^{223}Rn β^- decay 1992Ku03

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	E. Browne	NDS 93, 846 (2001)	1-May-2001

Parent: ^{223}Rn: E=0.0; J$^\pi$=7/2; $T_{1/2}$=24.3 min *4*; Q(β^-)=1900 *SY*; %β^- decay=100.0

^{223}Rn activity was produced by spallation of 600-MeV protons on targets of ^{232}Th and mass separated in the ISOLDE on-line separator. Characteristic Fr K x ray, and γ rays previously observed in the α decay of ^{227}Ac confirmed the assignment of the activity to ^{223}Rn.

^{223}Fr Levels

The structure of ^{223}Fr has been interpreted in terms of the reflection-asymmetric rotor model, and most of the levels below 600 keV have been assigned to K$^\pi$=3/2± and K$^\pi$=1/2± parity doublet bands.

E(level)[†]	J$^\pi$[‡]	Comments
0.0[#]	3/2$^{(-)}$	
12.882[#] *22*	(5/2$^-$)	
54.98[&] *4*	1/2$^{(-)}$	
82.129[#] *21*	(7/2$^-$)	
99.53[&] *3*	(3/2$^-$)	
100.999[&] *24*	(5/2$^-$)	
134.48[a] *4*	(3/2$^+$)	
160.43[@] *3*	(3/2$^+$)	
171.963[@] *25*	(5/2$^+$)	
187.07[d] *3*	(5/2$^-$)	
188.92[&] *3*	(7/2$^-$)	
219.53[a] *3*	(7/2$^+$)	
222.98[@] *4*	(7/2$^+$)	
242.45 *4*	(5/2)	
243.57 *4*	(5/2)	
244.674[d] *25*	(7/2$^-$)	
365.65 *5*		
519.89[c] *7*	3/2$^-$	Adopted level energy is 515.20 keV *22*. See Adopted Levels, gammas for deexciting γ rays.
540.53[b] *3*	(5/2$^+$)	
605.40[c] *3*	(5/2$^-$)	
647.58 *3*	(5/2$^-$,7/2$^-$)	
649.66 *3*	(5/2$^-$)	
684.80[b] *6*	(7/2$^+$)	
698.62 *7*		
736.88[c] *4*	(7/2$^-$)	
763.21 *4*		
782.66 *4*	(3/2$^+$,5/2$^+$)	
834.54 *5*		
839.30 *5*		
892.68 *4*		
921.63 *11*		
987.73 *11*		
995.61 *7*		
999.12 *6*		
1001.94 *7*		
1035.28 *6*		
1042.28 *10*		

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^{223}Rn β^- decay 1992Ku03 (continued)

^{223}Fr Levels (continued)

E(level)†	E(level)†	E(level)†	E(level)†
1070.11 *5*	1359.12 *5*	1552.11 *6*	1629.30 *10*
1102.81 *5*	1398.29 *9*	1566.56 *18*	1695.43 *21*
1120.24 *6*	1399.17 *6*	1573.78 *10*	
1221.10 *7*	1512.40 *10*	1590.49 *10*	
1322.17 *5*	1540.74 *6*	1595.05 *8*	

† Deduced by evaluator from a least-squares fit to γ-ray energies.
‡ From Adopted Levels.
# Band(A): K$^\pi$=3/2$^-$ parity doublet band.
@ Band(a): K$^\pi$=3/2$^+$ parity doublet band.
& Band(B): K$^\pi$=1/2$^-$ parity doublet band.
[a] Band(b): K$^\pi$=1/2$^+$ parity doublet band.
[b] Band(C): K$^\pi$=3/2$^+$ parity doublet band.
[c] Band(c): K$^\pi$=3/2$^-$ parity doublet band.
[d] Band(D): K$^\pi$=5/2$^-$ parity doublet band.

β^- radiations

E(decay)	E(level)	Iβ^-†‡	Log *ft*	Comments
(204 *SY*)	1695.43	0.029	6.7	av Eβ=55.26 *6*
(270 *SY*)	1629.30	0.16	6.3	av Eβ=74.75 *3*
(304 *SY*)	1595.05	0.18	6.4	av Eβ=85.118 *25*
(309 *SY*)	1590.49	0.21	6.4	av Eβ=86.51 *3*
(326 *SY*)	1573.78	0.094	6.8	av Eβ=91.65 *3*
(333 *SY*)	1566.56	0.12	6.7	av Eβ=93.88 *6*
(347 *SY*)	1552.11	0.48	6.2	av Eβ=98.364 *19*
(359 *SY*)	1540.74	0.44	6.3	av Eβ=101.911 *19*
(387 *SY*)	1512.40	0.094	7.0	av Eβ=110.84 *4*
(500 *SY*)	1399.17	0.31	6.9	av Eβ=147.571 *20*
(501 *SY*)	1398.29	0.10	7.4	av Eβ=147.86 *3*
(540 *SY*)	1359.12	0.70	6.6	av Eβ=160.936 *17*
(577 *SY*)	1322.17	0.39	7.0	av Eβ=173.42
(678 *SY*)	1221.10	0.12	7.7	av Eβ=208.311 *25*
(779 *SY*)	1120.24	0.57	7.3	av Eβ=244.09
(797 *SY*)	1102.81	0.49	7.4	av Eβ=250.36
(829 *SY*)	1070.11	0.52	7.4	av Eβ=262.20
(857 *SY*)	1042.28	0.10	8.2	av Eβ=272.34 *4*
(864 *SY*)	1035.28	0.15	8.0	av Eβ=274.89
(898 *SY*)	1001.94	0.22	7.9	av Eβ=287.13
(900 *SY*)	999.12	0.34	7.7	av Eβ=288.17
(904 *SY*)	995.61	0.21	7.9	av Eβ=289.47
(912 *SY*)	987.73	0.1	8.3	av Eβ=292.37 *4*
(978 *SY*)	921.63	0.19	8.1	av Eβ=316.89 *5*
(1007 *SY*)	892.68	0.53	7.7	av Eβ=327.73
(1060 *SY*)	839.30	0.27	8.1	av Eβ=347.90
(1065 *SY*)	834.54	0.6	7.7	av Eβ=349.71
(1117 *SY*)	782.66	1.4	7.4	av Eβ=369.45
(1136 *SY*)	763.21	0.53	7.9	av Eβ=376.86
(1163 *SY*)	736.88	11	6.6	av Eβ=386.97
(1201 *SY*)	698.62	0.25	8.3	av Eβ=401.72
(1215 *SY*)	684.80	0.44	8.1	av Eβ=407.07

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^{223}Rn β^- decay 1992Ku03 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^- †‡	Log *ft*	Comments
(1250 *SY*)	649.66	4.7	7.1	av Eβ=420.70
(1252 *SY*)	647.58	2.7	7.3	av Eβ=421.51
(1294 *SY*)	605.40	14	6.7	av Eβ=437.96
(1359 *SY*)	540.53	0.23	8.5	av Eβ=463.41
(1534 *SY*)	365.65	0.70	8.2	av Eβ=532.85
(1677 *SY*)	222.98	1.7	8.0	av Eβ=590.28
(1680 *SY*)	219.53	0.80	8.3	av Eβ=591.67
(1712 *SY*)	187.07	9.0	7.3	av Eβ=604.83
(1728 *SY*)	171.963	2.0	8.0	av Eβ=610.96
(1799 *SY*)	100.999	<2	>8.0	av Eβ=639.84
(1800 *SY*)	99.53	2.1	8.0	av Eβ=640.44
(1817 *SY*)	82.129	21	7.0	av Eβ=647.54
(1887 *SY*)	12.882	≤24	≥7.1	av Eβ=675.88

† Deduced by evaluator from γ-ray transition intensity balance at each level.
‡ Absolute intensity per 100 decays.

^{223}Rn β^- decay 1992Ku03 (continued)

$\gamma(^{223}$Fr)

Iγ normalization: deduced by evaluator using no direct β^- feeding to the g.s. of ^{223}Fr, Iγ(12.9γ)≈20, and Σ Ti(g.s.)=100.

Experimental Fr K x ray intensities: 330 *13* (Kα_2 x ray), 580 *30* (Kα_1 x ray), and 252 *10* (Kβ x ray), compare with 400 *42* (Kα_2 x ray), 650 *58* (Kα_1 x ray) and 300 *33* (Kβ x ray), respectively, deduced by evaluator (using RADLST) from the γ-ray intensities and K-conversion coefficients presented here, using a K-fluorescence yield of 0.967 *4* (1996Sc06).

Measured Eγ, Iγ, $\gamma\gamma$ coin, Ice. Deduced multipolarities. Detector: high-purity germanium, mini-orange magnetic spectrometer.

Others: 1986Bo35, 1982BrZF, 1975VyZS, 1964Bu02, 1961Be28.

