^{222}Fr β^- decay 1992Ru01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Sukhjeet Singh, A. K. Jain, Jagdish K. Tuli	NDS 112,2851 (2011)	31-Mar-2011

Parent: ^{222}Fr: E=0.0; $J^\pi=2^-$; $T_{1/2}$=14.2 min *3*; Q(β^-)=2032 *21*; %β^- decay=100.0

The ^{222}Fr β^- decay scheme is presented as constructed by 1992Ru01 based on their β-gated $\gamma\gamma$-coincidence measurements. The decay scheme was built upon the previously known levels which were established up to the 1170-keV level.

^{222}Ra Levels

E(level)	J^π	$T_{1/2}$	E(level)	J^π	E(level)	J^π
0.0	0^+	38.0 s *5*	1171.6 *3*	$1^+,1^-,2^+$	1439.9 *2*	(3^-)
111.12 *2*	2^+		1225.2 *2*	$1^+,1^-,2^+$	1499.5 *3*	$1^-,2,3^-$
242.11 *2*	1^-		1265.0 *3*	$(2^+,3)$	1556.1 *4*	2^+
301.39 *4*	4^+		1310.2 *3*		1619.6 *4*	
317.29 *5*	3^-		1360.6 *3*		1644.9 *3*	$2^+,3^-$
473.76 *8*	(5^-)		1375.7 *3*		1754.4 *6*	3^-
1024.9 *2*	2^+		1402.6 *2*	(3^-)	1821.5 *5*	1,2,3
1170.9 *2*	$(3^-,4^+)$		1432.6 *3*	$1,2,3^-$	1841.2 *5*	1,2,3

β^- radiations

See 1975We23 for singles β spectrum measurements. The spectrum shows a flat tail of low intensity and extended to much higher energy than the main portion of the data. After subtraction of this tail (which was assumed due to α particles from ^{222}Ra), an F-K analysis gives Eβ(max)=1780 *20* for the endpoint which does not agree with the Eβ^- (to 111.12 level).

E(decay)	E(level)	Iβ^-[†][‡]	Log *ft*	Comments
(191 *21*)	1841.2	0.10 *6*	5.8	av Eβ=51 *6*
(211 *21*)	1821.5	0.016 *4*	6.7	av Eβ=57 *7*
(278 *21*)	1754.4	0.103 *16*	6.3	av Eβ=77 *7*
(387 *21*)	1644.9	0.12 *6*	6.7	av Eβ=111 *7*
(412 *21*)	1619.6	0.049 *8*	7.2	av Eβ=119 *7*
(476 *21*)	1556.1	0.069 *10*	7.2	av Eβ=139 *7*
(533 *21*)	1499.5	0.117 *16*	7.2	av Eβ=158 *7*
(592 *21*)	1439.9	0.34 *5*	6.9	av Eβ=178 *8*
(599 *21*)	1432.6	0.147 *21*	7.2	av Eβ=181 *8*
(629 *21*)	1402.6	0.65 *10*	6.7	av Eβ=191 *8*
(656 *21*)	1375.7	0.037 *6*	8.0	av Eβ=200 *8*
(671 *21*)	1360.6	0.052 *9*	7.9	av Eβ=205 *8*
(722 *21*)	1310.2	0.022 *5*	8.3	av Eβ=223 *8*
(767 *21*)	1265.0	0.34 *5*	7.2	av Eβ=239 *8*
(807 *21*)	1225.2	0.087 *15*	7.9	av Eβ=253 *8*
(860 *21*)	1171.6	0.78 *11*	7.1	av Eβ=273 *8*
(861 *21*)	1170.9	0.07 *4*	8.1	av Eβ=273 *8*
(1007 *21*)	1024.9	0.85 *12*	7.3	av Eβ=327 *8*
(1715 *21*)	317.29	54 *9*	6.3	av Eβ=604 *9*
(1731 *21*)	301.39	0.37 *6*	9.4[1u]	av Eβ=586 *8*
(1790 *21*)	242.11	1.7 *4*	7.9	av Eβ=634 *9*
(1921 *21*)	111.12	38 *12*	6.2	av Eβ=688 *9*
(2032[#] *21*)	0.0	3 *3*	≥8.5[1u]	av Eβ= 703 *9*

[†] From intensity balance at each level.
[‡] Absolute intensity per 100 decays.
[#] Existence of this branch is questionable.

