Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	A. Sonzogni, G. Mukherjee, H. Huang, A. Tarazaga, J. Wang	NDS 114, 661 (2013)	28-Feb-2013

Q(β^-)=−4972 *14*; S(n)=8879 *19*; S(p)=1824 *13*; Q(α)=6662 *3* 2012Wa38
S(2n)=16514 *19*, S(2p)=5835 *13*, Q(εp)=543 *14* (2012Wa38).

^{211}**Fr evaluated by A. Sonzogni, G. Mukherjee, H. Huang,** $\beta\alpha$. Tarazaga, J. Wang.

^{211}Fr Levels

Cross Reference (XREF) Flags

A ^{215}Ac α decay
B ^{203}Tl(^{13}C,5nγ),^{205}Tl(^{12}C,6nγ)

E(level)†	J$^{\pi}$‡	T$_{1/2}$#	XREF	Comments
0.0	9/2$^-$	3.10 min *2*	AB	%α>80; %ε<20 μ=+4.00 *8* (1986Ek02,1989Ra17,2011StZZ) Q=−0.19 *3* (1985Co24,1989Ra17,2011StZZ) Evaluated nuclear rms charge radius <r^2>$^{1/2}$=5.588 fm *18* (2008 update of 2004An14 work available on http://cdfe.sinp.msu.ru). See also 2009An12 for trends of nuclear radii. Isotope Shift: 2000Gr20, 1999Gr15. J$^{\pi}$: J=9/2 from atomic beam (1978Ek02); π=− from HF=1.3 for the α branch to the 9/2$^-$ ^{207}At g.s. T$_{1/2}$: weighted average of 3.10 min *2* (1971ReZE), 3.06 min *6* (1967Va20), 3.10 min *7* (1964Gr04). %ε,%α: based on the assumption that log *ft*>5.8 for ε decay to any of the ^{211}Rn levels which might be expected to be fed on the basis of the proposed decay scheme. μ: atomic-beam magnetic resonance (1986Ek02). Q: atomic-beam laser spectroscopy (1985Co24).
395.82 *9*	(7/2$^-$)		A	
505.90 *18*	(5/2$^-$)		A	
583.28 *10*	(11/2$^-$)		AB	
633.09 *18*	(5/2$^-$)		A	
652.62 *10*	(13/2$^-$)	<1 ns	AB	
738.9 *3*	(7/2$^-$)		A	
1026.6 *4*			B	
1452.92 *14*	(17/2$^-$)	<2 ns	B	
1686.32 *17*	(21/2$^-$)	2.1 ns *2*	B	
1860.02 *20*	(23/2$^-$)	<2 ns	B	
2242.4 *4*			B	
2310.24 *22*	(25/2$^+$)	<2 ns	B	
2423.16 *24*	(29/2$^+$)	146 ns *14*	B	%IT=100 μ=15.37 *15* (1986By01,1989Ra17,2011StZZ) Q=−1.1 *2* (1991Ha02,2011StZZ) μ: for J=29/2, and g-factor=1.06 *1* from TDPAD method (1986By01). Q: level mixing resonance technique (LEMS) (1991Ha02). Other: 1990Ha30 (from the same group as 1991Ha02) give 1.24 *17*.
2980.0 *3*	(31/2$^+$)	<2 ns	B	
3244.0 *3*	(33/2$^+$)	<2 ns	B	
3601.6 *3*	(37/2$^+$)	<2 ns	B	
3928.9 *3*	(39/2$^+$)	<2 ns	B	

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Adopted Levels, Gammas (continued)

^{211}Fr Levels (continued)

