Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	A. K. Jain (a), R. Raut (b), J. K. Tuli	NDS 110,1409 (2009)	1-Dec-2008

Q(β^-)=1826 *13*; S(n)=6046 *18*; S(p)=5913 *16*; Q(α)=4613 *19* 2012Wa38
Note: Current evaluation has used the following Q record $ 1820 30 *5914* 58 *5915* syst 4576 syst 2003Au03.
Uncertainties in S(p) and Q(α) are 300 and 200, respectively (2003Au03).
Assignment: Th(600-MeV p) mass separation (1969Ha03,1975We23).
For discussions of the nuclear structure of ^{225}Fr see, for example, 1987Sh24, 1988Le13, 1991Cw01 and 2000Sh32.

^{225}Fr Levels

Cross Reference (XREF) Flags

A ^{225}Rn β^- decay
B ^{226}Ra(t,α)

E(level)†	Jπ	$T_{1/2}$	XREF	Comments
0.0‡	3/2$^-$	3.95 min *14*	AB	%β^-=100 μ=1.07 *2*; Q=1.32 *5* Δ<r^2>(^{212}Fr,^{225}Fr)=1.34862 *22* (1987Co19); the uncertainty indicated is statistical only; a systematic uncertainty of the order of a few percent is expected (1987Co19). μ, Q: from atomic beam LASER spectroscopy (1985Co24,1989Ra17). Sternheimer correction applied for Q. See 1987Co19 for further discussion and analysis. See 1988Le13 for calculated μ and Q values. Jπ: spin measured (atomic beam; 1985Co24). Nilsson orbital from cross section fingerprint in (t,α) for 0, 29, 83, 128 levels, supported by measured μ value. See 1986Ek02, 1997Bu03, and 1988Le13 for discussions. $T_{1/2}$: weighted average of 3.9 min *2* (1969Ha03), 4.0 min *2* (1983Ny01).
28.545‡ *23*	5/2$^-$		AB	Jπ: from cross section fingerprint in (t,α) for 0, 29, 83, 128 levels; supported by M1+E2 29γ to 3/2$^-$ g.s.
82.515‡ *24*	7/2$^-$		AB	Jπ: from cross section fingerprint in (t,α) for 0, 29, 83, 128 levels; supported by E2 83γ to 3/2$^-$ g.s., M1+E2 54γ to 5/2$^-$ 29 level.
128.06‡ *4*	9/2$^-$		AB	Jπ: from cross section fingerprint in (t,α) for 0, 29, 83, 128 levels; supported by E2 99γ to 5/2$^-$ 29 level.
142.59# *3*	(3/2)$^+$		AB	Jπ: E1 143γ to 3/2$^-$; E1 114γ to 5/2$^-$ 29 level.
151.63# *3*	5/2$^+$		A	E1 152γ to 3/2$^-$; E1 69γ to 7/2$^-$ 83 level.
181 *3*	(1/2$^+$)		B	Jπ: tentative value based on comparison of experimental σ(t,α) with DWBA calculation assuming this is the 1/2[400] bandhead. Assignment supported by comparison with (t,α) population of levels in neighboring odd-A Fr isotopes.
181.66# *3*	(9/2)$^+$		A	Jπ: E1 99γ to 7/2$^-$ 83 level; 99γ to 9/2$^-$ 128 level; band assignment.
198.23# *3*	(7/2)$^+$		A	Jπ: E1 169.7γ to 5/2$^-$ 29 level; E1 115.8γ to 7/2$^-$ 83 level; band assignment.
203.40@ *4*	(9/2)$^-$		Ab	XREF: b(205). Jπ: M1+E2 121γ to 7/2$^-$ 83 level; E2 175γ to 5/2$^-$ 29 level; band assignment.
205& *3*	(3/2$^+$)		B	XREF: B(205).
207.20@ *3*	(5/2)$^-$		Ab	XREF: b(205). Jπ: M1+E2 179γ to 5/2−29 level; M1+E2 207γ to 3/2$^-$ g.s.; band assignment.
228.36 *5*	(7/2,9/2)$^-$		A	Jπ: M1+E2 146γ to 7/2$^-$ 83 level; (E1) 47γ to (9/2)$^+$ 182 level.
241.37&b *3*	(5/2)$^+$		AB	XREF: B(244). Jπ: M1 90γ to 5/2$^+$ 152 level; (E1) 241γ to 3/2$^-$ g.s.; band assignment.
293.23& *4*	(7/2)$^+$		AB	Jπ: M1 95γ to (7/2)$^+$ 198 level; E1 265γ to 5/2$^-$ 29 level; 165γ to 9/2$^-$ 128.

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Adopted Levels, Gammas (continued)

^{225}Fr Levels (continued)

E(level)[†]	Jπ	XREF	Comments
303.25 *5*	7/2+,9/2+,11/2+	A	Jπ: E1 175γ to 9/2− 128 level.
330.10 *4*	(5/2,7/2)−	AB	Jπ: E1 131γ to (7/2)+ 198 level; 330γ to 3/2− g.s.
346.03[&] *4*	(9/2)+	A	Jπ: M1+E2 164γ to 9/2+ 182 level; 264γ to 7/2− 83 level; band assignment.
401 *3*		B	
409.04 *4*	(5/2)+	A	Jπ: M1(+E2) 210γ to (7/2)+ 198; M1+E2 257γ to 5/2+ 152; 409γ to 3/2− g.s.
424.97 *8*	(5/2−,7/2−)	A	Jπ: gammas to 3/2− g.s. and 9/2− 128 level.
≈448		B	
480.09 *6*	(5/2,7/2,9/2)+	A	Jπ: M1+E2 187γ to (7/2)+ 293 level.
502.96[b] *5*	(5/2)−	AB	XREF: B(500). Jπ: M1 296γ to (5/2)− 207 level; 360γ to (3/2)+ 143 level; 305γ to (7/2)+ 198 level.
559.68[@] *4*	7/2−	A	Jπ: M1 531γ to 5/2− 29 level; M1 431γ to 9/2− 28 level.
571.51[b] *5*	(7/2)−	AB	XREF: B(570). Jπ: M1 364γ to (5/2)− 207 level; 390γ to (9/2)+ 182 level.
591 *3*		B	
618.66 *6*	(5/2,7/2,9/2)+	A	Jπ: M1 420γ to (7/2)+ 198 level.
≈630		B	
635.60 *5*	(3/2,5/2,7/2)+	A	Jπ: M1 484γ to 5/2+ 152 level; possible 636γ to 3/2− g.s.
655 *3*		B	
665.18 *4*	(7/2)+	A	Jπ: M1 484γ to (9/2)+ 182 level; M1 423γ to (5/2)+ 241.
676 *3*		B	
721.06[a] *5*	(5/2)−	A	Jπ: M1 721γ to 3/2− g.s.; M1 693γ to 5/2− 29; weak, doubly-placed M1 639γ to 7/2− 82 level disfavors J=3/2.
744.26[b] *4*	(5/2,7/2)+	AB	XREF: B(741). Jπ: M1 335γ to (5/2)+ 409 level; M1 546γ to (7/2)+ 198 level.
754.53 *5*		A	Jπ: 602γ to 5/2+ 152 level; possible 573γ to (9/2)+ 182 level; possible 551γ to (9/2)− 203 level.
778.64[a] *4*	7/2−	A	Jπ: M1 750γ to 5/2− 29; M1 696γ to 7/2− 83 level; doubly-placed M1 651γ to 9/2− 128 level.
799 *3*		B	
832.18 *7*	(5/2+,7/2,9/2+)	A	Jπ: 681γ to 5/2+ 152 level; 651γ to (9/2)+ 182.
839.09 *5*	(5/2,7/2,9/2)+	A	Jπ: M1 536γ to 7/2+,9/2+,11/2+ 303 level.
845 *3*		B	
865.74 *4*	(7/2)−	A	Jπ: M1 658γ to (5/2)− 207 level; M1 738γ 9/2− 128 level.
885.95[b] *5*	(3/2,5/2)+	AB	XREF: B(882). Jπ: M1(+E2) 743γ to (3/2)+ 143 level; 858γ to 5/2− 29.
935.68 *8*	(5/2−,7/2,9/2+)	A	Jπ: 808γ to 9/2− 128 level; 784γ to 5/2+ 152 level.
974 *3*		B	
979.66 *5*	(3/2−,5/2)	A	Jπ: 980γ to 3/2− g.s.; 837γ to (3/2)+ 143; 408γ to (7/2)− 572.
1028 *3*		B	
1047.44 *5*		AB	Jπ: 1047γ to 3/2− g.s.; 896γ to 5/2+ 152 level.
1063.03 *5*		A	Jπ: 881γ to (9/2)+ 182;
1101.84 *8*	(7/2,9/2,11/2)+	A	Jπ: M1 920γ to (9/2)+ 182 level.
1127 *3*		B	
1185.18 *5*	(5/2−,7/2)	A	Jπ: 1034γ to 5/2+ 152; 982γ to (9/2)− 203; 978γ to (5/2)− 207.
1226.03[b] *7*		AB	XREF: B(1229). Jπ: 1144γ to 7/2− 83; 1045γ to (9/2)+ 182.
≈1247		B	
1321 *3*		B	
1351 *3*		B	
1392.17 *6*	(5/2,7/2−)	A	Jπ: 1392γ to 3/2− g.s.; 1194γ to (7/2)+ 198; 821γ to (7/2)− 572.
1398 *3*		B	
1479.63[b] *5*	(7/2)	AB	XREF: B(1477). Jπ: 1451γ to 5/2− 29; 1351γ to 9/2− 128; 1298γ to (9/2)+ 182; 1070γ to (5/2)+ 409.
1519.42[b] *6*		AB	XREF: B(1516).

