Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. Chen # and F. G. Kondev	NDS 126, 373 (2015)	30-Sep-2013

Q(β^-)=−5620 *50*; S(n)=9173 *19*; S(p)=1402 *18*; Q(α)=6777 *4* 2012Wa38

^{209}Fr Levels

Cross Reference (XREF) Flags

A ^{213}Ac α decay
B ^{176}Yb(^{37}Cl,4nγ)
C ^{197}Au(^{16}O,4nγ)

E(level)†	J$^\pi$‡	$T_{1/2}$#	XREF	Comments
0.0	9/2$^-$	50.5 s *7*	A C	%α=89 *3*; %ε+%β^+=11 *3* μ=+3.95 *2* (1985Co24); μ=+3.95 *8* (1986Ek02) Q=−0.24 *2* (1985Co24) J$^\pi$: J from atomic beam magnetic resonance (1978Ek02, 1978Ek05, 1985Co24, 1986Ek02). π from μ. $T_{1/2}$: weighted average of 50.0 s *3* (α(t), 1974Ho27), 52.0 s *20* (α(t), 1967Va20), 51.3 s *8* (α(t), 1996Xu02) and 54.7 s *10* (α(t), 1964Gr04). %α: from 1974Ho27, deduced from the growth and decay of ^{209}Fr and ^{209}Rn α groups, with the assumption that %α(^{209}Rn)=17 *2*. Other: %α=97.0% *15* using %ε+β^+=3.0% *15* (1996Xu02), but no convincing evidence was presented. μ,Q: from atomic beam laser spectroscopy. configuration=$\pi(h_{9/2})^{+1}$. $\delta\langle r^2\rangle$(^{209}Fr,^{212}Fr)=−0.13043 fm^2 *8* (1987Co19). Others: 1985Co24, 1980Li22, 1978Ek05. Eα=6646 *5* (1974Ho27), 6647 *5* (1967Va20), 6650 *20* (1964Gr04).
606.06 *18*	13/2$^-$		C	J$^\pi$: 606.0γ stretched E2 to 9/2$^-$. configuration=dominant $\pi(h_{9/2})^{+1}\otimes\nu(f_{5/2})^{-2}_{2^+}$.
622.64 *18*	11/2$^-$		C	J$^\pi$: 622.7γ M1+E2 to 9/2$^-$, 466.3γ E2 from 15/2$^-$.
1088.88 *21*	15/2$^-$		C	J$^\pi$: 482.7γ M1(+E2) to 13/2$^-$, 466.3γ E2 to 11/2$^-$ and 136.1γ M1(+E2) from 17/2$^-$. configuration=$\pi(h_{9/2})^{+1}\otimes\nu(f_{5/2})^{-2}_{4^+}$.
1224.97 *23*	17/2$^-$		C	J$^\pi$: 538.7γ E2 from 21/2$^-$ and 618.9γ E2 to 13/2$^-$. configuration=$\pi(h_{9/2})^{+1}\otimes\nu(f_{5/2})^{-2}_{4^+}$.
1330.46 *25*	17/2$^-$		C	J$^\pi$: 724.4γ stretched E2 to 13/2$^-$. configuration=$\pi(h_{9/2})^{+3}$.
1763.7 *3*	21/2$^-$		BC	J$^\pi$: 433.2γ and 538.7γ stretched E2 to 17/2$^-$. configuration=$\pi(h_{9/2})^{+3}$.
1928.6 *4*	23/2$^-$	<1.0 ns	C	J$^\pi$: 164.9γ M1+E2 to 21/2$^-$, the absence of transitions to levels with J$^\pi$<21/2$^-$ rules out the 19/2$^-$ and 21/2$^-$ alternatives. configuration=$\pi((h_{9/2})^{+2}(f_{7/2})^{+1})^3$.
2130.5 *4*	25/2$^+$	35 ns *3*	BC	J$^\pi$: 201.9γ E1 to 23/2$^-$, the absence of transitions to levels with J$^\pi$<23/2$^-$ rules out the 21/2$^+$ and 23/2$^+$ alternatives. $T_{1/2}$: weighted average of 33.3 ns *21* (2009Dr04) and 39 ns *3* (2011Ka37) in ^{197}Au(^{16}O,4nγ), both using 409γ+515γ+619γ)γ-202γ(Δt). configuration: $\pi(h_{9/2})^{+1}\otimes\nu((f_{5/2})^{-1}(i_{13/2})^{-1})_{9^-}$.
2175.9 *4*	25/2$^+$	<0.69 ns	BC	J$^\pi$: 247.6γ E1 to 23/2$^-$, 45.4γ M1 to 25/2$^+$, the absence of transitions to levels with J$^\pi$<23/2$^-$ rules out the 23/2$^+$ alternative. configuration=$\pi((h_{9/2})^{+2}(i_{13/2})^{+1})^3$.
2245.1 *4*	23/2$^{(+)}$		C	J$^\pi$: 481.4γ (E1) to 21/2$^-$, the absence of transitions to levels with J$^\pi$<21/2$^-$ rules out the J=19/2 alternatives.
2407.6 *5*	27/2$^+$		C	J$^\pi$: 231.7γ M1 to 25/2$^+$.

