^{227}Rn β^- decay (20.2 s) 1997Ku20

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Ictp-2014 Workshop Group	NDS 132, 257 (2016)	15-Jan-2016

Parent: ^{227}Rn: E=0.0; J$^\pi$=(5/2); T$_{1/2}$=20.2 s *4*; Q(β^-)=3200 *19*; %β^- decay=100.0

^{227}Rn-J$^\pi$,T$_{1/2}$: From ^{227}Rn Adopted Levels.

^{227}Rn-Q(β^-): From 2012Wa38.

1997Ku20: the ^{227}Rn activity was produced by spallation of 1-GeV protons on a ^{232}Th target and subsequently mass separated in the ISOLDE mass-separator. The separated activity was deposited on a tape transport for γ-ray, conversion electron, and β^- measurements. The assignment of γ rays to ^{227}Rn was based on its half-life of about 20 s. Measured Eγ, Iγ, $\gamma\gamma$ coin, $\beta\gamma$ coin, Ice, $\beta\gamma$(t), and $\beta\gamma\gamma$(t). Detectors: hyper-pure germanium detectors; the TESSA array of 12 Compton-suppressed germanium detectors for γ rays; a plastic scintillator for β^- particles; and a mini-orange magnetic spectrometer for conversion electrons. Deduced levels half-life and γ-ray multipolarities.

1997Ku20 measured K x ray intensities of 790 *25* (Kα_2 x ray), 1260 *50* (Kα_1 x ray), 453 *20* (Kβ_1' x ray), and 128 *10* (Kβ_2' x ray). The following values calculated by the evaluators using the computer program RADLST: 674 *60* (Kα_2 x ray), 1106 *98* (Kα_1 x ray), 512 *45* (Kβ ' x ray), and 3929 *1780* (L x ray). The normalization of the decay scheme, however, cannot be done accurately because possible β^- feedings to low energy levels are unknown. Nevertheless, 1997Ku20 normalized the decay scheme assuming no β^- feeding to any level below 40 keV. Except for the g.s. (1/2$^+$), this assumption seems unrealistic since these levels have spins of 3/2 or 5/2, and the parent nucleus ^{227}Rn is expected to have a spin of 5/2. As 1997Ku20 pointed out, their β^- and γ-ray deduced absolute intensities are just limits. Others: 1989Bo11, 1986Bo35.

Other measurements:

1989Bo11: measured Eγ, Iγ, $\beta\gamma$ coin. Detector: plastic scintillator for β^- particles, and a hyper-pure germanium detector for γ rays. Authors reported 33 γ rays, none of them placed in the level scheme.

1986Bo35: the activity was produced by spallation of 600-MeV protons on targets of ^{232}Th. Assignment to ^{227}Rn is based on mass separation, and on the genetic relationship with its daughter nucleus ^{227}Fr. Measured β^-. Detector: plastic scintillator (1986Bo35).

All data are from 1997Ku20, unless given otherwise.

^{227}Fr Levels

E(level)[@]	J$^\pi$[†‡]	T$_{1/2}$[#]	Comments
0.0[&]	1/2$^+$		
2.74[c] *4*	(3/2$^-$)		
31.96[&] *4*	(5/2$^+$)		
34.09[c] *10*	(5/2$^-$)		%β^-≤4.7, log *ft*≥6.7 (1997Ku20).
39.90[&] *4*	3/2$^+$	2.7 ns *2*	
56.03 *9*	1/2,3/2		
59.10 *5*	1/2$^-$,3/2$^-$		
62.97[a] *7*	1/2$^-$		
66.35 *5*	3/2$^+$		
87.98[c] *6*	(7/2$^-$)		J$^\pi$: based on rotational band structure.
95.40[a] *4*	3/2$^-$		
121.45[&] *16*	(7/2$^+$)		J$^\pi$: based on tentative assignment in rotational band structure.
132.08 *8*			
144.16[b] *4*	3/2$^+$	38 ps *12*	%β^-≤12.8, log *ft*≥6.2 (1997Ku20).
164.95[b] *4*	5/2$^+$	49 ps *8*	%β^-≤17.2, log *ft*≥6.0 (1997Ku20).
224.07 *4*	3/2$^-$,5/2$^-$	<36 ps	%β^-≤6.2, log *ft*≥6.4 (1997Ku20).
298.19 *8*			
306.49 *4*	3/2$^+$	<24 ps	%β^-≤13.1, log *ft*≥6.1 (1997Ku20).
330.77 *12*			267.8γ M1(+E2) to 1/2$^-$ suggests J$^\pi$=1/2$^-$,3/2$^-$. 209.3γ to (7/2$^+$) is inconsistent with this assignment.
378.55 *9*			
418.95 *4*	3/2$^-$,5/2$^-$	<29 ps	%β^-≤3.0, log *ft*≥6.6 (1997Ku20).

Continued on next page (footnotes at end of table)

^{227}Rn β^- decay (20.2 s) 1997Ku20 (continued)

^{227}Fr Levels (continued)

E(level)[@]	J^π[†‡]	Comments
427.73 *5*		%β^-≤2.2, log *ft*≥6.8 (1997Ku20).
444.88 *7*		
534.63 *5*	(3/2)$^-$	%β^-≤2.0, log *ft*≥6.8 (1997Ku20).
579.96 *12*	1/2$^-$,3/2$^-$,5/2$^-$	
675.46 *5*	3/2$^+$,5/2$^+$	%β^-≤2.5, log *ft*≥6.6 (1997Ku20).
686.23 *5*	3/2$^+$	%β^-≤4.7, log *ft*≥6.3 (1997Ku20).
689.09 *6*	(3/2$^+$,5/2$^+$)	%β^-≤2.6, log *ft*≥6.5 (1997Ku20).
690.31 *11*		
715.91 *9*		
849.95 *21*		
860.88 *10*		
872.03 *8*		
892.83 *5*	(3/2,5/2)$^+$	%β^-≤3.1, log *ft*≥6.3 (1997Ku20).
898.79 *8*		
904.10 *4*	3/2$^+$,5/2$^+$	%β^-≤5.1, log *ft*≥6.1 (1997Ku20).
922.92 *16*		
949.00 *5*	(3/2,5/2)$^-$	
955.02 *6*		

[†] Spin, parity, and rotational band assignments are based mostly on γ-ray multipolarities and the band structure expected from the reflection-symmetric rotor model, including an octupole deformation. Only the better established rotational bands are presented in this evaluation.

[‡] Although octupole deformations are small in this region, nuclear states are no longer fully characterized by single Nilsson orbitals. K=1/2 and 3/2 bands are expected parity-doublet pairs with same K but different parity. Decoupling parameters for these bands are the same but of opposite sign and enhanced E1 transitions connecting parity-pair band levels (1997Ku20).

[#] From $\beta\gamma$(t) and $\beta\gamma\gamma$(t) (1997Ku20).

[@] From least-squares fit to Eγ, by evaluators.

[&] Band(A): K^π=1/2$^+$ Band. Possible Configuration=(π 1/2[400]) (1997KU20).

[a] Band(a): K^π=1/2$^-$ Band. Possible Configuration=(π 1/2[530]) (1997KU20).

[b] Band(B): K^π=3/2$^+$ Band. Possible Configuration=(π 3/2[402]) (1997KU20).

[c] Band(b): K^π=3/2$^-$ Band. Possible Configuration=(π 3/2[532]) (1997KU20).