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Adopted Levels, Gammas (continued)

^{225}Fr Levels (continued)

E(level)†	Jπ	XREF	Comments
			Jπ: 1337γ to (9/2)+ 182; 960γ to 7/2− 560 level.
1526.13 *10*		A	Jπ: 1498γ to 5/2− 29.
≈1535		B	
1577.88 *7*	(5/2+,7/2)	A	Jπ: 1232γ to (9/2)+ 346 level; 1549γ to 5/2− 29 level; 1169γ to (5/2)+ 409 level.
1614.26 *7*	(5/2,7/2+)	A	Jπ: 1471γ to (3/2)+ 143; 1416γ to (7/2)+ 198; 1385γ to (7/2,9/2)− 228 level.
1655.35 *5*	(5/2,7/2+)	A	Jπ: 1513γ to (3/2)+ 143; 1457γ to (7/2)+ 198; 1095γ to 7/2− 560 level.
1749.84 *6*	(5/2,7/2+)	A	Jπ: 1667γ to 7/2− 83; 1607γ to (3/2)+ 143; 1551γ to (7/2)+ 198 level.

† From (t,α) for levels observed in (t,α) only; uncertainties vary between 1 and 3 keV, but evaluator has assigned 3 keV for all energies adopted from (t,α). All other level energies are from least-squares adjustment of Eγ, omitting 136.0γ, 668.05γ and 1421.0γ, each of which fits its placement very poorly (at least 5σ from least-squares adjusted value), and all unresolved or multiply-placed lines.

‡ Band(A): π 3/2[532] band (1997Bu03). Coriolis mixed with 1/2[541] band (1997Bu03). Assignment based on (t,α) reaction cross section fingerprint.

Band(B): π 3/2[651] band (1997Bu03). Coriolis mixed band with i13/2 orbital parentage. K=3/2 assignment based on relative E1 branching from J=5/2, 7/2, 9/2 band members to levels in g.s. band (Alaga rule).

@ Band(C): possible π 1/2[541] mixed band (1997Bu03). Supported by γ decay patterns assuming a 3/2[532] band admixture.

& Band(D): possible π 3/2[402] band (1997Bu03). Coriolis mixed with J>1/2 members of 1/2[660] and 1/2[400] bands. Assignment supported by (t,α) cross section fingerprint.

a Band(E): $K^{\pi}=5/2^{-}$ band (1997Bu03). possible configuration: π 5/2[523]. K=5/2 assignment based on comparison between Alaga rules and observed branching ratios for strong M1 transitions from J=5/2 and 7/2 band members to g.s. band levels. Supported by strong β^{-} branch from 7/2[743] ^{225}Rn parent to J=7/2 band member.

b It is questionable whether the (t,α) reaction excites this level or a separate level with comparable energy.

Adopted Levels, Gammas (continued)

$\gamma(^{225}Fr)$

E,RI,M,MR From ^{225}Rn β^- decay.

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	δ	α[@]	Comments
28.545	$5/2^-$	28.51 *5*	100	0.0	$3/2^-$	M1+E2	0.45 *15*	7.5×10^2 *27*	δ: values measured in β^- decay are 0.32 *2* and 0.44 *2*, but intensity balance at the 28 level in β^- decay implies $\delta\geq0.6$.
82.515	$7/2^-$	53.93 *5*	100 *6*	28.545	$5/2^-$	M1+E2	0.18 *3*	22.8	
		82.55[‡] *5*	38[‡] *10*	0.0	$3/2^-$	E2		22.1	
128.06	$9/2^-$	45.5 *1*	21 *3*	82.515	$7/2^-$	[M1]		29.6	
		99.4[‡] *1*	100[‡] *33*	28.545	$5/2^-$	E2		9.2	
142.59	$(3/2)^+$	114.03 *5*	28.7 *15*	28.545	$5/2^-$	E1		0.349	
		142.60[a] *5*	100[a] *5*	0.0	$3/2^-$	E1		0.202	
151.63	$5/2^+$	69.12 *5*	13.6 *7*	82.515	$7/2^-$	E1		0.291	
		123.06 *5*	45.3 *23*	28.545	$5/2^-$	E1		0.290	
		151.65 *5*	100.0	0.0	$3/2^-$	E1		0.174	
181.66	$(9/2)^+$	30.0[#]	0.0089[#]	151.63	$5/2^+$	[E2]		2.99×10^3	
		53.6[‡] *1*	2.0[‡] *7*	128.06	$9/2^-$	[E1]		0.576	
		99.15 *5*	100 *13*	82.515	$7/2^-$	E1		0.111	
198.23	$(7/2)^+$	46.6[a] *1*	0.64[a] *21*	151.63	$5/2^+$	[M1]		27.6	
		70.15 *5*	5.8 *3*	128.06	$9/2^-$	[E1]		0.280	
		115.75 *5*	12.4 *7*	82.515	$7/2^-$	E1		0.337	
		169.73 *5*	100 *6*	28.545	$5/2^-$	E1		0.132	
203.40	$(9/2)^-$	21.72 *10*	8.8 *19*	181.66	$(9/2)^+$	[E1]		6.37	
		120.83 *5*	100 *5*	82.515	$7/2^-$	M1+E2		6.4 *24*	
		174.90[‡] *10*	72[‡] *22*	28.545	$5/2^-$	E2		0.92	
207.20	$(5/2)^-$	64.6 *1*	2.7 *5*	142.59	$(3/2)^+$	[E1]		0.349	
		178.66 *5*	100 *5*	28.545	$5/2^-$	M1+E2	1.47 *+18−14*	1.50 *12*	
		207.21 *5*	36.0 *19*	0.0	$3/2^-$	M1+E2	1.4 *+4−3*	0.98 *17*	
228.36	$(7/2,9/2)^-$	46.6[a] *1*	25.0[a] *17*	181.66	$(9/2)^+$	(E1)		0.84	
		145.80 *5*	100 *5*	82.515	$7/2^-$	M1+E2		3.5 *17*	
241.37	$(5/2)^+$	89.7[‡] *1*	26[‡] *3*	151.63	$5/2^+$	M1		4.08	
		212.85 *5*	52 *3*	28.545	$5/2^-$	(E1)		0.0766	
		241.34 *5*	100 *5*	0.0	$3/2^-$	(E1)		0.0569	
293.23	$(7/2)^+$	94.9[‡] *1*	4.8[‡] *10*	198.23	$(7/2)^+$	M1		3.47	
		141.65[a] *10*	2.4[a] *10*	151.63	$5/2^+$	[M1]		5.61	
		165.20 *5*	87 *4*	128.06	$9/2^-$	[E1]		0.141	
		264.67 *5*	100 *5*	28.545	$5/2^-$	E1		0.0459	
303.25	$7/2^+,9/2^+,11/2^+$	175.17 *5*	100	128.06	$9/2^-$	E1		0.122	
330.10	$(5/2,7/2)^-$	126.80 *10*	35.4 *19*	203.40	$(9/2)^-$	[M1,E2]		5.5 *22*	

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Adopted Levels, Gammas (continued)