E(level)†	Jπ‡	$T_{1/2}$#	XREF	Comments
4369.0 *4*			B	
4657.3 *4*	(45/2−)	123 ns *14*	B	%IT=100 μ=24.30 *23* (1986By01,1989Ra17,2011StZZ) Q=−2.0 *6* (1991Ha02,2011StZZ) μ: for J=45/2, and g-factor=1.08 *1* from TDPAD method (1986By01). Q: level mixing resonance technique (LEMS) (1991Ha02). Other: 1990Ha30 (from the same group as 1991Ha02) give 2.3 *6*.
5196.0 *5*			B	
5303.3 *6*			B	
5556.4 *5*	(47/2−)	<7 ns	B	
5785.9 *4*	(−)		B	Jπ: 1128.4γ (M1) to (45/2−).
6023.8 *4*			B	
6182.5 *5*	(49/2−)	<7 ns	B	
6259.4 *5*	(−)	<7 ns	B	Jπ: 703.0γ (M1) to (47/2−); 76.9γ to (49/2−).
6560.1 *5*	(−)	<7 ns	B	Jπ: 377.6γ (M1) to (49/2−).
7031.1? *6*			B	
7822.1? *6*			B	
8230.0? *7*			B	

† From a least squares fit to Eγ.
‡ Spin and parity assignments for the high-spin excited states are based on γ-ray multipolarities, angular distributions and transition strengths (1986By01). The low-spin values are from Hindrance Factors.
# From ^{203}Tl(^{13}C,5nγ),^{205}Tl(^{12}C,6nγ) for excited states.

γ(^{211}Fr)

E_i(level)	J^π_i	Eγ	Iγ	E_f	J^π_f	Mult.	δ‡	α†	Comments
395.82	(7/2−)	395.8 *1*	100	0.0	9/2−				
505.90	(5/2−)	110.1 *4*	15 *8*	395.82	(7/2−)	(M1)		10.88 *19*	α(K)=8.74 *16*; α(L)=1.62 *3*; α(M)=0.386 *7*; α(N)=0.1013 *18*; α(O)=0.0227 *4*; α(P)=0.00363 *7* α(Q)=0.000203 *4*
		505.9 *2*	100 *27*	0.0	9/2−				
583.28	(11/2−)	583.3 *1*	100	0.0	9/2−	M1+E2	0.84 *32*	0.074 *17*	α(K)=0.059 *14*; α(L)=0.0116 *20*; α(M)=0.0028 *5*; α(N)=0.00073 *12*; α(O)=0.00016 *3* α(P)=2.6×10^{-5} *5*; α(Q)=1.3×10^{-6} *4* Eγ: from ^{215}Ac α decay.
633.09	(5/2−)	237.2 *4*	40 *40*	395.82	(7/2−)				
		633.1 *2*	100 *60*	0.0	9/2−				
652.62	(13/2−)	69.5 *3*		583.28	(11/2−)	(M1)		8.12 *16*	α(L)=6.16 *12*; α(M)=1.47 *3*; α(N)=0.385 *8*; α(O)=0.0862 *17*; α(P)=0.0138 *3* α(Q)=0.000773 *15* Eγ: Not observed in alpha decay.
		652.6 *1*	100	0.0	9/2−	E2		0.0202	B(E2)(W.u.)>0.063 α(K)=0.01459 *21*; α(L)=0.00424 *6*; α(M)=0.001061 *15*; α(N)=0.000278 *4*; α(O)=6.03×10^{-5} *9* α(P)=8.96×10^{-6} *13*; α(Q)=3.23×10^{-7} *5*

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Adopted Levels, Gammas (continued)

$\gamma(^{211}Fr)$ (continued)