E$_\gamma$	I$_\gamma$[@]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.	δ	α[†]	I$_{(\gamma+ce)}$[@]	Comments
12.90[‡]	≤0.14	12.882	(5/2$^-$)	0.0	3/2$^{(-)}$	(E2)		5.11×10^4		γ ray not observed. Iγ deduced by evaluator to reproduce a≤24% β^- feeding (reported by 1992Ku03) using α=51100 for an (E2) adopted multipolarity. Iγ≤20 (1992Ku03).
25.95[‡]	≈0.009[#]	160.43	(3/2$^+$)	134.48	(3/2$^+$)	[M1+E2]			26 *8*	
37.47[‡]	≈0.28[#]	171.963	(5/2$^+$)	134.48	(3/2$^+$)	[M1+E2]		500	1.4×10^2 *40*	
45.95[‡]	≈0.42[#]	100.999	(5/2$^-$)	54.98	1/2$^{(-)}$	[E2]		352	≈150	
51.06[‡]	≈0.29[#]	222.98	(7/2$^+$)	171.963	(5/2$^+$)	[M1+E2]		1.2×10^2 *10*	35 *10*	I$_{(\gamma+ce)}$: from the γ-ray spectrum of 1992Ku03 evaluator concluded that the Iγ value listed by 1992Ku03 actually corresponds to I(γ+ce).
52.32[‡]	≈15[#]	187.07	(5/2$^-$)	134.48	(3/2$^+$)	[E1]		0.61	24 *5*	
53.3[‡] *3*	≈3.0	242.45	(5/2)	188.92	(7/2$^-$)					
55.00 *5*	10.2 *4*	54.98	1/2$^{(-)}$	0.0	3/2$^{(-)}$	M1+E2	0.05 *4*	17.4 *8*		α(L)=13.1 *6*; α(M)=3.14 *16*; α(N+..)=1.11 *6* δ: deduced by evaluator from α(exp)=24 *7*.
55.80 *5*	3.4 *4*	244.674	(7/2$^-$)	188.92	(7/2$^-$)	[M1+E2]		8.×10^1 *7*		
57.56 *5*	2.8 *4*	244.674	(7/2$^-$)	187.07	(5/2$^-$)	M1		14.9		α(L)=11.3; α(M)=2.69; α(N+..)=0.95 Mult.: from α(L)exp=9.8 *39*.
69.21 *5*	185 *10*	82.129	(7/2$^-$)	12.882	(5/2$^-$)	M1+E2	0.42 *8*	15.0 *22*		α(L)=11.2 *16*; α(M)=2.9 *5*; α(N+..)=1.00 *15* δ: deduced by evaluator from α(L1)exp + α(L2)exp=8.2 *13*, α(L3)exp=11 *4*.
70.60 *10*	3.7 *5*	242.45	(5/2)	171.963	(5/2$^+$)					
72.4[‡] *2*	6.7 *13*	171.963	(5/2$^+$)	99.53	(3/2$^-$)	[E1]		0.257		
79.50 *10*	62[‡] *10*	134.48	(3/2$^+$)	54.98	1/2$^{(-)}$	[E1]		0.200		
82.10 *5*	43.4 *22*	82.129	(7/2$^-$)	0.0	3/2$^{(-)}$	E2		22.6		α(L)=16.6; α(M)=4.48; α(N+..)=1.58 Mult.: from α(L1)exp + α(L2)exp=11 *4*, α(M)exp=3.4 *10*.
83.0[‡] *1*	≈1.5	243.57	(5/2)	160.43	(3/2$^+$)	[M1+E2]		13 *9*		
85.0[‡] *5*	≈1.0	219.53	(7/2$^+$)	134.48	(3/2$^+$)	[E2]		19.2		
86.1[‡] *1*	48 *5*	187.07	(5/2$^-$)	100.999	(5/2$^-$)	[M1]		4.6		
86.7[‡] *3*	≈12	99.53	(3/2$^-$)	12.882	(5/2$^-$)	[M1+E2]		11 *7*		

$\gamma(^{223}Fr)$ (continued)

E_γ	I_γ[@]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	α[†]	Comments
88.0[&] *1*	≈50[&]	100.999	(5/2⁻)	12.882	(5/2⁻)	[M1+E2]	10 *6*	
88.0[&] *1*	11.0[&] *14*	188.92	(7/2⁻)	100.999	(5/2⁻)	[M1+E2]	10 *6*	
88.5[‡] *5*	≈1.0	222.98	(7/2⁺)	134.48	(3/2⁺)	[E2]	15.9	
89.90 *5*	17.4 *15*	171.963	(5/2⁺)	82.129	(7/2⁻)	[E1]	0.144	
99.55 *5*	25 *5*	99.53	(3/2⁻)	0.0	3/2⁽⁻⁾	M1	3.02	α(L)=2.28; α(M)=0.544; α(N+..)=0.192 Mult.: from α(L)exp=2.8 *5*.
100.95 *5*	76 *4*	100.999	(5/2⁻)	0.0	3/2⁽⁻⁾	M1	2.90	α(L)=2.19; α(M)=0.523; α(N+..)=0.185 Mult.: from α(L)exp=2.4 *5*, α(M)exp=0.52 *9*.
104.87 *5*	35 *2*	187.07	(5/2⁻)	82.129	(7/2⁻)	M1	13.3	α(K)=10.7; α(L)=1.96; α(M)=0.468; α(N+..)=0.166 Mult.: from α(M)exp=0.34 *15*.
106.80 *5*	50 *3*	188.92	(7/2⁻)	82.129	(7/2⁻)	M1	12.6	α(K)=10.1; α(L)=1.86; α(M)=0.444; α(N+..)=0.157 Mult.: from α(L)exp=2.1 *4*.
118.58 *10*	2.7 *6*	219.53	(7/2⁺)	100.999	(5/2⁻)	[E1]	0.318	
121.58 *5*	51.5 *20*	134.48	(3/2⁺)	12.882	(5/2⁻)	E1	0.299	α(K)=0.234; α(L)=0.0490; α(M)=0.0117; α(N+..)=0.00399 Mult.: from α(L)exp<0.18.
134.50 *5*	24.0 *20*	134.48	(3/2⁺)	0.0	3/2⁽⁻⁾	E1	0.233	α(K)=0.184; α(L)=0.0376; α(M)=0.0090; α(N+..)=0.00306 Mult.: from α(L)exp<0.05.
137.35 *5*	35.4 *14*	219.53	(7/2⁺)	82.129	(7/2⁻)	[E1]	0.222	
140.93 *5*	214 *7*	222.98	(7/2⁺)	82.129	(7/2⁻)	E1	0.208	α(K)=0.164; α(L)=0.0333; α(M)=0.00794; α(N+..)=0.00271 Mult.: from α(L)exp≤0.03.
142.74 *5*	9.4 *4*	365.65		222.98	(7/2⁺)	[M1+E2]	3.8 *18*	
143.65 *5*	23.3 *9*	244.674	(7/2⁻)	100.999	(5/2⁻)	M1	5.38	α(K)=4.33; α(L)=0.795; α(M)=0.190; α(N+..)=0.0669 Mult.: from α(L)exp=0.71 *14*.
146.0[‡] *2*	1.8 *6*	365.65		219.53	(7/2⁺)	[M1+E2]	3.5 *17*	
147.52 *5*	38.0 *15*	160.43	(3/2⁺)	12.882	(5/2⁻)	[E1]	0.186	
159.08 *5*	57.0 *21*	171.963	(5/2⁺)	12.882	(5/2⁻)	[E1]	0.155	
160.45 *5*	76.5 *30*	160.43	(3/2⁺)	0.0	3/2⁽⁻⁾	E1	0.152	α(K)=0.120; α(L)=0.0238; α(M)=0.00567; α(N+..)=0.00193 Mult.: from α(L)exp<0.044.
161.38 *5*	15.1 *6*	243.57	(5/2)	82.129	(7/2⁻)	[E1]	0.150	
162.50 *5*	49.5 *20*	244.674	(7/2⁻)	82.129	(7/2⁻)	M1,E2	2.5 *13*	α(K)=1.6 *14*; α(L)=0.64 *8*; α(M)=0.16 *3*; α(N+..)=0.058 *11* Mult.: from α(L)exp=0.69 *14*.
171.95 *5*	100	171.963	(5/2⁺)	0.0	3/2⁽⁻⁾	E1	0.128	α(K)=0.102; α(L)=0.0199; α(M)=0.00474; α(N+..)=0.00162 Mult.: from α(L)exp<0.07.
174.15 *5*	25.0 *10*	187.07	(5/2⁻)	12.882	(5/2⁻)	[M1+E2]	2.0 *11*	
176.10 *5*	16.0 *6*	188.92	(7/2⁻)	12.882	(5/2⁻)	M1,E2	2.0 *11*	α(K)=1.3 *11*; α(L)=0.47 *3*; α(M)=0.121 *15*; α(N+..)=0.043 *6* Mult.: from α(L)exp=0.50 *10*.
206.65 *5*	81.1 *32*	219.53	(7/2⁺)	12.882	(5/2⁻)	E1	0.0822	α(K)=0.0657; α(L)=0.0125; α(M)=0.00297; α(N+..)=0.00101 Mult.: from α(K)exp<0.08, α(L)exp=0.014 *5*.
216.40 *5*	19.0 *8*	999.12		782.66	(3/2⁺,5/2⁺)			
229.60 *5*	8.6 *4*	242.45	(5/2)	12.882	(5/2⁻)			
231.79 *5*	6.5 *4*	244.674	(7/2⁻)	12.882	(5/2⁻)	[M1+E2]	0.9 *6*	
242.41 *5*	6.6 *4*	242.45	(5/2)	0.0	3/2⁽⁻⁾			

From ENSDF

γ(^{223}Fr) (continued)