γ(^{225}Fr) (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	α[@]	Comments
330.10	$(5/2,7/2)^-$	131.84[‡] *10*	100[‡] *5*	198.23	$(7/2)^+$	E1	0.245	
		247.60 *5*	89 *4*	82.515	$7/2^-$	[M1,E2]	0.7 *5*	
		301.5 *2*	11.9 *19*	28.545	$5/2^-$	[M1,E2]	0.4 *3*	
		330.10 *10*	40.5 *20*	0.0	$3/2^-$	[M1,E2]	0.32 *21*	
346.03	$(9/2)^+$	104.72 *10*	10.5 *20*	241.37	$(5/2)^+$	[E2]	7.52	
		142.60[a] *10*	26[a] *3*	203.40	$(9/2)^-$	[E1]	0.202	
		147.96 *10*	22 *4*	198.23	$(7/2)^+$	M1,E2	3.4 *16*	
		164.41 *5*	52 *3*	181.66	$(9/2)^+$	M1+E2	2.4 *13*	
		263.56 *5*	100 *5*	82.515	$7/2^-$			
409.04	$(5/2)^+$	202.02 *5*	78 *4*	207.20	$(5/2)^-$	[E1]	0.087	Measured multipolarity (β^- decay) is M1, inconsistent with this placement.
		210.70[‡] *10*	24[‡] *3*	198.23	$(7/2)^+$	M1(+E2)	1.1 *7*	
		257.38 *5*	100 *5*	151.63	$5/2^+$	M1+E2	0.6 *4*	
		326.47[&] *10*	<84[&]	82.515	$7/2^-$			
		409.1 *2*	28 *4*	0.0	$3/2^-$			
424.97	$(5/2^-,7/2^-)$	296.80 *10*	100 *5*	128.06	$9/2^-$	[M1+E2]	0.4 *3*	
		424.9 *2*	12.0 *23*	0.0	$3/2^-$			
480.09	$(5/2,7/2,9/2)^+$	71.16 *10*	21.2 *24*	409.04	$(5/2)^+$	[M1]	8.01	
		186.6[‡] *3*	21[‡] *4*	293.23	$(7/2)^+$	M1+E2	1.6 *10*	
		251.65 *10*	12.6 *13*	228.36	$(7/2,9/2)^-$			
		298.35 *10*	100 *5*	181.66	$(9/2)^+$	[M1]	0.696	
502.96	$(5/2)^-$	295.55 *10*	100 *8*	207.20	$(5/2)^-$	M1	0.714	
		299.6 *2*	17 *3*	203.40	$(9/2)^-$	[E2]	0.148	
		304.7 *2*	19.2 *23*	198.23	$(7/2)^+$			
		351.3[‡] *2*	38[‡] *9*	151.63	$5/2^+$			
		360.45 *10*	57 *6*	142.59	$(3/2)^+$			
		503.00[&] *10*	<52[&]	0.0	$3/2^-$			
559.68	$7/2^-$	229.45 *5*	16.8 *8*	330.10	$(5/2,7/2)^-$	M1	1.44	
		318.32 *10*	20.7 *10*	241.37	$(5/2)^+$			
		352.30 *10*	100 *5*	207.20	$(5/2)^-$	M1	0.442	
		356.30 *10*	52.4 *26*	203.40	$(9/2)^-$	M1	0.429	
		361.55 *10*	11.1 *7*	198.23	$(7/2)^+$			
		378.05 *10*	20.7 *10*	181.66	$(9/2)^+$			
		408.10[a] *10*	22.7[a] *16*	151.63	$5/2^+$			
		431.63 *10*	12.6 *13*	128.06	$9/2^-$	M1	0.255	
		476.9[&] *2*	<6.7[&]	82.515	$7/2^-$			
		531.10 *10*	58 *3*	28.545	$5/2^-$	M1	0.147	
571.51	$(7/2)^-$	364.10 *10*	91 *5*	207.20	$(5/2)^-$	M1	0.404	
		368.2 *2*	30 *3*	203.40	$(9/2)^-$	[M1]	0.392	
		373.40 *10*	78 *4*	198.23	$(7/2)^+$			

$^{225}_{87}Fr_{138}$-5

Adopted Levels, Gammas (continued)

γ(^{225}Fr) (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	α[@]
571.51	$(7/2)^-$	389.90 *10*	44 *3*	181.66	$(9/2)^+$		
		419.8[‡] *2*	100[‡] *11*	151.63	$5/2^+$		
		543.05 *10*	47 *4*	28.545	$5/2^-$		
618.66	$(5/2,7/2,9/2)^+$	273.07 *10*	46 *4*	346.03	$(9/2)^+$	[M1,E2]	0.5 *4*
		288.80 *10*	100 *6*	330.10	$(5/2,7/2)^-$		
		420.15[‡] *20*	75[‡] *18*	198.23	$(7/2)^+$	M1	0.274
635.60	$(3/2,5/2,7/2)^+$	394.50 *10*	41 *4*	241.37	$(5/2)^+$		
		483.80[a] *10*	100[a] *14*	151.63	$5/2^+$	M1	0.188
		635.60[&] *10*	<72[&]	0.0	$3/2^-$		
665.18	$(7/2)^+$	105.29 *10*	34 *4*	559.68	$7/2^-$	[E1]	0.425
		256.20 *10*	20.9 *21*	409.04	$(5/2)^+$		
		423.65 *10*	59 *3*	241.37	$(5/2)^+$	M1	0.268
		461.55 *10*	26.0 *23*	203.40	$(9/2)^-$		
		466.90 *10*	62 *4*	198.23	$(7/2)^+$	M1	0.207
		483.80[a] *10*	100[a] *7*	181.66	$(9/2)^+$	M1	0.188
		537.15[&] *10*	<61[&]	128.06	$9/2^-$		
721.06	$(5/2)^-$	240.6[‡] *3*	1.3[‡] *4*	480.09	$(5/2,7/2,9/2)^+$	[E1]	0.0573
		514.2 *2*	10.5 *17*	207.20	$(5/2)^-$	M1	0.160
		517.8 *2*	2.0 *5*	203.40	$(9/2)^-$		
		638.50[&] *10*	<6.7[&]	82.515	$7/2^-$	M1	0.090
		692.60 *10*	42.5 *21*	28.545	$5/2^-$	M1	0.0728
		721.10 *10*	100 *5*	0.0	$3/2^-$	M1	0.0655
744.26	$(5/2,7/2)^+$	335.45 *10*	52.0 *26*	409.04	$(5/2)^+$	M1	0.505
		398.5 *2*	23 *5*	346.03	$(9/2)^+$		
		414.1[&] *2*	<22[&]	330.10	$(5/2,7/2)^-$		
		451.00 *10*	44 *3*	293.23	$(7/2)^+$		
		503.00[&] *10*	<54[&]	241.37	$(5/2)^+$		
		537.15[&] *10*	<85[&]	207.20	$(5/2)^-$		
		545.85[a] *10*	100[a] *4*	198.23	$(7/2)^+$	M1	0.137
		562.50 *10*	20 *6*	181.66	$(9/2)^+$		
		600.9 *2*	33 *4*	142.59	$(3/2)^+$		
754.53		136.06 *5*	100 *5*	618.66	$(5/2,7/2,9/2)^+$		
		551.10[&] *10*	47[&] *4*	203.40	$(9/2)^-$		
		572.70[&] *10*	97[&] *11*	181.66	$(9/2)^+$		
		602.2 *2*	25 *4*	151.63	$5/2^+$		
778.64	$7/2^-$	218.60 *10*	0.86 *6*	559.68	$7/2^-$	[M1,E2]	1.0 *7*
		275.65 *10*	0.54 *6*	502.96	$(5/2)^-$	[M1]	0.87
		369.65 *10*	1.58 *9*	409.04	$(5/2)^+$		

$^{225}_{87}Fr_{138}$-6

Adopted Levels, Gammas (continued)

γ(^{225}Fr) (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	α[@]
778.64	7/2⁻	432.54 *10*	2.56 *19*	346.03	(9/2)⁺		
		448.65 *10*	2.56 *14*	330.10	(5/2,7/2)⁻		
		537.15[&] *10*	<1.98[&]	241.37	(5/2)⁺		
		571.40 *10*	12.7 *6*	207.20	(5/2)⁻	M1	0.121
		627.10 *10*	4.37 *23*	151.63	5/2⁺		
		650.65[a] *10*	12.1[a] *7*	128.06	9/2⁻	M1	0.086
		696.20 *10*	70 *3*	82.515	7/2⁻	M1	0.0718
		750.15 *10*	100 *5*	28.545	5/2⁻	M1	0.0591
		778.70 *10*	5.9 *3*	0.0	3/2⁻		
832.18	(5/2⁺,7/2,9/2⁺)	486.1 *2*	93 *27*	346.03	(9/2)⁺		
		590.6 *2*	38 *7*	241.37	(5/2)⁺		
		634.0 *2*	41 *6*	198.23	(7/2)⁺		
		650.65[a] *10*	100[a] *17*	181.66	(9/2)⁺		
		680.9 *2*	54 *6*	151.63	5/2⁺		
839.09	(5/2,7/2,9/2)⁺	203.4[‡] *3*	14[‡] *4*	635.60	(3/2,5/2,7/2)⁺	[M1,E2]	1.3 *8*
		414.1[&] *2*	<15.1[&]	424.97	(5/2⁻,7/2⁻)		
		535.80 *10*	100 *6*	303.25	7/2⁺,9/2⁺,11/2⁺	M1	0.144
		545.85[a] *10*	28[a] *3*	293.23	(7/2)⁺	M1	0.137
		635.60[&] *10*	<37[&]	203.40	(9/2)⁻		
		640.8 *2*	21 *7*	198.23	(7/2)⁺		
		711.0 *2*	23.5 *24*	128.06	9/2⁻		
		756.70[&] *10*	<36[&]	82.515	7/2⁻		
		839.2[&] *2*	<55[&]	0.0	3/2⁻		
865.74	(7/2)⁻	362.75 *10*	5.2 *4*	502.96	(5/2)⁻	[M1]	0.408
		562.50 *10*	3.9 *8*	303.25	7/2⁺,9/2⁺,11/2⁺		
		572.70[&] *10*	<13.2[&]	293.23	(7/2)⁺		
		624.3 *2*	3.5 *4*	241.37	(5/2)⁺		
		658.30 *10*	18.4 *10*	207.20	(5/2)⁻	M1	0.0832
		662.30 *10*	20.7 *13*	203.40	(9/2)⁻		
		668.05[†] *10*	8.2 *4*	198.23	(7/2)⁺		
		683.9 *2*	4.4 *5*	181.66	(9/2)⁺		
		714.00 *10*	7.7 *4*	151.63	5/2⁺		
		723.00 *10*	22.0 *10*	142.59	(3/2)⁺		
		737.70 *10*	25.4 *13*	128.06	9/2⁻	M1	0.0617
		783.40 *10*	18.7 *10*	82.515	7/2⁻	M1	0.0527
		837.00[a] *10*	100[a] *6*	28.545	5/2⁻	M1	0.0444
		866.0[&] *2*	<3.4[&]	0.0	3/2⁻		
885.95	(3/2,5/2)⁺	141.65[a] *10*	8[a] *6*	744.26	(5/2,7/2)⁺	[M1,E2]	3.9 *18*