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Adopted Levels, Gammas (continued)

^{209}Fr Levels (continued)

E(level)[†]	J$^{\pi}$[‡]	T$_{1/2}$[#]	XREF	Comments
				configuration=$\pi((h_{9/2})^{+2}(i_{13/2})^{+1})^3$.
2424.7 *5*	29/2$^+$	<0.69 ns	C	J$^{\pi}$: 248.8γ E2 to 25/2$^+$. configuration=$\pi((h_{9/2})^{+2}(i_{13/2})^{+1})^3$.
2559.1 *5*	25/2$^{(-)}$		C	J$^{\pi}$: 630.5γ (M1+E2) to 23/2$^-$. configuration=$\pi(h_{9/2})^{+5}$.
2599.1 *5*	27/2$^-$		C	J$^{\pi}$: 670.5γ E2 to 23/2$^-$. configuration=$\pi((h_{9/2})^{+4}(f_{7/2})^{+1})^5$.
2696.7 *5*	27/2$^+$		C	J$^{\pi}$: 566.2γ M1+E2 to 25/2$^+$, the absence of transitions to levels with J$^{\pi}$<25/2$^+$ rules out the 23/2$^+$ and 25/2$^+$ alternatives. configuration=$\pi(h_{9/2})^{+1}\otimes\nu((f_{5/2})^{-1}(i_{13/2})^{-1})_{9^-}$.
2717.4 *5*	(29/2)		C	J$^{\pi}$: 309.8γ to 27/2$^+$.
2857.7? *6*			C	
2903.3? *5*	29/2$^+$		C	J$^{\pi}$: 727.4γ E2 to 25/2$^+$.
2917.9 *5*	29/2$^{(+)}$		C	J$^{\pi}$: 787.4γ (E2) to 25/2$^+$.
2937.8 *5*	(27/2)		C	J$^{\pi}$: 692.7γ to 23/2$^+$.
3027.4 *6*	31/2$^+$		C	J$^{\pi}$: 602.7γ M1+E2 to 29/2$^+$, the absence of transitions to levels with J$^{\pi}$<29/2$^+$ rules out the 27/2$^+$ and 29/2$^+$ alternative. configuration=$\pi((h_{9/2})^{+4}(i_{13/2})^{+1})^5$.
3115.4 *5*	33/2$^+$		BC	J$^{\pi}$: 690.7γ stretched E2 to 29/2$^+$. configuration=$\pi((h_{9/2})^{+4}(i_{13/2})^{+1})^5$.
3127.4 *6*	31/2$^-$		C	J$^{\pi}$: 528.3γ E2 to 27/2$^-$. configuration=$\pi((h_{9/2})^{+4}(f_{7/2})^{+1})^5$.
3153.1 *5*	31/2		C	J$^{\pi}$: 745.5γ Q to 27/2$^+$.
3234.5 *5*	31/2$^{(+)}$		C	J$^{\pi}$: 331.2γ (M1+E2) to 29/2$^+$. Additional information 1.
3369.6 *6*	33/2$^+$		C	J$^{\pi}$: 342.2γ M1+E2 to 31/2$^+$.
3409.4 *6*	33/2$^{(+)}$		C	J$^{\pi}$: 174.9γ M1+E2 to 31/2$^{(+)}$. Additional information 2.
3415.9 *6*	33/2$^{(-)}$	≈62 ns	C	J$^{\pi}$: 181.4γ E1(+M2) 31/2$^{(+)}$. T$_{1/2}$: from 181γ(t), consistent with 810γ(t), in (2009Dr04). possible configuration=$\pi(h_{9/2})^{+1}\otimes\nu((i_{13/2})^{-2})_{12^+}$.
3630.9 *6*	37/2$^+$		BC	J$^{\pi}$: 515.5γ stretched E2 to 33/2$^+$. configuration=$\pi((h_{9/2})^{+4}(i_{13/2})^{+1})^5$.
3923.4 *7*	35/2$^{(+)}$		C	J$^{\pi}$: 514.0γ (M1+E2) to 33/2$^{(+)}$.
3968.7 *7*	35/2		C	J$^{\pi}$: 559.3γ D+Q to 33/2$^{(+)}$.
4039.6 *6*	39/2$^+$		BC	J$^{\pi}$: 408.7γ M1+E2 to 37/2$^+$. configuration=$\pi((h_{9/2})^{+3}(f_{7/2})^{+1}(i_{13/2})^{+1})^5$.
4166.4 *7*	(37/2)		C	
4324.3 *7*	41/2$^+$		C	J$^{\pi}$: 284.7γ M1+E2 to 39/2$^+$. configuration=$\pi((h_{9/2})^{+3}(f_{7/2})^{+1}(i_{13/2})^{+1})^5$.
4364.1 *6*	39/2$^+$		C	J$^{\pi}$: 733.2γ M1+E2 to 37/2$^+$.
4423.6 *6*	41/2$^{(+)}$		C	J$^{\pi}$: 792.7γ (E2) to 37/2$^+$.
4659.8 *7*	45/2$^-$	420 ns *18*	BC	J$^{\pi}$: 620.2γ E3 to 39/2$^+$. T$_{1/2}$: from 232γ+409γ+620γ(t) in 2009Dr04. Selected γ's as gates were not contaminated in the γ-ray spectra. Other: 360 ns 140 from from 433.5γ(t) in ^{176}Yb(^{37}Cl,4nγ) (2006Me03). configuration=$\pi((h_{9/2})^{+3}(i_{13/2})^{+2})^5$.
5046.2? *7*			C	
5069.3 *7*	(43/2)		C	J$^{\pi}$: 745.0γ to 41/2$^+$.
5194.6 *7*	47/2$^{(-)}$		C	J$^{\pi}$: 534.8γ (M1+E2) to 45/2$^-$.
5302.1 *7*	(47/2)		C	J$^{\pi}$: 642.3γ D+Q to 45/2$^-$.
5399.5 *7*	49/2$^-$		C	J$^{\pi}$: 739.7γ E2 to 45/2$^-$.
5413.9? *7*			C	
5480.3? *7*			C	

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Adopted Levels, Gammas (continued)

^{209}Fr Levels (continued)

E(level)[†]	Jπ[‡]	XREF	Comments
5488.5 *7*	$47/2^-$	C	Jπ: 828.7γ M1+E2 to $45/2^-$.
5657.2 *7*	$47/2^{(-)}$	C	Jπ: 997.4γ (M1+E2) to $45/2^{(-)}$.
5765.2 *7*	(47/2)	C	Jπ: 1105.4γ (D+Q) to $45/2^-$.
5903.4 *8*	$49/2^-$	C	Jπ: 414.9γ M1+E2 to $47/2^-$.