^{222}Fr β^- decay 1992Ru01 (continued)

$\gamma(^{222}Ra)$

$\beta\gamma$, $\beta\gamma\gamma$: see 1992Ru01

X rays(Ra):

E 1985Go05	I(x ray)/I(206γ) 1985Go05	I(x ray)/I(206γ) calculated		
88.5	0.143 *20*	0.111 *16*	Kα	x ray
100.0	0.0275 *35*	0.032 *5*	Kβ	x ray

E_γ[†]	I_γ[‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[&]	Comments
[x]54.14 *2*	0.030 *5*							
75.13 *2*	0.017 *4*	317.29	3^-	242.11	1^-	[E2]	37.5	α(L)=27.4; α(M)=7.44; α(N+..)=2.67
111.11 *1*	26.2 *26*	111.12	2^+	0.0	0^+	E2	6.26	α(K)=0.298; α(L)=4.35; α(M)=1.18; α(N+..)=0.429
130.98 *1*	1.25 *12*	242.11	1^-	111.12	2^+	(E1)	0.254	α(K)=0.199; α(L)=0.0416; α(M)=0.0100; α(N+..)=0.00345
172.37 *2*	0.12 *1*	473.76	(5^-)	301.39	4^+	[E1]	0.130	α(K)=0.103; α(L)=0.0205; α(M)=0.00489; α(N+..)=0.00169
190.24 *2*	1.19 *1*	301.39	4^+	111.12	2^+	E2	0.716	α(K)=0.180; α(L)=0.392; α(M)=0.106; α(N+..)=0.0380
196.31 *4*	0.08 *1*	1841.2	1,2,3	1644.9	2^+,3^-	[D,E2]	1.3 *12*	
206.17 *5*	100 *10*	317.29	3^-	111.12	2^+	E1	0.0847	α(K)=0.0675; α(L)=0.0130; α(M)=0.00310; α(N+..)=0.00107 Eγ=206.18 *2* (1992Ru01), 206.10 *4* (1985Go05); 206.23 *5* from ^{226}Th α decay.
[x]218.66 *4*	0.12 *1*							
[x]221.36 *2*	0.52 *5*							
[x]224.10 *2*	0.19 *2*							
231.67 *4*	0.076 *8*	1402.6	(3^-)	1170.9	$(3^-,4^+)$	[D,E2]	0.8 *7*	α: α(E1)=0.0643, α(M1)=1.53, α(E2)=0.356.
242.11 *1*	3.9 *4*	242.11	1^-	0.0	0^+	E1	0.0580	α(K)=0.0464; α(L)=0.0087; α(M)=0.00208; α(N+..)=0.00072
268.99 *4*	0.040 *8*	1439.9	(3^-)	1170.9	$(3^-,4^+)$		0.53 *48*	α: α(E1)=0.0454, α(M1)=1.01, α(E2)=0.217.
351.75 *4*	0.037 *8*	1754.4	3^-	1402.6	(3^-)	[M1,E2]	0.29 *19*	α(M1)=0.484, α(E2)=0.0973.
377.64 *4*	0.12 *1*	1402.6	(3^-)	1024.9	2^+	[E1]	0.0213	α(K)=0.0173; α(L)=0.00307; α(M)=0.000728; α(N+..)=0.000253
415.05 *4*	0.032 *6*	1439.9	(3^-)	1024.9	2^+	[E1]	0.00030	
[x]455.37 *7*	0.018 *4*							
474.45 *9*	0.079 *8*	1499.5	1^-,2,3^-	1024.9	2^+			
619.95 *4*	0.072 *8*	1644.9	2^+,3^-	1024.9	2^+			
696.88 *5*	0.046 *8*	1170.9	$(3^-,4^+)$	473.76	(5^-)			
707.54 *3*	0.89 *4*	1024.9	2^+	317.29	3^-	[E1]	0.00602	α(K)=0.00493; α(L)=0.00082
723.45 *4*	0.030 *4*	1024.9	2^+	301.39	4^+	[E2]	0.0173	α(K)=0.0126; α(L)=0.00350
782.77 *3*	0.87 *8*	1024.9	2^+	242.11	1^-	[E1]	0.00499	α(K)=0.00409; α(L)=0.00067
[x]831.58 *5*	0.036 *5*							
[x]846.72 *8*	0.070 *14*							
853.78 *8*	0.16 *1*	1170.9	$(3^-,4^+)$	317.29	3^-			
869.6 *2*	0.13 *4*	1170.9	$(3^-,4^+)$	301.39	4^+			
913.69 *5*	0.15 *2*	1024.9	2^+	111.12	2^+			
929.47 *8*	0.14 *2*	1171.6	1^+,1^-,2^+	242.11	1^-			
963.61 *6*	0.14 *2*	1265.0	$(2^+,3)$	301.39	4^+			
966.24 *9*	0.070 *14*	1439.9	(3^-)	473.76	(5^-)			