$^{225}_{87}Fr_{138}$-7

Adopted Levels, Gammas (continued)

γ(^{225}Fr) (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	α[@]
885.95	(3/2,5/2)$^+$	326.47[&] *10*	<51[&]	559.68	7/2$^-$		
		405.6 *2*	44 *5*	480.09	(5/2,7/2,9/2)$^+$		
		476.9[&] *2*	<20.2[&]	409.04	(5/2)$^+$		
		644.40 *10*	27.8 *23*	241.37	(5/2)$^+$		
		679.1[&] *2*	<13.1[&]	207.20	(5/2)$^-$		
		734.40 *10*	55 *3*	151.63	5/2$^+$		
		743.35 *10*	100 *5*	142.59	(3/2)$^+$	M1(+E2)	0.038 *23*
		857.5 *2*	23 *3*	28.545	5/2$^-$		
		885.85 *10*	58 *3*	0.0	3/2$^-$		
935.68	(5/2$^-$,7/2,9/2$^+$)	605.6 *2*	100 *14*	330.10	(5/2,7/2)$^-$		
		784.0[‡] *2*	[‡]	151.63	5/2$^+$		
		808.0 *2*	79 *11*	128.06	9/2$^-$		
979.66	(3/2$^-$,5/2)	408.10[a] *10*	34[a] *7*	571.51	(7/2)$^-$		
		828.05 *10*	27 *3*	151.63	5/2$^+$		
		837.00[a] *10*	100[a] *25*	142.59	(3/2)$^+$		
		951.00 *10*	55 *3*	28.545	5/2$^-$		
		979.6 *2*	14.1 *20*	0.0	3/2$^-$		
1047.44		292.80 *10*	13.0 *19*	754.53			
		326.47[&] *10*	<97[&]	721.06	(5/2)$^-$		
		638.50[&] *10*	<59[&]	409.04	(5/2)$^+$		
		806.2 *2*	40 *3*	241.37	(5/2)$^+$		
		866.0[&] *2*	<24[&]	181.66	(9/2)$^+$		
		895.7 *2*	100 *15*	151.63	5/2$^+$		
		1047.32 *10*	77 *5*	0.0	3/2$^-$		
1063.03		127.31[&] *10*	<52[&]	935.68	(5/2$^-$,7/2,9/2$^+$)		
		308.8 *2*	27 *3*	754.53			
		397.6 *2*	39 *7*	665.18	(7/2)$^+$		
		427.65 *10*	100 *6*	635.60	(3/2,5/2,7/2)$^+$		
		759.6 *2*	58 *6*	303.25	7/2$^+$,9/2$^+$,11/2$^+$		
		834.6 *2*	47 *8*	228.36	(7/2,9/2)$^-$		
		855.5[&] *2*	<35[&]	207.20	(5/2)$^-$		
		859.2 *2*	35 *5*	203.40	(9/2)$^-$		
		864.5 *2*	86 *6*	198.23	(7/2)$^+$		
		881.40 *10*	95 *6*	181.66	(9/2)$^+$		
1101.84	(7/2,9/2,11/2)$^+$	808.0 *2*		293.23	(7/2)$^+$		
		899.0 *2*	15.7 *17*	203.40	(9/2)$^-$		
		903.2 *2*	18 *5*	198.23	(7/2)$^+$		
		920.30 *10*	100 *5*	181.66	(9/2)$^+$	M1	0.0347
1185.18	(5/2$^-$,7/2)	319.61 *10*	37.5 *19*	865.74	(7/2)$^-$		

$^{225}_{87}Fr_{138}$-8

Adopted Levels, Gammas (continued)

γ(^{225}Fr) (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π
1185.18	(5/2$^-$,7/2)	566.3 *2*	23 *3*	618.66	(5/2,7/2,9/2)$^+$
		705.10 *10*	81 *4*	480.09	(5/2,7/2,9/2)$^+$
		839.2[&] *2*	<50[&]	346.03	(9/2)$^+$
		855.5[&] *2*	14[&] *3*	330.10	(5/2,7/2)$^-$
		891.7 *2*	29.1 *25*	293.23	(7/2)$^+$
		978.1 *2*	16.0 *25*	207.20	(5/2)$^-$
		981.5 *2*	29 *3*	203.40	(9/2)$^-$
		1033.5 *2*	100 *5*	151.63	5/2$^+$
		1102.55 *10*	41 *3*	82.515	7/2$^-$
1226.03		472.1[&] *2*	<27[&]	754.53	
		801.0 *2*	39 *4*	424.97	(5/2$^-$,7/2$^-$)
		1027.4 *2*	39 *8*	198.23	(7/2)$^+$
		1044.7 *2*	24 *5*	181.66	(9/2)$^+$
		1143.65 *10*	100 *6*	82.515	7/2$^-$
1392.17	(5/2,7/2$^-$)	412.30 *10*	65 *6*	979.66	(3/2$^-$,5/2)
		727.4 *2*	44 *6*	665.18	(7/2)$^+$
		756.70[&] *10*	<79[&]	635.60	(3/2,5/2,7/2)$^+$
		821.1 *2*	41 *7*	571.51	(7/2)$^-$
		1194.1 *2*	100 *9*	198.23	(7/2)$^+$
		1363.3 *2*	70 *6*	28.545	5/2$^-$
		1392.0 *2*	35 *7*	0.0	3/2$^-$
1479.63	(7/2)	758.5 *2*	16.7 *23*	721.06	(5/2)$^-$
		814.1 *2*	20.9 *25*	665.18	(7/2)$^+$
		999.5 *2*	22.9 *22*	480.09	(5/2,7/2,9/2)$^+$
		1070.48 *10*	39 *3*	409.04	(5/2)$^+$
		1176.2 *2*	16.0 *24*	303.25	7/2$^+$,9/2$^+$,11/2$^+$
		1281.3 *2*	17.1 *23*	198.23	(7/2)$^+$
		1298.03 *10*	83 *4*	181.66	(9/2)$^+$
		1328.1[a] *2*	84[a] *11*	151.63	5/2$^+$
		1337.40[a] *10*	34[a] *11*	142.59	(3/2)$^+$
		1351.40 *10*	63 *4*	128.06	9/2$^-$
		1397.00 *10*	28.7 *24*	82.515	7/2$^-$
		1451.16 *10*	100 *6*	28.545	5/2$^-$
1519.42		127.31[&] *10*	<40[&]	1392.17	(5/2,7/2$^-$)
		472.1[&] *2*	<26[&]	1047.44	
		798.7[&] *2*	<40[&]	721.06	(5/2)$^-$
		959.8 *2*	22 *4*	559.68	7/2$^-$
		1173.3 *2*	48 *6*	346.03	(9/2)$^+$
		1226.7 *2*	25 *5*	293.23	(7/2)$^+$

$^{225}_{87}Fr_{138}$-9

Adopted Levels, Gammas (continued)

$\gamma(^{225}Fr)$ (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π
1519.42		1321.4 *2*	49 *4*	198.23	$(7/2)^+$
		1337.40[a] *10*	100[a] *20*	181.66	$(9/2)^+$
1526.13		1195.7 *2*	83 *17*	330.10	$(5/2,7/2)^-$
		1328.1[a] *2*	100[a] *33*	198.23	$(7/2)^+$
		1374.6[&] *2*	<55[&]	151.63	$5/2^+$
		1443.2 *2*	49 *7*	82.515	$7/2^-$
		1498.0 *2*	69 *7*	28.545	$5/2^-$
1577.88	$(5/2^+,7/2)$	798.7[&] *2*	<28[&]	778.64	$7/2^-$
		942.8 *2*	14.6 *25*	635.60	$(3/2,5/2,7/2)^+$
		1017.6 *2*	23 *4*	559.68	$7/2^-$
		1169.2 *2*	36 *3*	409.04	$(5/2)^+$
		1232.2 *2*	20 *3*	346.03	$(9/2)^+$
		1374.6[&] *2*	<22.9[&]	203.40	$(9/2)^-$
		1495.30 *10*	100 *6*	82.515	$7/2^-$
		1549.3 *2*	22 *3*	28.545	$5/2^-$
1614.26	$(5/2,7/2^+)$	388.50 *10*	100 *5*	1226.03	
		551.10[&] *10*	<72[&]	1063.03	
		679.1[&] *2*	<38[&]	935.68	$(5/2^-,7/2,9/2^+)$
		948.9 *2*	62 *6*	665.18	$(7/2)^+$
		1111.2 *2*	32 *12*	502.96	$(5/2)^-$
		1385.3 *2*	55 *6*	228.36	$(7/2,9/2)^-$
		1416.3 *2*	50 *4*	198.23	$(7/2)^+$
		1471.2 *2*	45 *8*	142.59	$(3/2)^+$
1655.35	$(5/2,7/2^+)$	470.2 *2*	27 *6*	1185.18	$(5/2^-,7/2)$
		823.40 *10*	84 *5*	832.18	$(5/2^+,7/2,9/2^+)$
		876.7 *2*	43 *6*	778.64	$7/2^-$
		901.8 *2*	38 *10*	754.53	
		990.0 *2*	35 *4*	665.18	$(7/2)^+$
		1019.40 *10*	100 *8*	635.60	$(3/2,5/2,7/2)^+$
		1095.1 *2*	41 *8*	559.68	$7/2^-$
		1229.9 *2*	32 *6*	424.97	$(5/2^-,7/2^-)$
		1457.10 *10*	62 *8*	198.23	$(7/2)^+$
		1504.4 *2*	59 *5*	151.63	$5/2^+$
		1512.8 *2*	63 *6*	142.59	$(3/2)^+$
		1626.8 *2*	26 *4*	28.545	$5/2^-$
1749.84	$(5/2,7/2^+)$	702.40 *10*	26 *3*	1047.44	
		917.4 *2*	11.4 *22*	832.18	$(5/2^+,7/2,9/2^+)$
		1028.8 *2*	26 *5*	721.06	$(5/2)^-$
		1084.2 *2*	22 *3*	665.18	$(7/2)^+$
		1130.9 *2*	17 *6*	618.66	$(5/2,7/2,9/2)^+$

