^{250}Bk β^- decay

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Y. Akovali	NDS 94,131 (2001)	1-Aug-2001

Parent: ^{250}Bk: E=0.0; $J^\pi=2^-$; $T_{1/2}$=3.212 h *5*; Q(β^-)=1780 *4*; %β^- decay=100.0

^{250}Cf Levels

E(level)	J^π	E(level)	J^π	E(level)	J^π	E(level)	J^π
0.0	0^+	1031.852 *21*	2^+	1210? *1*	(3^-)	1411.33 *6*	$(1,2^+)$
42.721 *5*	2^+	1071.37 *2*	3^+	≈1218.2?		1426.86? *12*	(3^-)
141.875 *10*	4^+	1154.24 *10*	0^+	1244.50 *8*	2^+	1658.00 *4*	2^+
871.57 *3*	2^-	1175.52 *3*	1^-	1266.6 *2*	0^+	1695.15 *10*	(3^+)
905.89 *2*	3^-	1189.39 *3*	2^+	1296.60 *4*	2^+		
951.98 *2*	4^-	1209.97 *4*	$(2)^-$	1385.50 *10*	$1,2^+$		

β^- radiations

E(decay)	E(level)	Iβ^-[†][‡]	Log *ft*	Comments
(85 *4*)	1695.15	0.0015 *2*	7.95 *9*	av Eβ=21.9 *11*
(122 *4*)	1658.00	0.117 *4*	6.55 *5*	av Eβ=31.8 *11*
(353[#] *4*)	1426.86?	0.0076 *11*	9.18 *7*	av Eβ=98.9 *13*
(369 *4*)	1411.33	0.0034 *4*	9.59 *6*	av Eβ=103.6 *13*
(395 *4*)	1385.50	0.0039 *2*	9.62 *3*	av Eβ=111.6 *13*
(483 *4*)	1296.60	0.021 *4*	9.18 *9*	av Eβ=139.7 *13*
(513 *4*)	1266.6	0.0080 *8*	9.69[1u] *5*	av Eβ=150.7 *12*
(536 *4*)	1244.50	0.0065 *4*	9.83 *3*	av Eβ=156.6 *14*
(562[#] *4*)	≈1218.2?	0.0067 *14*		
(570[#] *4*)	1210?			
(570 *4*)	1209.97	0.027 *2*	9.30 *4*	av Eβ=167.9 *14*
(591 *4*)	1189.39	0.0161 *9*	9.58 *3*	av Eβ=174.7 *14*
(604 *4*)	1175.52	0.059 *4*	9.05 *3*	av Eβ=179.3 *14*
(626 *4*)	1154.24	0.0015 *2*	10.8[1u] *1*	av Eβ=184.7 *13*
(709 *4*)	1071.37	6.23 *18*	7.25 *2*	av Eβ=214.4 *14*
(748 *4*)	1031.852	83.4 *16*	6.21 *2*	av Eβ=227.9 *14* E(decay): 1984Li04 measured Eβ=705 *20*.
(874[#] *4*)	905.89			av Eβ=271.9 *15*
(908 *4*)	871.57	≈0.06	≈9.6	av Eβ=284.0 *15* Iβ^-: sum of β transitions to 871.57- and 905.89-keV levels. Actual β intensities to these levels are dependent on Iγ(34.325γ) which has not been measured In ^{250}Bk β^- decay work.
(1638 *4*)	141.875	0.35 *20*	10.6[1u] *3*	av Eβ=523.0 *15*
(1737 *4*)	42.721	≈4.9	≈8.7	av Eβ=594.1 *16* Additional information 1.
1780 *4*	0.0	≈4.9	≈9.7[1u]	av Eβ=574.3 *15* E(decay): recommended by 1995Au04 from their mass adjustments. The measured energies are: Eβ^-=1760 *50* (1959Va02), 1820 *25* (1984Li05). Iβ^-: Iβ(Eβ^- >1.25 MeV In singles)/Iβ(Eβ^- >1.25 MeV In coin with L x rays)≈2, indicating that half of the high-energy β's decay to the 42.7-keV level and half to the g.s. (1959Va02). Iβ(to g.s.)+Iβ(to 42.72 level)=9.7 *14* is deduced from γ transitions.