$\gamma(^{227}Fr)$

E_γ	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α[‡]	$I_{(\gamma+ce)}$	Comments
(2.74)		2.74	(3/2$^-$)	0.0	1/2$^+$	[E1]		74.5		α(N)=67.5 *10*; α(O)=6.77 *10*; α(P)=0.262 *4*; α(Q)=0.00218 *3* γ ray not observed.
7.40		66.35	3/2$^+$	59.10	1/2$^-$,3/2$^-$	[E1]		27.8	≈20	ce(M)/(γ+ce)=0.751 *7* ce(N)/(γ+ce)=0.183 *4*; ce(O)/(γ+ce)=0.0294 *6*; ce(P)/(γ+ce)=0.00217 *5*; ce(Q)/(γ+ce)=3.04×10^{-5} *6* α(M)=21.6 *3* α(N)=5.26 *8*; α(O)=0.845 *12*; α(P)=0.0625 *9*; α(Q)=0.000875 *13*
20.63		164.95	5/2$^+$	144.16	3/2$^+$	[M1+E2]		9.4×10^3 *92*	100 *20*	ce(L)/(γ+ce)=0.74 *52*; ce(M)/(γ+ce)=0.20 *25* ce(N)/(γ+ce)=0.052 *69*; ce(O)/(γ+ce)=0.011 *15*; ce(P)/(γ+ce)=0.0014 *19*; ce(Q)/(γ+ce)=2.9×10^{-6} *29* α(L)=7.0×10^3 *68*; α(M)=1.9×10^3 *19* α(N)=4.9×10^2 *48*; α(O)=1.01×10^2 *98*; α(P)=13 *13*; α(Q)=0.0274 *6*
(31.35)		34.09	(5/2$^-$)	2.74	(3/2$^-$)	[E2]		2.34×10^3		α(L)=1727 *25*; α(M)=463 *7* α(N)=121.0 *17*; α(O)=25.0 *4*; α(P)=3.16 *5*; α(Q)=0.00399 *6* γ ray not observed.
(31.96)	≤5	31.96	(5/2$^+$)	0.0	1/2$^+$	[E2]		2.12×10^3		α(L)=1567 *22*; α(M)=420 *6* α(N)=109.8 *16*; α(O)=22.6 *4*; α(P)=2.87 *4*; α(Q)=0.00364 *6* γ ray not observed.
32.35		95.40	3/2$^-$	62.97	1/2$^-$	[M1,E2]		1.05×10^3 *98*	≈35	ce(L)/(γ+ce)=0.74 *50*; ce(M)/(γ+ce)=0.20 *24* ce(N)/(γ+ce)=0.052 *66*; ce(O)/(γ+ce)=0.011 *14*; ce(P)/(γ+ce)=0.0014 *18*; ce(Q)/(γ+ce)=5.1×10^{-6} *51* α(L)=7.8×10^2 *72*; α(M)=2.1×10^2 *20* α(N)=54 *51*; α(O)=11 *11*; α(P)=1.4 *13*; α(Q)=0.0054 *20*
39.88 *8*	30 *4*	39.90	3/2$^+$	0.0	1/2$^+$	M1+E2	0.16 *14*	59 *40*		α(L)=44 *29*; α(M)=10.9 *79* α(N)=2.9 *21*; α(O)=0.62 *43*; α(P)=0.094 *53*; α(Q)=0.00389 *17* δ: deduced by evaluator from α(M)exp=11 *3*.
48.77 *10*	8 *3*	144.16	3/2$^+$	95.40	3/2$^-$	[E1]		0.729		α(L)=0.552 *9*; α(M)=0.1346 *21* α(N)=0.0345 *6*; α(O)=0.00712 *11*; α(P)=0.000934 *14*; α(Q)=2.69×10^{-5} *4*
54.3 *5*	7.8 *37*	87.98	(7/2$^-$)	34.09	(5/2$^-$)					
^{x}55.40 *10*	9.2 *15*									
56.00 *10*	12.1 *15*	56.03	1/2,3/2	0.0	1/2$^+$	M1,E1		7.9 *74*		α(L)=6.0 *56*; α(M)=1.4 *14* α(N)=0.37 *35*; α(O)=0.084 *79*; α(P)=0.013 *13*;

$^{227}_{87}Fr_{140}$-3

$\gamma(^{227}$Fr) (continued)

E_γ	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	δ	α[‡]	$I_{(\gamma+ce)}$	Comments
										α(Q)=7.4×10^{-4} *72* Mult.: from α(M)exp≤12.
59.10 *5*	56.7 *20*	59.10	$1/2^-,3/2^-$	0.0	$1/2^+$	E1		0.436		α(L)=0.330 *5*; α(M)=0.0801 *12* α(N)=0.0206 *3*; α(O)=0.00429 *6*; α(P)=0.000578 *9*; α(Q)=1.78×10^{-5} *3* Mult.: from α(L1)exp + α(L2)exp≤2.
61.22	≤5	95.40	$3/2^-$	34.09	$(5/2^-)$	E2		90.4		α(L)=66.6 *10*; α(M)=18.0 *3* α(N)=4.71 *7*; α(O)=0.974 *14*; α(P)=0.1244 *18*; α(Q)=0.000203 *3* Mult.: from α(M)exp>4.8.
63.07 *10*	23.9 *31*	62.97	$1/2^-$	0.0	$1/2^+$	E1		0.366		α(L)=0.278 *4*; α(M)=0.0672 *10* α(N)=0.0173 *3*; α(O)=0.00361 *6*; α(P)=0.000491 *8*; α(Q)=1.545×10^{-5} *23* Mult.: from α(L1)exp + α(L2)exp≤0.28.
66.39 *10*		444.88		378.55					≈10	
66.50 *10*	24.4 *15*	66.35	$3/2^+$	0.0	$1/2^+$	M1+E2	0.57 *23*	21.9 *75*		α(L)=16.3 *55*; α(M)=4.2 *16* α(N)=1.11 *40*; α(O)=0.235 *81*; α(P)=0.0324 *99*; α(Q)=0.00070 *11* δ: deduced by evaluator from α(L3)exp=5 *2*.
77.85 *5*	53.0 *19*	144.16	$3/2^+$	66.35	$3/2^+$	M1+E2	0.5 *4*	10.4 *57*		α(L)=7.8 *42*; α(M)=2.0 *12* α(N)=0.52 *31*; α(O)=0.111 *62*; α(P)=0.0159 *74*; α(Q)=4.6×10^{-4} *12* Mult.,δ: from α(L1)exp + α(L2)exp=6.0 *10*.
88.08		418.95	$3/2^-,5/2^-$	330.77					≈20	
89.51[@]		121.45	$(7/2^+)$	31.96	$(5/2^+)$					1997Ku20 presented this γ ray in the decay scheme only.
92.65 *5*	27.9 *11*	95.40	$3/2^-$	2.74	$(3/2^-)$	(M1)		3.52		α(L)=2.67 *4*; α(M)=0.637 *9* α(N)=0.1669 *24*; α(O)=0.0373 *6*; α(P)=0.00599 *9*; α(Q)=0.000335 *5* Mult.: E1,M1 from α(L3)exp≤0.4. Decay scheme requires M1.
95.42 *5*	52.1 *20*	95.40	$3/2^-$	0.0	$1/2^+$	E1		0.1212		α(L)=0.0920 *13*; α(M)=0.0221 *4* α(N)=0.00571 *8*; α(O)=0.001215 *17*; α(P)=0.0001723 *25*; α(Q)=6.18×10^{-6} *9* Mult.: from α(L1)exp + α(L2)exp≤0.3.
97.90 *10*	44 *7*	132.08		34.09	$(5/2^-)$					
98.53 *10*	27.9 *84*	164.95	$5/2^+$	66.35	$3/2^+$	M1		2.94		α(L)=2.23 *4*; α(M)=0.533 *8* α(N)=0.1397 *20*; α(O)=0.0312 *5*; α(P)=0.00501 *8*; α(Q)=0.000280 *4* Mult.: from α(L1)exp + α(L2)exp=2.3 *7*.
104.4 *1*	63 *5*	144.16	$3/2^+$	39.90	$3/2^+$	M1+E2	1.0 *5*	10.0 *16*		α(K)=5.2 *30*; α(L)=3.6 *11*; α(M)=0.94 *30* α(N)=0.247 *78*; α(O)=0.052 *16*; α(P)=0.0071 *18*; α(Q)=1.32×10^{-4} *63* Mult.,δ: from α(L1)exp + α(L2)exp=2.5 *3*.