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.	δ‡	α†	Comments
									E_γ: From ^{203}Tl(^{13}C,5nγ), ^{205}Tl(^{12}C,6nγ).
738.9	(7/2⁻)	342.6 *5*	100 *67*	395.82	(7/2⁻)				
		739.2 *4*	73 *53*	0.0	9/2⁻				
1026.6		374.0 *4*	100	652.62	(13/2⁻)				
1452.92	(17/2⁻)	800.3 *1*	100	652.62	(13/2⁻)	E2		0.01325	B(E2)(W.u.)>0.011 α(K)=0.00997 *14*; α(L)=0.00247 *4*; α(M)=0.000609 *9*; α(N)=0.0001595 *23*; α(O)=3.49×10^{-5} *5* α(P)=5.28×10^{-6} *8*; α(Q)=2.16×10^{-7} *3*
1686.32	(21/2⁻)	233.4 *1*	100	1452.92	(17/2⁻)	E2		0.323	α(K)=0.1189 *17*; α(L)=0.1506 *22*; α(M)=0.0402 *6*; α(N)=0.01055 *15*; α(O)=0.00221 *4* α(P)=0.000296 *5*; α(Q)=3.04×10^{-6} *5* B(E2)(W.u.)=3.9 *4*
1860.02	(23/2⁻)	173.7 *1*	100	1686.32	(21/2⁻)	M1		2.98	α(K)=2.40 *4*; α(L)=0.440 *7*; α(M)=0.1048 *15*; α(N)=0.0275 *4*; α(O)=0.00614 *9* α(P)=0.000985 *14*; α(Q)=5.50×10^{-5} *8*
2242.4		382.4 *4*	100	1860.02	(23/2⁻)				
2310.24	(25/2⁺)	450.2 *1*	100	1860.02	(23/2⁻)	(E1)		0.01414	B(E1)(W.u.)>1.0×10^{-6} α(K)=0.01154 *17*; α(L)=0.00198 *3*; α(M)=0.000469 *7*; α(N)=0.0001220 *17*; α(O)=2.69×10^{-5} *4* α(P)=4.18×10^{-6} *6*; α(Q)=2.08×10^{-7} *3*
2423.16	(29/2⁺)	112.9 *1*	93 *12*	2310.24	(25/2⁺)	(E2)		5.32	α(K)=0.332 *5*; α(L)=3.67 *6*; α(M)=0.995 *15*; α(N)=0.261 *4*; α(O)=0.0541 *8*; α(P)=0.00700 *11* α(Q)=2.14×10^{-5} *3* B(E2)(W.u.)=0.38 *8*
		563.3 *3*	100 *10*	1860.02	(23/2⁻)	(E3)		0.0907	α(K)=0.0473 *7*; α(L)=0.0321 *5*; α(M)=0.00852 *12*; α(N)=0.00225 *4*; α(O)=0.000480 *7* α(P)=6.83×10^{-5} *10*; α(Q)=1.518×10^{-6} *22* B(E3)(W.u.)=25 *5*
2980.0	(31/2⁺)	556.8 *2*	100	2423.16	(29/2⁺)	M1(+E2)	−0.1 *+1−6*	0.12 *3*	α(K)=0.10 *3*; α(L)=0.018 *4*; α(M)=0.0042 *8*; α(N)=0.00110 *21*; α(O)=0.00024 *5* α(P)=3.9×10^{-5} *9*; α(Q)=2.2×10^{-6} *6*
3244.0	(33/2⁺)	264.0 *2*	34.9 *13*	2980.0	(31/2⁺)	(M1+E2)	1 *1*	0.6 *4*	α(K)=0.4 *4*; α(L)=0.114 *23*;

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Adopted Levels, Gammas (continued)

