321 *20*; α(M)=0.315 *5*; α(N+..)=0.1042 *16*

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^{220}Ac α decay 1997Sh09 (continued)

γ(^{216}Fr) (continued)

E_γ	I_γ †#	E_i(level)	J^π_i	E_f	J^π_f	Mult.‡	α@	Comments
								α(N)=0.0826 *13*; α(O)=0.0185 *3*; α(P)=0.00296 *5*; α(Q)=0.0001654 *25* Mult.: α(K)exp>3.
121.0 *2*	8.0 *14*	254.4	(2)	133.3	3⁻			
123.3 *3*	5.5 *14*	532.1	3,4,5	409.3	2,3,4,5⁻			
ˣ127.1 *4*	≈3							
130.4 *4*	≈4	539.4	3,4,5⁻	409.3	2,3,4,5⁻			
133.3 *1*	82 *7*	133.3	3⁻	0	1⁻	E2	2.65	α(K)=0.314 *5*; α(L)=1.717 *25*; α(M)=0.464 *7*; α(N+..)=0.1504 *22* α(N)=0.1218 *18*; α(O)=0.0253 *4*; α(P)=0.00329 *5*; α(Q)=1.302×10^{-5} *19* Mult.: K/L<0.2, L2/L3=2.0 *5*.
137.3 *2*	15 *3*	349.3	2,3,4	212.0	2,3			
141.6 *2*	13.2 *30*	141.6	(0)⁻	0	1⁻	M1	5.32	α(K)=4.29 *7*; α(L)=0.787 *12*; α(M)=0.188 *3*; α(N+..)=0.0620 *9* α(N)=0.0492 *8*; α(O)=0.01099 *16*; α(P)=0.00176 *3*; α(Q)=9.85×10^{-5} *15* Mult.: K x ray/g=4 *1*.
149.0 *3*	9.5 *28*	493.4	3,4,5⁻	344.2	4,5⁻			
ˣ151.5 *4*	7.0 *25*							
153.1 *2*	18.2 *35*	344.2	4,5⁻	191.2	(5)⁻			
160.0 *1*	33 *5*	409.3	2,3,4,5⁻	249.4	3,4⁻	M1	3.76	α(K)=3.03 *5*; α(L)=0.555 *8*; α(M)=0.1324 *19*; α(N+..)=0.0438 *7* α(N)=0.0347 *5*; α(O)=0.00776 *11*; α(P)=0.001244 *18*; α(Q)=6.95×10^{-5} *10* Mult.: K/L=5 *1*.
ˣ169.2 *3*	4.3 *11*							
172.2 *3*	5.0 *13*	581.5	(3)	409.3	2,3,4,5⁻			
ˣ179.3 *4*	3.8 *13*							
182.8 *3*	5.4 *16*	532.1	3,4,5	349.3	2,3,4			
187.8 *2*	14.4 *30*	532.1	3,4,5	344.2	4,5⁻			
ˣ197.3 *5*	≈3							
203.6 *5*	≈3	493.4	3,4,5⁻	290.4	3,4,5			
206.7 *2*	12 *3*	550.9	(3)⁻	344.2	4,5⁻			
ˣ214.8 *3*	5.1 *16*							
ˣ221.3 *3*	6.2 *18*							
ˣ238.8 *3*	10.5 *28*							
243.7 *2*	18 *4*	493.4	3,4,5⁻	249.4	3,4⁻	M1	1.156	α(K)=0.932 *14*; α(L)=0.1696 *24*; α(M)=0.0404 *6*; α(N+..)=0.01336 *19* α(N)=0.01059 *15*; α(O)=0.00237 *4*; α(P)=0.000380 *6*; α(Q)=2.12×10^{-5} *3* Mult.: α(K)exp=1.1 *5*.
247.8& *4*	4.7 *14*	247.8?	0,1,2	0	1⁻			E_γ: transition assigned as deexciting the Ex=247.8 state in the level scheme; not assigned in the gamma ray transitions table.
254.4 *5*	5.4 *17*	254.4	(2)	0	1⁻			
ˣ260.8 *5*	5.0 *17*							
ˣ263.6 *4*	6.2 *20*							
ˣ265.4 *4*	9 *3*							
267.8 *3*	18 *4*	493.4	3,4,5⁻	226.1	(4)⁻	M1	0.890	α(K)=0.718 *11*; α(L)=0.1304 *19*; α(M)=0.0310 *5*; α(N+..)=0.01027 *15* α(N)=0.00814 *12*; α(O)=0.00182 *3*; α(P)=0.000292 *5*; α(Q)=1.629×10^{-5} *24* Mult.: α(K)exp=1.2 *5*.
296.4 *3*	20 *5*	550.9	(3)⁻	254.4	(2)	M1	0.673	α(K)=0.543 *8*; α(L)=0.0985 *14*; α(M)=0.0234 *4*; α(N+..)=0.00775 *11*