[†] From a least-squares fit to Eγ.
[‡] From 2009Dr04 in ^{197}Au(^{16}O,4nγ), based on deduced γ-ray transition multipolarities, multiple γ-ray decay branches and transition strengths, unless otherwise stated.
[#] From 2009Dr04 in ^{197}Au(^{16}O,4nγ), unless otherwise stated.

Adopted Levels, Gammas (continued)

$\gamma(^{209}Fr)$

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[#]	δ[@ a]	α[&]	Comments
606.06	13/2$^-$	606.0 *2*	100	0.0	9/2$^-$	E2		0.0238	α(K)=0.01680 *24*; α(L)=0.00522 *8*; α(M)=0.001315 *19* α(N)=0.000345 *5*; α(O)=7.46×10^{-5} *11*; α(P)=1.099×10^{-5} *16*; α(Q)=3.74×10^{-7} *6* Mult.: α(K)exp=0.016 *2*, α(L)exp=0.007 *1*, A_2=+0.27 *3* (2009Dr04).
622.64	11/2$^-$	622.7 *2*	100	0.0	9/2$^-$	M1+E2	0.64 *11*	0.071 *5*	α(K)=0.057 *5*; α(L)=0.0107 *7*; α(M)=0.00256 *14* α(N)=0.00067 *4*; α(O)=0.000150 *9*; α(P)=2.38×10^{-5} *14*; α(Q)=1.27×10^{-6} *10* Mult.,δ: from α(K)exp=0.057 *4* (2009Dr04). Also A_2=−0.43 *10* (2009Dr04).
1088.88	15/2$^-$	466.3 *2*	100 *3*	622.64	11/2$^-$	E2		0.0436	α(K)=0.0280 *4*; α(L)=0.01162 *17*; α(M)=0.00298 *5* α(N)=0.000783 *11*; α(O)=0.0001677 *24*; α(P)=2.40×10^{-5} *4*; α(Q)=6.42×10^{-7} *9* Mult.: α(K)exp=0.031 *3*, A_2=+0.21 *5* (2009Dr04).
		482.7 *3*	36.8 *22*	606.06	13/2$^-$	M1(+E2)	<1.8	0.13 *6*	α(K)=0.10 *5*; α(L)=0.020 *6*; α(M)=0.0048 *14* α(N)=0.0013 *4*; α(O)=0.00028 *9*; α(P)=4.4×10^{-5} *14*; α(Q)=2.2×10^{-6} *11* Mult.,δ: from α(K)exp>0.054 (2009Dr04). Also A_2=−0.48 *17* (2009Dr04).
1224.97	17/2$^-$	136.1 *3*	26 *4*	1088.88	15/2$^-$	M1(+E2)	<0.4	5.7 *3*	α(K)=4.5 *4*; α(L)=0.93 *5*; α(M)=0.225 *15* α(N)=0.059 *4*; α(O)=0.0131 *8*; α(P)=0.00205 *8*; α(Q)=0.000104 *7* Mult.,δ: from α(exp)=7.0 *10* (2009Dr04). Also A_2=−0.31 *7* (2009Dr04).
		618.9 *2*	100 *13*	606.06	13/2$^-$	E2		0.0227	α(K)=0.01614 *23*; α(L)=0.00492 *7*; α(M)=0.001236 *18* α(N)=0.000324 *5*; α(O)=7.02×10^{-5} *10*; α(P)=1.037×10^{-5} *15*; α(Q)=3.59×10^{-7} *5* Mult.: α(K)exp=0.017 *3*, A_2=+0.23 *9* (2009Dr04).
1330.46	17/2$^-$	724.4 *2*	100	606.06	13/2$^-$	E2		0.01624	α(K)=0.01200 *17*; α(L)=0.00319 *5*; α(M)=0.000794 *12* α(N)=0.000208 *3*; α(O)=4.53×10^{-5} *7*; α(P)=6.79×10^{-6} *10*; α(Q)=2.63×10^{-7} *4* Mult.: α(K)exp=0.012 *2*, α(L)exp=0.0022 *4*, A_2=+0.23 *4* (2009Dr04).
1763.7	21/2$^-$	433.2 *2*	100.0 *15*	1330.46	17/2$^-$	E2		0.0524	α(K)=0.0325 *5*; α(L)=0.01481 *21*; α(M)=0.00382 *6* α(N)=0.001003 *15*; α(O)=0.000214 *3*; α(P)=3.04×10^{-5} *5*; α(Q)=7.51×10^{-7} *11* E_γ: 433.5 *4* from ^{176}Yb(^{37}Cl,4nγ) (2006Me03). Mult.: α(K)exp=0.032 *2*, α(M)exp=0.003 *1*, A_2=+0.26 *5* (2009Dr04).
		538.7 *2*	26.7 *11*	1224.97	17/2$^-$	E2		0.0310	α(K)=0.0211 *3*; α(L)=0.00739 *11*; α(M)=0.00188 *3* α(N)=0.000492 *7*; α(O)=0.0001060 *15*; α(P)=1.544×10^{-5} *22*; α(Q)=4.75×10^{-7} *7* Mult.: α(K)exp=0.019 *3*, A_2=+0.20 *9* (2009Dr04).
1928.6	23/2$^-$	164.9 *2*	100	1763.7	21/2$^-$	M1+E2	0.44 *+9−8*	3.08 *14*	α(K)=2.37 *15*; α(L)=0.535 *12*; α(M)=0.131 *4* α(N)=0.0343 *10*; α(O)=0.00755 *19*; α(P)=0.001165 *19*;

