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^-)=314 *7*; S(n)=6276 *7*; S(p)=4624 *5*; Q(α)=6457.8 *14* 2012Wa38
Note: Current evaluation has used the following Q record 314 6 *6276* 6 *4624* 5 *6457.8* *14* 2003Au03.

^{221}Fr Levels

1977LiYX and 1990Li46 suggest strong coriolis coupling among parity doublet bands, K^π=1/2± and 3/2±. See 1977LiYX for levels calculated including couplings between 1/2[541], 3/2[521] and 3/2[532] bands, and for amplitudes of each state in these bands. See 1988Le13 for energies of states calculated in a model by coupling a deformed shell model including octupole deformation to a reflection-asymmetric rotor core. See 1992Kv03 for intrepretation of levels in terms of quasipartice plus phonon model.

Cross Reference (XREF) Flags

A ^{225}Ac α decay
B ^{221}Rn β^- decay

E(level)	$J^{\pi\dagger}$	$T_{1/2}$	XREF	Comments
0.0‡	5/2$^-$	4.9 min *2*	AB	%α=100; %β^-<0.1 μ=+1.58 *3* (1985Co24,1987Du13,2005St24) Q=−0.98 *6* (1985Co24,2005St24) Limit on %β^- was determined from absence of ^{221}Ra α groups in the decay of ^{221}Fr (1964Va20). ^{14}C decay observed by 1994Bo28, 1986Ba26,1985Pr01. See 1989Ci03, 1988Sh29, 1988Bl11, 1987Sh04, 1987Po08, 1986Ir01,1986Gr20 and 1990Sh01 for calculations of partial $T_{1/2}$(^{14}C); see 1986Po06 for calculations of decay rates by ^{14}C, ^{12}C, ^{8}Be, ^{15}N, ^{13}C, ^{11}B, ^{16}O and ^{15}C emission. μ: For calculated values, see 1986Ek02 and 1988Le13. Q: LASER spectroscopy. J^π: spin measured by 1978Ek02 (atomic-beam magnetic resonance). Parity from magnetic moment. See 1986Ek02 and 1987Co19 for deduced deformation parameters. Isotope shift relative to ^{212}Fr (d2 line): −23570 *2* MHZ (1986Ba45), −23569 *8* MHZ (1987Co19). $T_{1/2}$: from 1967LoZZ. Other values: 5 min (1947En03), 4.8 min (1950Ha52).
26.00‡ *4*	(1/2)$^-$		AB	J^π: parity from E1 character of 73.9γ from 99.85-keV level. The 526.09γ from (3/2$^-$) state at 552.05 keV rules out 9/2$^-$ assignment. The 74.6-keV transition from 100.89−keV level is (M1+E2) in conflict with Δ′ (J).
36.64@ *4*	(3/2)$^-$	1.5 ns *2*	AB	$T_{1/2}$: from (α)(ce)(t) data of 1978LiZN.
38.54‡ *6*	(9/2)$^-$		AB	J^π: 38.5 E2 γ to 5/2$^-$ g.s. and the log *ft* value of 7.4 for the β branch from 7/2$^{(+)}$ ^{221}Rn limit J^π to 5/2$^-$, 7/2$^-$, 9/2$^-$. J(38.5 level)=9/2 deduced by 1975PeZO from their (α)(γ)(θ) data (not given in the report) is also consistent with $\alpha\gamma$ coin measurements of 2003Ku44.
99.62‡ *5*	(3/2)$^-$	80 ps *30*	AB	$T_{1/2}$: determined by 1978AgZX (Doppler-shift method). J^π: 134.86 γ from (5/2)$^+$ state at 234.51 keV is E1(2003Ku44).
99.85# *7*	(3/2)$^+$	160 ps *30*	AB	$T_{1/2}$: determined by 1978AgZX (Doppler-shift method). J^π: 99.8γ to 5/2$^-$ g.s. is E1; β branch from 7/2$^{(+)}$ ^{221}Rn suggests J^π≠3/2$^+$.
100.89@ *5*	(5/2)$^-$		AB	J^π: parity is from 64.3 keV, M1+E2 transition to 36.64 keV level. The 100.8γ M1+(E2) to 5/2$^-$ g.s. and log *ft* for β branch from 7/2$^{(+)}$ ^{221}Rn limit spin to 5/2 and 7/2. J^π=5/2$^-$, since J^π(36.6 level)=3/2$^-$ (2003Ku44).

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Adopted Levels, Gammas (continued)

^{221}Fr Levels (continued)