E_γ	I_γ[@]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	α[†]	Comments
243.69 5	24.9 12	243.57	(5/2)	0.0	$3/2^{(-)}$	[E1]	0.0556	
283.45 5	11.0 5	365.65		82.129	$(7/2^-)$	[E1]	0.0392	
319.5[‡] 5	≈4	684.80	$(7/2^+)$	365.65				
351.8[‡] 5	4.0 15	540.53	$(5/2^+)$	188.92	$(7/2^-)$	[E1]	0.0241	
360.73 5	32.6 13	605.40	$(5/2^-)$	244.674	$(7/2^-)$	M1	0.414	α(K)=0.335; α(L)=0.0605; α(M)=0.0144; α(N+..)=0.00502 Mult.: from α(K)exp=0.32 6.
382.0[‡] 5	2.0 6	605.40	$(5/2^-)$	222.98	$(7/2^+)$	[E1]	0.0201	
385.32 10	4.3 2	1070.11		684.80	$(7/2^+)$			
397.8[‡] 5	≈3	763.21		365.65				
402.80 5	15.4 7	647.58	$(5/2^-,7/2^-)$	244.674	$(7/2^-)$	M1	0.307	α(K)=0.248; α(L)=0.0448; α(M)=0.0106; α(N+..)=0.00372 Mult.: from α(K)exp=0.27 6.
404.7[‡] 5	4.2 14	649.66	$(5/2^-)$	244.674	$(7/2^-)$			
416.52 5	355 14	605.40	$(5/2^-)$	188.92	$(7/2^-)$	M1	0.281	α(K)=0.227; α(L)=0.0409; α(M)=0.0097; α(N+..)=0.00340 Mult.: from α(K)exp=0.23 3, α(L)exp=0.044 7, α(M)exp=0.014 3.
420.61 20	1.0 2	519.89	$3/2^-$	99.53	$(3/2^-)$	[M1+E2]	0.17 11	
424.76 10	2.3 3	647.58	$(5/2^-,7/2^-)$	222.98	$(7/2^+)$	[E1]	0.0160	
^{x}428.10 20	1.1 2							
439.60 5	8.8 5	540.53	$(5/2^+)$	100.999	$(5/2^-)$	[E1]	0.0149	
441.08 5	14.0 6	540.53	$(5/2^+)$	99.53	$(3/2^-)$	[E1]	0.0148	
458.65 5	32.6 12	647.58	$(5/2^-,7/2^-)$	188.92	$(7/2^-)$	M1	0.217	α(K)=0.175; α(L)=0.0315; α(M)=0.00749; α(N+..)=0.00262 Mult.: from α(K)exp=0.22 3.
460.85 10	14.9 6	649.66	$(5/2^-)$	188.92	$(7/2^-)$	M1	0.214	α(K)=0.173; α(L)=0.0311; α(M)=0.00739; α(N+..)=0.00259 Mult.: from α(K)exp=0.17 4.
461.81 5	30.3 12	684.80	$(7/2^+)$	222.98	$(7/2^+)$	M1	0.213	α(K)=0.172; α(L)=0.0310; α(M)=0.00735; α(N+..)=0.00257 Mult.: from α(K)exp=0.17 4.
464.83 10	7.2 4	519.89	$3/2^-$	54.98	$1/2^{(-)}$	[M1+E2]	0.13 9	
477.8[‡] 3	4.5 9	649.66	$(5/2^-)$	171.963	$(5/2^+)$			
^{x}485.85 20	1.4 2							
492.21 5	112 3	736.88	$(7/2^-)$	244.674	$(7/2^-)$	M1	0.180	α(K)=0.145; α(L)=0.0261; α(M)=0.00620; α(N+..)=0.00217 Mult.: from α(K)exp=0.14 2, α(L)exp=0.029 6.
493.3[‡] 3	≈10	736.88	$(7/2^-)$	243.57	(5/2)			
^{x}498.30 20	1.4 2							
^{x}499.75 10	4.5 3							
^{x}502.59 10	7.3 4							
504.35 10	2.6 2	605.40	$(5/2^-)$	100.999	$(5/2^-)$	[M1+E2]	0.10 7	
505.85 5	25.3 13	605.40	$(5/2^-)$	99.53	$(3/2^-)$	[M1+E2]	0.10 7	
509.75 10	12.1 6	698.62		188.92	$(7/2^-)$			
514.3[‡] 5	3 1	736.88	$(7/2^-)$	222.98	$(7/2^+)$			
517.8[‡] 5	4 1	736.88	$(7/2^-)$	219.53	$(7/2^+)$			
520.75 5	6.6 4	763.21		242.45	(5/2)			
523.26 5	72.8 30	605.40	$(5/2^-)$	82.129	$(7/2^-)$	M1	0.153	α(K)=0.123; α(L)=0.0221 Mult.: from α(K)exp=0.14 2.

γ(^{223}Fr) (continued)

E_γ	I_γ[@]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	δ	α[†]	Comments
526.52 *10*	7.3 *4*	698.62		171.963	$(5/2^+)$				
527.60 *10*	7.2 *4*	540.53	$(5/2^+)$	12.882	$(5/2^-)$	[E1]		0.0103	
^{x}532.80 *20*	1.6 *2*								
540.40[&] *5*	18[&] *6*	540.53	$(5/2^+)$	0.0	$3/2^{(-)}$	[E1]		0.0098	
540.4[&‡] *5*	6[&‡] *2*	763.21		222.98	$(7/2^+)$				
540.4[&‡] *5*	6[&‡] *2*	782.66	$(3/2^+,5/2^+)$	242.45	(5/2)				
543.70 *10*	2.8 *2*	763.21		219.53	$(7/2^+)$				
546.53 *5*	65.6 *26*	647.58	$(5/2^-,7/2^-)$	100.999	$(5/2^-)$	M1		0.136	α(K)=0.110; α(L)=0.0197 Mult.: from α(K)exp=0.12 *2*.
548.0[‡] *3*	12 *3*	736.88	$(7/2^-)$	188.92	$(7/2^-)$				
548.55 *5*	36[‡] *3*	649.66	$(5/2^-)$	100.999	$(5/2^-)$				
550.10 *5*	19.9 *10*	649.66	$(5/2^-)$	99.53	$(3/2^-)$				
^{x}559.10 *20*	1.3 *3*								
563.10 *10*	5.4 *3*	782.66	$(3/2^+,5/2^+)$	219.53	$(7/2^+)$				
565.52 *5*	44.3 *20*	647.58	$(5/2^-,7/2^-)$	82.129	$(7/2^-)$	M1+E2	1.1 *6*	0.07 *4*	α(K)=0.06 *3*; α(L)=0.012 *4* δ: deduced by evaluator from α(K)exp=0.057 *17*.
^{x}566.8[‡] *5*	8.6 *21*								
567.60 *5*	26.1 *14*	649.66	$(5/2^-)$	82.129	$(7/2^-)$	M1+E2	0.9 *5*	0.08 *3*	α(K)=0.064 *25*; α(L)=0.013 *4* δ: deduced by evaluator from α(K)exp=0.065 *17*.
^{x}571.75 *5*	20.6 *11*					M1		0.121	α(K)=0.098; α(L)=0.0175 Mult.: from α(K)exp=0.17 *5*.
576.10 *5*	19.1 *10*	763.21		187.07	$(5/2^-)$				Mult.: E1 or E2 from α(K)exp<0.06.
^{x}578.40 *20*	1.3 *2*								
590.1[‡] *3*	8 *2*	834.54		244.674	$(7/2^-)$				
590.9[‡] *3*	≈10	834.54		243.57	(5/2)				
591.3[‡] *5*	5 *2*	763.21		171.963	$(5/2^+)$				
592.55 *5*	555 *23*	605.40	$(5/2^-)$	12.882	$(5/2^-)$	M1+E2	0.60 *15*	0.088 *9*	α(K)=0.070 *7*; α(L)=0.0132 *10* δ: deduced by evaluator from α(K)exp=0.070 *7*, α(L)exp=0.0130 *13*, α(M)exp=0.0052 *10*.
595.80 *10*	5.9 *6*	839.30		243.57	(5/2)				
605.40 *10*	9.2 *5*	605.40	$(5/2^-)$	0.0	$3/2^{(-)}$	(E2)		0.0241	α(K)=0.0170; α(L)=0.00532 Mult.: E1 or E2 from α(K)exp<0.05. Decay scheme requires E2.
610.65 *5*	19.4 *8*	782.66	$(3/2^+,5/2^+)$	171.963	$(5/2^+)$				
619.65 *10*	7.2 *4*	839.30		219.53	$(7/2^+)$				
622.25 *5*	86.7 *35*	782.66	$(3/2^+,5/2^+)$	160.43	$(3/2^+)$	M1(+E2)	0.5 *3*	0.082 *14*	α(K)=0.066 *12*; α(L)=0.0121 *18* δ: deduced by evaluator from α(K)exp=0.066 *10*.
634.65 *10*	36.1 *40*	647.58	$(5/2^-,7/2^-)$	12.882	$(5/2^-)$	M1(+E2)			α(K)=0.04 *3*; α(L)=0.009 *5* Mult.: from α(K)exp=0.061 *6* for 634.6γ + 635.8γ.
635.80 *10*	320 *13*	736.88	$(7/2^-)$	100.999	$(5/2^-)$	M1(+E2)			α(K)=0.04 *3*; α(L)=0.009 *5* Mult.: from α(K)exp=0.061 *6* for 634.6γ + 635.8γ.