$^{209}_{87}Fr_{122}$-4

Adopted Levels, Gammas (continued)

$\gamma(^{209}Fr)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[#]	δ[@a]	α[&]	Comments
									α(Q)=5.5×10^{-5} *4* B(M1)(W.u.)>0.00091; B(E2)(W.u.)>1.6 Mult.,δ: from α(exp)=3.08 *11* (2009Dr04). Also A_2=−0.24 *4* (2009Dr04).
2130.5	25/2$^+$	201.9 *2*	100	1928.6	23/2$^-$	E1		0.0862	B(E1)(W.u.)=6.1×10^{-7} *6* α(K)=0.0689 *10*; α(L)=0.01311 *19*; α(M)=0.00313 *5* α(N)=0.000812 *12*; α(O)=0.000176 *3*; α(P)=2.64×10^{-5} *4*; α(Q)=1.141×10^{-6} *17* E_γ: 202.1 *4* from ^{176}Yb(^{37}Cl,4nγ) (2006Me03). Mult.: α(exp)≤0.14 (2009Dr04), combined analysis for 201.9γ and 247.3γ, with the main contribution being from the latter. A_2=−0.12 *5* (2009Dr04).
2175.9	25/2$^+$	45.4 *3*	5.1 *9*	2130.5	25/2$^+$	M1		28.3 *7*	B(M1)(W.u.)>0.0066 α(L)=21.5 *6*; α(M)=5.12 *13* α(N)=1.34 *4*; α(O)=0.300 *8*; α(P)=0.0482 *12*; α(Q)=0.00270 *7* Mult.: α(exp)=28.0 *8* (2009Dr04).
		247.3 *2*	100 *3*	1928.6	23/2$^-$	E1		0.0533	B(E1)(W.u.)>7.2×10^{-6} α(K)=0.0429 *6*; α(L)=0.00793 *12*; α(M)=0.00189 *3* α(N)=0.000490 *7*; α(O)=0.0001069 *16*; α(P)=1.619×10^{-5} *23*; α(Q)=7.29×10^{-7} *11* E_γ: 247.4 *4* from ^{176}Yb(^{37}Cl,4nγ) (2006Me03). Mult.: α(exp)≤0.14 (2009Dr04), combined analysis for 201.9γ and 247.3γ, with the main contribution being from the latter. A_2=−0.24 *4* (2009Dr04).
2245.1	23/2$^{(+)}$	481.4 *3*	100	1763.7	21/2$^-$	(E1)		0.01231	α(K)=0.01006 *15*; α(L)=0.001716 *25*; α(M)=0.000405 *6* α(N)=0.0001055 *15*; α(O)=2.33×10^{-5} *4*; α(P)=3.62×10^{-6} *5*; α(Q)=1.82×10^{-7} *3* Mult.: A_2=−0.34 *17* (2009Dr04).
2407.6	27/2$^+$	231.7 *2*	100 *8*	2175.9	25/2$^+$	M1(+E2)	<0.4	1.26 *8*	α(K)=1.01 *7*; α(L)=0.193 *4*; α(M)=0.0462 *8* α(N)=0.01210 *20*; α(O)=0.00270 *5*; α(P)=0.000428 *11*; α(Q)=2.29×10^{-5} *15* E_γ: 231.4 *4* from ^{176}Yb(^{37}Cl,4nγ) (2006Me03). Mult.,δ: from α(exp)=1.33 *13* (2009Dr04). Also A_2=−0.58 *4* (2009Dr04).
2424.7	29/2$^+$	(17.1 *7*)	9.5 *19*	2407.6	27/2$^+$	[M1]		126 *17*	α(L)=2.9 *4*; α(M)=92 *13* α(N)=24 *4*; α(O)=5.4 *8*; α(P)=0.87 *12*; α(Q)=0.049 *7* B(M1)(W.u.)>0.037 E_γ: from level energy differences.
		248.8 *3*	100 *19*	2175.9	25/2$^+$	E2		0.261	α(K)=0.1040 *15*; α(L)=0.1160 *18*; α(M)=0.0309 *5* α(N)=0.00811 *12*; α(O)=0.00170 *3*; α(P)=0.000229 *4*; α(Q)=2.61×10^{-6} *4* B(E2)(W.u.)>0.87 Mult.: A_2=+0.18 *11* (2009Dr04).