E(level)	J^{π} [†]	$T_{1/2}$	XREF	Comments
108.41[@] *5*	(7/2)$^-$	≈280 ps	AB	$T_{1/2}$: determined by 1978AgZX (Doppler-shift method). J^{π}: 108.4γ to g.s. is M1+E2; log *ft* for the β^- feeding from ^{221}Rn. 126.15 keV γ from 234.51 keV level at (5/2)$^+$ to this level is (E1).
145.91[#] *8*	(1/2)$^+$		A	
150.07[#] *6*	(7/2)$^+$	80 ps *20*	AB	$T_{1/2}$: determined by 1978AgZX (Doppler-shift method). J^{π}: 150.1γ to g.s. is E1; 111.5γ to (9/2)$^-$ state. Spin and parity assignments are consistent with αγ coin measurements of 2003Ku44.
195.77[‡] *7*	(7/2)$^-$	20 ps *5*	AB	$T_{1/2}$: determined by 1978AgZX (Doppler-shift method). J^{π}: 195.8γ to 5/2$^-$ g.s. and 157.3γ to (9/2)$^-$, 38.54 keV level are M1+E2.
224.64[&] *6*	(3/2)$^+$	35 ps *10*	AB	$T_{1/2}$: determined by 1978AgZX (Doppler-shift method). J^{π}: E1 188.0γ to (3/2)$^-$; M1 78.8γ to (1/2)$^+$.
234.51[#] *6*	(5/2)$^+$		AB	J^{π}: 134.86 and 126.15 γ's to (3/2)$^-$ state at 99.62 and (7/2)$^-$ state at 108.41 keV are (E1).
253.56[&] *4*	(5/2)$^+$	35 ps *15*	AB	$T_{1/2}$: determined by 1978AgZX (Doppler-shift method). J^{π}: parity from (E1) transitions to negative parity levels; 253.54γ to 5/2$^-$ g.s. and the log *ft* value for the β branch from 7/2$^{(+)}$ ^{221}Rn limit J^{π} to 5/2$^+$, 7/2$^+$. Since J^{π}(36.64 level)=3/2$^-$, J^{π}(253.56 level)=5/2$^+$.
272.6 *6*	(7/2$^-$,9/2$^-$)		A	
279.21[&] *10*	(7/2)$^+$		AB	J^{π}: parity from E1 character of 178.3γ to 100.89-keV level; 279.3γ to 5/2$^-$ g.s. and 240.7γ to (9/2)$^-$ state at 38.54 keV limit J^{π} to 7/2$^+$.
288.08 *16*	(9/2)$^-$		A	
294.66[&] *14*	(9/2)$^+$		AB	J^{π}: 186.3γ to 108.41 level is E1; 144.7−keV, (M1+E2) transition to (7/2)$^+$ 150.07 level and 256.0-keV transition to (9/2)$^-$ state at 38.54 keV limit J^{π} to 7/2$^+$,9/2$^+$. 1977Vy02 suggest J^{π}=9/2$^+$ from absence of transition to g.s which is consistent with αγ coin measurements of 2003Ku44.
393.35 *7*	(5/2,7/2)$^+$		AB	J^{π}: 197.77γ to (7/2)$^-$ state at 195.77 keV is (E1); Spin and parity assignments are consistent with αγ coin measurements of 2003Ku44.
400.75 *19*	(7/2$^-$)		A	
410.2 *12*			A	
497.3 *4*			A	
517.81 *12*	(5/2$^+$)[b]		A	
552.05 *5*	(3/2)$^-$[c]		A	J^{π}: favored α decay from (3/2$^-$) ^{225}Ac rules out the possibility of 5/2$^-$ assignment of 2003Ku44.
570.81 *16*	(5/2$^+$,7/2$^+$)[b]		A	
602.2 *7*	(5/2$^-$)		A	
630.71 *13*	(5/2$^+$)[a]		A	
637.72 *10*			A	
712 *5*			A	
714.2 *6*			A	
749.16 *20*			A	
780.2 *4*			A	
824.2 *7*			A	

† From band assignments, model calculations (1992Kv03), and alpha decay (2003Ku44), unless given explicitly.

‡ Band(A): K^{π}=1/2$^-$, 1/2[541] (1992Kv03). Assignment was suggested by 1977LiYX, 1988Sh12 and 1992Kv03. The band was interpreted by 1988Sh12 in terms of the 1/2$^-$ octupole deformed band.

Band(B): K^{π}=1/2$^+$, 1/2[411]+(1/2[541]+Q_{30}) (1992Kv03). Aassignment was suggested by 1992Kv03 and 1990Li46.

@ Band(C): K^{π}=3/2$^-$, 3/2[532]+(3/2[402]+Q_{30})(1992Kv03). Assignment was suggested by 1988Sh12 and 1992Kv03. Strongly coriolis mixed with 5/2± parity doublets (1990Li46).

& Band(D): K^{π}=3/2$^+$, 3/2[402]+(3/2[532]+Q_{30}) (1992Kv03) Assignment was suggested by 1992Kv03 and 1990Li46.

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Adopted Levels, Gammas (continued)

^{221}Fr Levels (continued)

[a] Configuration 5/2[523] +(1/2[541]+Q_{22}) suggested by 1992Kv03.
[b] Configuration 5/2[402]+(5/2[523]+Q_{30}) suggested by 1992Kv03.
[c] Configuration 3/2[521]+(7/2[514]+Q_{22}) suggested by 1992Kv03.