γ(^{223}Fr) (continued)

E_γ	I_γ[@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α[†]	Comments
636.75 *10*	76.5 *40*	649.66	(5/2$^-$)	12.882	(5/2$^-$)				
^{x}641.00 *20*	1.7 *2*								
^{x}645.50 *10*	3.4 *2*								
647.75 *10*	5.2 *3*	647.58	(5/2$^-$,7/2$^-$)	0.0	3/2$^{(-)}$				
648.1[‡] *5*	3.7 *10*	782.66	(3/2$^+$,5/2$^+$)	134.48	(3/2$^+$)				
649.73 *5*	187 *7*	649.66	(5/2$^-$)	0.0	3/2$^{(-)}$	M1		0.086	α(K)=0.0696; α(L)=0.0124 Mult.: from α(K)exp=0.058 *6*, α(L)exp=0.019 *4*.
654.78 *5*	253 *10*	736.88	(7/2$^-$)	82.129	(7/2$^-$)	M1		0.084	α(K)=0.0682; α(L)=0.0122 Mult.: from α(K)exp=0.051 *6*, α(L)exp=0.015 *3*.
^{x}659.10 *20*	1.2 *2*								
^{x}665.20 *10*	2.2 *2*								
667.35 *5*	9.2 *5*	839.30		171.963	(5/2$^+$)				
669.70 *5*	13.1 *5*	892.68		222.98	(7/2$^+$)				
673.20 *5*	22.3 *11*	892.68		219.53	(7/2$^+$)				
674.25 *20*	2.9 *4*	834.54		160.43	(3/2$^+$)				
^{x}676.88 *20*	2.0 *3*								
^{x}680.80 *20*	2.5 *2*								
^{x}687.55 *10*	3.5 *3*								
^{x}690.11 *20*	1.7 *2*								
^{x}691.90 *20*	1.0 *2*								
698.90 *20*	1.8 *2*	698.62		0.0	3/2$^{(-)}$				
705.44 *10*	3.6 *3*	892.68		187.07	(5/2$^-$)				
^{x}707.60 *20*	1.1 *2*								
^{x}709.80 *20*	1.3 *2*								
^{x}719.80 *20*	1.3 *3*								
724.00 *5*	141 *6*	736.88	(7/2$^-$)	12.882	(5/2$^-$)	M1+E2	0.75 *25*	0.047 *8*	α(K)=0.038 *7*; α(L)=0.0071 *10* δ: deduced by evaluator from α(K)exp=0.038 *6*.
734.55 *10*	15.5 *6*	921.63		187.07	(5/2$^-$)				
736.75 *10*	19.6 *8*	736.88	(7/2$^-$)	0.0	3/2$^{(-)}$				
744.15 *10*	6.3 *3*	987.73		243.57	(5/2)				
750.80 *20*	1.4 *2*	763.21		12.882	(5/2$^-$)				
752.40 *5*	25.0 *25*	834.54		82.129	(7/2$^-$)				
753.75 *10*	12.3 *6*	1359.12		605.40	(5/2$^-$)				
^{x}762.90 *20*	1.5 *3*								
781.70 *10*	6.0 *4*	1322.17		540.53	(5/2$^+$)				
782.60 *10*	3.9 *4*	782.66	(3/2$^+$,5/2$^+$)	0.0	3/2$^{(-)}$				
^{x}788.10 *10*	4.6 *4*								
791.30 *20*	1.7 *2*	892.68		100.999	(5/2$^-$)				
793.80 *20*	2.1 *2*	1399.17		605.40	(5/2$^-$)				
^{x}795.20 *20*	2.2 *2*								
800.00 *20*	2.6 *3*	1042.28		242.45	(5/2)				
^{x}801.60 *20*	1.5 *2*								
^{x}803.10 *20*	1.6 *2*								

γ(^{223}Fr) (continued)

E_γ	I_γ[@]	E_i(level)	J_i^π	E_f	J_f^π	Comments
810.60 *20*	1.2 *2*	892.68		82.129	$(7/2^-)$	
812.50 *20*	1.2 *2*	1035.28		222.98	$(7/2^+)$	
815.55 *10*	4.8 *3*	1035.28		219.53	$(7/2^+)$	
818.60 *10*	27.5 *11*	1359.12		540.53	$(5/2^+)$	
821.65 *20*	2.7 *2*	834.54		12.882	$(5/2^-)$	
[x]825.90 *20*	1.7 *2*					
827.40 *20*	2.3 *3*	999.12		171.963	$(5/2^+)$	
830.00 *10*	4.1 *3*	1001.94		171.963	$(5/2^+)$	
835.20 *20*	3.4 *3*	995.61		160.43	$(3/2^+)$	
841.50 *10*	8.9 *4*	1001.94		160.43	$(3/2^+)$	
847.05 *10*	12.2 *5*	1070.11		222.98	$(7/2^+)$	
850.65 *10*	4.5 *3*	1070.11		219.53	$(7/2^+)$	
[x]854.00 *20*	2.4 *2*					
[x]855.95 *10*	4.1 *21*					
858.50[a] *10*	3.4 *3*	1102.81		244.674	$(7/2^-)$	
863.45 *10*	3.3 *3*	1035.28		171.963	$(5/2^+)$	
[x]866.35 *20*	2.9 *4*					
867.45 *10*	5.4 *5*	1001.94		134.48	$(3/2^+)$	
[x]873.15 *10*	4.1 *3*					
881.80 *10*	5.7 *4*	1042.28		160.43	$(3/2^+)$	
883.0[‡] *5*	3[‡] *1*	1102.81		219.53	$(7/2^+)$	
883.05 *10*	12[‡] *2*	1070.11		187.07	$(5/2^-)$	
[x]891.20 *20*	1.5 *2*					
892.80 *20*	2.0 *2*	892.68		0.0	$3/2^{(-)}$	
894.60 *10*	10.2 *4*	995.61		100.999	$(5/2^-)$	
898.10 *10*	10.5 *4*	1070.11		171.963	$(5/2^+)$	E_γ: $E\gamma$=899.10 reported on a table, $E\gamma$=898.10 given in the decay scheme.
900.80 *10*	3.5 *3*	1035.28		134.48	$(3/2^+)$	
[x]902.40 *20*	2.3 *3*					
[x]908.40 *20*	1.7 *2*					
913.75 *10*	5.9 *3*	1102.81		188.92	$(7/2^-)$	
915.75 *10*	5.7 *3*	1102.81		187.07	$(5/2^-)$	
[x]918.45 *10*	4.5 *4*					
[x]919.80 *20*	2.8 *3*					
931.30 *10*	4.7 *4*	1120.24		188.92	$(7/2^-)$	
[x]935.45 *10*	9.4 *4*					
942.40 *10*	11.9 *5*	1102.81		160.43	$(3/2^+)$	
944.30 *10*	7.4 *4*	999.12		54.98	$1/2^{(-)}$	
948.45 *10*	28.8 *12*	1120.24		171.963	$(5/2^+)$	
[x]953.30 *10*	5.5 *3*					
[x]956.65 *10*	9.5 *4*					
959.85 *10*	7.3 *3*	1120.24		160.43	$(3/2^+)$	
[x]962.80 *10*	11.5 *5*					
[x]975.68 *10*	3.0 *2*					

γ(^{223}Fr) (continued)