Continued on next page (footnotes at end of table)

^{222}Fr β^- decay 1992Ru01 (continued)

$\gamma(^{222}Ra)$ (continued)

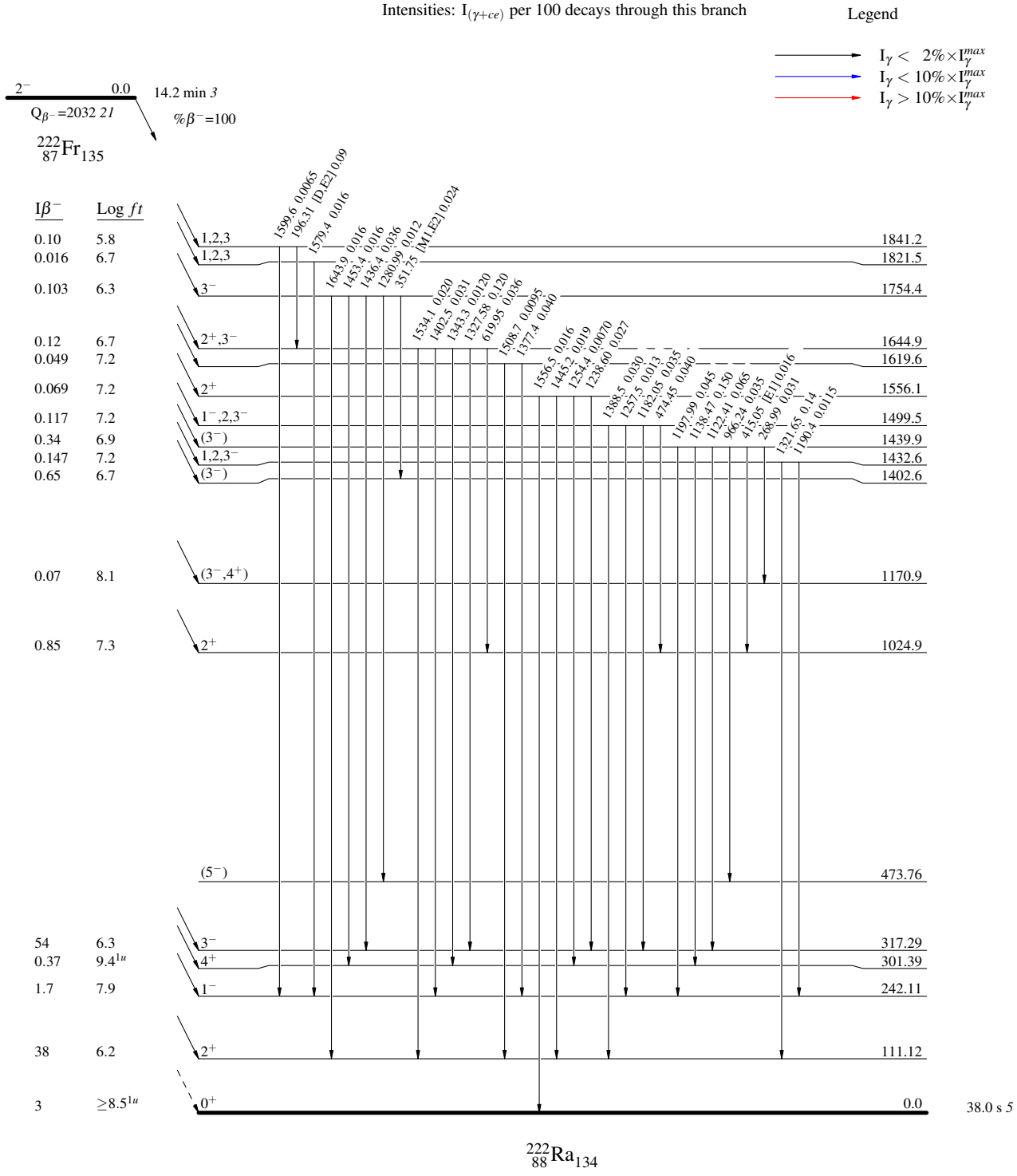
E_γ [†]	I_γ [‡@]	E_i(level)	J_i^π	E_f	J_f^π
982.90 *8*	0.072 *14*	1225.2	$1^+,1^-,2^+$	242.11	1^-
1025.02 *8*	0.060 *10*	1024.9	2^+	0.0	0^+
1043.60 *9*	0.065 *8*	1360.6		317.29	3^-
1060.33 *5*	0.92 *7*	1171.6	$1^+,1^-,2^+$	111.12	2^+
1068.08 *8*	0.043 *8*	1310.2		242.11	1^-
1085.20 *5*	0.46 *6*	1402.6	(3^-)	317.29	3^-
1101.09 *5*	0.50 *5*	1402.6	(3^-)	301.39	4^+
1114.26 *8*	0.074 *14*	1225.2	$1^+,1^-,2^+$	111.12	2^+
1122.41 *9*	0.12 *2*	1439.9	(3^-)	317.29	3^-
1133.61 *8*	0.074 *8*	1375.7		242.11	1^-
1138.47 *5*	0.30 *3*	1439.9	(3^-)	301.39	4^+
1153.87 *5*	0.54 *5*	1265.0	$(2^+,3)$	111.12	2^+
[x]1156.75 *9*	0.044 *9*				
1160.52 *8*	0.072 *7*	1402.6	(3^-)	242.11	1^-
1171.69 *8*	0.49 *5*	1171.6	$1^+,1^-,2^+$	0.0	0^+
1182.05 *8*	0.069 *8*	1499.5	$1^-,2,3^-$	317.29	3^-
1190.4 *1*	0.023 *4*	1432.6	$1,2,3^-$	242.11	1^-
1197.99 *8*	0.089 *15*	1439.9	(3^-)	242.11	1^-
1225.24 *8*	0.028 *5*	1225.2	$1^+,1^-,2^+$	0.0	0^+
1238.60 *8*	0.054 *7*	1556.1	2^+	317.29	3^-
1249.1 *1*	0.039 *7*	1360.6		111.12	2^+
1254.4 *2*	0.014 *3*	1556.1	2^+	301.39	4^+
1257.5 *1*	0.026 *5*	1499.5	$1^-,2,3^-$	242.11	1^-
1280.99 *9*	0.024 *5*	1754.4	3^-	473.76	(5^-)
1291.61 *8*	0.048 *8*	1402.6	(3^-)	111.12	2^+