$\gamma(^{221}Fr)$

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[#]	δ[#]	α[@]	$I_{(\gamma+ce)}$	Comments
26.00	(1/2)⁻	26.0 *1*	100 *33*	0.0	5/2⁻	(E2)		5.94×10³ *15*		α(L)=4.39×10³ *11*; α(M)=1.18×10³ *3*; α(N+..)=378 *9* α(N)=307 *8*; α(O)=63.3 *15*; α(P)=8.01 *19*; α(Q)=0.00946 *22*
36.64	(3/2)⁻	10.642 *2*		26.00	(1/2)⁻				5.2×10⁴ *12*	$I_{(\gamma+ce)}$: from I(γ+ce)(10.642γ)/I(γ+ce)(36.7γ)=0.47 *11*.
		36.7 *1*	100 *9*	0.0	5/2⁻	E2(+M1)		6.×10² *6*		B(E2)(W.u.)=44 *7* α(L)=4.E2 4; α(M)=1.1×10² *11*; α(N+..)=4.E1 4 α(N)=3.E1 3; α(O)=6 *6*; α(P)=0.8 *7*; α(Q)=0.0035 *16* Mult.: M1 admixture <10% (2003Ku44).
38.54	(9/2)⁻	38.5 *1*	100 *9*	0.0	5/2⁻	E2		863 *17*		α(L)=637 *12*; α(M)=171 *4*; α(N+..)=55.1 *11* α(N)=44.7 *9*; α(O)=9.23 *18*; α(P)=1.173 *23*; α(Q)=0.00158 *3*
99.62	(3/2)⁻	62.9 *1*	61.4 *29*	36.64	(3/2)⁻	M1		10.87		α(L)=8.25 *13*; α(M)=1.97 *3*; α(N+..)=0.651 *10* α(N)=0.516 *8*; α(O)=0.1154 *17*; α(P)=0.0185 *3*; α(Q)=0.001035 *16* B(M1)(W.u.)=0.056 *22*
		73.5 *1*	3.6 *10*	26.00	(1/2)⁻	E2+M1		22 *16*		B(E2)(W.u.)=48 *22* α(L)=16 *12*; α(M)=4 *4*; α(N+..)=1.4 *10* α(N)=1.1 *9*; α(O)=0.24 *17*; α(P)=0.032 *21*; α(Q)=0.0004 *3*
		99.6 *5*	100 *9*	0.0	5/2⁻	M1+E2	0.18 *5*	3.04 *14*		α(L)=2.30 *10*; α(M)=0.56 *3*; α(N+..)=0.183 *9* α(N)=0.146 *7*; α(O)=0.0323 *15*; α(P)=0.00509 *18*; α(Q)=0.000264 *7* B(M1)(W.u.)=0.022 *9*; B(E2)(W.u.)=23 *16*
99.85	(3/2)⁺	73.9 *1*	26.4 *17*	26.00	(1/2)⁻	E1		0.240		α(L)=0.182 *3*; α(M)=0.0439 *7*; α(N+..)=0.01401 *21* α(N)=0.01129 *17*; α(O)=0.00238 *4*; α(P)=0.000329 *5*; α(Q)=1.091×10⁻⁵ *16* B(E1)(W.u.)=0.00053 *12*
		99.8 *1*	100 *11*	0.0	5/2⁻	E1(+M2)		0.1076		α(L)=0.0816 *12*; α(M)=0.0196 *3*; α(N+..)=0.00631 *9* α(N)=0.00507 *8*; α(O)=0.001080 *16*; α(P)=0.0001538 *22*; α(Q)=5.58×10⁻⁶ *8* B(E1)(W.u.)=0.00081 *19*
100.89	(5/2)⁻	64.3 *1*	47 *5*	36.64	(3/2)⁻	M1+E2	0.45 *13*	20 *6*		α(L)=15 *4*; α(M)=3.9 *11*; α(N+..)=1.3 *4* α(N)=1.0 *3*; α(O)=0.22 *6*; α(P)=0.031 *7*; α(Q)=0.00084 *7*
		74.6 *4*	29 *9*	26.00	(1/2)⁻	(E2)		35.0 *11*		α(L)=25.8 *8*; α(M)=6.98 *21*; α(N+..)=2.26 *7* α(N)=1.83 *6*; α(O)=0.378 *12*; α(P)=0.0485 *15*;

$^{221}_{87}Fr_{134}$-4

Adopted Levels, Gammas (continued)

γ(^{221}Fr) (continued)

E$_i$(level)	J^π_i	E$_γ$ †	I$_γ$ ‡	E$_f$	J^π_f	Mult.#	δ#	α@	Comments
									α(Q)=9.11×10^{-5} 24 Mult.: Adopted from Δ′ (J^π). Measured M1+E2.
100.89	(5/2)$^-$	100.8 2	100 8	0.0	5/2$^-$	M1+(E2)		6 3	α(L)=4.2 21; α(M)=1.1 6; α(N+..)=0.36 19 α(N)=0.29 16; α(O)=0.06 4; α(P)=0.008 4; α(Q)=0.00015 12
108.41	(7/2)$^-$	69.87 5	1.9 5	38.54	(9/2)$^-$	E2+M1		28 20	B(E2)(W.u.)≈49 α(L)=21 15; α(M)=5 4; α(N+..)=1.8 13 α(N)=1.4 11; α(O)=0.30 22; α(P)=0.04 3; α(Q)=0.0004 4
		71.4 3	5.8 12	36.64	(3/2)$^-$	(E2)		43.2 11	α(L)=31.8 8; α(M)=8.60 22; α(N+..)=2.78 7 α(N)=2.25 6; α(O)=0.466 12; α(P)=0.0597 15; α(Q)=0.0001083 24 B(E2)(W.u.)≈55 Mult.: Adopted from Δ′ (J^π). Measured M1+E2.
		108.4 1	100 5	0.0	5/2$^-$	M1+E2	0.53 13	10.3 5	α(K)=7.2 8; α(L)=2.30 24; α(M)=0.58 7; α(N+..)=0.190 22 α(N)=0.152 18; α(O)=0.033 4; α(P)=0.0048 4; α(Q)=0.000171 16 B(M1)(W.u.)≈0.0033; B(E2)(W.u.)≈26
145.91	(1/2)$^+$	46.2 2	5.9 9	99.62	(3/2)$^-$			0.841	
		119.9 1	100 5	26.00	(1/2)$^-$			0.305	
150.07	(7/2)$^+$	49.1 2	1.1 1	100.89	(5/2)$^-$	(E1)		0.716 13	α(L)=0.542 10; α(M)=0.1322 24; α(N+..)=0.0418 8 α(N)=0.0338 6; α(O)=0.00699 13; α(P)=0.000918 16; α(Q)=2.65×10^{-5} 5 B(E1)(W.u.)=0.00012 4
		111.5 1	44 2	38.54	(9/2)$^-$	(E1)		0.363	α(K)=0.283 4; α(L)=0.0609 9; α(M)=0.01462 21; α(N+..)=0.00470 7 α(N)=0.00378 6; α(O)=0.000808 12; α(P)=0.0001162 17; α(Q)=4.35×10^{-6} 7 B(E1)(W.u.)=0.00041 11
		150.1 1	100 5	0.0	5/2$^-$	E1		0.1764	α(K)=0.1396 20; α(L)=0.0280 4; α(M)=0.00669 10; α(N+..)=0.00216 3 α(N)=0.001733 25; α(O)=0.000374 6; α(P)=5.49×10^{-5} 8; α(Q)=2.22×10^{-6} 4 B(E1)(W.u.)=0.00038 10
195.77	(7/2)$^-$	87.4 1	70.6 41	108.41	(7/2)$^-$	M1		4.17	B(M1)(W.u.)=0.10 3 α(L)=3.16 5; α(M)=0.754 11; α(N+..)=0.249 4 α(N)=0.198 3; α(O)=0.0442 7; α(P)=0.00709 11; α(Q)=0.000396 6
		94.9 1	26.3 25	100.89	(5/2)$^-$	M1(+E2)		7 4	B(M1)(W.u.)=0.028 8 α(L)=5 3; α(M)=1.4 9; α(N+..)=0.5 3 α(N)=0.37 22; α(O)=0.08 5; α(P)=0.011 5; α(Q)=0.00017 14
		96.7 5	8.8 16	99.62	(3/2)$^-$	(E2)		10.3 3	α(L)=7.55 22; α(M)=2.05 6; α(N+..)=0.662 19 α(N)=0.536 16; α(O)=0.111 4; α(P)=0.0143 4; α(Q)=3.54×10^{-5} 8 B(E2)(W.u.)=3.2×10^2 12 Mult.: Adopted from Δ′ (J^π). Measured M1+E2, δ=0.69 27, α=6.0 14.