E_γ	I_γ@	E_i(level)	J^π_i	E_f	J^π_f
977.40 20	1.3 2	1221.10		243.57	(5/2)
982.70 10	2.4 3	995.61		12.882	(5/2$^-$)
x984.30 10	2.8 3				
x988.34 5	21.4 11				
992.40 20	1.9 3	1512.40		519.89	3/2$^-$
995.70 20	1.4 3	995.61		0.0	3/2$^{(-)}$
998.15 10	5.3 3	1221.10		222.98	(7/2$^+$)
x1000.30 10	3.1 3				
1001.85 10	7.5 4	1102.81		100.999	(5/2$^-$)
x1004.45 10	3.7 4				
x1011.76 10	2.7 3				
x1017.80 10	6.2 3				
x1019.90 3	1.3 2				
x1022.80 10	3.4 3				
x1029.70 10	5.6 3				
x1030.90 20	3.2 5				
1032.22 10	10.3 7	1552.11		519.89	3/2$^-$
1037.90 10	4.7 3	1120.24		82.129	(7/2$^-$)
x1044.80 20	1.9 2				
x1052.60 20	1.5 2				
x1054.90 20	1.2 3				
x1070.50 10	5.9 7				
x1075.70 3	1.2 3				
1077.40 10	3.7 3	1322.17		244.674	(7/2$^-$)
x1082.40 10	2.5 3				
x1087.60 10	4.0 3				
1090.00 10	4.9 3	1102.81		12.882	(5/2$^-$)
x1094.15 10	3.5 3				
1099.30 10	4.1 3	1322.17		222.98	(7/2$^+$)
1102.80 20	1.6 2	1102.81		0.0	3/2$^{(-)}$
1107.30 20	1.8 2	1120.24		12.882	(5/2$^-$)
x1118.50 10	4.7 6				
x1133.6 5	1.6 3				
x1135.25 10	3.7 4				
1139.50 10	2.7 3	1359.12		219.53	(7/2$^+$)
x1150.10 20	1.7 3				
1154.50 10	5.3 3	1399.17		244.674	(7/2$^-$)
1156.70 10	4.4 3	1399.17		242.45	(5/2)
x1161.00 10	2.9 3				
1170.15 10	3.0 3	1359.12		188.92	(7/2$^-$)
1175.30 10	3.6 3	1398.29		222.98	(7/2$^+$)
1187.10 10	5.2 3	1359.12		171.963	(5/2$^+$)
1208.20 10	3.7 3	1221.10		12.882	(5/2$^-$)
1210.20 10	4.3 3	1399.17		188.92	(7/2$^-$)
1221.10 10	2.4 3	1322.17		100.999	(5/2$^-$)
x1229.60 10	3.5 3				
1239.95 10	14.6 8	1322.17		82.129	(7/2$^-$)
x1246.60 20	3.5 4				
x1248.80 20	2.7 4				
x1249.80 20	1.8 3				
1258.20 10	3.2 3	1359.12		100.999	(5/2$^-$)
1268.85 10	5.9 3	1512.40		243.57	(5/2)
1277.30 20	2.6 3	1359.12		82.129	(7/2$^-$)
x1286.10 20	1.7 3				
1296.20 10	11.6 6	1540.74		244.674	(7/2$^-$)
1298.20 10	9.3 5	1399.17		100.999	(5/2$^-$)
x1304.60 10	3.0 3				
1307.50 10	8.2 5	1552.11		244.674	(7/2$^-$)
1309.50 20	1.8 3	1322.17		12.882	(5/2$^-$)
x1313.20 10	3.9 3				
1315.90 20	2.5 3	1398.29		82.129	(7/2$^-$)
1317.60 10	14.3 8	1540.74		222.98	(7/2$^+$)
1329.10 10	7.5 4	1552.11		222.98	(7/2$^+$)
1332.60 10	8.4 4	1552.11		219.53	(7/2$^+$)
1350.80 10	3.5 3	1573.78		222.98	(7/2$^+$)
x1353.80 20	1.9 3				
1358.90 20	1.5 2	1359.12		0.0	3/2$^{(-)}$
x1365.50 20	2.0 3				
1367.4‡ 5	3.0 10	1590.49		222.98	(7/2$^+$)
1368.7‡ 5	2.4 8	1540.74		171.963	(5/2$^+$)
x1369.3 5	2.2 5				
1371.40 20	2.6 3	1595.05		222.98	(7/2$^+$)
1375.40 20	3.8 4	1595.05		219.53	(7/2$^+$)
1379.70 20	2.4 3	1552.11		171.963	(5/2$^+$)
1385.70 20	2.6 3	1398.29		12.882	(5/2$^-$)
x1390.60 20	2.2 3				
1394.8‡ 5	1.6 5	1566.56		171.963	(5/2$^+$)
1402.0 5	3.1 5	1590.49		188.92	(7/2$^-$)
1403.40 10	11.2 6	1590.49		187.07	(5/2$^-$)
1406.20 20	7.4 5	1566.56		160.43	(3/2$^+$)
x1407.70 20	5.4 5				
1409.70 10	11.2 6	1629.30		219.53	(7/2$^+$)
1423.25 10	6.7 5	1595.05		171.963	(5/2$^+$)
x1435.80 20	1.9 3				
1439.80 10	4.8 4	1540.74		100.999	(5/2$^-$)
1451.30 20	2.8 3	1552.11		100.999	(5/2$^-$)
x1470.90 20	1.7 3				
1472.8 5	1.4 3	1573.78		100.999	(5/2$^-$)

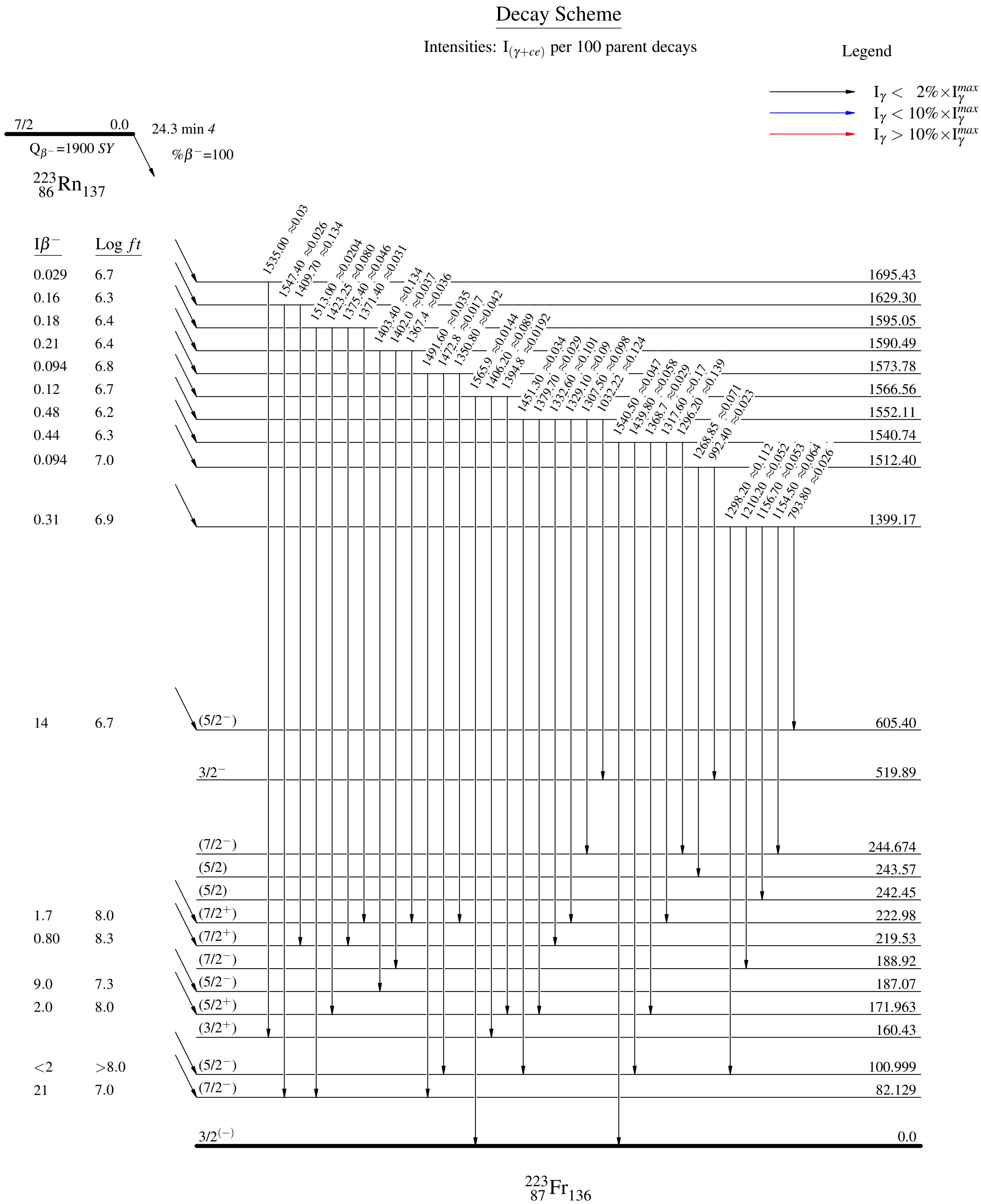
$^{223}_{87}$Fr$_{136}$-10

γ(^{223}Fr) (continued)

E_γ	I_γ[@]	E_i(level)	E_f	J^π_f	E_γ	I_γ[@]	E_i(level)	J^π_i	E_f	J^π_f
[x]1475.80 *20*	1.8 *3*				1540.50 *20*	3.9 *3*	1540.74		0.0	$3/2^{(-)}$
1491.60 *20*	2.9 *3*	1573.78	82.129	$(7/2^-)$	1547.40 *20*	2.1 *2*	1629.30		82.129	$(7/2^-)$
[x]1506.5 *5*	1.2 *2*				[x]1563.6 *5*	1.3 *2*				
1513.00 *20*	1.6 *2*	1595.05	82.129	$(7/2^-)$	1565.9 *5*	1.1 *2*	1566.56		0.0	$3/2^{(-)}$
1535.00 *20*	2.4 *2*	1695.43	160.43	$(3/2^+)$	[x]1620.6 *5*	1.1 *2*				

[†] Conversion coefficients for M1+E2 multipolarities are for δ=1.0, unless δ is given.
[‡] From $\gamma\gamma$ coin measurement.
[#] Deduced by evaluator from reported I(γ+ce), and α.
[@] For absolute intensity per 100 decays, multiply by ≈0.012.
[&] Multiply placed with intensity suitably divided.
[a] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