[x]1295.6 *1*	0.028 *5*				
1321.65 *6*	0.27 *2*	1432.6	$1,2,3^-$	111.12	2^+
1327.58 *6*	0.23 *2*	1644.9	$2^+,3^-$	317.29	3^-
1343.3 *1*	0.024 *4*	1644.9	$2^+,3^-$	301.39	4^+
1377.4 *1*	0.080 *9*	1619.6		242.11	1^-
1388.5 *1*	0.060 *8*	1499.5	$1^-,2,3^-$	111.12	2^+
1402.5 *2*	0.062 *7*	1644.9	$2^+,3^-$	242.11	1^-
1436.4 *1*	0.071 *7*	1754.4	3^-	317.29	3^-
1445.2 *2*	0.037 *6*	1556.1	2^+	111.12	2^+
1453.4 *1*	0.032 *6*	1754.4	3^-	301.39	4^+
[x]1502.3 *1*	0.050 *9*				
1508.7 *2*	0.019 *4*	1619.6		111.12	2^+
1534.1 *2*	0.039 *7*	1644.9	$2^+,3^-$	111.12	2^+
1556.5 *2*	0.032 *6*	1556.1	2^+	0.0	0^+
1579.4 *2*	0.032 *6*	1821.5	1,2,3	242.11	1^-
1599.6 *2*	0.013 *4*	1841.2	1,2,3	242.11	1^-
1643.9 *1*	0.031 *8*	1754.4	3^-	111.12	2^+

[†] From 1992Ru01, except where noted. Other measurement: 1985Go05.
[‡] Relative photon intensities, measured by 1992Ru01.
[#] From ^{226}Th α decay. The multipolarities in square brackets are from the level scheme.
[@] For absolute intensity per 100 decays, multiply by 0.50 *6*.
[&] 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.
[x] γ ray not placed in level scheme.

^{222}Fr β^- decay 1992Ru01

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 decays through this branch



^{222}Fr β^- decay 1992Ru01

Decay Scheme (continued)

Intensities: $I_{(\gamma+ce)}$ per 100 decays through this branch