$^{209}_{87}Fr_{122}$-5

Adopted Levels, Gammas (continued)

γ(^{209}Fr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[#]	α[&]	Comments
2559.1	25/2$^{(-)}$	630.5 *3*	100	1928.6	23/2$^-$	(M1+E2)	0.0881	α(K)=0.0714 *10*; α(L)=0.01270 *18*; α(M)=0.00301 *5* α(N)=0.000790 *12*; α(O)=0.0001766 *25*; α(P)=2.84×10^{-5} *4*; α(Q)=1.589×10^{-6} *23* Mult.: A_2=−0.60 *12* (2009Dr04).
2599.1	27/2$^-$	670.5 *3*	100	1928.6	23/2$^-$	E2	0.0191	α(K)=0.01386 *20*; α(L)=0.00393 *6*; α(M)=0.000983 *14* α(N)=0.000258 *4*; α(O)=5.59×10^{-5} *8*; α(P)=8.33×10^{-6} *12*; α(Q)=3.06×10^{-7} *5* Mult.: A_2=+0.33 *9* (2009Dr04).
2696.7	27/2$^+$	566.2 *3*	100	2130.5	25/2$^+$	M1+E2	0.1171	α(K)=0.0948 *14*; α(L)=0.01693 *24*; α(M)=0.00402 *6* α(N)=0.001053 *15*; α(O)=0.000236 *4*; α(P)=3.78×10^{-5} *6*; α(Q)=2.12×10^{-6} *3* Mult.: A_2=−0.65 *14* (2009Dr04).
2717.4	(29/2)	309.8 *3*	100	2407.6	27/2$^+$			
2857.7?		140.3[b] *3*	100	2717.4	(29/2)			
2903.3?	29/2$^+$	727.4[‡] *3*	100	2175.9	25/2$^+$	E2	0.01610	α(K)=0.01190 *17*; α(L)=0.00316 *5*; α(M)=0.000785 *11* α(N)=0.000206 *3*; α(O)=4.48×10^{-5} *7*; α(P)=6.72×10^{-6} *10*; α(Q)=2.60×10^{-7} *4* Mult.: A_2=+0.26 *9* (2009Dr04).
2917.9	29/2$^{(+)}$	787.4 *3*	100	2130.5	25/2$^+$	(E2)	0.01369	α(K)=0.01028 *15*; α(L)=0.00257 *4*; α(M)=0.000635 *9* α(N)=0.0001664 *24*; α(O)=3.63×10^{-5} *6*; α(P)=5.50×10^{-6} *8*; α(Q)=2.23×10^{-7} *4* Mult.: A_2=+0.30 *11*.
2937.8	(27/2)	692.7 *3*	100	2245.1	23/2$^{(+)}$			
3027.4	31/2$^+$	602.7 *3*	100	2424.7	29/2$^+$	M1+E2	0.0992	α(K)=0.0804 *12*; α(L)=0.01432 *21*; α(M)=0.00340 *5* α(N)=0.000891 *13*; α(O)=0.000199 *3*; α(P)=3.20×10^{-5} *5*; α(Q)=1.79×10^{-6} *3* Mult.: A_2=−0.57 *8* (2009Dr04).
3115.4	33/2$^+$	690.7 *2*	100	2424.7	29/2$^+$	E2	0.0179	α(K)=0.01311 *19*; α(L)=0.00363 *5*; α(M)=0.000904 *13* α(N)=0.000237 *4*; α(O)=5.15×10^{-5} *8*; α(P)=7.70×10^{-6} *11*; α(Q)=2.88×10^{-7} *4* E_γ: 690.9 *4* from ^{176}Yb(^{37}Cl,4nγ) (2006Me03). Mult.: A_2=+0.25 *5* (2009Dr04).
3127.4	31/2$^-$	528.3 *3*	100	2599.1	27/2$^-$	E2	0.0324	α(K)=0.0219 *3*; α(L)=0.00785 *11*; α(M)=0.00200 *3* α(N)=0.000523 *8*; α(O)=0.0001126 *16*; α(P)=1.636×10^{-5} *23*; α(Q)=4.95×10^{-7} *7* Mult.: A_2=+0.44 *16* (2009Dr04).
3153.1	31/2	435.7 *3*		2717.4	(29/2)			
		728.4 *3*	100 *33*	2424.7	29/2$^+$			
		745.5 *3*	73 *7*	2407.6	27/2$^+$	Q		Mult.: A_2=+0.22 *11* (2009Dr04).
3234.5	31/2$^{(+)}$	331.2[‡] *3*	44 *3*	2903.3?	29/2$^+$	(M1+E2)	0.496	α(K)=0.401 *6*; α(L)=0.0725 *11*; α(M)=0.01725 *25* α(N)=0.00452 *7*; α(O)=0.001011 *15*; α(P)=0.0001622 *23*; α(Q)=9.05×10^{-6} *13* Mult.: A_2=−0.40 *13* (2009Dr04).
		809.8 *3*	100 *9*	2424.7	29/2$^+$	(M1+E2)	0.0456	α(K)=0.0370 *6*; α(L)=0.00654 *10*; α(M)=0.001550 *22* α(N)=0.000406 *6*; α(O)=9.08×10^{-5} *13*; α(P)=1.459×10^{-5} *21*; α(Q)=8.20×10^{-7} *12* Mult.: A_2=−0.10 *8* (2009Dr04).
3369.6	33/2$^+$	342.2 *3*	100	3027.4	31/2$^+$	M1+E2	0.454	α(K)=0.367 *6*; α(L)=0.0663 *10*; α(M)=0.01576 *23* α(N)=0.00413 *6*; α(O)=0.000924 *14*; α(P)=0.0001482 *21*; α(Q)=8.28×10^{-6} *12* Mult.: A_2=−0.45 *20* (2009Dr04).