$\gamma(^{227}Fr)$ (continued)

E_γ	I_γ†	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α‡	Comments
112.22 *5*	26 *2*	144.16	3/2$^+$	31.96	(5/2$^+$)	M1+E2	1.0 *5*	7.9 *15*	α(K)=4.3 *24*; α(L)=2.66 *68*; α(M)=0.69 *20* α(N)=0.182 *52*; α(O)=0.039 *11*; α(P)=0.0053 *12*; α(Q)=1.07×10^{-4} *52* Mult.,δ: from α(L)exp=2.7 *5*, α(M)exp≈0.2.
112.38 *10*	≈10	418.95	3/2$^-$,5/2$^-$	306.49	3/2$^+$	[E1]		0.356	α(K)=0.277 *4*; α(L)=0.0596 *9*; α(M)=0.01432 *21* α(N)=0.00370 *6*; α(O)=0.000791 *12*; α(P)=0.0001139 *17*; α(Q)=4.27×10^{-6} *6*
^{x}114.48 *5*	10.7 *9*								
124.6 *4*	5.0 *6*	164.95	5/2$^+$	39.90	3/2$^+$	[M1,E2]		5.6 *21*	α(K)=3.2 *30*; α(L)=1.73 *60*; α(M)=0.45 *18* α(N)=0.118 *48*; α(O)=0.0251 *93*; α(P)=0.00350 *96*; α(Q)=7.9×10^{-5} *64*
128.78 *5*	80.4 *24*	224.07	3/2$^-$,5/2$^-$	95.40	3/2$^-$	M1		6.97	α(K)=5.61 *8*; α(L)=1.033 *15*; α(M)=0.246 *4* α(N)=0.0645 *9*; α(O)=0.01443 *21*; α(P)=0.00231 *4*; α(Q)=0.0001292 *19* Mult.: from α(L)exp=1.2 *2*.
132.95 *5*	130 *4*	164.95	5/2$^+$	31.96	(5/2$^+$)	M1		6.37	α(K)=5.13 *8*; α(L)=0.943 *14*; α(M)=0.225 *4* α(N)=0.0589 *9*; α(O)=0.01317 *19*; α(P)=0.00211 *3*; α(Q)=0.0001179 *17* Mult.: from α(L)exp=0.6 *3*.
133.0 *2*	5.5 *8*	298.19		164.95	5/2$^+$				
135.9 *2*	8.1 *8*	224.07	3/2$^-$,5/2$^-$	87.98	(7/2$^-$)				
141.53# *5*	78# *5*	144.16	3/2$^+$	2.74	(3/2$^-$)	E1		0.204	α(K)=0.1607 *23*; α(L)=0.0326 *5*; α(M)=0.00780 *11* α(N)=0.00202 *3*; α(O)=0.000435 *7*; α(P)=6.37×10^{-5} *9*; α(Q)=2.54×10^{-6} *4* Mult.: from α(L)exp=0.30 *5* for the 141.5-keV doublet.
141.53# *5*	42# *4*	306.49	3/2$^+$	164.95	5/2$^+$	M1		5.33	α(K)=4.29 *6*; α(L)=0.788 *11*; α(M)=0.188 *3* α(N)=0.0493 *7*; α(O)=0.01101 *16*; α(P)=0.001766 *25*; α(Q)=9.86×10^{-5} *14* Mult.: from α(L)exp=0.30 *5* for the 141.5-keV doublet.
144.4 *3*	5.4 *8*	144.16	3/2$^+$	0.0	1/2$^+$	[M1+E2]		3.5 *16*	α(K)=2.2 *19*; α(L)=0.97 *23*; α(M)=0.250 *74* α(N)=0.066 *20*; α(O)=0.0140 *37*; α(P)=0.0020 *4*; α(Q)=5.2×10^{-5} *42*
154.25 *10*	10.9 *11*	298.19		144.16	3/2$^+$				
157.90 *10*	14.6 *15*	224.07	3/2$^-$,5/2$^-$	66.35	3/2$^+$	[E1]		0.1560	α(K)=0.1237 *18*; α(L)=0.0245 *4*; α(M)=0.00587 *9* α(N)=0.001520 *22*; α(O)=0.000328 *5*; α(P)=4.84×10^{-5} *7*; α(Q)=1.98×10^{-6} *3*
162.17 *8*	433 *15*	164.95	5/2$^+$	2.74	(3/2$^-$)	E1		0.1462	α(K)=0.1160 *17*; α(L)=0.0229 *4*; α(M)=0.00547 *8* α(N)=0.001419 *20*; α(O)=0.000307 *5*; α(P)=4.53×10^{-5} *7*; α(Q)=1.87×10^{-6} *3* Mult.: from α(L)exp=0.071 *12* for 162.17γ + 162.22γ.
162.22 *8*	97 *7*	306.49	3/2$^+$	144.16	3/2$^+$	M1		3.62	α(K)=2.92 *5*; α(L)=0.534 *8*; α(M)=0.1273 *18* α(N)=0.0334 *5*; α(O)=0.00746 *11*; α(P)=0.001196 *17*; α(Q)=6.68×10^{-5} *10* Mult.: from α(L)exp=0.071 *12* for 162.17γ + 162.22γ.

γ(^{227}Fr) (continued)