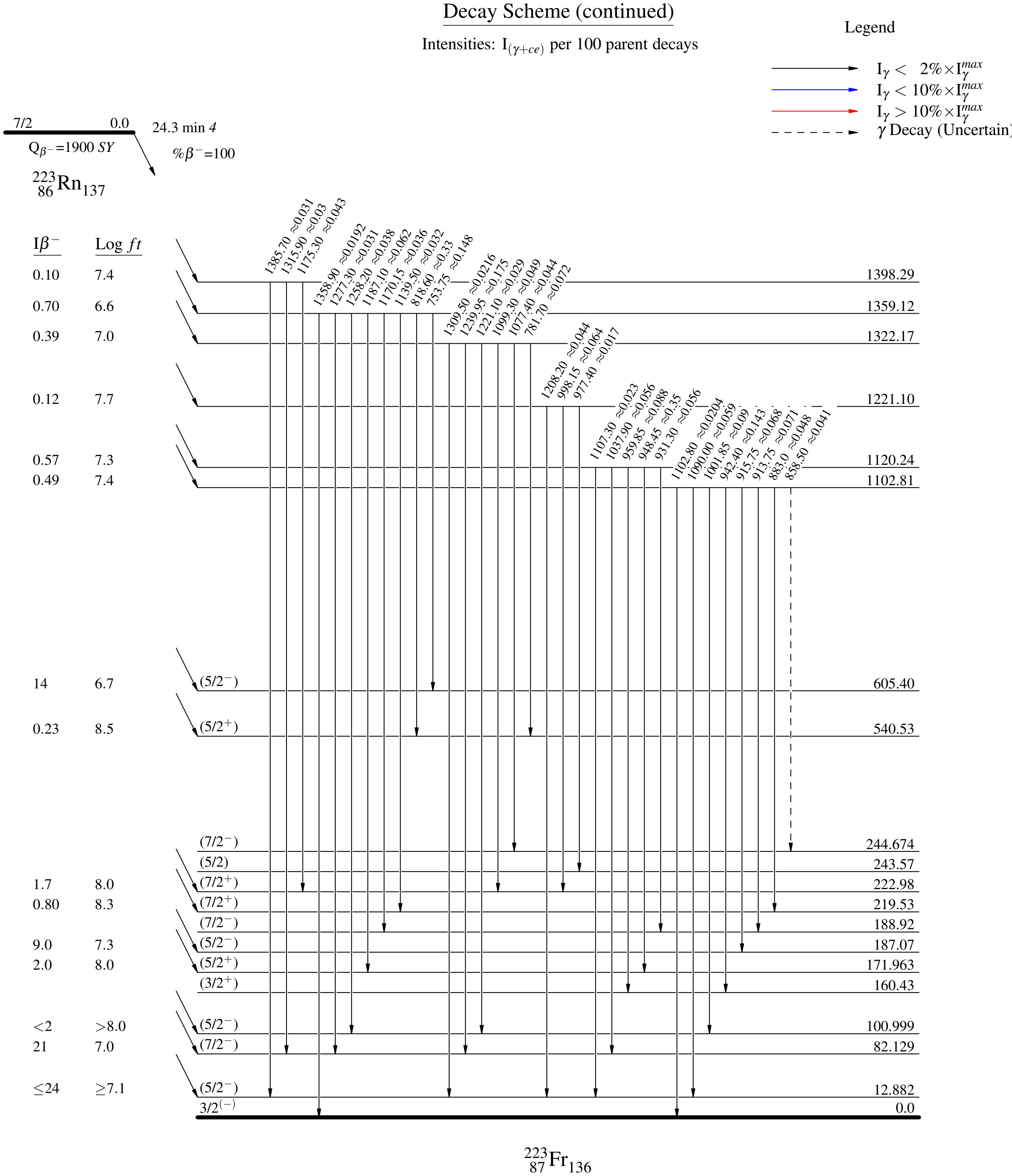
^{223}Rn β^- decay 1992Ku03



^{223}Rn β^- decay 1992Ku03

Decay Scheme (continued)

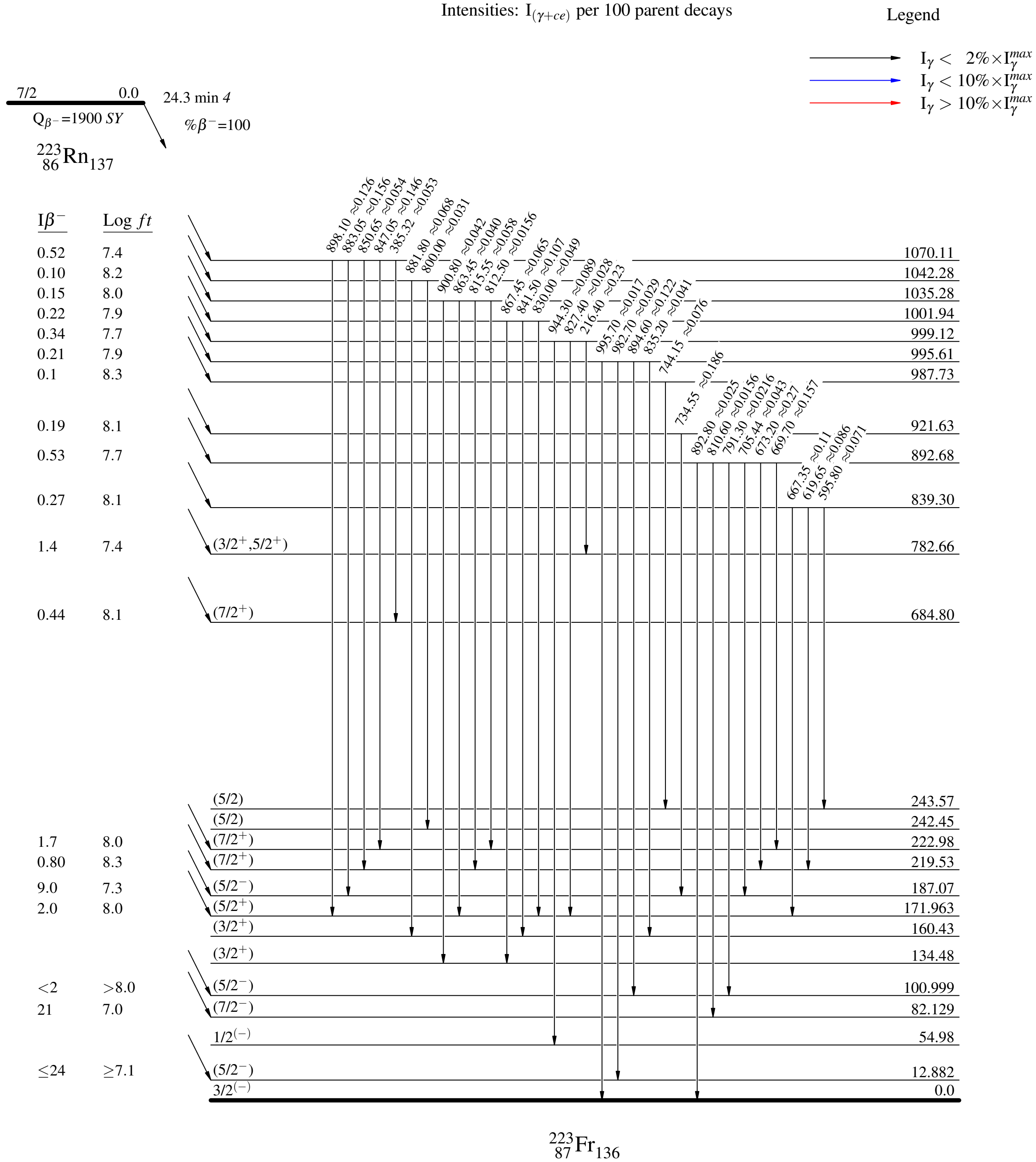
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{223}Rn β^- decay 1992Ku03

Decay Scheme (continued)