$^{221}_{87}$Fr$_{134}$-5

Adopted Levels, Gammas (continued)

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

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[#]	δ[#]	α[@]	Comments
									This γ was interpreted by 1988Sh12 to be doublet with about 85% E2 and 15% M2 transitions decaying to the 99.62 and 99.85 keV levels, respectively. The assumed M2 part would be highly enhanced, having a B(M2)(W.u.) value of about 3200 which rules out this assumption.
195.77	(7/2)$^-$	157.3 *2*	100 *6*	38.54	(9/2)$^-$	M1+E2		2.7 *13*	B(M1)(W.u.)=0.023 *7*; B(E2)(W.u.)≤13 α(K)=1.7 *15*; α(L)=0.70 *12*; α(M)=0.18 *4*; α(N+..)=0.059 *13* α(N)=0.047 *11*; α(O)=0.0101 *20*; α(P)=0.00144 *14*; α(Q)=4.E−5 *4*
		169.9	3.8 *3*	26.00	(1/2)$^-$				
		195.8 *2*	38.4 *19*	0.0	5/2$^-$	M1+E2	0.8 *2*	1.53 *20*	α(K)=1.11 *20*; α(L)=0.314 *5*; α(M)=0.0785 *17*; α(N+..)=0.0258 *5* α(N)=0.0206 *5*; α(O)=0.00448 *8*; α(P)=0.000667 *15*; α(Q)=2.6×10^{-5} *5* B(M1)(W.u.)=0.0030 *12*; B(E2)(W.u.)=16 *8* B(E2)(W.u.): B(E2)(W.u.)<≈47.
224.64	(3/2)$^+$	78.8	2.4 *3*	145.91	(1/2)$^+$	M1		5.63	α(L)=4.27 *6*; α(M)=1.019 *15*; α(N+..)=0.337 *5* α(N)=0.267 *4*; α(O)=0.0597 *9*; α(P)=0.00958 *14*; α(Q)=0.000536 *8* B(M1)(W.u.)=0.015 *5*
		123.8 *1*	16.0 *9*	100.89	(5/2)$^-$	[E1]		0.282	α(K)=0.221 *4*; α(L)=0.0462 *7*; α(M)=0.01108 *16*; α(N+..)=0.00357 *5* α(N)=0.00287 *4*; α(O)=0.000615 *9*; α(P)=8.92×10^{-5} *13*; α(Q)=3.43×10^{-6} *5* B(E1)(W.u.)=0.00021 *7*
		124.8 *1*	5.33 *22*	99.85	(3/2)$^+$	M1+E2		5.6 *21*	B(M1)(W.u.)≈0.005; B(E2)(W.u.)≈68 α(K)=3 *3*; α(L)=1.7 *6*; α(M)=0.45 *18*; α(N+..)=0.15 *6* α(N)=0.12 *5*; α(O)=0.025 *10*; α(P)=0.0035 *10*; α(Q)=8.E−5 *7*
		186.1	2.44 *22*	38.54	(9/2)$^-$				
		188.0 *1*	100 *4*	36.64	(3/2)$^-$	E1		0.1023	α(K)=0.0816 *12*; α(L)=0.01570 *22*; α(M)=0.00375 *6*; α(N+..)=0.001216 *17* α(N)=0.000972 *14*; α(O)=0.000211 *3*; α(P)=3.14×10^{-5} *5*; α(Q)=1.338×10^{-6} *19* B(E1)(W.u.)=0.00038 *11*
		198.4 *3*	3.78 *22*	26.00	(1/2)$^-$	[E1]		0.0899	α(K)=0.0718 *11*; α(L)=0.01370 *20*; α(M)=0.00327 *5*; α(N+..)=0.001061 *16* α(N)=0.000848 *13*; α(O)=0.000184 *3*; α(P)=2.75×10^{-5} *4*; α(Q)=1.186×10^{-6} *17* B(E1)(W.u.)=1.2×10^{-5} *4*
		224.7 *1*	21.8 *11*	0.0	5/2$^-$	[E1]		0.0668	α(K)=0.0536 *8*; α(L)=0.01004 *14*; α(M)=0.00239 *4*; α(N+..)=0.000777 *11* α(N)=0.000621 *9*; α(O)=0.0001352 *19*; α(P)=2.04×10^{-5} *3*; α(Q)=9.00×10^{-7} *13* B(E1)(W.u.)=4.8×10^{-5} *15*
234.51	(5/2)$^+$	126.15 *10*	21.2 *61*	108.41	(7/2)$^-$	(E1)		0.269	α(K)=0.211 *3*; α(L)=0.0440 *7*; α(M)=0.01055 *15*; α(N+..)=0.00340 *5*

Adopted Levels, Gammas (continued)

γ(^{221}Fr) (continued)