$\gamma(^{211}Fr)$ (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	δ‡	α†	Comments
									α(M)=0.028 *4*; α(N)=0.0074 *11*; α(O)=0.0016 *3*; α(P)=0.00024 *7* α(Q)=1.0×10^{-5} *8*; α(N+..)=0.0093 *14*
3244.0	(33/2$^+$)	820.9 *2*	100.0 *20*	2423.16	(29/2$^+$)	E2		0.01259	α(K)=0.00952 *14*; α(L)=0.00231 *4*; α(M)=0.000570 *8*; α(N)=0.0001494 *21*; α(O)=3.27×10^{-5} *5* α(P)=4.96×10^{-6} *7*; α(Q)=2.06×10^{-7} *3*
3601.6	(37/2$^+$)	357.6 *1*	100	3244.0	(33/2$^+$)	(E2)		0.0871	B(E2)(W.u.)>0.60 α(K)=0.0483 *7*; α(L)=0.0289 *4*; α(M)=0.00754 *11*; α(N)=0.00198 *3*; α(O)=0.000420 *6* α(P)=5.85×10^{-5} *9*; α(Q)=1.139×10^{-6} *16*
3928.9	(39/2$^+$)	327.3 *1*	100	3601.6	(37/2$^+$)	M1(+E2)	0.6 *6*	0.41 *13*	α(K)=0.32 *12*; α(L)=0.066 *12*; α(M)=0.0159 *24*; α(N)=0.0042 *7*; α(O)=0.00092 *15* α(P)=0.00014 *3*; α(Q)=7.E−6 *3*
4369.0		440.1 *2*	100	3928.9	(39/2$^+$)				
4657.3	(45/2$^-$)	728.4 *2*	100	3928.9	(39/2$^+$)	E3		0.0444	α(K)=0.0276 *4*; α(L)=0.01248 *18*; α(M)=0.00324 *5*; α(N)=0.000853 *12*; α(O)=0.000184 *3* α(P)=2.68×10^{-5} *4*; α(Q)=7.84×10^{-7} *11* B(E3)(W.u.)=33 *4*
5196.0		827.0 *4*	100	4369.0					
5303.3		934.3 *5*	100	4369.0					
5556.4	(47/2$^-$)	899.0 *3*	100	4657.3	(45/2$^-$)	M1+E2	0.8 *4*	0.025 *7*	α(K)=0.020 *5*; α(L)=0.0037 *8*; α(M)=0.00089 *19*; α(N)=0.00023 *5*; α(O)=5.2×10^{-5} *11* α(P)=8.3×10^{-6} *18*; α(Q)=4.5×10^{-7} *12*
5785.9	($^-$)	1128.4 *3*	100	4657.3	(45/2$^-$)	(M1)		0.0192	α(K)=0.01559 *22*; α(L)=0.00273 *4*; α(M)=0.000647 *9*; α(N)=0.0001694 *24*; α(O)=3.79×10^{-5} *6* α(P)=6.09×10^{-6} *9*; α(Q)=3.43×10^{-7} *5*
6023.8		237.9 *2*	25 *9*	5785.9	($^-$)				
		1366.6 *3*	100 *9*	4657.3	(45/2$^-$)				
6182.5	(49/2$^-$)	626.1 *2*	100 *11*	5556.4	(47/2$^-$)	M1+E2	1.4 +*7*−*4*	0.045 *11*	α(K)=0.035 *10*; α(L)=0.0075 *14*; α(M)=0.0018 *3*; α(N)=0.00048 *8*;

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Adopted Levels, Gammas (continued)

$\gamma(^{211}Fr)$ (continued)