E_γ	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	δ	α[‡]	Comments
165.3 *5*	17 *3*	164.95	5/2$^+$	0.0	1/2$^+$	[E2]		1.123 *21*	α(K)=0.233 *4*; α(L)=0.656 *13*; α(M)=0.177 *4* α(N)=0.0464 *9*; α(O)=0.00966 *19*; α(P)=0.001268 *25*; α(Q)=7.22$\times10^{-6}$ *12*
174.43 *10*	17.8 *18*	306.49	3/2$^+$	132.08					
192.06 *5*	25 *4*	224.07	3/2$^-$,5/2$^-$	31.96	(5/2$^+$)	[E1]		0.0971	α(K)=0.0776 *11*; α(L)=0.01487 *21*; α(M)=0.00355 *5* α(N)=0.000921 *13*; α(O)=0.000200 *3*; α(P)=2.98$\times10^{-5}$ *5*; α(Q)=1.275$\times10^{-6}$ *18*
194.95 *5*	70 *7*	418.95	3/2$^-$,5/2$^-$	224.07	3/2$^-$,5/2$^-$	M1+E2	0.9 *3*	1.5 *3*	α(K)=1.04 *29*; α(L)=0.319 *5*; α(M)=0.0803 *23* α(N)=0.0211 *6*; α(O)=0.00456 *9*; α(P)=0.000672 *19*; α(Q)=2.40$\times10^{-5}$ *64* Mult.,δ: from α(K)exp=1.0 *2*.
^{x}202.05 *10*	13.1 *13*								
209.32 *10*	12.1 *13*	330.77		121.45	(7/2$^+$)				
210.76 *10*	16.1 *16*	306.49	3/2$^+$	95.40	3/2$^-$	[E1]		0.0778	α(K)=0.0623 *9*; α(L)=0.01177 *17*; α(M)=0.00281 *4* α(N)=0.000729 *11*; α(O)=0.0001584 *23*; α(P)=2.38$\times10^{-5}$ *4*; α(Q)=1.037$\times10^{-6}$ *15*
213.66 *10*	18.1 *18*	378.55		164.95	5/2$^+$				
235.06 *10*	7.8 *8*	298.19		62.97	1/2$^-$				
^{x}239.35 *5*	27.4 *14*					M1,E2		0.76 *46*	α(K)=0.55 *44*; α(L)=0.157 *22*; α(M)=0.039 *4* α(N)=0.0103 *9*; α(O)=0.00224 *25*; α(P)=0.00033 *7*; α(Q)=1.26$\times10^{-5}$ *97*
240.3 *5*	≈9	306.49	3/2$^+$	66.35	3/2$^+$	[M1+E2]		0.75 *46*	α(K)=0.54 *43*; α(L)=0.155 *22*; α(M)=0.039 *4* α(N)=0.0102 *9*; α(O)=0.0022 *3*; α(P)=0.00033 *7*; α(Q)=1.24$\times10^{-5}$ *96*
244.33 *10*	9.6 *9*	689.09	(3/2$^+$,5/2$^+$)	444.88					
247.8 *5*	≈6	675.46	3/2$^+$,5/2$^+$	427.73					
253.85 *10*	8.9 *9*	418.95	3/2$^-$,5/2$^-$	164.95	5/2$^+$	[E1]		0.0502	α(K)=0.0404 *6*; α(L)=0.00744 *11*; α(M)=0.001770 *25* α(N)=0.000460 *7*; α(O)=0.0001004 *14*; α(P)=1.521$\times10^{-5}$ *22*; α(Q)=6.89$\times10^{-7}$ *10*
^{x}258.24 *5*	24.2 *15*								
262.63 *10*	11.7 *12*	427.73		164.95	5/2$^+$				
266.55 *5*	38.3 *23*	306.49	3/2$^+$	39.90	3/2$^+$	M1+E2	1.0 *3*	0.56 *12*	α(K)=0.41 *11*; α(L)=0.110 *8*; α(M)=0.0274 *15* α(N)=0.0072 *4*; α(O)=0.00157 *10*; α(P)=0.000235 *21*; α(Q)=9.4$\times10^{-6}$ *25* δ: deduced by evaluator from α(K)exp=0.41 *8*.
267.81 *10*	45.1 *27*	330.77		62.97	1/2$^-$	M1(+E2)	≈0.3	≈0.833	α(K)≈0.666; α(L)≈0.1268; α(M)≈0.0304 α(N)≈0.00796; α(O)≈0.001774; α(P)≈0.000282; α(Q)≈1.512$\times10^{-5}$ δ: deduced by evaluator from α(K)exp=0.66 *13*.
^{x}270.35 *10*	20.9 *10*								
279.9 *2*	10.0 *10*	444.88		164.95	5/2$^+$				
283.60 *10*	7.7 *8*	427.73		144.16	3/2$^+$				
295.54 *10*	32.8 *16*	427.73		132.08		M1		0.678	α(K)=0.548 *8*; α(L)=0.0993 *14*; α(M)=0.0236 *4*

$\gamma(^{227}$Fr) (continued)

E_γ	I_γ†	E_i(level)	J^π_i	E_f	J^π_f	Mult.	δ	α‡	Comments
									α(N)=0.00619 *9*; α(O)=0.001384 *20*; α(P)=0.000222 *4*; α(Q)=1.239×10^{-5} *18* Mult.: from α(K)exp=0.8 *2*.
296.3 *5*	≈15	330.77		34.09	(5/2$^-$)				
^{x}297.32 *10*	14.3 *14*								
300.80 *10*	15.4 *9*	444.88		144.16	3/2$^+$				
303.74 *5*	43.9 *17*	306.49	3/2$^+$	2.74	(3/2$^-$)	(E1)		0.0333	α(K)=0.0269 *4*; α(L)=0.00484 *7*; α(M)=0.001149 *16* α(N)=0.000299 *5*; α(O)=6.54×10^{-5} *10*; α(P)=1.000×10^{-5} *14*; α(Q)=4.68×10^{-7} *7* Mult.: E1,E2 from α(K)exp=0.11 *3*. Decay scheme requires E1.
306.53 *5*	72.7 *22*	306.49	3/2$^+$	0.0	1/2$^+$	M1		0.613	α(K)=0.495 *7*; α(L)=0.0897 *13*; α(M)=0.0214 *3* α(N)=0.00560 *8*; α(O)=0.001251 *18*; α(P)=0.000201 *3*; α(Q)=1.120×10^{-5} *16* Mult.: from α(K)exp=0.48 *10*.
^{x}322.60 *10*	14.7 *15*					M1+E2	1.9 *5*	0.21 *5*	α(K)=0.140 *45*; α(L)=0.050 *5*; α(M)=0.0127 *10* α(N)=0.00333 *24*; α(O)=0.00072 *6*; α(P)=0.000104 *11*; α(Q)=3.2×10^{-6} *10*
331.00 *5*	30.8 *22*	418.95	3/2$^-$,5/2$^-$	87.98	(7/2$^-$)				
332.40 *5*	37.5 *22*	427.73		95.40	3/2$^-$				
^{x}367.53 *10*	14.5 *12*								
369.5 *5*	16 *3*	534.63	(3/2)$^-$	164.95	5/2$^+$	[E1]		0.0215	α(K)=0.0175 *3*; α(L)=0.00307 *5*; α(M)=0.000728 *11* α(N)=0.000190 *3*; α(O)=4.16×10^{-5} *6*; α(P)=6.42×10^{-6} *10*; α(Q)=3.10×10^{-7} *5*
379.05 *5*	34.0 *16*	418.95	3/2$^-$,5/2$^-$	39.90	3/2$^+$	[E1]		0.0204	α(K)=0.01656 *24*; α(L)=0.00290 *4*; α(M)=0.000687 *10* α(N)=0.000179 *3*; α(O)=3.93×10^{-5} *6*; α(P)=6.07×10^{-6} *9*; α(Q)=2.95×10^{-7} *5*
387.03 *5*	42.3 *17*	418.95	3/2$^-$,5/2$^-$	31.96	(5/2$^+$)	[E1]		0.0195	α(K)=0.01584 *23*; α(L)=0.00277 *4*; α(M)=0.000655 *10* α(N)=0.0001706 *24*; α(O)=3.75×10^{-5} *6*; α(P)=5.79×10^{-6} *9*; α(Q)=2.82×10^{-7} *4*
^{x}399.7 *5*	7.9 *8*								
416.16 *5*	58.6 *18*	418.95	3/2$^-$,5/2$^-$	2.74	(3/2$^-$)	[M1+E2]		0.16 *11*	α(K)=0.126 *91*; α(L)=0.028 *11*; α(M)=0.0068 *25* α(N)=0.00179 *64*; α(O)=3.9×10^{-4} *15*; α(P)=6.1×10^{-5} *26*; α(Q)=2.8×10^{-6} *21*
427.4 *2*	13.0 *10*	427.73		0.0	1/2$^+$				
431.0 *2*	9.6 *10*	849.95		418.95	3/2$^-$,5/2$^-$				
442.3 *5*	≈20	860.88		418.95	3/2$^-$,5/2$^-$				
468.4 *5*	6.9 *10*	534.63	(3/2)$^-$	66.35	3/2$^+$	[E1]		0.01303	α(K)=0.01064 *15*; α(L)=0.00182 *3*; α(M)=0.000430 *6* α(N)=0.0001120 *16*; α(O)=2.47×10^{-5} *4*; α(P)=3.84×10^{-6} *6*; α(Q)=1.92×10^{-7} *3*
470.5 *5*	5.4 *10*	898.79		427.73					
473.95 *10*	31.9 *16*	892.83	(3/2,5/2)$^+$	418.95	3/2$^-$,5/2$^-$				
485.16 *5*	31.6 *16*	904.10	3/2$^+$,5/2$^+$	418.95	3/2$^-$,5/2$^-$	[E1]		0.01212	α(K)=0.00990 *14*; α(L)=0.001688 *24*; α(M)=0.000398 *6*

γ(^{227}Fr) (continued)