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays

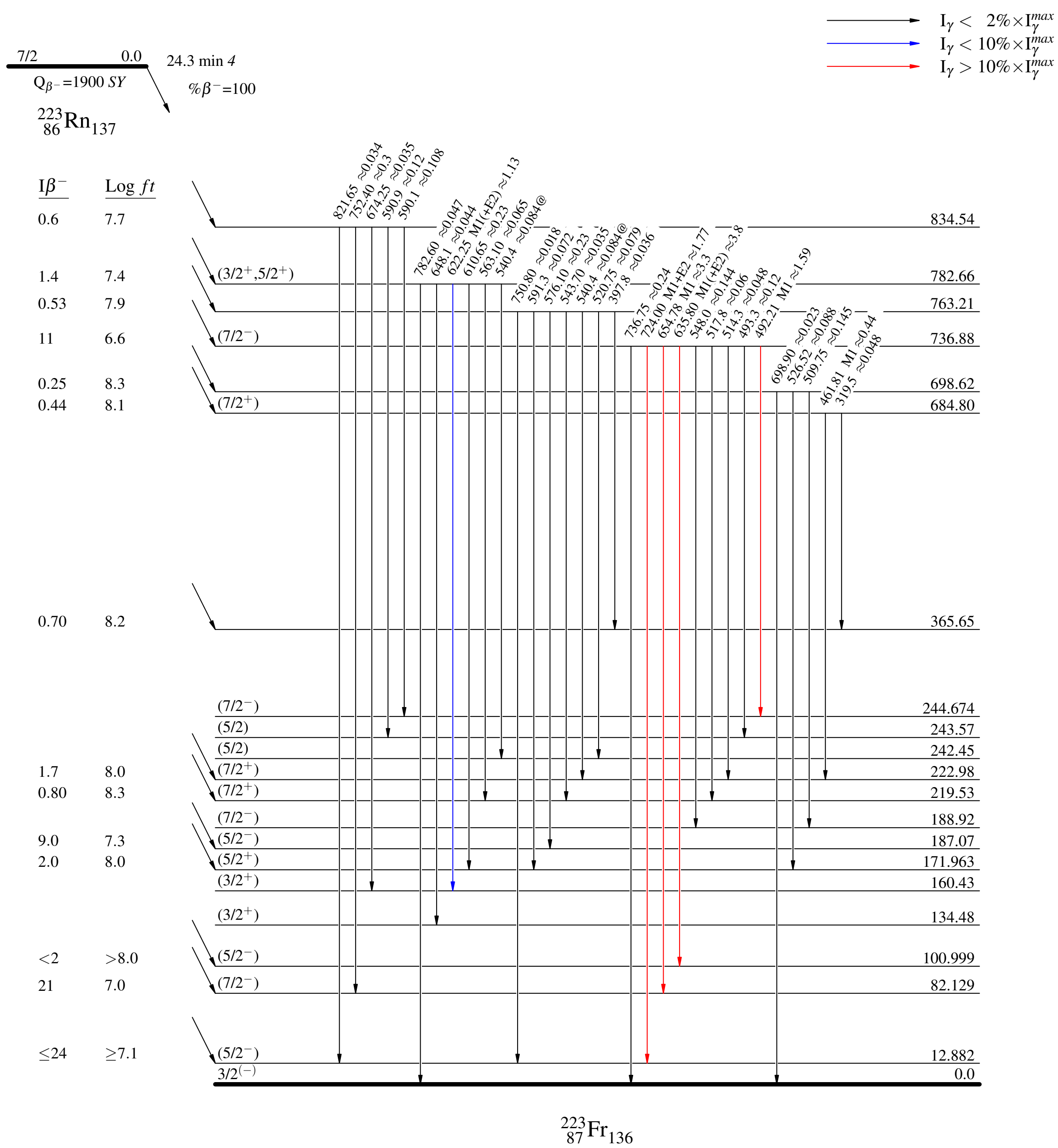


^{223}Rn β^- decay 1992Ku03

Decay Scheme (continued)

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays

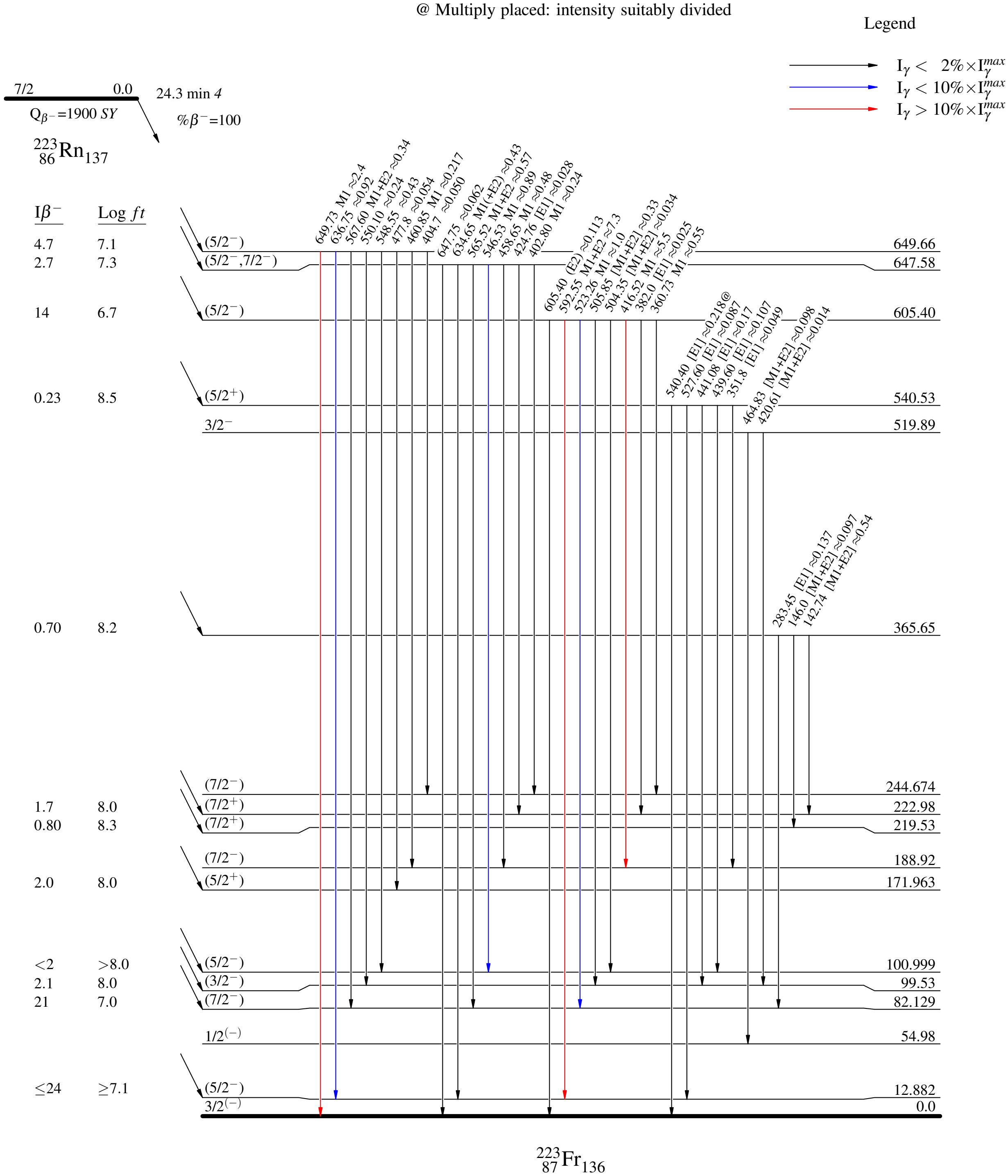
@ Multiply placed: intensity suitably divided



^{223}Rn β^- decay 1992Ku03

Decay Scheme (continued)

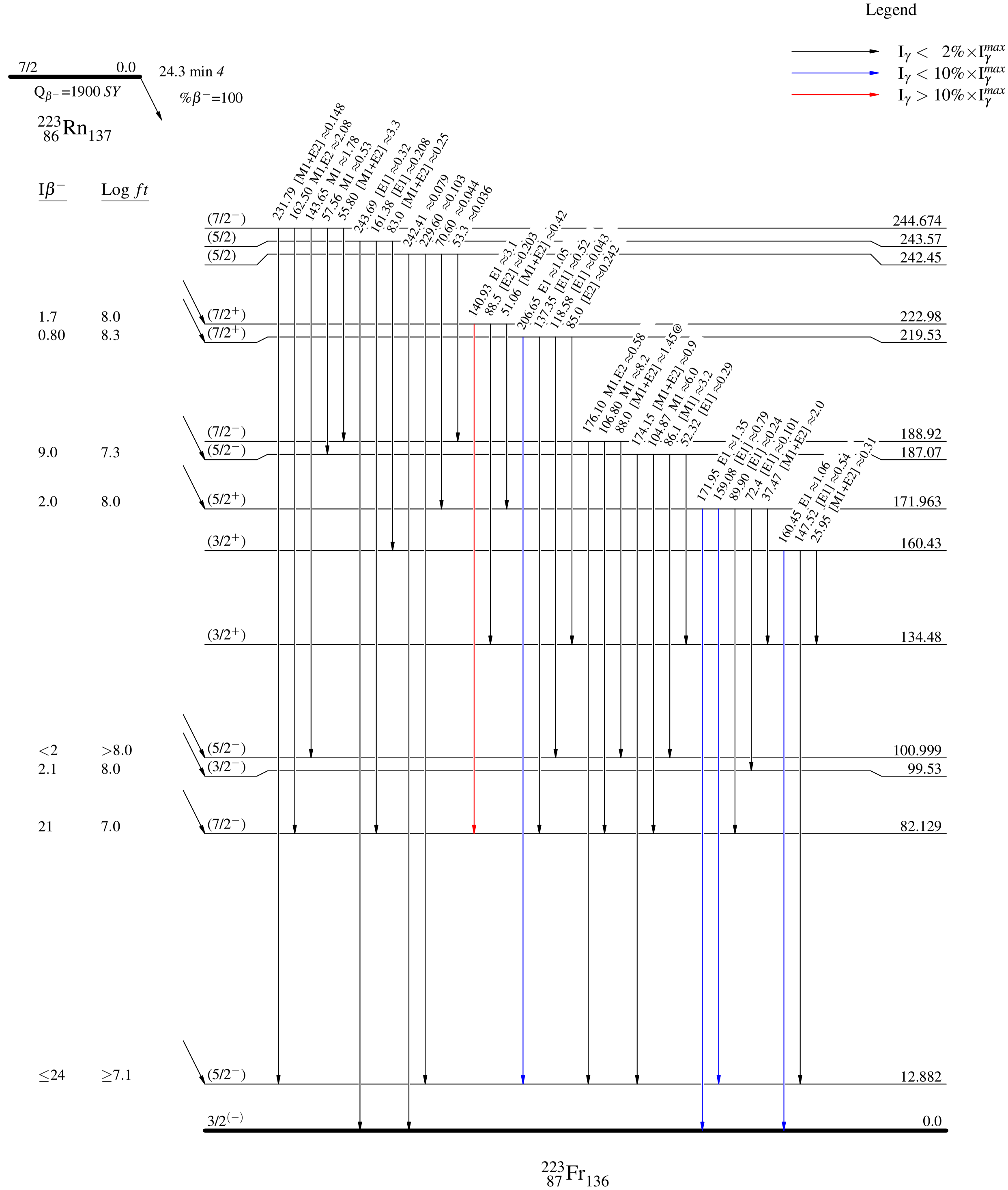
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
@ Multiply placed: intensity suitably divided