$^{225}_{87}Fr_{138}$-10

Adopted Levels, Gammas (continued)

$\gamma(^{225}Fr)$ (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π
1749.84	(5/2,7/2$^+$)	1421.0† *2*	18.6 *18*	330.10	(5/2,7/2)$^-$
		1508.6 *2*	27.0 *24*	241.37	(5/2)$^+$
		1551.4 *2*	29.2 *24*	198.23	(7/2)$^+$
		1568.10 *10*	100 *6*	181.66	(9/2)$^+$
		1607.3 *3*	12.2 *13*	142.59	(3/2)$^+$
		1667.4 *2*	29.8 *22*	82.515	7/2$^-$

† Eγ values for 136.0γ, 668.05γ and 1421.0γ are at least 5σ from expected least-squares adjusted value for placements indicated.

‡ Peak obscured or unresolved in singles spectrum; most of information was obtained from coincidence experiments.

Transition not observed, but its existence and total intensity was deduced from coincidences between lines feeding the 182 level and those depopulating the 152 and 182 levels in β^- decay.

@ 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 with undivided intensity.

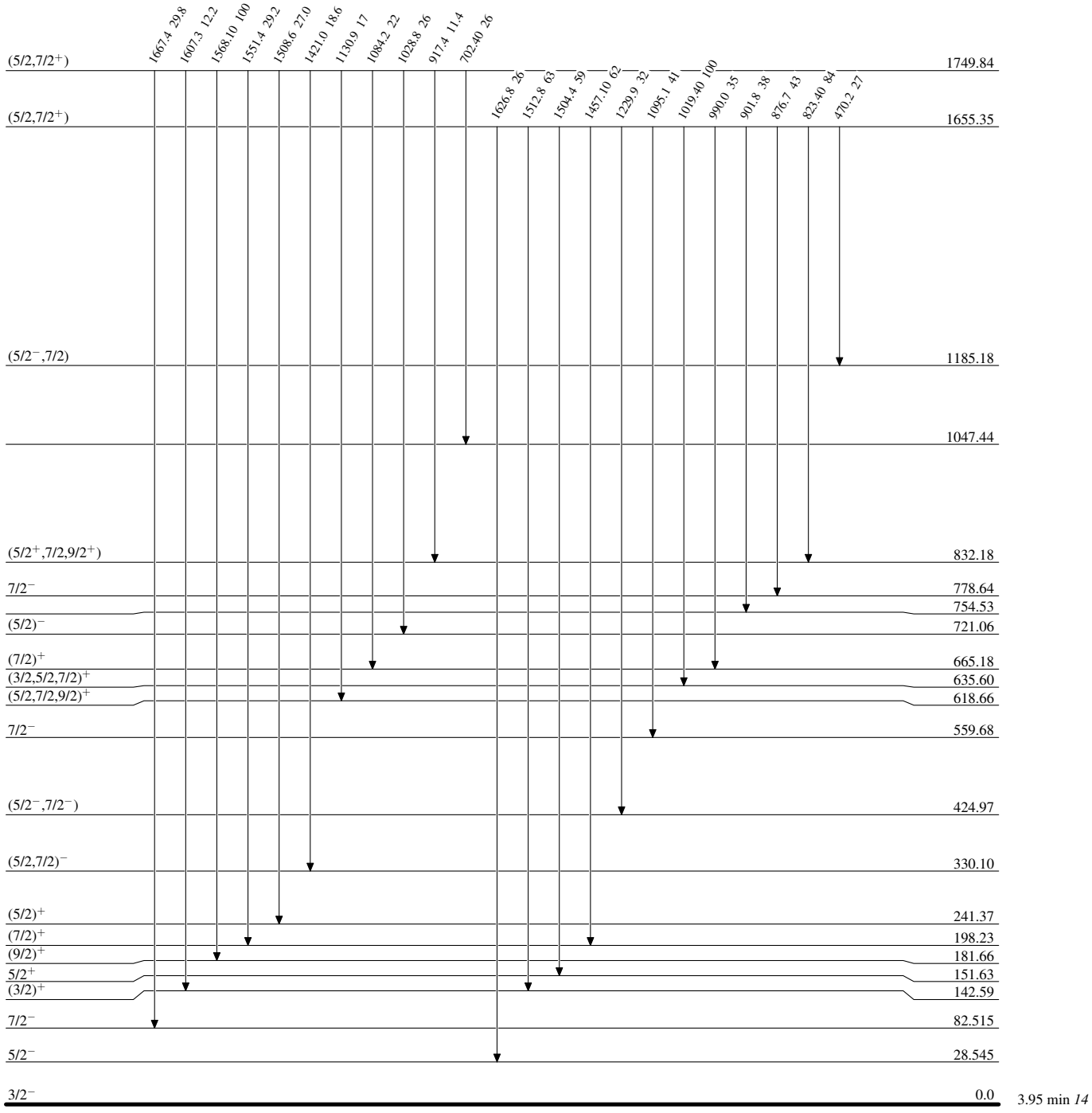
a Multiply placed with intensity suitably divided.