[†] β intensity per 100 ^{250}Bk β^- decays, deduced from intensity balances. The uncertainties do not include the effects of unplaced γ's. The sum of all I(γ+ce)'s to g.s. plus to 42-keV level is 90.3% 14, based on the absolute Iγ(989)=45.0% 8. This suggests

Continued on next page (footnotes at end of table)

^{250}Bk β^- decay (continued)

β^- radiations (continued)

Iβ(to g.s.)+Iβ(to 42.72 level)=9.7 *14*.

‡ Absolute intensity per 100 decays.

Existence of this branch is questionable.

^{250}Bk β^- decay (continued)

$\gamma(^{250}Cf)$

Iγ normalization: absolute γ intensities were measured by 1972Re01: I(989γ)=0.450% 8.
γγ coincidence and 4π (β^-)(γ) coincidence data were taken by 1979Re01. Other coincidence measurements: 1959Va02.

Californium x-rays:

1982Ba56		1972Re01		1972Di02		
E(x-ray)	I(REL.)	E(x-ray)	I(REL.)	E(x-ray)	I(REL.)	
109.838 8	0.65 1	109.84 1	0.654 20	109.818 5	0.670 8	Kα$_2$ x ray
115.036 8	1.02	115.03 1	1.02 3	115.031 5	1.02	Kα$_1$ x ray
				128.599 7	0.136 4	Kβ$_3$ x ray
				129.816 7	0.264 10	Kβ$_1$ x ray

x-ray Intensities Were Listed In 1972Re01 Relative To I(989.125γ)=100;
Intensities Of 1982Ba56 And 1972Di02 Are Normalized Here To
I(Kα$_1$ x ray)=1.02.

E$_\gamma$[†]	I$_\gamma$[‡d]	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.[#]	δ	α[e]	Comments
(34.325[&] 5)	2.2×10^{-6}[a] 4	905.89	3$^-$	871.57	2$^-$	M1+E2	0.42 5	7.4×10^2 11	
42.740 15	0.084 6	42.721	2$^+$	0.0	0$^+$	E2[@]		1293	α(L)=939; α(M)=266 I$_\gamma$: if Iβ(to 42.7-keV level)=4.9%, the intensity balance At the 42.7-keV level yields Iγ(42.7γ)=0.101 26.
(46.093[&] 5)	4.7×10^{-6}[b] 7	951.98	4$^-$	905.89	3$^-$	M1+E2	0.40 2	200 10	
(80.412[&] 10)	7.2×10^{-6}[b] 10	951.98	4$^-$	871.57	2$^-$	E2		63.3	
99.166 9	0.285 15	141.875	4$^+$	42.721	2$^+$	E2[@]		23.8	α(L)=17.0; α(M)=4.84; α(N+..)=1.934
119.4 3	0.0015 5	1071.37	3$^+$	951.98	4$^-$	[E1]		0.0956	α(L)=0.0714; α(M)=0.01769; α(N+..)=0.00656
126.01 3	0.0140 12	1031.852	2$^+$	905.89	3$^-$	[E1]		0.0834	α(L)=0.0622; α(M)=0.01541; α(N+..)=0.00573
160.26 4	0.063 4	1031.852	2$^+$	871.57	2$^-$	[E1]		0.1859	α(K)=0.1403; α(L)=0.0340; α(M)=0.00840; α(N+..)=0.00313
165.44 15	0.0030 4	1071.37	3$^+$	905.89	3$^-$	[E1]		0.1726	α(K)=0.1305; α(L)=0.0315; α(M)=0.00776; α(N+..)=0.00289
199.72 20	0.0024 3	1071.37	3$^+$	871.57	2$^-$	[E1]		0.1127	α(K)=0.0861; α(L)=0.01986; α(M)=0.00488; α(N+..)=0.001816
303.95 20	0.0051 5	1175.52	1$^-$	871.57	2$^-$	[M1,E2]		1.0 8	
555.22 10	0.014 1	1426.86?	(3$^-$)	871.57	2$^-$	[M1,E2]		0.20 14	placement of this γ between the 1427- and 871-keV levels is based on the 3$^-$ level seen In (d,d′) At 1429 keV and on observation of (555γ)(828γ) coincidences by 1979Re01.
586.43 7	0.014 1	1658.00	2$^+$	1071.37	3$^+$	M1(+E2)		0.24 1	α(K)exp= 0.18 5; α(L)=0.4