E_i(level)	J^{π}_i	E_{γ}†	I_{γ}‡	E_f	J^{π}_f	Mult.#	α@	Comments
								α(N)=0.00273 *4*; α(O)=0.000586 *9*; α(P)=8.50×10^{-5} *12*; α(Q)=3.29×10^{-6} *5*
234.51	(5/2)+	133.64 *5*	39.4 *61*	100.89	(5/2)−	(E1)	0.234	α(K)=0.184 *3*; α(L)=0.0378 *6*; α(M)=0.00906 *13*; α(N+..)=0.00293 *5* α(N)=0.00235 *4*; α(O)=0.000504 *7*; α(P)=7.35×10^{-5} *11*; α(Q)=2.89×10^{-6} *4*
		134.86 *5*	84.8 *9*	99.62	(3/2)−	(E1)	0.229	α(K)=0.180 *3*; α(L)=0.0369 *6*; α(M)=0.00885 *13*; α(N+..)=0.00286 *4* α(N)=0.00229 *4*; α(O)=0.000493 *7*; α(P)=7.19×10^{-5} *10*; α(Q)=2.83×10^{-6} *4*
		197.9	100 *9*	36.64	(3/2)−			
253.56	(5/2)+	57.8 *2*	1.4 *3*	195.77	(7/2)−	[E1]	0.463 *8*	α(L)=0.350 *6*; α(M)=0.0851 *15*; α(N+..)=0.0270 *5* α(N)=0.0218 *4*; α(O)=0.00455 *8*; α(P)=0.000611 *10*; α(Q)=1.87×10^{-5} *3* B(E1)(W.u.)=0.00012 *7*
		103.6 *2*	0.9 *2*	150.07	(7/2)+	[M1+E2]	10 *3*	α(K)=5 *5*; α(L)=3.7 *18*; α(M)=1.0 *6*; α(N+..)=0.32 *17* α(N)=0.25 *14*; α(O)=0.05 *3*; α(P)=0.007 *3*; α(Q)=0.00014 *11*
		145.2 *1*	46.5 *22*	108.41	(7/2)−	(E1)	0.191	α(K)=0.1512 *22*; α(L)=0.0305 *5*; α(M)=0.00729 *11*; α(N+..)=0.00236 *4* α(N)=0.00189 *3*; α(O)=0.000407 *6*; α(P)=5.97×10^{-5} *9*; α(Q)=2.39×10^{-6} *4* B(E1)(W.u.)=0.00026 *13*
		152.6 *2*	7.0 *4*	100.89	(5/2)−	[E1]	0.1695	α(K)=0.1342 *20*; α(L)=0.0268 *4*; α(M)=0.00641 *10*; α(N+..)=0.00207 *3* α(N)=0.001660 *24*; α(O)=0.000358 *6*; α(P)=5.27×10^{-5} *8*; α(Q)=2.14×10^{-6} *3* B(E1)(W.u.)=3.4×10^{-5} *16*
		153.9 *1*	67.2 *33*	99.62	(3/2)−	E1	0.1660	α(K)=0.1315 *19*; α(L)=0.0262 *4*; α(M)=0.00627 *9*; α(N+..)=0.00203 *3* α(N)=0.001624 *23*; α(O)=0.000351 *5*; α(P)=5.16×10^{-5} *8*; α(Q)=2.10×10^{-6} *3* B(E1)(W.u.)=0.00032 *15*
		216.9 *2*	100 *52*	36.64	(3/2)−	(E1)	0.0726	α(K)=0.0582 *9*; α(L)=0.01096 *16*; α(M)=0.00261 *4*; α(N+..)=0.000849 *12* α(N)=0.000678 *10*; α(O)=0.0001475 *21*; α(P)=2.22×10^{-5} *4*; α(Q)=9.73×10^{-7} *14* B(E1)(W.u.)=0.00017 *12*
		228.2 *4*	1.5 *4*	26.00	(1/2)−			
		253.54 *5*	42.8 *22*	0.0	5/2−	[E1]	0.0503	α(K)=0.0405 *6*; α(L)=0.00746 *11*; α(M)=0.001775 *25*; α(N+..)=0.000578 *8* α(N)=0.000461 *7*; α(O)=0.0001007 *15*; α(P)=1.526×10^{-5} *22*; α(Q)=6.91×10^{-7} *10* B(E1)(W.u.)=4.5×10^{-5} *22*
272.6	(7/2−,9/2−)	236.0 *6*	100 *13*	36.64	(3/2)−			
279.21	(7/2)+	129.2 *2*	8.8 *16*	150.07	(7/2)+		5.0 *20*	
		170.7 *2*	68 *4*	108.41	(7/2)−	(E1)	0.1291	α(K)=0.1027 *15*; α(L)=0.0201 *3*; α(M)=0.00480 *7*; α(N+..)=0.001554 *23* α(N)=0.001244 *18*; α(O)=0.000269 *4*; α(P)=3.99×10^{-5} *6*; α(Q)=1.662×10^{-6} *24*
		178.3 *2*	56 *4*	100.89	(5/2)−	E1	0.1162	α(K)=0.0925 *14*; α(L)=0.0180 *3*; α(M)=0.00429 *7*; α(N+..)=0.001391 *20* α(N)=0.001112 *16*; α(O)=0.000241 *4*; α(P)=3.58×10^{-5} *6*; α(Q)=1.507×10^{-6} *22*
		240.7 *2*	40 *4*	38.54	(9/2)−		0.0568	

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Adopted Levels, Gammas (continued)