E_γ	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α[‡]	Comments
								α(N)=0.0001038 *15*; α(O)=2.29×10^{-5} *4*; α(P)=3.57×10^{-6} *5*; α(Q)=1.80×10^{-7} *3*
^{x}489.95 *10*	9.3 *9*							
502.88 *10*	27.3 *16*	534.63	(3/2)$^-$	31.96	(5/2$^+$)	(E1)	0.01126	α(K)=0.00921 *13*; α(L)=0.001564 *22*; α(M)=0.000369 *6* α(N)=9.61×10^{-5} *14*; α(O)=2.12×10^{-5} *3*; α(P)=3.31×10^{-6} *5*; α(Q)=1.675×10^{-7} *24* Mult.: E1,E2 from α(K)exp≤0.09. Decay scheme requires E1.
510.4 *5*	12 *2*	675.46	3/2$^+$,5/2$^+$	164.95	5/2$^+$	[M1+E2]	0.095 *60*	α(K)=0.074 *51*; α(L)=0.0155 *69*; α(M)=0.0038 *16* α(N)=9.9×10^{-4} *41*; α(O)=2.18×10^{-4} *93*; α(P)=3.4×10^{-5} *16*; α(Q)=1.7×10^{-6} *12*
^{x}518.66 *10*	14.3 *13*							
520.86 *10*	33.6 *13*	579.96	1/2$^-$,3/2$^-$,5/2$^-$	59.10	1/2$^-$,3/2$^-$	M1	0.1462	α(K)=0.1184 *17*; α(L)=0.0212 *3*; α(M)=0.00503 *7* α(N)=0.001318 *19*; α(O)=0.000295 *5*; α(P)=4.73×10^{-5} *7*; α(Q)=2.65×10^{-6} *4* Mult.: from α(K)exp=0.13 *4*.
529.90 *10*	24.8 *17*	949.00	(3/2,5/2)$^-$	418.95	3/2$^-$,5/2$^-$	[M1+E2]	0.086 *54*	α(K)=0.067 *46*; α(L)=0.0140 *63*; α(M)=0.0034 *15* α(N)=8.9×10^{-4} *37*; α(O)=1.96×10^{-4} *85*; α(P)=3.1×10^{-5} *15*; α(Q)=1.5×10^{-6} *11*
531.87 *5*	52.1 *21*	534.63	(3/2)$^-$	2.74	(3/2$^-$)	M1	0.1383	α(K)=0.1120 *16*; α(L)=0.0200 *3*; α(M)=0.00475 *7* α(N)=0.001246 *18*; α(O)=0.000279 *4*; α(P)=4.47×10^{-5} *7*; α(Q)=2.50×10^{-6} *4* Mult.: from α(K)exp=0.15 *7*.
534.52 *10*	16.5 *17*	534.63	(3/2)$^-$	0.0	1/2$^+$	[E1]	0.00996	α(K)=0.00815 *12*; α(L)=0.001376 *20*; α(M)=0.000324 *5* α(N)=8.45×10^{-5} *12*; α(O)=1.87×10^{-5} *3*; α(P)=2.92×10^{-6} *4*; α(Q)=1.489×10^{-7} *21*
536.10 *5*	25.2 *20*	955.02		418.95	3/2$^-$,5/2$^-$			
^{x}538.84 *10*	14.0 *11*							
^{x}544.55 *10*	12.3 *14*							
546.15 *10*	17.6 *18*	690.31		144.16	3/2$^+$			
^{x}559.6 *5*	6.0 *6*							
586.16 *10*	100 *10*	892.83	(3/2,5/2)$^+$	306.49	3/2$^+$	M1	0.1068	α(K)=0.0865 *13*; α(L)=0.01543 *22*; α(M)=0.00366 *6* α(N)=0.000960 *14*; α(O)=0.000215 *3*; α(P)=3.45×10^{-5} *5*; α(Q)=1.93×10^{-6} *3* Mult.: from α(K)exp=0.11 *2*.
592.15 *10*	24.4 *19*	922.92		330.77				
593.8 *2*	11.6 *13*	689.09	(3/2$^+$,5/2$^+$)	95.40	3/2$^-$	[E1]	0.00809	α(K)=0.00663 *10*; α(L)=0.001108 *16*; α(M)=0.000261 *4* α(N)=6.80×10^{-5} *10*; α(O)=1.504×10^{-5} *21*; α(P)=2.36×10^{-6} *4*; α(Q)=1.219×10^{-7} *17*
597.57 *5*	100	904.10	3/2$^+$,5/2$^+$	306.49	3/2$^+$	M1	0.1015	α(K)=0.0822 *12*; α(L)=0.01465 *21*; α(M)=0.00348 *5* α(N)=0.000912 *13*; α(O)=0.000204 *3*; α(P)=3.27×10^{-5} *5*; α(Q)=1.83×10^{-6} *3* Mult.: from α(K)exp=0.12 *4*.

$\gamma(^{227}$Fr) (continued)

E_γ	I_γ†	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α‡	Comments
601.10 *5*	41.5 *21*	689.09	(3/2$^+$,5/2$^+$)	87.98	(7/2$^-$)			
623.6 *3*	11.2 *11*	686.23	3/2$^+$	62.97	1/2$^-$	[E1]	0.00735	α(K)=0.00603 *9*; α(L)=0.001003 *14*; α(M)=0.000236 *4* α(N)=6.15×10^{-5} *9*; α(O)=1.362×10^{-5} *20*; α(P)=2.14×10^{-6} *3*; α(Q)=1.112×10^{-7} *16*
643.51 *5*	56.7 *22*	675.46	3/2$^+$,5/2$^+$	31.96	(5/2$^+$)	M1	0.0835	α(K)=0.0676 *10*; α(L)=0.01203 *17*; α(M)=0.00285 *4* α(N)=0.000748 *11*; α(O)=0.0001672 *24*; α(P)=2.69×10^{-5} *4*; α(Q)=1.505×10^{-6} *21* Mult.: from α(K)exp=0.23 *10*.
652.94 *5*	25.6 *13*	715.91		62.97	1/2$^-$			
655.3 *2*	18.7 *24*	689.09	(3/2$^+$,5/2$^+$)	34.09	(5/2$^-$)	[E1]	0.00668	α(K)=0.00549 *8*; α(L)=0.000908 *13*; α(M)=0.000214 *3* α(N)=5.57×10^{-5} *8*; α(O)=1.233×10^{-5} *18*; α(P)=1.94×10^{-6} *3*; α(Q)=1.015×10^{-7} *15*
656.95 *10*	75.1 *38*	689.09	(3/2$^+$,5/2$^+$)	31.96	(5/2$^+$)	M1(+E0)		Mult.: from α(K)exp=0.22 *7*.
^{x}660.8 *2*	17.7 *18*							
672.71 *5*	61.8 *19*	675.46	3/2$^+$,5/2$^+$	2.74	(3/2$^-$)	[E1]	0.00635	α(K)=0.00522 *8*; α(L)=0.000862 *12*; α(M)=0.000203 *3* α(N)=5.28×10^{-5} *8*; α(O)=1.171×10^{-5} *17*; α(P)=1.84×10^{-6} *3*; α(Q)=9.67×10^{-8} *14*
680.06 *10*	25.7 *10*	904.10	3/2$^+$,5/2$^+$	224.07	3/2$^-$,5/2$^-$	[E1]	0.00622	α(K)=0.00512 *8*; α(L)=0.000844 *12*; α(M)=0.000198 *3* α(N)=5.17×10^{-5} *8*; α(O)=1.146×10^{-5} *16*; α(P)=1.80×10^{-6} *3*; α(Q)=9.48×10^{-8} *14*
686.22 *5*	268 *8*	686.23	3/2$^+$	0.0	1/2$^+$	M1	0.0704	α(K)=0.0571 *8*; α(L)=0.01014 *15*; α(M)=0.00241 *4* α(N)=0.000630 *9*; α(O)=0.0001409 *20*; α(P)=2.26×10^{-5} *4*; α(Q)=1.269×10^{-6} *18* Mult.: from α(K)exp=0.11 *2*.
^{x}695.33 *10*	14.9 *12*							
^{x}707.10 *10*	16.0 *10*							
^{x}711.50 *10*	27.0 *14*							
724.95 *5*	84.7 *25*	949.00	(3/2,5/2)$^-$	224.07	3/2$^-$,5/2$^-$	M1	0.0610	α(K)=0.0494 *7*; α(L)=0.00876 *13*; α(M)=0.00208 *3* α(N)=0.000545 *8*; α(O)=0.0001218 *17*; α(P)=1.96×10^{-5} *3*; α(Q)=1.098×10^{-6} *16* Mult.: from α(K)exp=0.13 *6*.
739.16 *5*	279 *8*	904.10	3/2$^+$,5/2$^+$	164.95	5/2$^+$	M1	0.0579	α(K)=0.0470 *7*; α(L)=0.00832 *12*; α(M)=0.00197 *3* α(N)=0.000517 *8*; α(O)=0.0001157 *17*; α(P)=1.86×10^{-5} *3*; α(Q)=1.043×10^{-6} *15* Mult.: from α(K)exp=0.05 *2*.
^{x}744.46 *10*	15.0 *10*							
748.78 *5*	25.7 *10*	892.83	(3/2,5/2)$^+$	144.16	3/2$^+$			
754.48 *10*	11.8 *12*	898.79		144.16	3/2$^+$			
759.97 *5*	114 *3*	904.10	3/2$^+$,5/2$^+$	144.16	3/2$^+$	M1	0.0539	α(K)=0.0437 *7*; α(L)=0.00773 *11*; α(M)=0.00183 *3* α(N)=0.000481 *7*; α(O)=0.0001075 *15*; α(P)=1.726×10^{-5} *25*; α(Q)=9.69×10^{-7} *14* Mult.: from α(K)exp=0.06 *3*.