$^{250}_{98}Cf_{152}$-3

^{250}Bk β^- decay (continued)

$\gamma(^{250}Cf)$ (continued)

E_γ[†]	I_γ[‡d]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[e]	Comments
								α(K)exp is from 2.22-H ^{250}Es ε decay, determined by 1980Ah03.
626.11 *4*	0.052 *3*	1658.00	2^+	1031.852	2^+	M1(+E2)	0.24 *1*	α(K)exp= 0.18 *3*; α(L)exp=0.044 *9* α(K)exp and α(L)exp are from 2.22-H ^{250}Es ε decay, determined by 1980Ah03.
(764.2[&] *1*)	0.00133[a] *5*	905.89	3^-	141.875	4^+	E1	0.00758	
786.26 *14*	0.011 *2*	1658.00	2^+	871.57	2^-	[E1]	0.00721	α(K)=0.00579; α(L)=0.00107
(810.2[&] *1*)	2.26×10^{-4}[b] *15*	951.98	4^-	141.875	4^+	E1	0.00684	
828.812 *25*	0.260 *14*	871.57	2^-	42.721	2^+	E1	0.006 *58*	α(K)=0.00528; α(L)=0.000972
(863.2[&] *1*)	0.00170[a] *11*	905.89	3^-	42.721	2^+	E1	0.00613	
889.956 *22*	3.40 *5*	1031.852	2^+	141.875	4^+	[E2]	0.01961	α(K)=0.01376; α(L)=0.00439
929.468 *22*	2.74 *4*	1071.37	3^+	141.875	4^+	[E2]	0.0180	α(K)=0.01280; α(L)=0.00394
989.125 *21*	100	1031.852	2^+	42.721	2^+	E2[@]	0.01603	α(K)=0.01153; α(L)=0.00338 Eγ=989.225 *17* was measured by 1982Ho07 In ^{249}Bk(n,γ)^{250}Bk, followed by β^- decay; Iγ=21 *4* per 100 neutron captures (1982Ho07).
1028.654 *25*	10.9 *3*	1071.37	3^+	42.721	2^+	(E2)[@]	0.0149	α(K)=0.01079; α(L)=0.00308 Eγ=1028.1 *4* was measured by 1982Ho07 In ^{249}Bk(n,γ)^{250}Bk, followed by β^- decay; Iγ=1.4 *4* per 100 neutron captures (1982Ho07).
1031.852 *21*	79.1 *12*	1031.852	2^+	0.0	0^+	E2[@]	0.01480	α(K)=0.01074; α(L)=0.00306 Eγ=1031.921 *25* was measured by 1982Ho07 In ^{249}Bk(n,γ)^{250}Bk, followed by β^- decay; Iγ=14.1 *27* per 100 neutron captures (1982Ho07).
1047.51 *5*	0.0050 *4*	1189.39	2^+	141.875	4^+	[E2]	0.0144	α(K)=0.0105; α(L)=0.00295
1068.27[g] *17*	0.0013 *2*	1210?	(3^-)	141.875	4^+			existence of this transition is not certain.
[x]1098.36[c] *16*	0.0012 *2*							
1103.0 *3*	0.00076 *26*	1244.50	2^+	141.875	4^+	[E2]	0.01306	E_γ: from 2.22-H ^{250}Cf ε decay. A peak observed by 1979Re01 At 1103.33 is assumed doublet: the measured intensity of the 1103-keV peak relative to 1201- and 1244-keV gammas deexciting the 1244-keV level does not agree with the relative intensities measured In ^{250}Es ε decay. I_γ: Iγ(1103-keV peak)=0.0020 *3* was measured. Iγ(1103.0γ from 1244-keV level)=0.00076 *26*, calculated from the adopted branching of Iγ(1103γ)/Iγ(1201.79γ)=0.072 and Iγ(1201.79γ)=0.0105 *6*. The remaining intensity, 0.0012, is assigned to second part of the doublet, not yet placed.
[x]1103.33 *10*	0.0012 *5*							
1111.50 *10*	0.0024 *2*	1154.24	0^+	42.721	2^+	[E2]	0.0129	α(K)=0.00947; α(L)=0.00256
1132.80 *3*	0.0430 *22*	1175.52	1^-	42.721	2^+	[E1]	0.00385	α(K)=0.00311; α(L)=0.00056
1146.67 *3*	0.0280 *14*	1189.39	2^+	42.721	2^+	E0+E2	0.10 *3*	α: deduced In 2.22-H ^{250}Es ε decay.
(1154.3 *2*)		1154.24	0^+	0.0	0^+	E0		E_γ: transition was seen In ce spectrum taken In 2.22-H ^{250}Es ε