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^{220}Ac α decay 1997Sh09 (continued)

γ(^{216}Fr) (continued)

E_γ	I_γ [†#]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [‡]	α [@]	Comments
								α(N)=0.00614 *9*; α(O)=0.001373 *20*; α(P)=0.000220 *4*; α(Q)=1.229×10^{-5} *18* Mult.: α(K)exp=0.8 *4*.
301.4 *3*	13 *4*	550.9	(3)$^-$	249.4	3,4$^-$			
305.6 *4*	10 *4*	532.1	3,4,5	226.1	(4)$^-$			
312.9 *4*	14 *2*	539.4	3,4,5$^-$	226.1	(4)$^-$	(M1)	0.580	α(K)=0.468 *7*; α(L)=0.0848 *13*; α(M)=0.0202 *3*; α(N+..)=0.00667 *10* α(N)=0.00529 *8*; α(O)=0.001182 *17*; α(P)=0.000190 *3*; α(Q)=1.059×10^{-5} *16* Mult.: α(K)exp≈0.7.
327.0 *6*	≈4	581.5	(3)	254.4	(2)			
342.7 *3*	35 *5*	568.8	4,5$^-$	226.1	(4)$^-$	M1	0.452	α(K)=0.365 *6*; α(L)=0.0660 *10*; α(M)=0.01570 *23*; α(N+..)=0.00519 *8* α(N)=0.00412 *6*; α(O)=0.000920 *13*; α(P)=0.0001476 *21*; α(Q)=8.24×10^{-6} *12* Mult.: α(K)exp=0.5 *2*.
378.0 *10*	≈2	568.8	4,5$^-$	191.2	(5)$^-$			
390.2 *5*	6.6 *25*	581.5	(3)	191.2	(5)$^-$			
448.4 *10*	≈2	581.5	(3)	133.3	3$^-$			

† Iγ per 1000 α′s.
‡ The method of α measurements is not given.
\# For absolute intensity per 100 decays, multiply by 0.1.
@ 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.
^{x} γ ray not placed in level scheme.