From ENSDF

$\gamma(^{227}Fr)$ (continued)

E_γ	I_γ†	E_i(level)	J^π_i	E_f	J^π_f	Mult.	α‡	Comments
^{x}762.29 *10*	23.5 *14*							
765.8 *2*	13.7 *14*	860.88		95.40	3/2$^-$			
794.41 *10*	28.2 *11*	860.88		66.35	3/2$^+$			
798.7 *5*	4.6 *6*	860.88		62.97	1/2$^-$			
801.7 *5*	5.8 *8*	860.88		59.10	1/2$^-$,3/2$^-$			
804.96 *5*	158 *5*	949.00	(3/2,5/2)$^-$	144.16	3/2$^+$	[E1]	0.00454	α(K)=0.00374 *6*; α(L)=0.000608 *9*; α(M)=0.0001427 *20* α(N)=3.72×10^{-5} *6*; α(O)=8.26×10^{-6} *12*; α(P)=1.305×10^{-6} *19*; α(Q)=6.99×10^{-8} *10*
810.75 *10*	14.2 *9*	955.02		144.16	3/2$^+$			
815.97 *10*	32.6 *13*	872.03		56.03	1/2,3/2			
826.4 *5*	9.3 *7*	892.83	(3/2,5/2)$^+$	66.35	3/2$^+$			
835.98 *10*	21.5 *12*	898.79		62.97	1/2$^-$			
838.2 *5*	7.6 *8*	872.03		34.09	(5/2$^-$)			
^{x}845.12 *10*	35.5 *12*							
853.17 *10*	28.6 *30*	949.00	(3/2,5/2)$^-$	95.40	3/2$^-$	[M1,E2]	0.026 *14*	α(K)=0.021 *12*; α(L)=0.0039 *18*; α(M)=9.3×10^{-4} *42* α(N)=2.4×10^{-4} *11*; α(O)=5.4×10^{-5} *25*; α(P)=8.6×10^{-6} *41*; α(Q)=4.5×10^{-7} *27*
^{x}861.00 *10*	26.8 *27*							
864.7 *5*	8.1 *8*	898.79		34.09	(5/2$^-$)			
872.05 *10*	45.6 *14*	872.03		0.0	1/2$^+$			
^{x}876.66 *10*	11.2 *8*							
^{x}889.34 *10*	16.0 *40*							
892.54 *10*	16.7 *11*	892.83	(3/2,5/2)$^+$	0.0	1/2$^+$			
^{x}897.7 *5*	5.5 *8*							
901.38 *10*	28.6 *11*	904.10	3/2$^+$,5/2$^+$	2.74	(3/2$^-$)	[E1]	0.00369	α(K)=0.00305 *5*; α(L)=0.000491 *7*; α(M)=0.0001151 *17* α(N)=3.00×10^{-5} *5*; α(O)=6.67×10^{-6} *10*; α(P)=1.058×10^{-6} *15*; α(Q)=5.72×10^{-8} *8*

† Relative photon intensity.

‡ From BrIcc v2.3 (9-Dec-2011) 2008Ki07, "Frozen Orbitals" appr. α overlaps M1 and E2 if δ not given.

Multiply placed with intensity suitably divided.

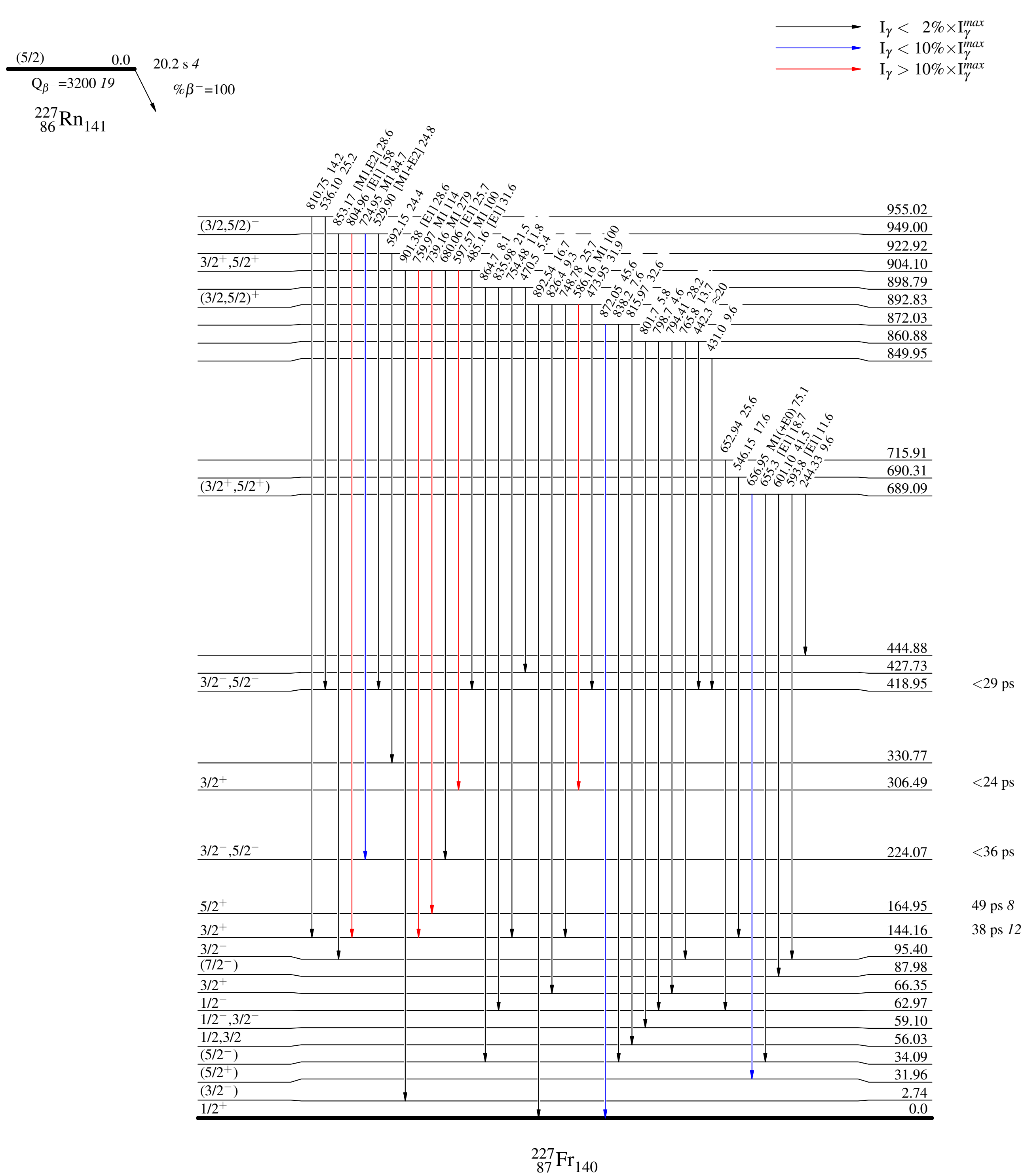
@ Placement of transition in the level scheme is uncertain.