^{250}Bk β^- decay (continued)

$\gamma(^{250}Cf)$ (continued)

E_γ[†]	I_γ[‡ d]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[e]	$I_{(\gamma+ce)}$[d]	Comments
									decay. Total Ice=0.00095 *18*, calculated from the branching for this E0 transition, measured In 2.22-H ^{250}Es ε decay, and Iγ(1111.5γ)=0.0024 *2*.
1154.77 *3*	0.0159 *8*	1296.60	2^+	141.875	4^+	[E2]	0.0120		α(K)=0.00888; α(L)=0.00235
1167.25[f] *3*	0.061 *3*	1209.97	$(2)^-$	42.721	2^+	E1	0.0036 *6*		
1167.25[f g]		1210?	(3^-)	42.721	2^+				
1175.50 *3*	0.078 *5*	1175.52	1^-	0.0	0^+	[E1]	0.00362		α(K)=0.00292; α(L)=0.00052
≈1175.5[g]	0.015 *3*	≈1218.2?		42.721	2^+				the observed γ peak At 1175.5 keV had more than one component. Intensity of the 1175.5γ deexciting the 1218.5-keV level was obtained by 1979Re01 from comparison of singles and (L x-ray)(γ) coincidence spectra. Placement of the weaker component is not well established.
1201.79 *3*	0.0105 *6*	1244.50	2^+	42.721	2^+	[E2,M1]	0.027 *16*		
1223.92 *4*	0.0062 *4*	1266.6	0^+	42.721	2^+	[E2]	0.01078		α(K)=0.00804; α(L)=0.00206
1244.42 *7*	0.0029 *2*	1244.50	2^+	0.0	0^+	[E2]	0.01045		α(K)=0.00781; α(L)=0.00198
1253.82 *7*	0.0037 *3*	1296.60	2^+	42.721	2^+	E0+E2		0.028 *7*	K/Total ce= 0.56, L/Total ce= 0.11, M/Total ce=0.040 $. I$_{(\gamma+ce)}$: I($\gamma$+ce)=0.028 *7*, calculated from Ti(1253.8γ)/Iγ(1154.8γ)=1.77 *43*, measured In 2.22-H ^{250}Es ε decay.
(1266.6 *2*)		1266.6	0^+	0.0	0^+	E0			K/Total ce=0.79 *6*, L/Total ce=0.153 *14*, M/Total ce=0.042 *6* $. total Ice=0.0116 *17*, calculated from Iγ(1223.92γ)/Ice(1266.6γ)=0.33 *3*/0.620 *52*, measured In 2.22-H ^{250}Es ε decay, and Iγ(1223.92γ)=0.0062 *4*.
[x]1279.21[c] *23*	0.0018 *2*								
1296.54 *13*	0.0015 *2*	1296.60	2^+	0.0	0^+	[E2]	0.00969		α(K)=0.00728; α(L)=0.00181
[x]1302.90[c] *22*	0.0010 *2*								
[x]1312.95[c] *6*	0.0033 *2*								
1342.87 *8*	0.0042 *3*	1385.50	$1,2^+$	42.721	2^+				
1368.61 *5*	0.0070 *5*	1411.33	$(1,2^+)$	42.721	2^+				
1385.42 *6*	0.0045 *3*	1385.50	$1,2^+$	0.0	0^+				
1411.6[g] *4*	0.0013 *3*	1411.33	$(1,2^+)$	0.0	0^+				
1516.22 *7*	0.0027 *2*	1658.00	2^+	141.875	4^+	[E2]	0.00727		α(K)=0.00556; α(L)=0.00129
1553.37 *18*	0.0012 *3*	1695.15	(3^+)	141.875	4^+				
1615.29 *4*	0.102 *5*	1658.00	2^+	42.721	2^+	E2	0.00498		
[x]1633.18[c] *24*	0.0012 *2*								
1652.40 *10*	0.0022 *2*	1695.15	(3^+)	42.721	2^+				
1658.00 *4*	0.061 *3*	1658.00	2^+	0.0	0^+	E2			