$^{225}_{87}Fr_{138}$-11

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level

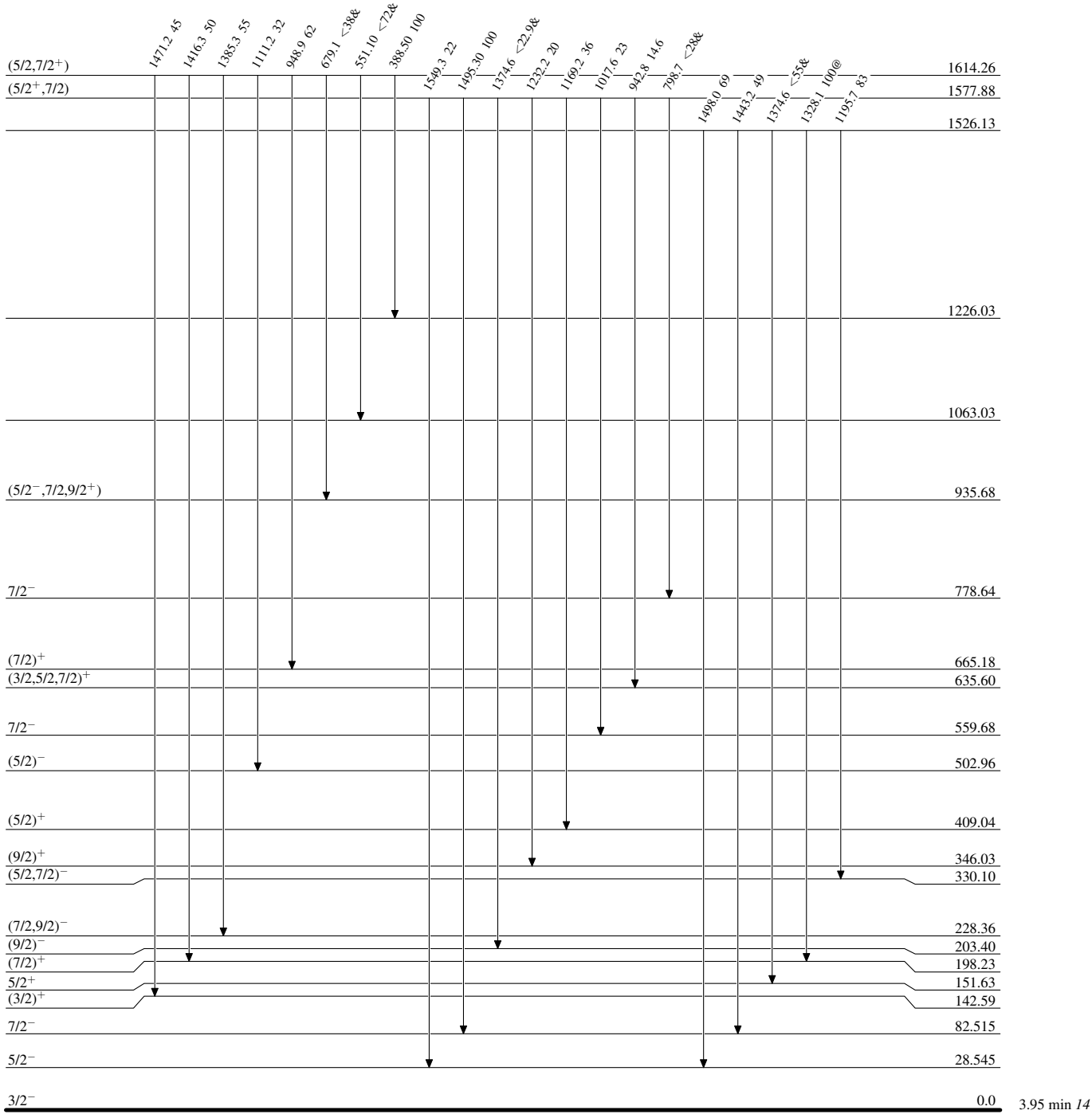


$^{225}_{87}Fr_{138}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

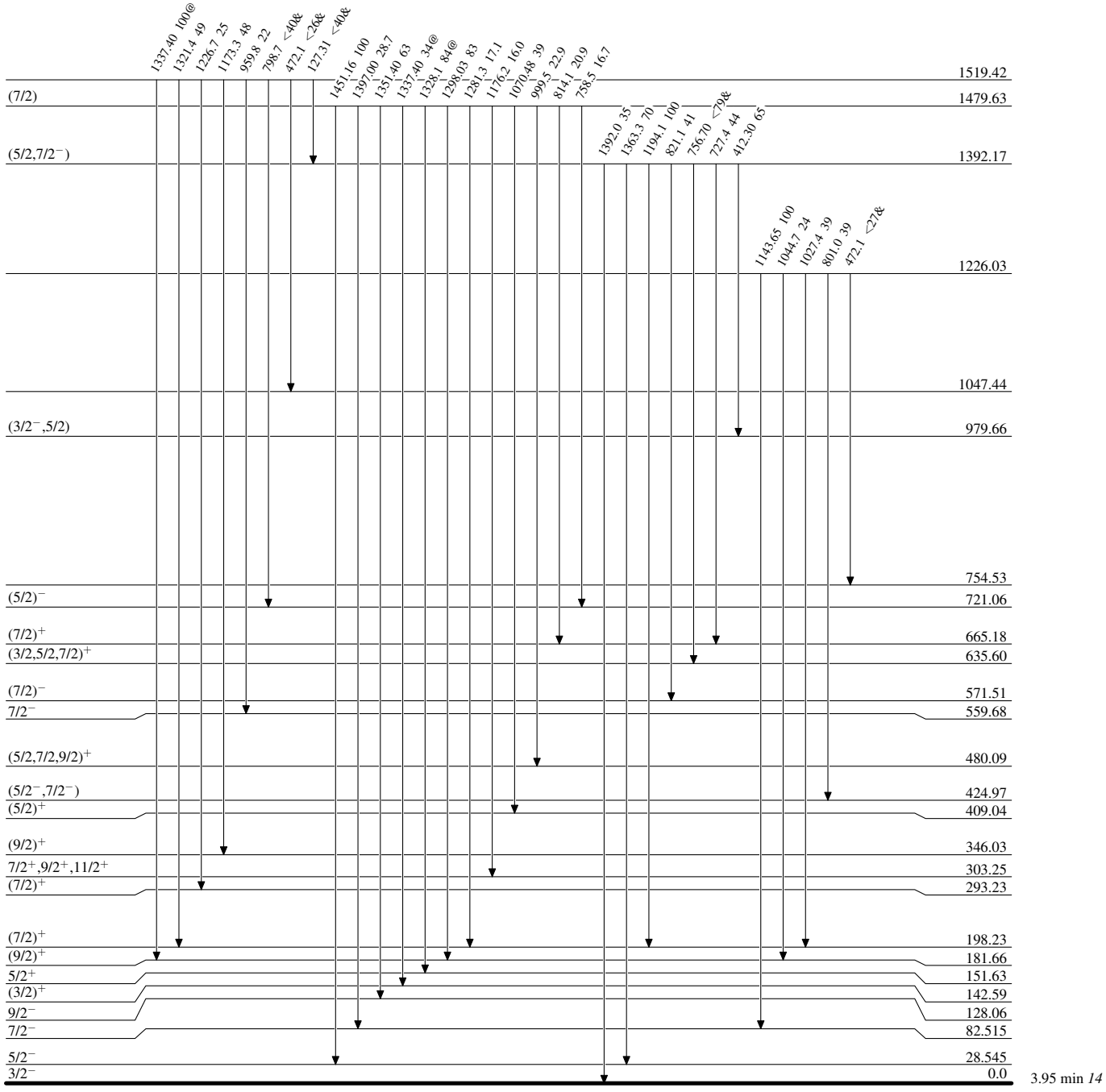


$^{225}_{87}Fr_{138}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