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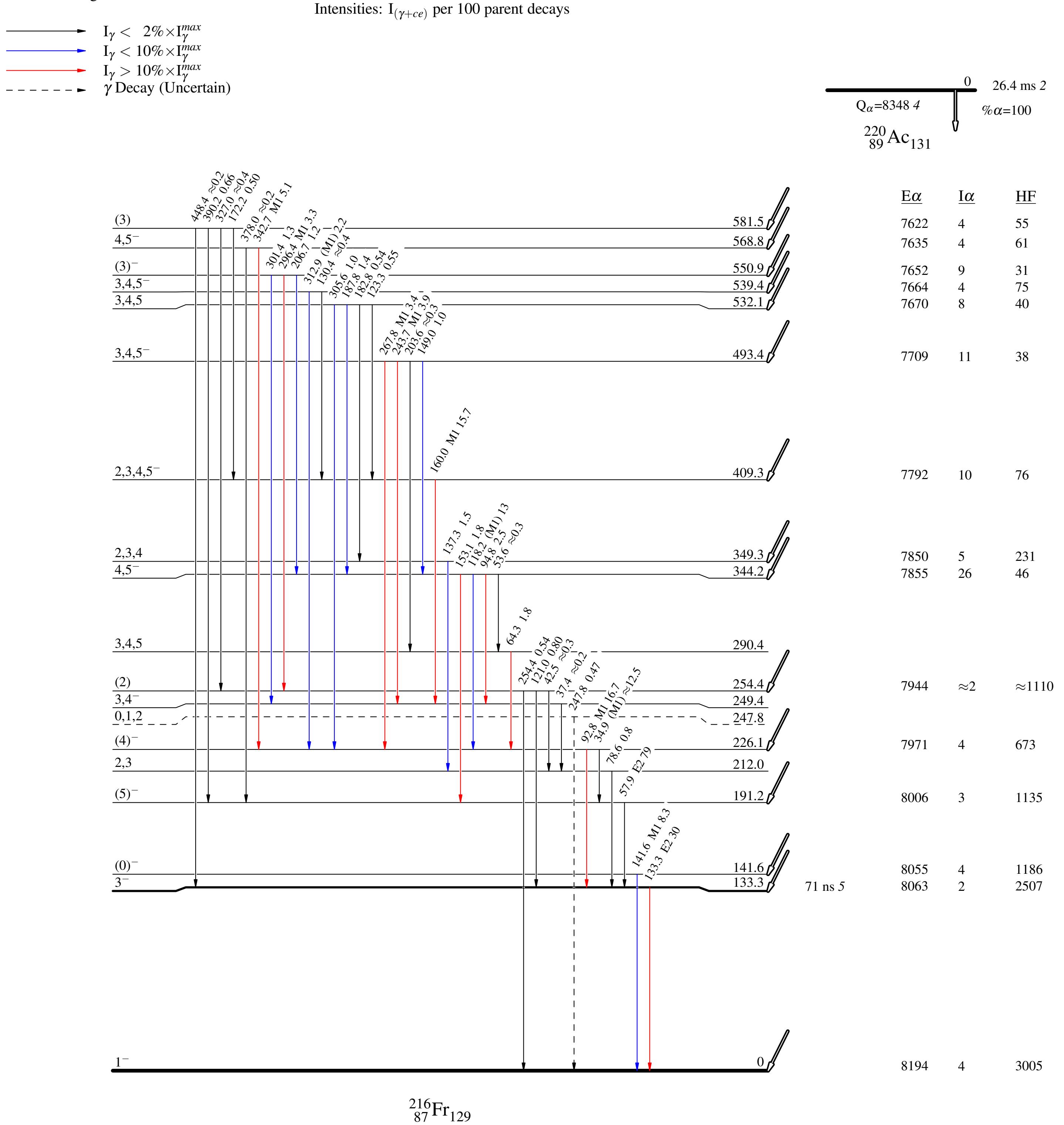
Decay Scheme