[†] Measurements of 1979Re01. Others: 1959Va02, 1970St05, 1975UeZY.
[‡] Photon intensities, measured by 1972Re01, relative to Iγ(989γ)=100. The absolute γ intensity of 989.125γ was determined by 1972Re01 to Be I(989γ)=45.0 *8*

$^{250}_{98}Cf_{152}$-5

^{250}Bk β^- decay (continued)

$\gamma(^{250}Cf)$ (continued)

per 100 b- decays by using the 4π β-γ coincidence-counting technique.

[#] The multipolarities were deduced primarily from ce′s measured In ^{250}Es ε decays. The adopted γ multipolarities and the mixing ratios are given here, and those determined In ^{250}Bk β^- decay are indicated. The multipolarities given In square brackets are from the level scheme; they were not determined experimentally.

[@] From ce data of 1959Va02.

[&] γ was not observed In ^{250}Bk β^- decay; Eγ is from Adopted Gammas.

[a] Lower limit, deduced by requiring Ti(34.3γ)+Ti(764.2γ)+Ti(863.2γ) to Be greater or equal to sum of γ transitions feeding the 905.89 level (*i.e.* Iβ(to 905.89 level)≥0).

[b] Calculated by requiring intensity balance At the 952.98-keV level, assuming that there are No other transitions feeding the level. The adopted γ branchings from the level are used.

[c] Transition was not placed by 1979Re01; its assignment to ^{250}Bk is not definite (1979Re01).

[d] For absolute intensity per 100 decays, multiply by 0.450 *8*.