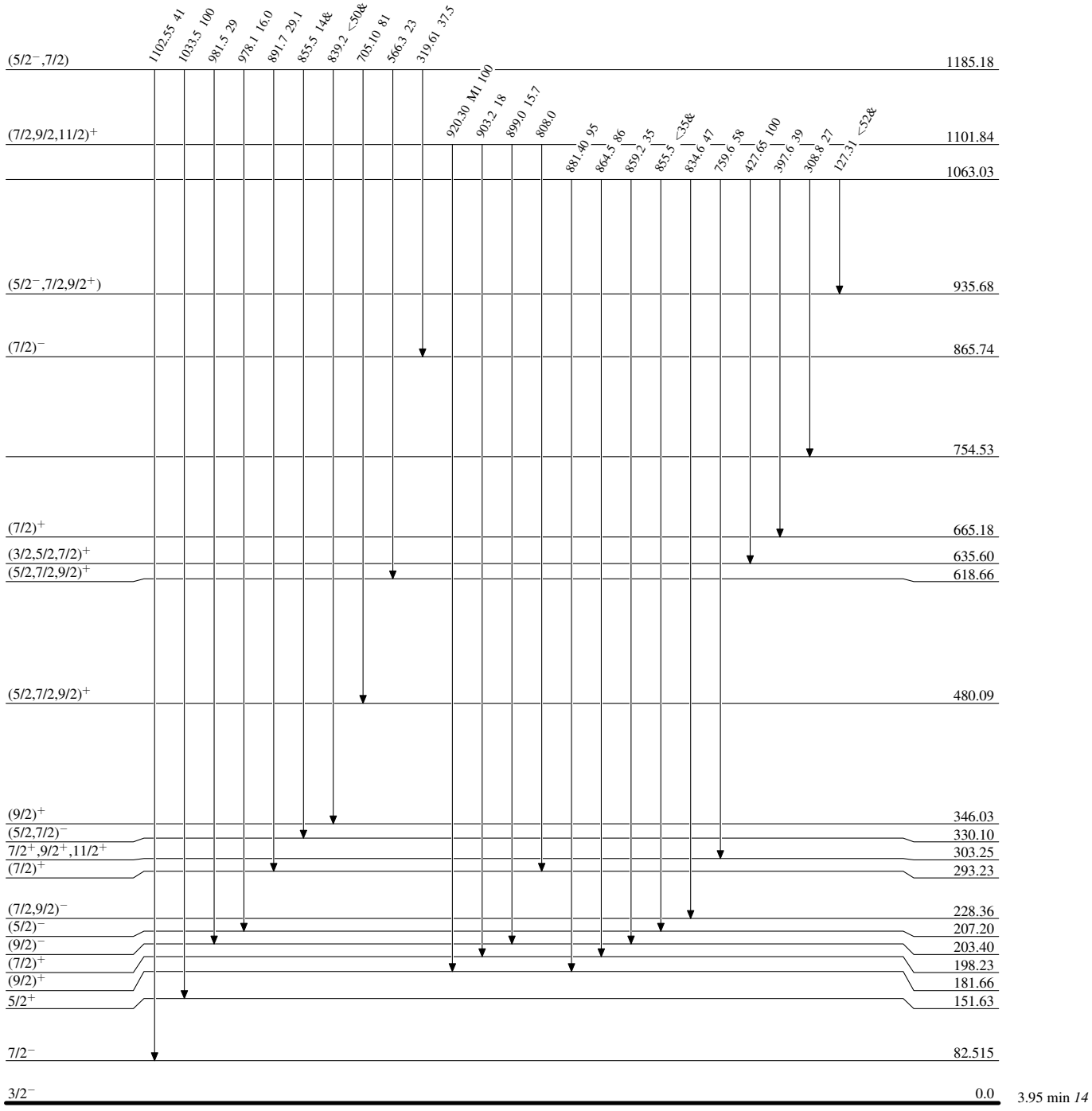


$^{225}_{87}Fr_{138}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

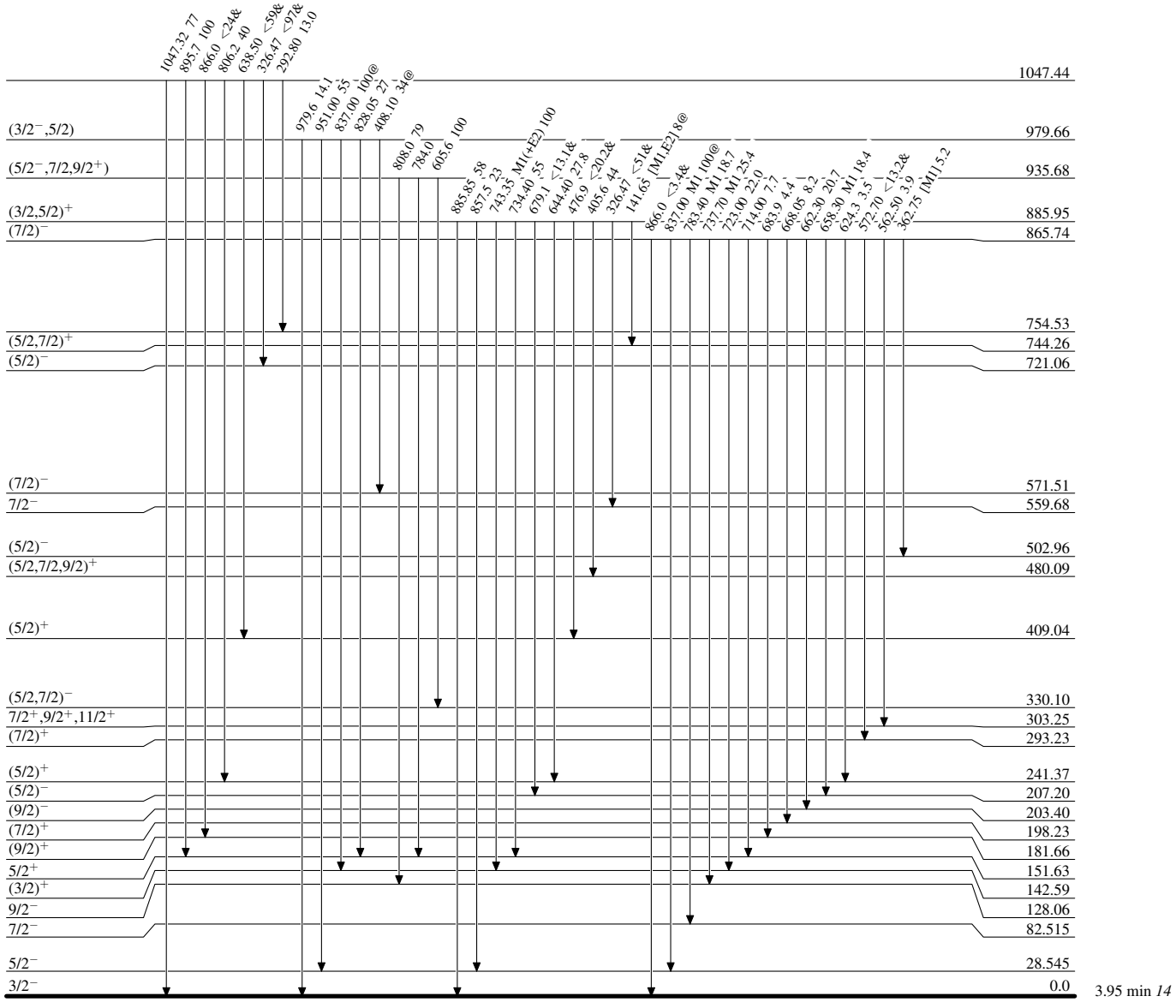


$^{225}_{87}Fr_{138}$

Adopted Levels, Gammas

Level Scheme (continued)

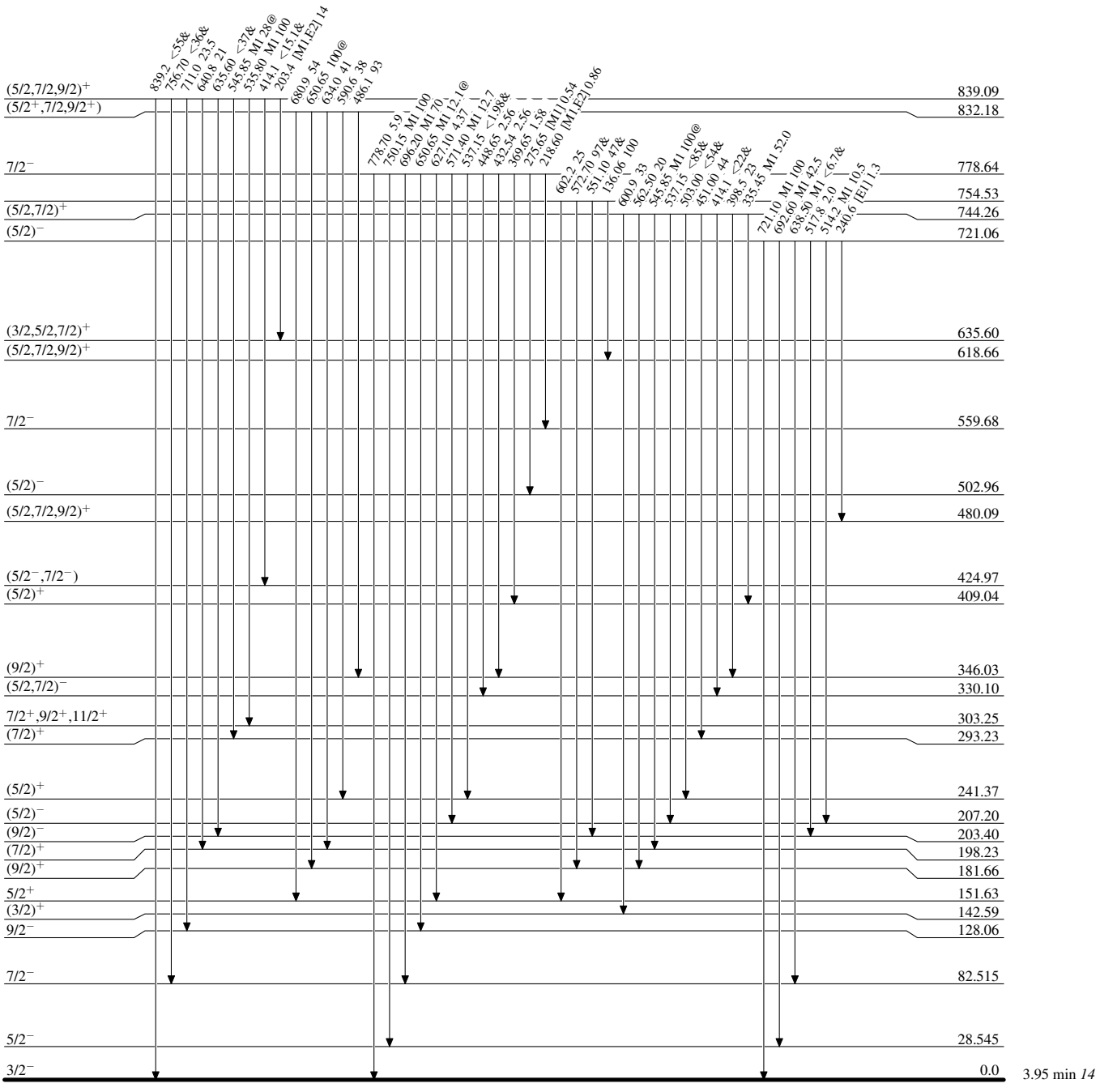
Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided



Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

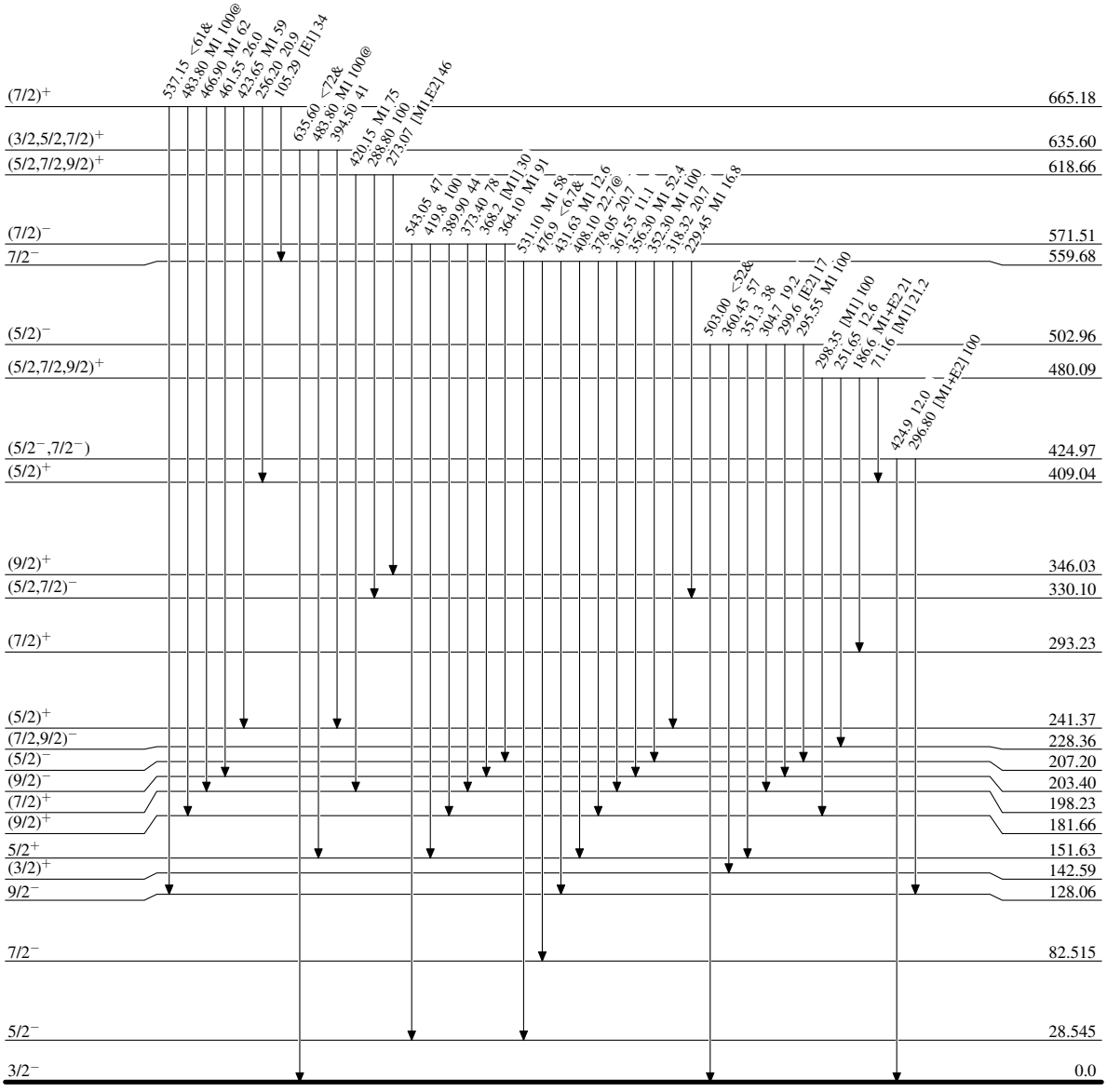


$^{225}_{87}Fr_{138}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

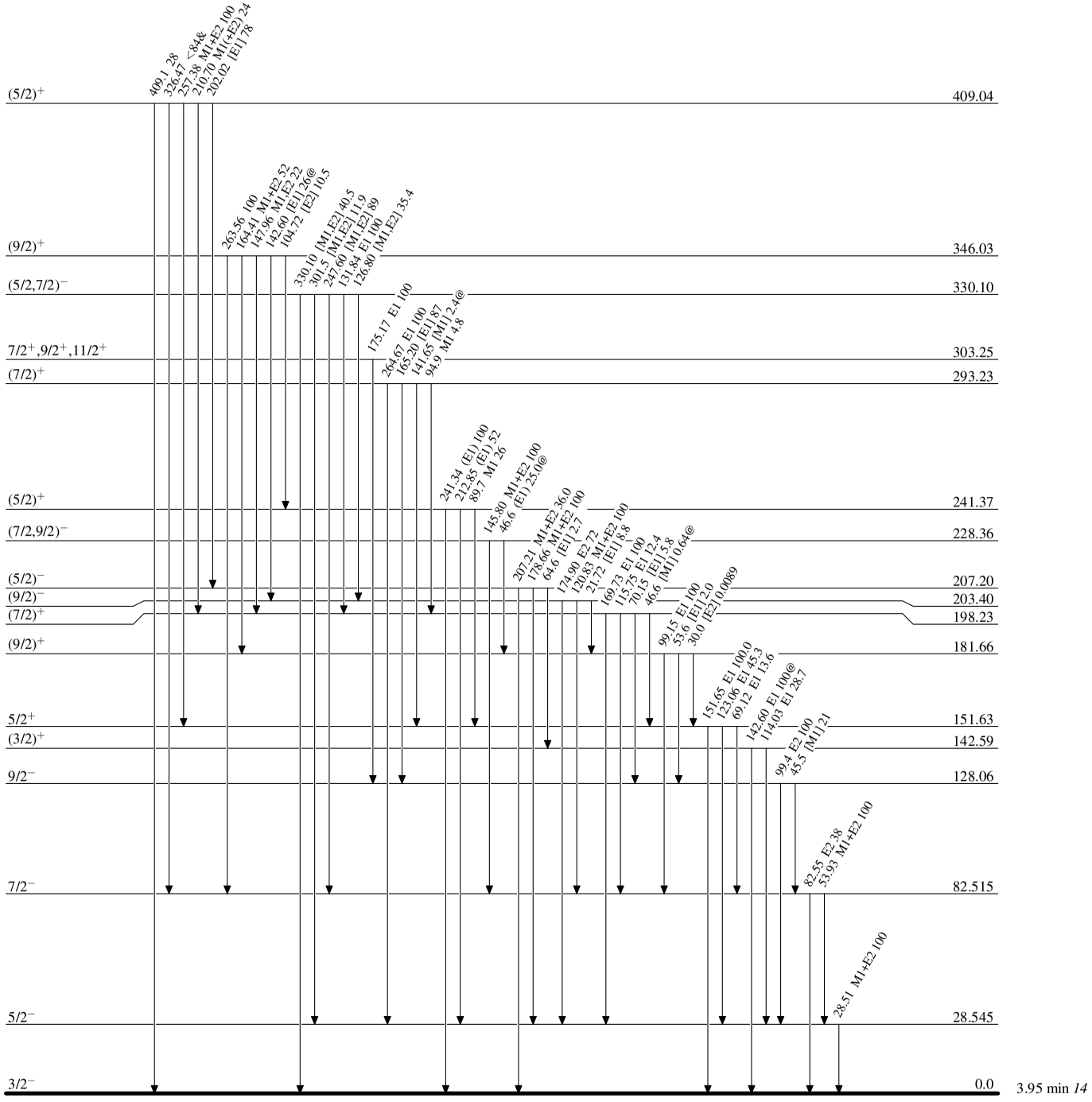


$^{225}_{87}Fr_{138}$

Adopted Levels, Gammas

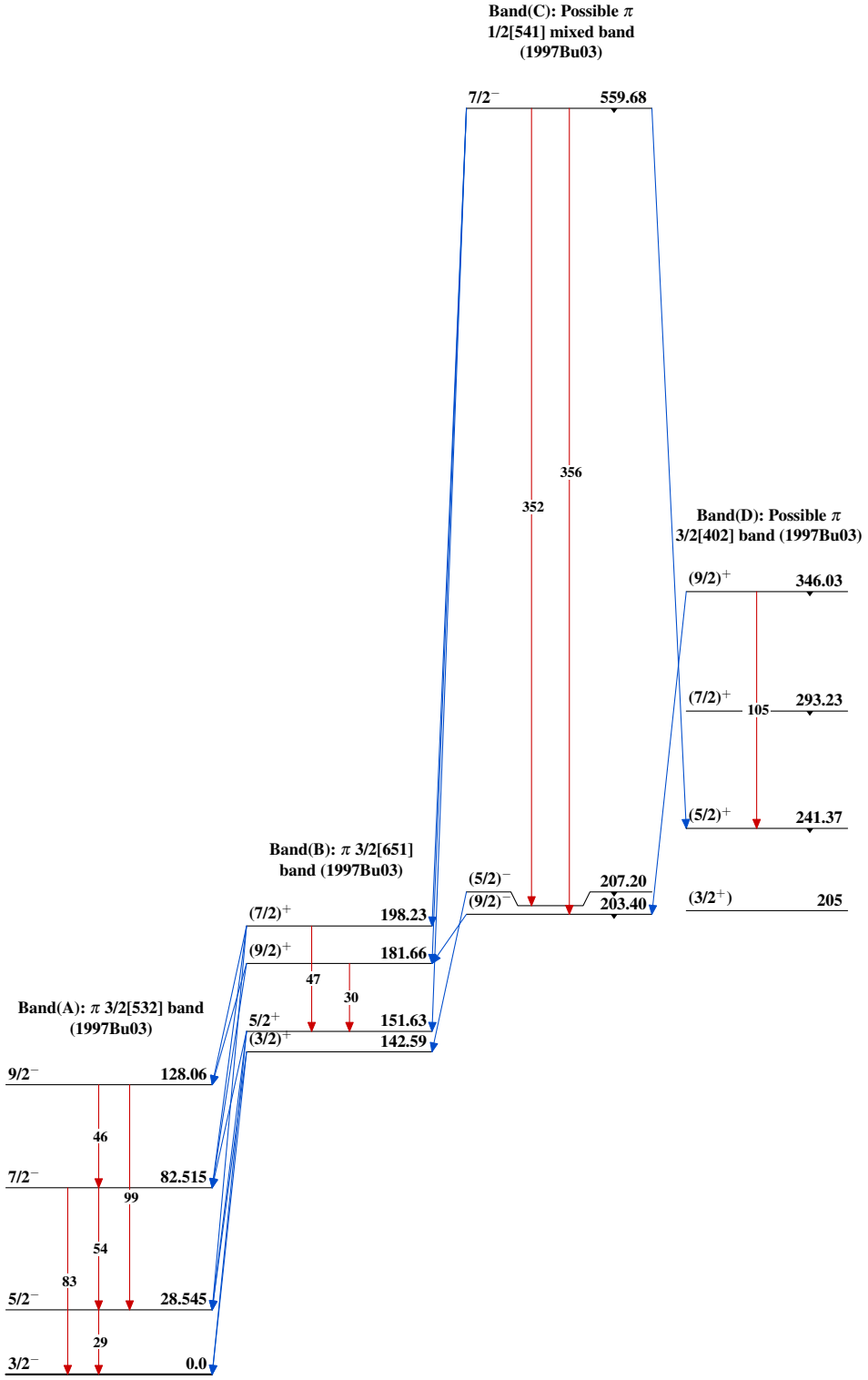
Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided



$^{225}_{87}Fr_{138}$

Adopted Levels, Gammas



$^{225}_{87}Fr_{138}$

Adopted Levels, Gammas (continued)

Band(E): $K^{\pi}=5/2^{-}$ band (1997Bu03)

$7/2^{-}$ 778.64

$(5/2)^{-}$ 721.06

$^{225}_{87}Fr_{138}$