^{x} γ ray not placed in level scheme.

^{227}Rn β^- decay (20.2 s) 1997Ku20

Decay Scheme

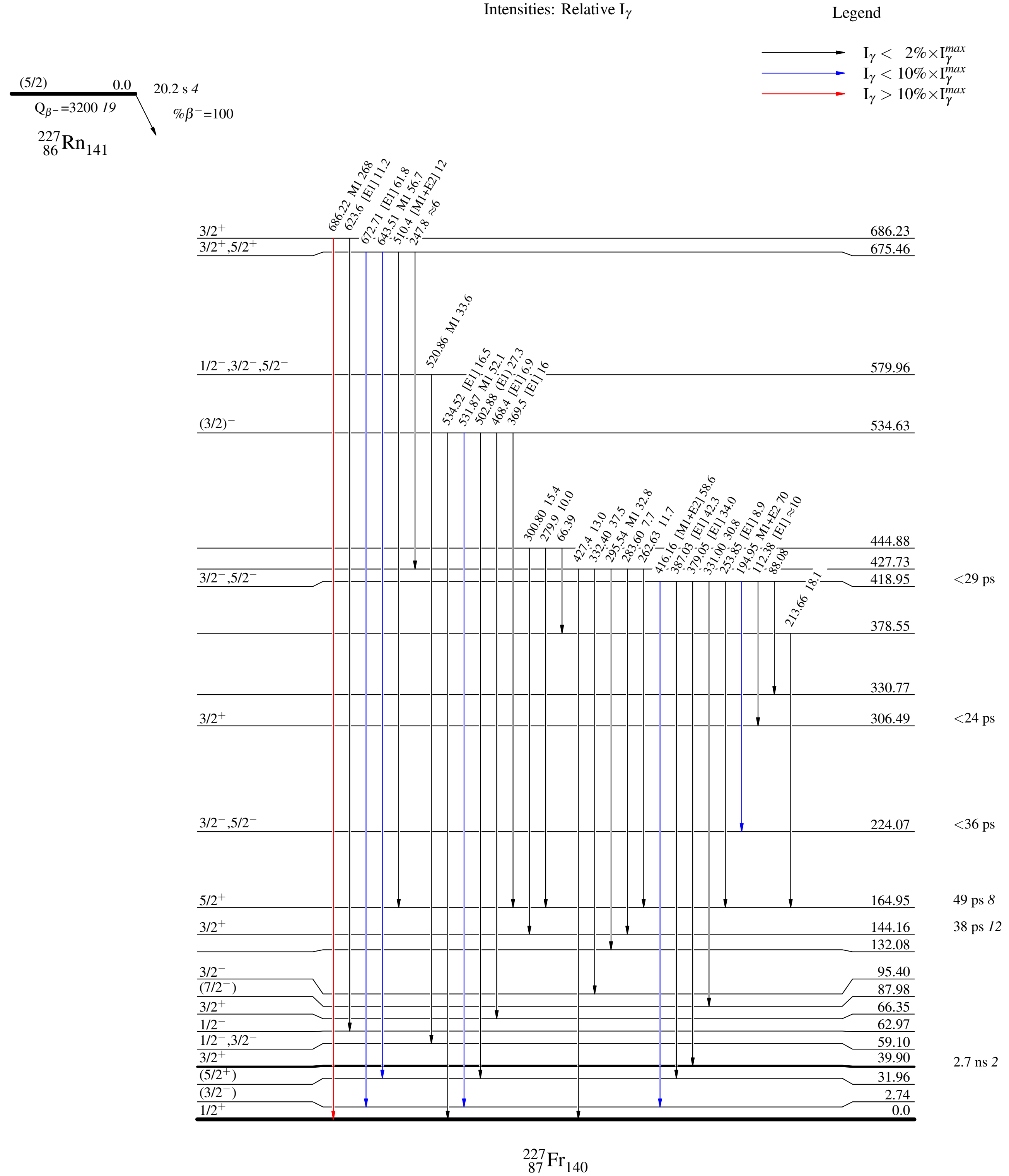
Intensities: Relative I_γ



^{227}Rn β^- decay (20.2 s) 1997Ku20

Decay Scheme (continued)