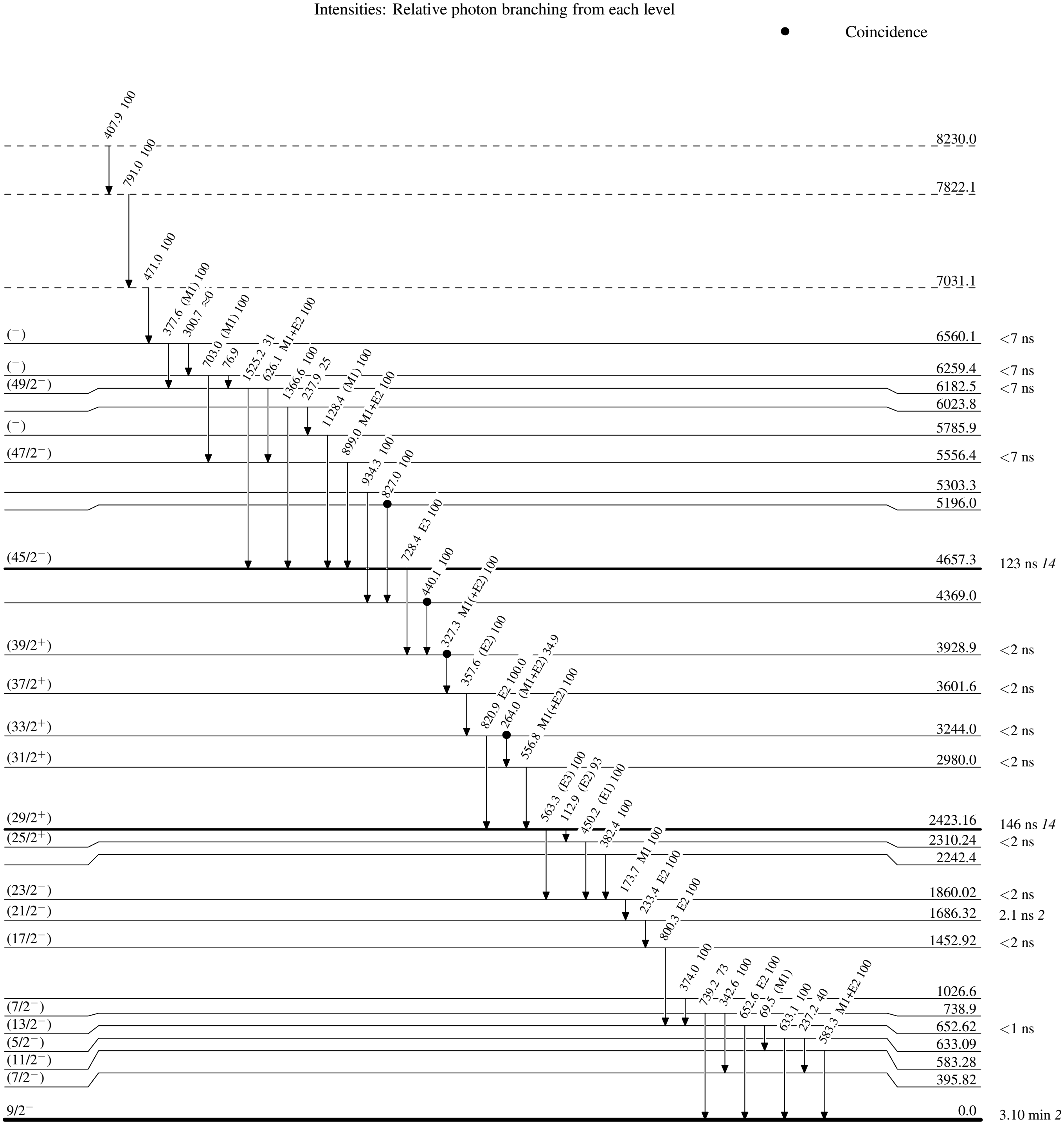
E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.	α†	Comments
								α(O)=0.000106 *19* α(P)=1.6×10^{-5} *3*; α(Q)=7.8×10^{-7} *21*
6182.5	(49/2$^-$)	1525.2 *4*	31 *6*	4657.3	(45/2$^-$)			
6259.4	($^-$)	76.9 *5*		6182.5	(49/2$^-$)			
		703.0 *3*	100 *25*	5556.4	(47/2$^-$)	(M1)	0.0661	α(K)=0.0536 *8*; α(L)=0.00951 *14*; α(M)=0.00226 *4*; α(N)=0.000591 *9*; α(O)=0.0001322 *19* α(P)=2.12×10^{-5} *3*; α(Q)=1.191×10^{-6} *17*
6560.1	($^-$)	300.7 *5*	≈0	6259.4	($^-$)			
		377.6 *3*	100 *18*	6182.5	(49/2$^-$)	(M1)	0.347	α(K)=0.281 *4*; α(L)=0.0506 *8*; α(M)=0.01204 *17*; α(N)=0.00316 *5*; α(O)=0.000705 *10* α(P)=0.0001132 *16*; α(Q)=6.32×10^{-6} *9*
7031.1?		471.0 *2*	100	6560.1	($^-$)			
7822.1?		791.0 *3*	100	7031.1?				
8230.0?		407.9 *3*	100	7822.1?				

† Additional information 1.
‡ From ^{203}Tl(^{13}C,5nγ),^{205}Tl(^{12}C,6nγ).

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level

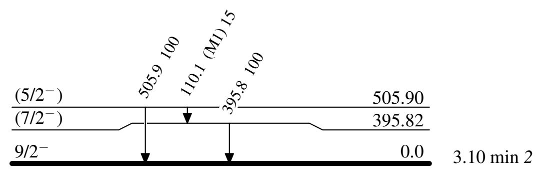


$^{211}_{87}Fr_{124}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level



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