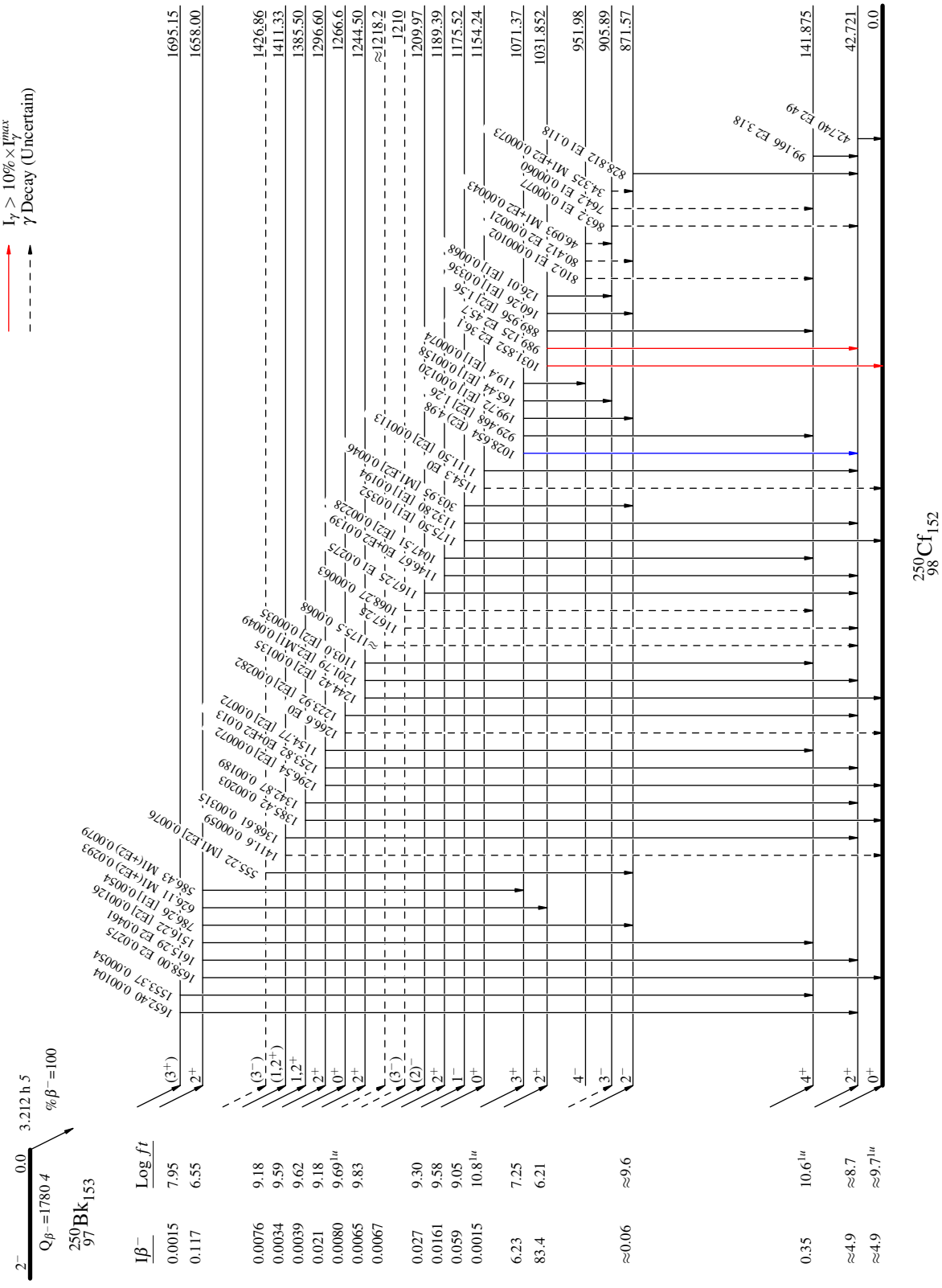
[e] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

[f] Multiply placed.

[g] Placement of transition in the level scheme is uncertain.

[x] γ ray not placed in level scheme.

$^{250}_{98}Cf_{152}$-6


250Bk β− decay
Decay Scheme
Intensities: I(γ+ce) per 100 parent decays
Legend
Iγ < 2%×Iγmax
Iγ < 10%×Iγmax
Iγ > 10%×Iγmax
γ Decay (Uncertain)
2− 0.0 3.212 h 5
Qβ−=1780 4
%β−=100
250 97 Bk153
Iβ− Log ft
0.0015 7.95
0.117 6.55
0.0076 9.18
0.0034 9.59
0.0039 9.62
0.021 9.18
0.0080 9.69lu
0.0065 9.83
0.0067
0.027 9.30
0.0161 9.58
0.059 9.05
0.0015 10.8lu
6.23 7.25
83.4 6.21
≈0.06 ≈9.6
0.35 10.6lu
≈4.9 ≈8.7
≈4.9 ≈9.7lu
1695.15
1658.00
1426.86
1411.33
1385.50
1296.60
1266.6
1244.50
≈1218.2
1210
1209.97
1189.39
1175.52
1154.24
1071.37
1031.852
951.98
905.89
871.57
141.875
42.721
0.0
250 98 Cf152