Intensities: Relative I_γ

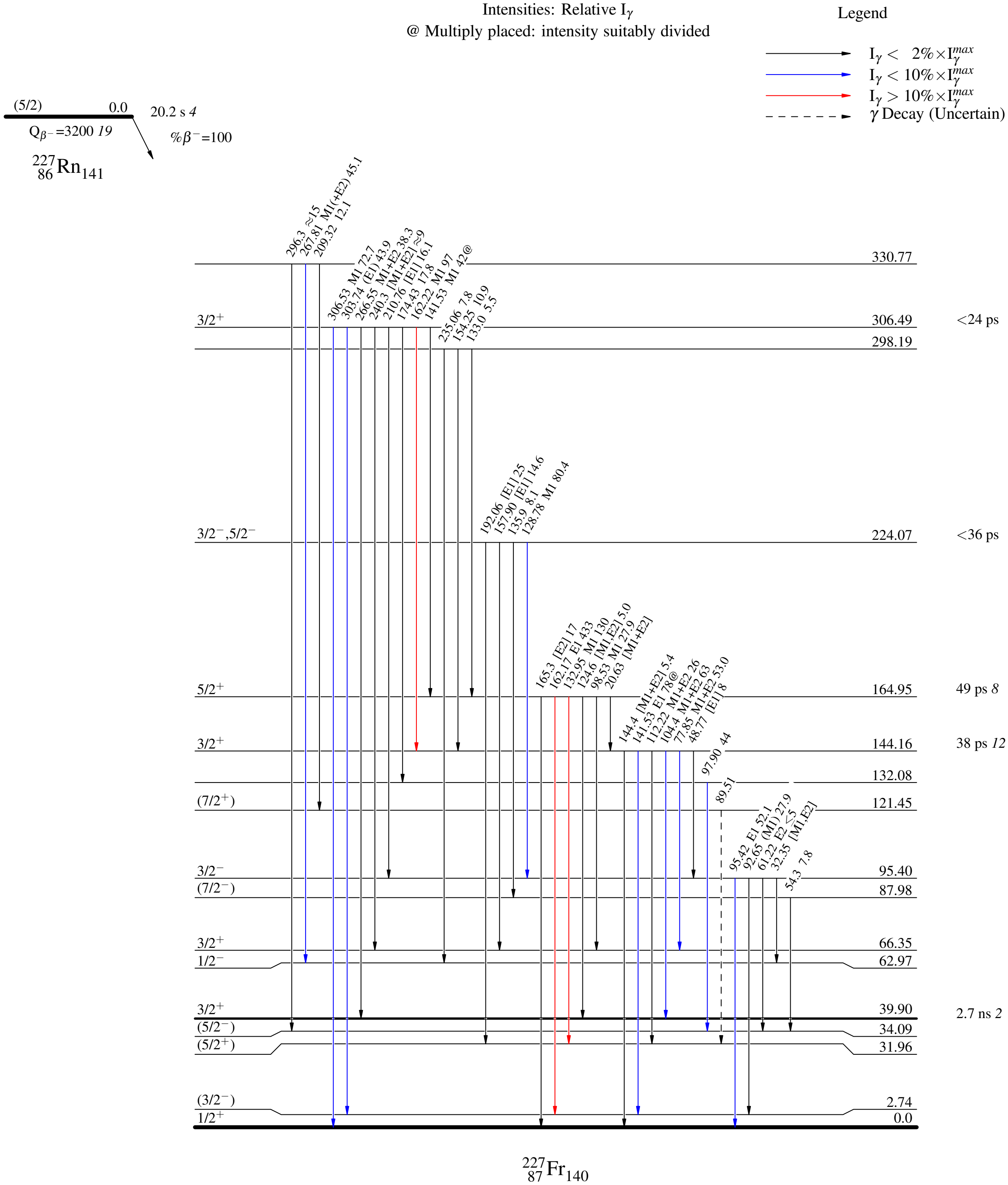


^{227}Rn β^- decay (20.2 s) 1997Ku20

Decay Scheme (continued)

Intensities: Relative I_γ

@ Multiply placed: intensity suitably divided

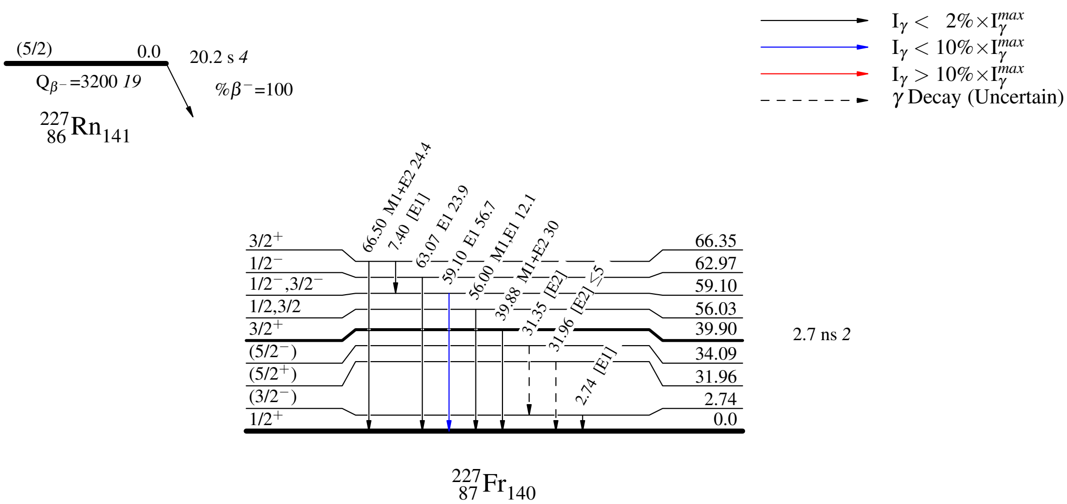


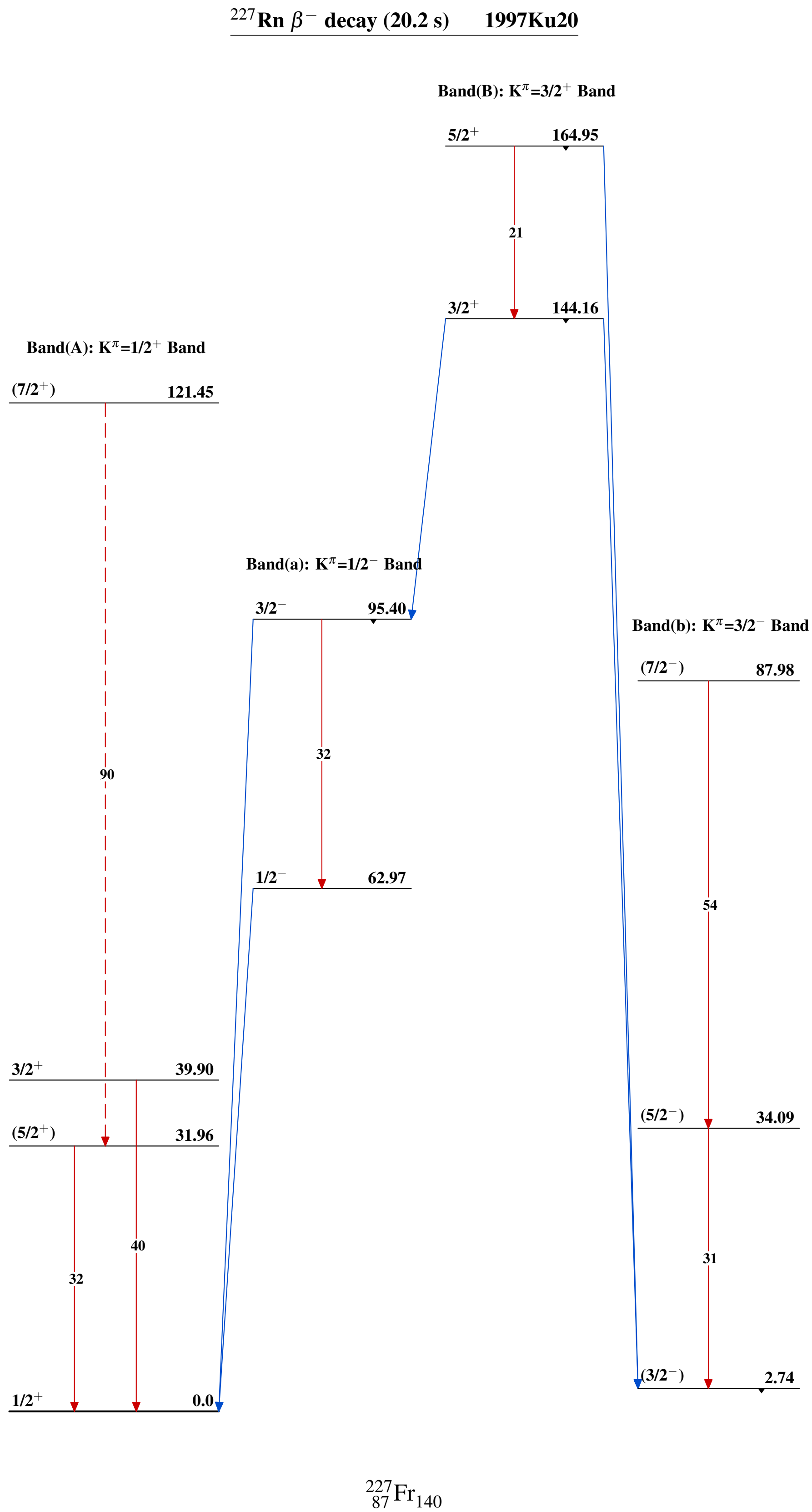
^{227}Rn β^- decay (20.2 s) 1997Ku20

Decay Scheme (continued)

Intensities: Relative I_γ

@ Multiply placed: intensity suitably divided




^{227}Rn β^- decay (20.2 s) 1997Ku20
Band(B): K$^\pi$=3/2$^+$ Band
5/2$^+$ 164.95
21
3/2$^+$ 144.16
Band(A): K$^\pi$=1/2$^+$ Band
(7/2$^+$) 121.45
90
Band(a): K$^\pi$=1/2$^-$ Band
3/2$^-$ 95.40
32
1/2$^-$ 62.97
Band(b): K$^\pi$=3/2$^-$ Band
(7/2$^-$) 87.98
54
(5/2$^-$) 34.09
31
(3/2$^-$) 2.74
3/2$^+$ 39.90
(5/2$^+$) 31.96
32
40
1/2$^+$ 0.0
$^{227}_{87}Fr_{140}$