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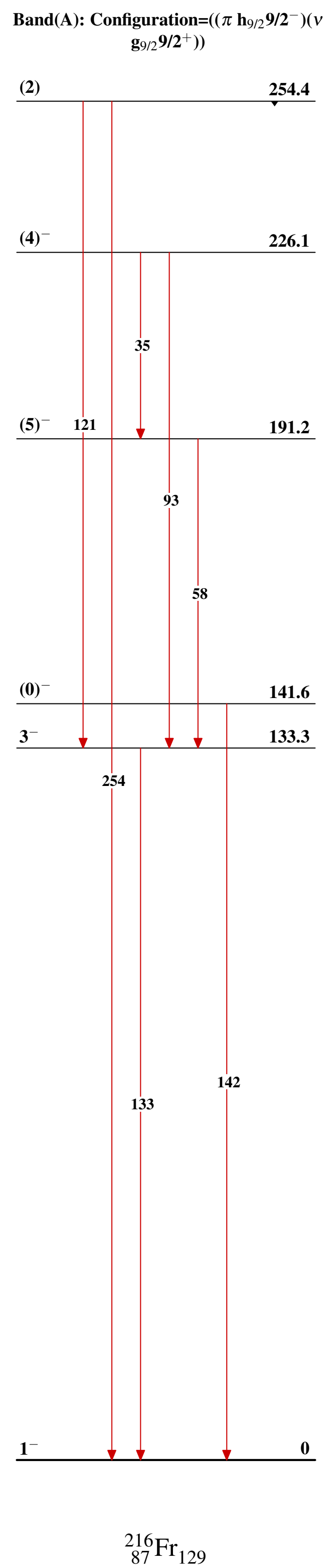
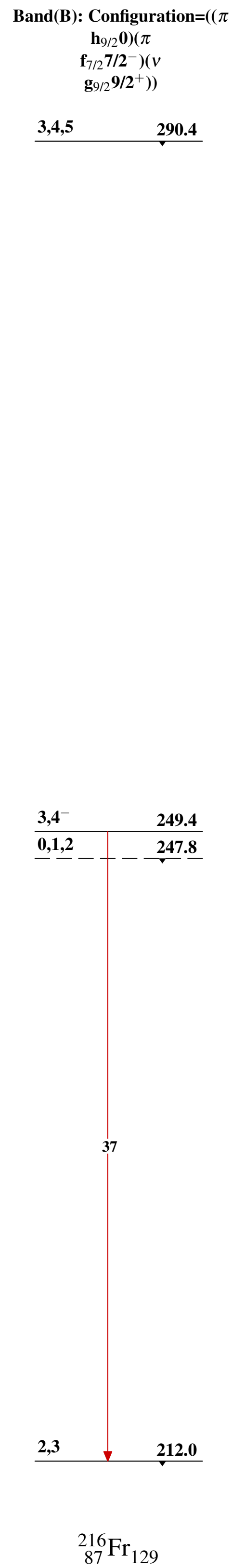
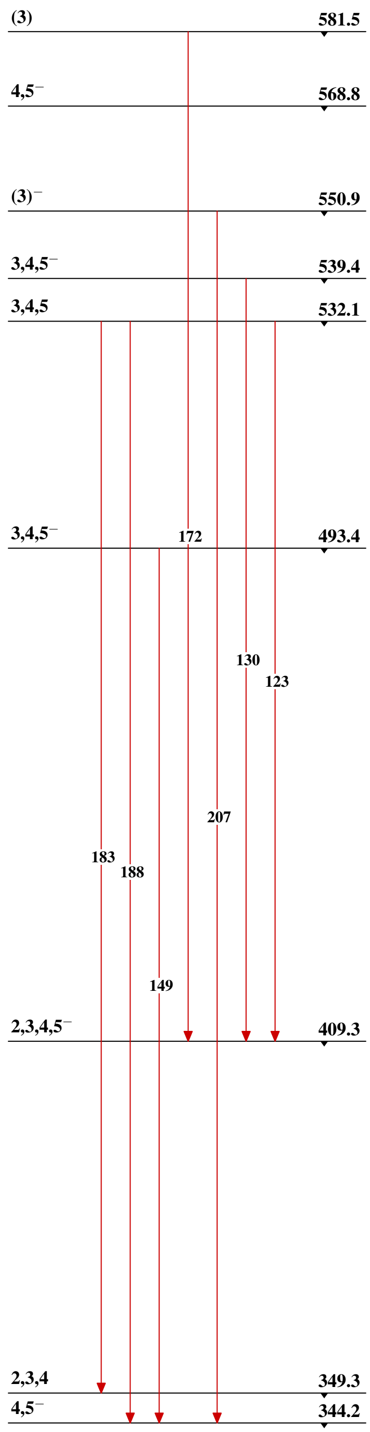


^{220}Ac α decay 1997Sh09 (continued)



^{220}Ac α decay 1997Sh09 (continued)

Band(C): Configuration=((π $h_{9/2}$9/2$^-$)(ν $g_{9/2}$0)(ν $i_{11/2}$11/2$^+$))



$^{216}_{87}Fr_{129}$