γ(^{221}Fr) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[#]	α[@]	Comments
279.21	(7/2)+	279.3 *3*	100 *8*	0.0	5/2−	E1	0.0402	α(K)=0.0325 *5*; α(L)=0.00591 *9*; α(M)=0.001404 *20*; α(N+..)=0.000457 *7* α(N)=0.000365 *6*; α(O)=7.98×10^{-5} *12*; α(P)=1.215×10^{-5} *18*; α(Q)=5.60×10^{-7} *8*
288.08	(9/2)−	179.8 *3*	78.3 *49*	108.41	(7/2)−		1.8 *10*	
		187.2	74.2 *25*	100.89	(5/2)−			
		249.6 *2*	100 *8*	38.54	(9/2)−		1.083	
294.66	(9/2)+	144.7 *2*	11.1 *28*	150.07	(7/2)+	M1+E2	3.5 *16*	α(K)=2.2 *19*; α(L)=0.96 *23*; α(M)=0.25 *8*; α(N+..)=0.081 *23* α(N)=0.065 *19*; α(O)=0.014 *4*; α(P)=0.0020 *4*; α(Q)=5.E−5 *5*
		186.3 *4*	100 *8*	108.41	(7/2)−	E1	0.1045 *16*	α(K)=0.0834 *13*; α(L)=0.01607 *25*; α(M)=0.00383 *6*; α(N+..)=0.001244 *19* α(N)=0.000995 *15*; α(O)=0.000216 *4*; α(P)=3.21×10^{-5} *5*; α(Q)=1.365×10^{-6} *21*
		256.0 *2*	16.7 *56*	38.54	(9/2)−		0.0492	
393.35	(5/2,7/2)+	114	3.3 *4*	279.21	(7/2)+	M1	9.86	α(K)=7.93 *12*; α(L)=1.466 *21*; α(M)=0.350 *5*; α(N+..)=0.1156 *17* α(N)=0.0917 *13*; α(O)=0.0205 *3*; α(P)=0.00329 *5*; α(Q)=0.000184 *3*
		139.6	5.2 *9*	253.56	(5/2)+	M1+E2	3.9 *17*	α(K)=2.4 *21*; α(L)=1.1 *3*; α(M)=0.29 *9*; α(N+..)=0.09 *3* α(N)=0.075 *24*; α(O)=0.016 *5*; α(P)=0.0023 *5*; α(Q)=6.E−5 *5*
		168.86 *13*	30 *4*	224.64	(3/2)+		2.1 *11*	
		197.77 *12*	100 *9*	195.77	(7/2)−	E1	0.0905	α(K)=0.0724 *11*; α(L)=0.01381 *20*; α(M)=0.00329 *5*; α(N+..)=0.001070 *15* α(N)=0.000855 *12*; α(O)=0.000186 *3*; α(P)=2.78×10^{-5} *4*; α(Q)=1.195×10^{-6} *17*
		243.2 *1*	13.0 *13*	150.07	(7/2)+		1.162	
		284.8 *1*	27.4 *22*	108.41	(7/2)−		0.0385	
		354.8 *2*	10.0 *13*	38.54	(9/2)−		0.0235	
400.75	(7/2−)	112.8 *2*	42.9 *48*	288.08	(9/2)−		10.16	
		204.7 *3*	26.2 *95*	195.77	(7/2)−			
		362.2 *4*	100 *10*	38.54	(9/2)−		0.388	
410.2		137.6	100	272.6	(7/2−,9/2−)			
497.3		458.8 *4*	100 *38*	38.54	(9/2)−			
517.81	(5/2+)	321.8 *4*	10.3 *14*	195.77	(7/2)−			
		368.3 *6*	2.1 *7*	150.07	(7/2)+			
		417.9 *3*	16.6 *14*	99.62	(3/2)−			
		481.1 *2*	100 *7*	36.64	(3/2)−			
		492.6 *6*	0.7 *4*	26.00	(1/2)−			
		517.9 *2*	52 *4*	0.0	5/2−			
552.05	(3/2)−	298.6 *3*	2.0 *6*	253.56	(5/2)+			
		317.4[&]	>0.11	234.51	(5/2)+			
		356.6	0.26 *11*	195.77	(7/2)−			

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Adopted Levels, Gammas (continued)

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

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	α[@]
552.05	$(3/2)^-$	406.1 *1*	7.5 *5*	145.91	$(1/2)^+$	0.01757
		450.1 *7*	3.6 *9*	100.89	$(5/2)^-$	
		452.4 *1*	100 *6*	99.62	$(3/2)^-$	0.213
		512.5 *7*	0.56 *22*	38.54	$(9/2)^-$	
		515.40 *5*	21.4 *11*	36.64	$(3/2)^-$	0.1504
		526.09 *5*	37.1 *23*	26.00	$(1/2)^-$	0.1424
		552.0 *1*	6.3 *5*	0.0	$5/2^-$	0.1253
570.81	$(5/2^+,7/2^+)$	317.4[&]	3.12 *5*	253.56	$(5/2)^+$	
		375.0 *7*	53 *13*	195.77	$(7/2)^-$	
		462.4 *6*	25 *9*	108.41	$(7/2)^-$	
		469.5 *3*	88 *9*	100.89	$(5/2)^-$	
		571.0 *2*	100 *16*	0.0	$5/2^-$	
602.2	$(5/2^-)$	565.6 *7*	100	36.64	$(3/2)^-$	
630.71	$(5/2^+)$	435.0 *3*	34 *4*	195.77	$(7/2)^-$	
		522.1 *2*	25 *4*	108.41	$(7/2)^-$	
		529.7 *3*	100 *10*	100.89	$(5/2)^-$	
		531.2 *3*	56 *7*	99.62	$(3/2)^-$	
		591.4 *7*	10 *3*	38.54	$(9/2)^-$	
		594.6 *3*	39 *8*	36.64	$(3/2)^-$	
637.72		403.4 *3*	5 *3*	234.51	$(5/2)^+$	
		538.1 *1*	≈27	99.62	$(3/2)^-$	
		601.0 *3*	100 *24*	36.64	$(3/2)^-$	
		637.1 *7*	≈2.7	0.0	$5/2^-$	
714.2		568.3 *6*	100	145.91	$(1/2)^+$	
749.16		603.5 *5*	100 *25*	145.91	$(1/2)^+$	
		649.5 *2*	75 *19*	99.62	$(3/2)^-$	
780.2		545.8 *6*	84 *17*	234.51	$(5/2)^+$	
		629.9 *7*	50 *17*	150.07	$(7/2)^+$	
		680.4 *6*	100 *33*	99.85	$(3/2)^+$	
		780.6 *6*		0.0	$5/2^-$	
824.2		824.2 *7*	100	0.0	$5/2^-$	

† From ^{225}Ac α decay and ^{221}Rn β^- decay.

‡ Relative photon intensity deexciting each level, adopted from ^{225}Ac α decay and ^{221}Rn β^- decay.