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Adopted Levels, Gammas (continued)

$\gamma(^{209}Fr)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[#]	δ[@a]	α[&]	Comments
3409.4	$33/2^{(+)}$	174.9 *3*	100	3234.5	$31/2^{(+)}$	M1+E2	1.1 *+4−3*	1.8 *4*	α(K)=1.2 *4*; α(L)=0.476 *15*; α(M)=0.122 *6* α(N)=0.0320 *16*; α(O)=0.0069 *3*; α(P)=0.000981 *16*; α(Q)=2.8×10^{-5} *8* Mult.: α(exp)=0.24 *15*, A_2=−0.19 *20* (2009Dr04).
3415.9	$33/2^{(-)}$	181.4 *3*	100	3234.5	$31/2^{(+)}$	E1(+M2)	≤0.15	0.25 *14*	α(K)=0.19 *10*; α(L)=0.05 *4*; α(M)=0.013 *9* α(N)=0.0033 *23*; α(O)=0.0007 *5*; α(P)=0.00011 *8*; α(Q)=5.E−6 *4* B(E1)(W.u.)>4.1×10^{-7}?; B(M2)(W.u.)<1.3? Mult.,δ: from α(exp)=0.24 *15* (2009Dr04). Also A_2=−0.19 *20* (2009Dr04).
3630.9	$37/2^+$	515.5 *2*	100	3115.4	$33/2^+$	E2		0.0343	α(K)=0.0230 *4*; α(L)=0.00846 *12*; α(M)=0.00216 *3* α(N)=0.000565 *8*; α(O)=0.0001216 *17*; α(P)=1.761×10^{-5} *25*; α(Q)=5.21×10^{-7} *8* E_γ: 515.2 *4* from ^{176}Yb(^{37}Cl,4nγ) (2006Me03). Mult.: A_2=+0.38 *10* (2009Dr04).
3923.4	$35/2^{(+)}$	514.0 *3*	100	3409.4	$33/2^{(+)}$	(M1+E2)		0.1515	α(K)=0.1226 *18*; α(L)=0.0219 *3*; α(M)=0.00521 *8* α(N)=0.001366 *20*; α(O)=0.000305 *5*; α(P)=4.90×10^{-5} *7*; α(Q)=2.74×10^{-6} *4* Mult.: A_2=−0.53 *24* (2009Dr04).
3968.7	35/2	559.3 *3*	100	3409.4	$33/2^{(+)}$	D+Q			A_2=−0.19 *4* (2009Dr04).
4039.6	$39/2^+$	408.7 *2*	100	3630.9	$37/2^+$	M1+E2	1.10 *+17−15*	0.160 *19*	α(K)=0.123 *16*; α(L)=0.0283 *20*; α(M)=0.0069 *5* α(N)=0.00182 *12*; α(O)=0.00040 *3*; α(P)=6.1×10^{-5} *5*; α(Q)=2.8×10^{-6} *4* E_γ: 408.8 *4* from ^{176}Yb(^{37}Cl,4nγ) (2006Me03). Mult.,δ: from α(K)exp=0.145 *14*, α(L)exp=0.012 *4* (2009Dr04). Also α(exp)=0.25 *13* and A_2=−0.46 *7* (2009Dr04).
4166.4	(37/2)	757.0 *3*	100	3409.4	$33/2^{(+)}$				
4324.3	$41/2^+$	284.7 *3*	100	4039.6	$39/2^+$	M1+E2		0.752	α(K)=0.607 *9*; α(L)=0.1101 *16*; α(M)=0.0262 *4* α(N)=0.00687 *10*; α(O)=0.001535 *22*; α(P)=0.000246 *4*; α(Q)=1.374×10^{-5} *20* Mult.: A_2=−0.32 *13* (2009Dr04).
4364.1	$39/2^+$	733.2 *3*	100	3630.9	$37/2^+$	M1+E2		0.0592	α(K)=0.0480 *7*; α(L)=0.00850 *12*; α(M)=0.00202 *3* α(N)=0.000529 *8*; α(O)=0.0001182 *17*; α(P)=1.90×10^{-5} *3*; α(Q)=1.065×10^{-6} *15* Mult.: A_2=−0.63 *17* (2009Dr04).
4423.6	$41/2^{(+)}$	792.7 *3*	100	3630.9	$37/2^+$	(E2)		0.01351	α(K)=0.01015 *15*; α(L)=0.00253 *4*; α(M)=0.000624 *9* α(N)=0.0001635 *23*; α(O)=3.57×10^{-5} *5*; α(P)=5.40×10^{-6} *8*; α(Q)=2.20×10^{-7} *3* Mult.: A_2=+0.33 *14* (2009Dr04).
4659.8	$45/2^-$	335.5[b] *3*	13 *3*	4324.3	$41/2^+$	(M2)		1.602	α(K)=1.188 *17*; α(L)=0.311 *5*; α(M)=0.0779 *12* α(N)=0.0206 *3*; α(O)=0.00458 *7*; α(P)=0.000722 *11*; α(Q)=3.77×10^{-5} *6*

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Adopted Levels, Gammas (continued)