^{223}Rn β^- decay 1992Ku03

Decay Scheme (continued)

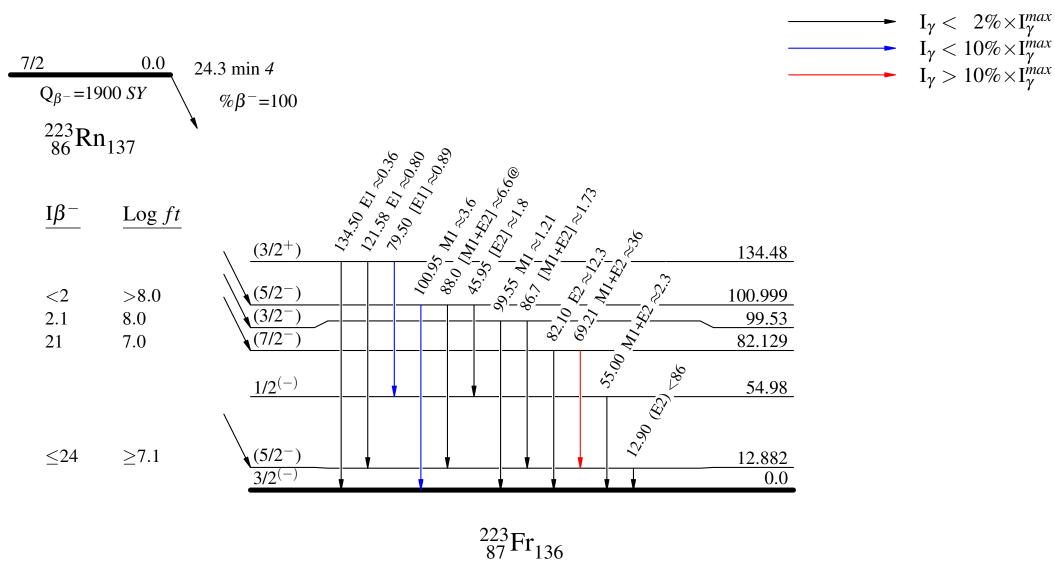
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
@ Multiply placed: intensity suitably divided



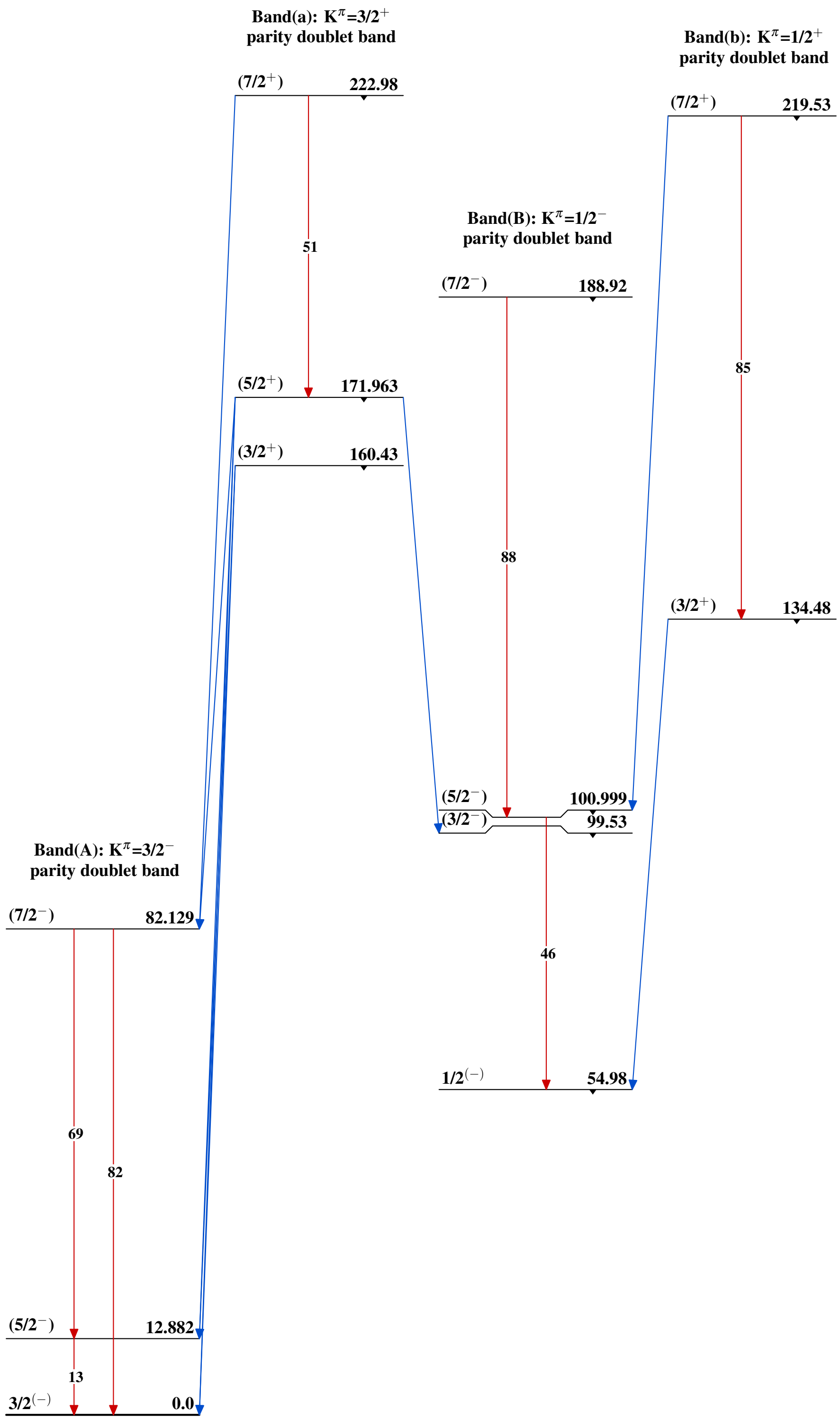
^{223}Rn β^- decay 1992Ku03

Decay Scheme (continued)

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
@ Multiply placed: intensity suitably divided

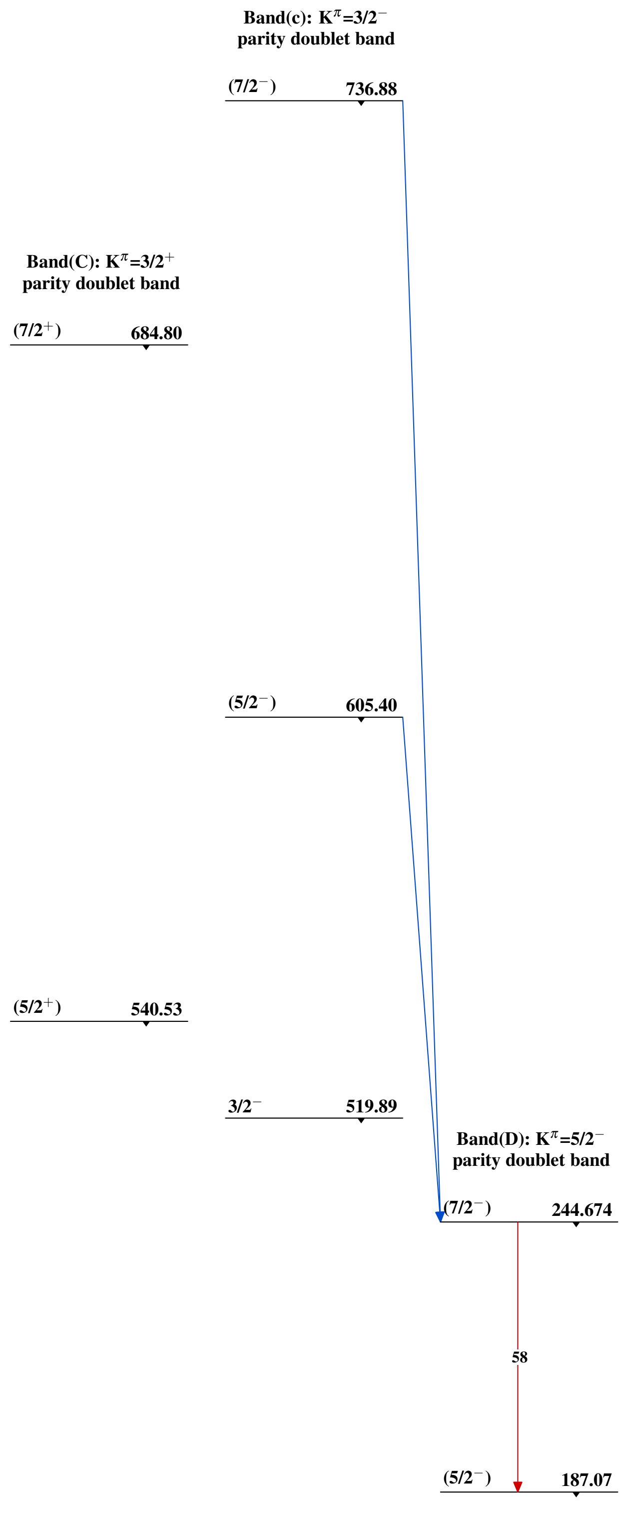


^{223}Rn β^- decay 1992Ku03



$^{223}_{87}Fr_{136}$

^{223}Rn β^- decay 1992Ku03 (continued)



$^{223}_{87}Fr_{136}$