From ce data taken in ^{225}Ac α decay and ^{221}Rn β^- decay. Multipolarities in brackets are from decay scheme; they are added with the purpose of calculating γ transition probabilities, when the level's half-life is known.

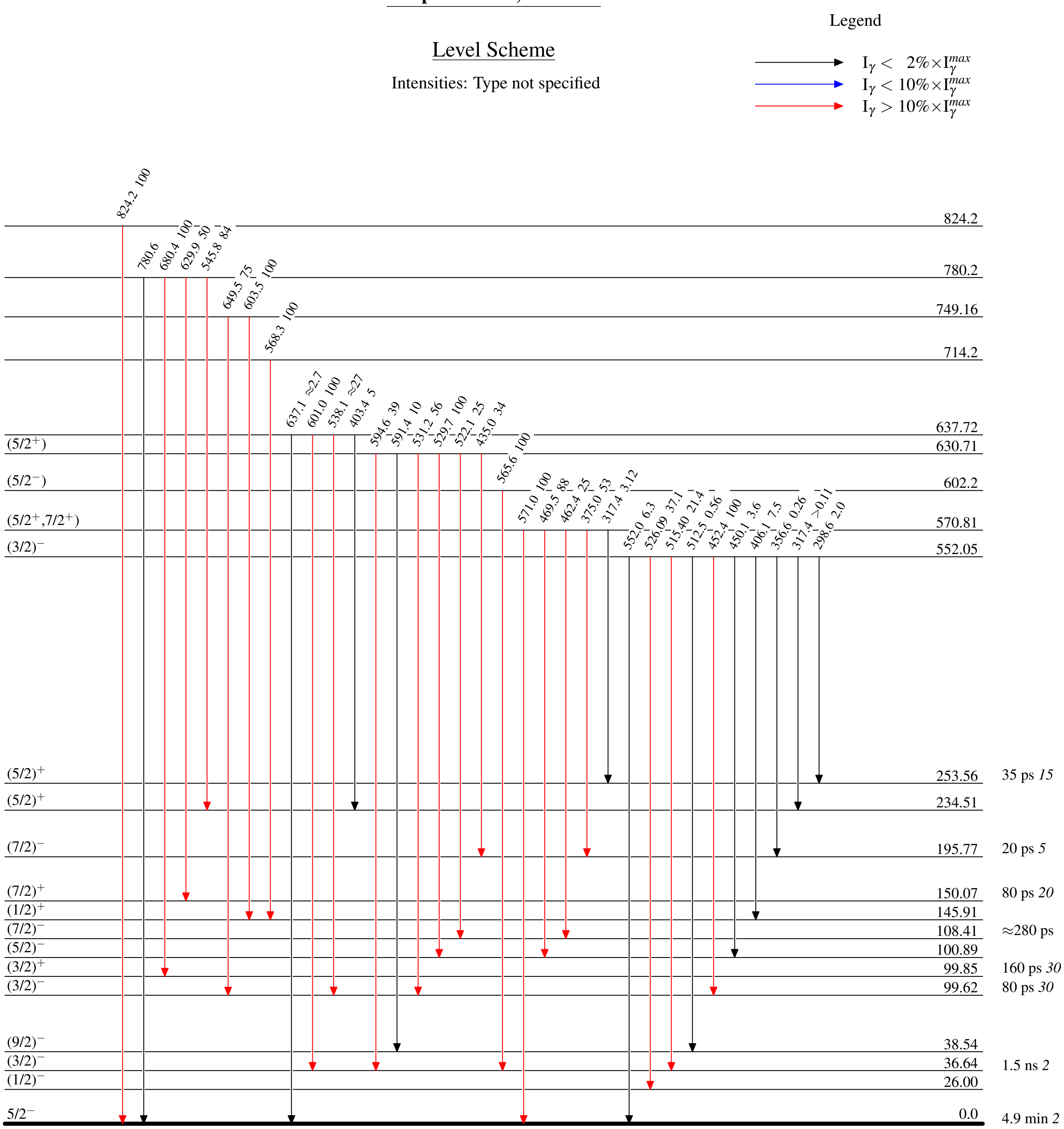
@ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

& Multiply placed.