$\gamma(^{209}Fr)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[#]	α[&]	Comments
								B(M2)(W.u.)=0.046 *12* Mult.: A_2=+0.1 *3* (2009Dr04).
4659.8	45/2$^-$	620.2 *3*	100 *7*	4039.6	39/2$^+$	E3	0.0686	α(K)=0.0386 *6*; α(L)=0.0223 *4*; α(M)=0.00586 *9* α(N)=0.001544 *22*; α(O)=0.000331 *5*; α(P)=4.75×10^{-5} *7*; α(Q)=1.178×10^{-6} *17* B(E3)(W.u.)=22 *3* E_γ: 619.5 *5* from ^{176}Yb(^{37}Cl,4nγ) (2006Me03). Mult.: α(K)exp=0.042 *8*, K/L=1.6 *3*, A_2=+0.07 *12* (2009Dr04).
5046.2?		386.4[b] *3*	100	4659.8	45/2$^-$			
5069.3	(43/2)	745.0 *3*	100	4324.3	41/2$^+$			
5194.6	47/2$^{(-)}$	534.8 *3*	100	4659.8	45/2$^-$	(M1+E2)	0.1363 *20*	α(K)=0.1104 *16*; α(L)=0.0197 *3*; α(M)=0.00469 *7* α(N)=0.001228 *18*; α(O)=0.000274 *4*; α(P)=4.41×10^{-5} *7*; α(Q)=2.47×10^{-6} *4* Mult.: A_2=−0.45 *11* (2009Dr04).
5302.1	(47/2)	642.3 *3*	100	4659.8	45/2$^-$	D+Q		Mult.: A_2=−0.23 *19* (2009Dr04).
5399.5	49/2$^-$	739.7 *3*	100	4659.8	45/2$^-$	E2	0.01556	α(K)=0.01154 *17*; α(L)=0.00302 *5*; α(M)=0.000750 *11* α(N)=0.000196 *3*; α(O)=4.28×10^{-5} *6*; α(P)=6.44×10^{-6} *9*; α(Q)=2.52×10^{-7} *4* Mult.: A_2=+0.39 *8* (2009Dr04).
5413.9?		754.1[b] *3*	100	4659.8	45/2$^-$			
5480.3?		820.5[b] *3*	100	4659.8	45/2$^-$			
5488.5	47/2$^-$	828.7 *3*	100	4659.8	45/2$^-$	M1+E2	0.0429	α(K)=0.0348 *5*; α(L)=0.00615 *9*; α(M)=0.001459 *21* α(N)=0.000382 *6*; α(O)=8.55×10^{-5} *12*; α(P)=1.373×10^{-5} *20*; α(Q)=7.71×10^{-7} *11* Mult.: A_2=−0.66 *6* (2009Dr04).
5657.2	47/2$^{(-)}$	997.4 *3*	100	4659.8	45/2$^-$	(M1+E2)	0.0265	α(K)=0.0215 *3*; α(L)=0.00377 *6*; α(M)=0.000895 *13* α(N)=0.000234 *4*; α(O)=5.24×10^{-5} *8*; α(P)=8.43×10^{-6} *12*; α(Q)=4.74×10^{-7} *7* Mult.: A_2=−0.56 *13* (2009Dr04).
5765.2	(47/2)	1105.4 *3*	100	4659.8	45/2$^-$	(D+Q)		Mult.: A_2=−0.32 *13* (2009Dr04).
5903.4	49/2$^-$	414.9 *3*	100	5488.5	47/2$^-$	M1+E2	0.269	α(K)=0.218 *3*; α(L)=0.0392 *6*; α(M)=0.00931 *14* α(N)=0.00244 *4*; α(O)=0.000545 *8*; α(P)=8.75×10^{-5} *13*; α(Q)=4.89×10^{-6} *7* Mult.: A_2=−0.50 *16* (2009Dr04).

[†] From 2009Dr04 in ^{197}Au(^{16}O,4nγ).
[‡] The ordering of the 331γ-727γ cascade is not firmly established.
[#] From 2009Dr04 in ^{197}Au(^{16}O,4nγ), based on ce data, anisotropies and transition strengths.
[@] From 2009Dr04 in ^{197}Au(^{16}O,4nγ), based on measured ce data.
[&] Additional information 3.
[a] Additional information 4.
[b] Placement of transition in the level scheme is uncertain.

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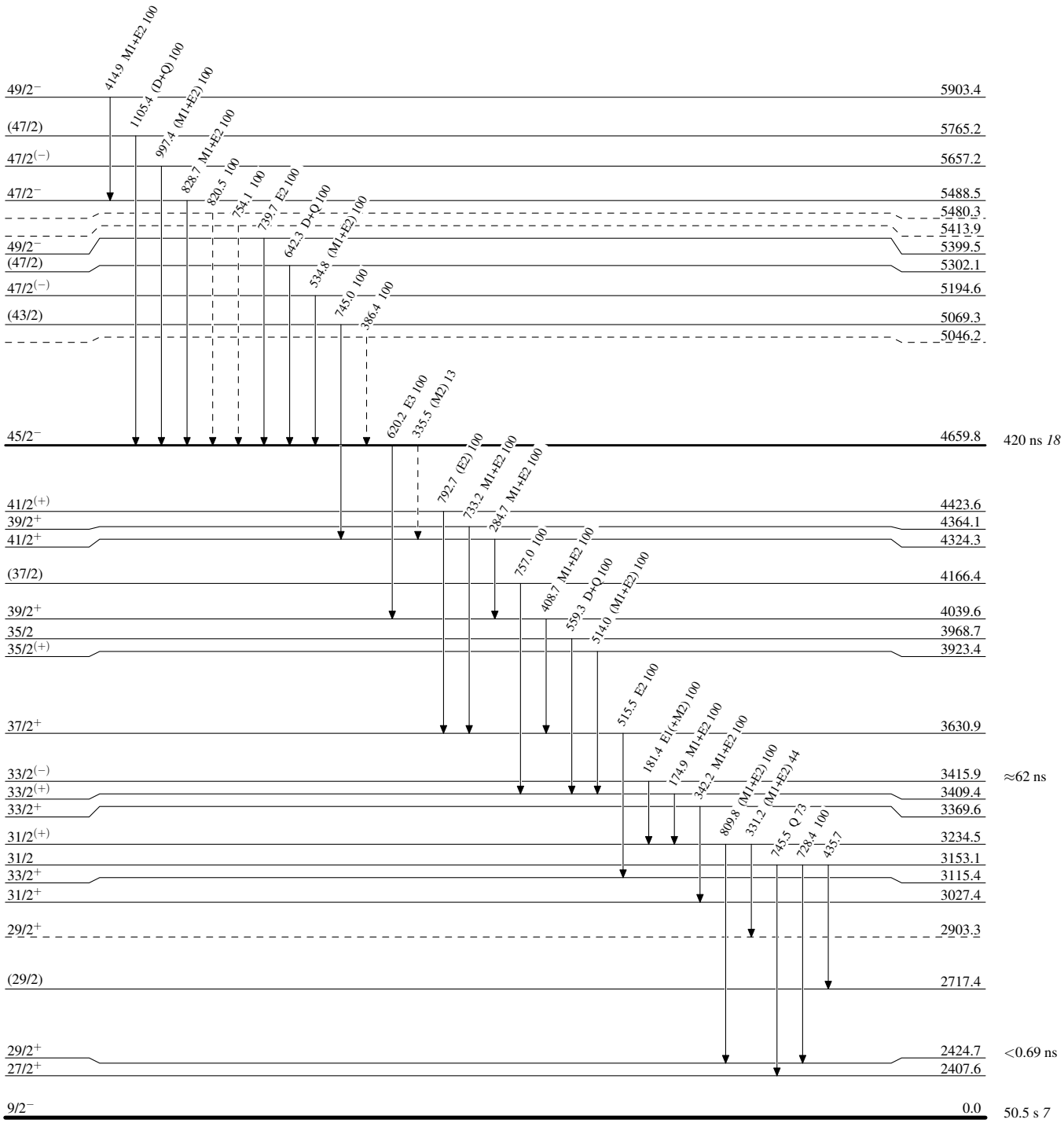
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