Adopted Levels, Gammas

Level Scheme

Intensities: Type not specified



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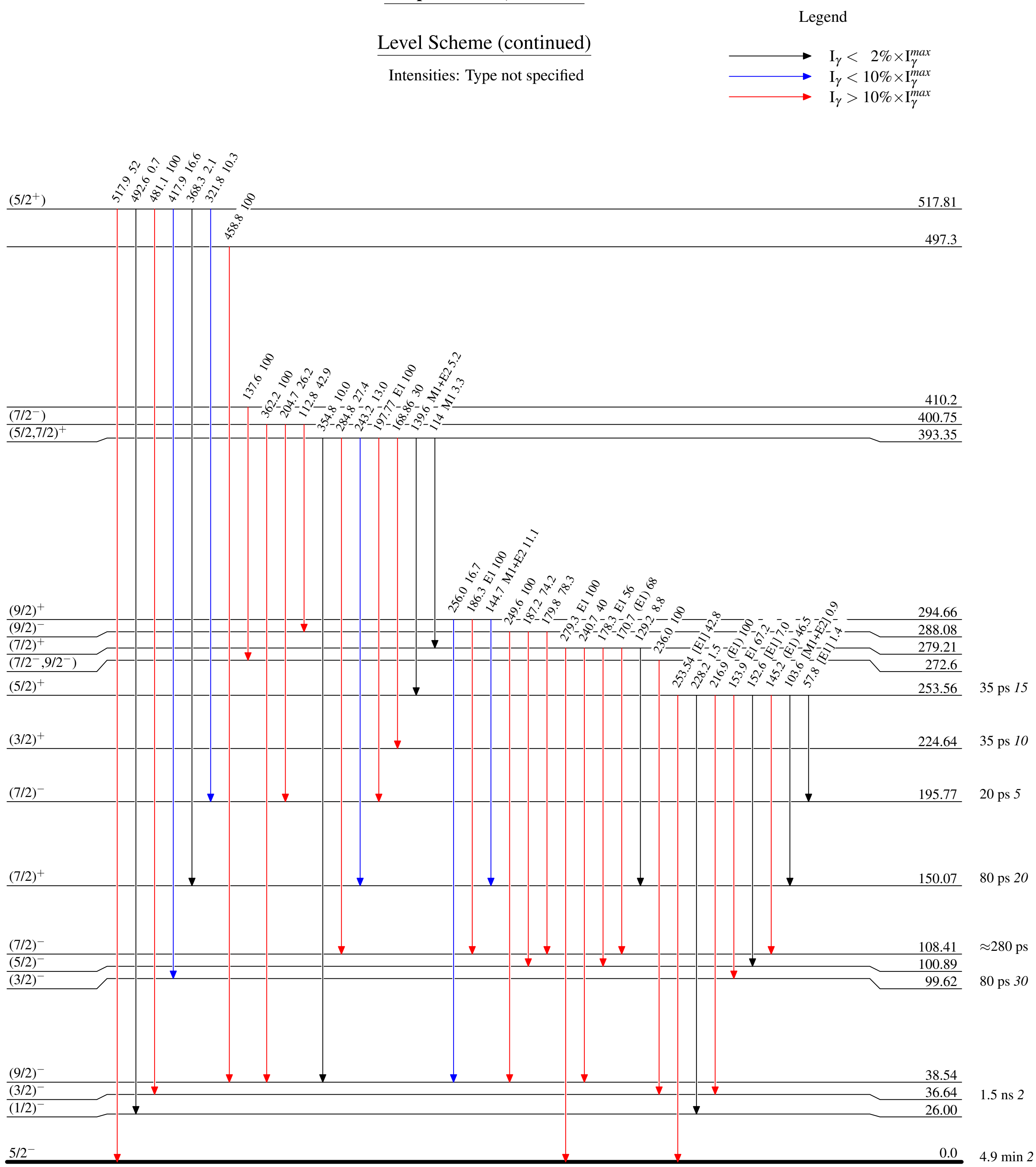
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified



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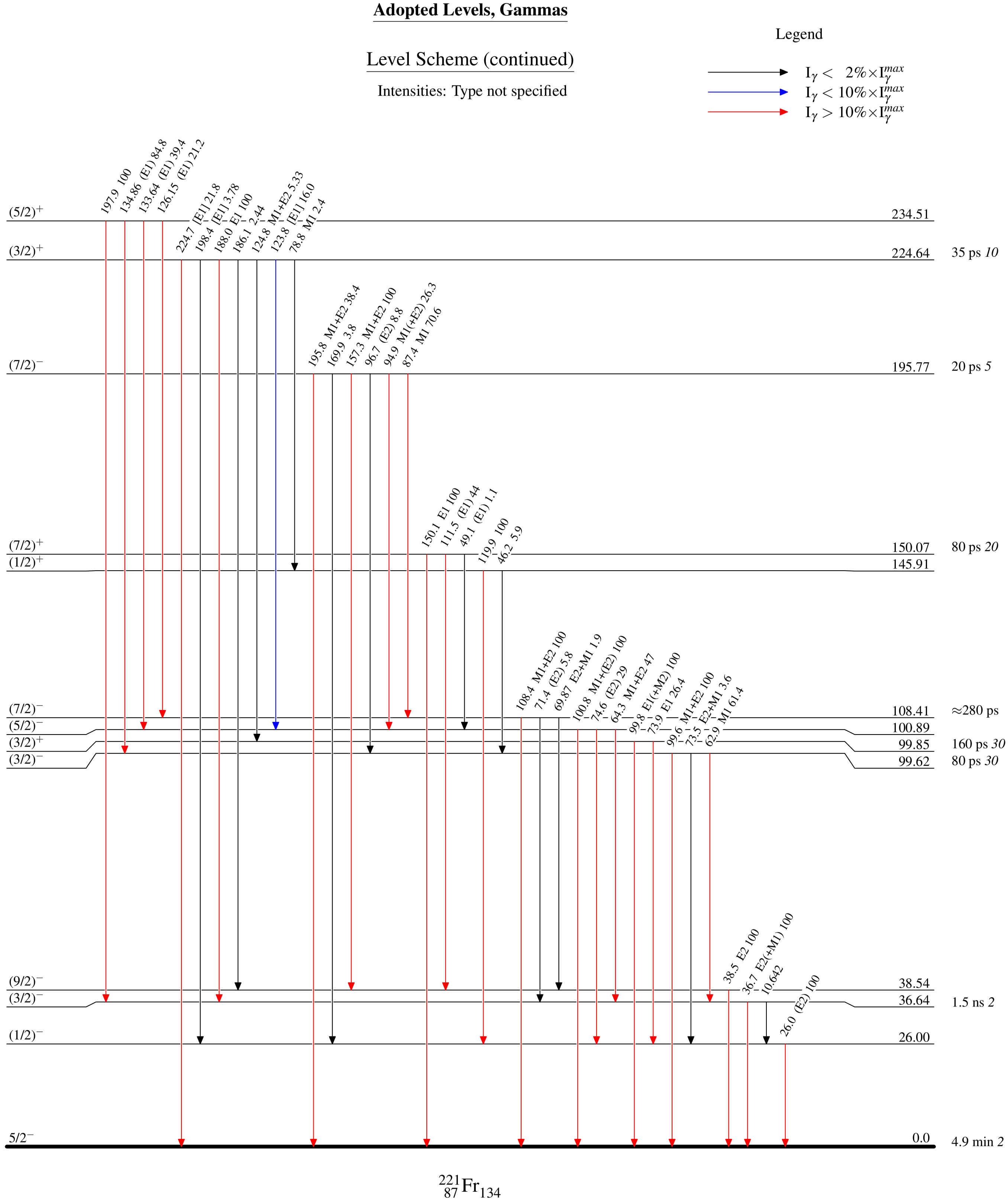
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified



Adopted Levels, Gammas