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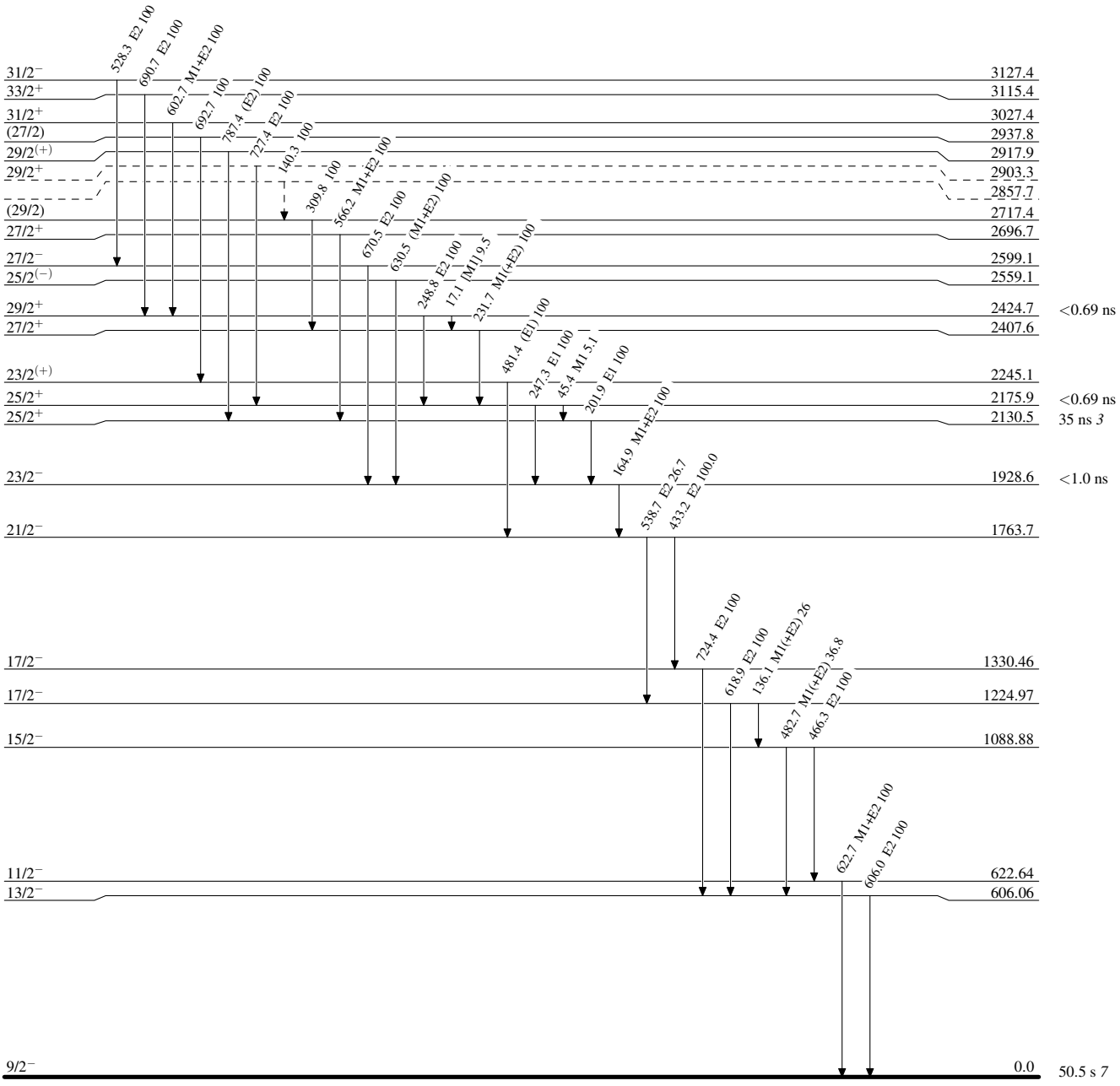
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



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