^{138}Xe β^- decay (14.14 min) 1974Ca02,1975ScZZ

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 146, 1 (2017)	30-Sep-2017

Parent: ^{138}Xe: E=0.0; J$^\pi$=0$^+$; T$_{1/2}$=14.14 min *7*; Q(β^-)=2915 *10*; %β^- decay=100.0

^{138}Xe-T$_{1/2}$: From Adopted Levels of ^{138}Xe.

^{138}Xe-Q(β^-): From 2017Wa10.

1974Ca02,1975ScZZ: source of ^{138}Xe was produced from fission of ^{235}U induced by neutron flux from the Ames Laboratory research reactor. γ rays were detected with a pair of Ge(Li) detectors, a NaI(Tl) crystal, a Ge(Li) planar low-energy photon spectrometer and a Si(Li) detector; β particles were detected with a well-type plastic scintillation detector. Measured Eγ, Iγ, Eβ, $\beta\gamma$-coin, $\gamma\gamma$-coin. Deduced levels, J, π, β-decay branching ratios, log *ft* values, configurations. Comparisons with available data and shell-model calculations. Observed about 100 γ rays that belong to ^{138}Cs. Values of γ-ray intensities from 1975ScZZ supersede those from 1974Ca02. 1974Ca02 supersedes 1972CaYY.

1972Mo33: source of ^{138}Xe was produced from fission of ^{235}U. γ and x rays were detected with Ge(Li) and Si(Li) detectors; β particles and conversion electrons were detected with a β detector. Measured Eγ, Iγ, $\beta\gamma$-coin, $\gamma\gamma$-coin, Eβ, Iβ, E(ce), I(ce). Deduced levels, J, π, β-decay branching ratios, log *ft*. Observed 62 γ rays for ^{138}Cs.

1973Ac01: source of ^{138}Xe was produced from fission of ^{235}U induced by thermal neutrons from the Buenos Aires isotope separator on-line facility. γ rays were detected with a Si(Li) detector (low energy γ and x rays) and Ge(Li) detectors (medium and high energy γ); β particles and conversion electrons were detected with a solid-state detector. Measured Eγ, Iγ, Eβ, E(ce), I(ce), $\beta\gamma$-coin, $\gamma\gamma$-coin. Deduced levels, J, π, conversion coefficients, γ-ray multipolarities, β-decay branching ratios, log *ft*. Observed 55 γ rays for ^{138}Cs. 1974Ac02 re-determined the intensities for part of γ rays in 1973Ac01 using a new efficiency calibration for Ge(Li) detectors.

2013Xi08: Sources was homogeneous sources of ^{138}Xe-^{138}Cs. γ rays were detected with a HPGe detector. Measured Eγ, Iγ. Deduced ^{138}Xe activity, absolute γ-ray emission probabilities in ^{138}Xe β^- decay.

Other: 1969Na01.

The total average radiation energy released by ^{138}Xe β^- decay is 2967 keV *146* (calculated by evaluator using the computer program RADLST). This value agrees well with Q(β^-)=2915 keV *10* (2017Wa10) and shows the completeness of the decay scheme.

Level scheme is taken from 1974Ca02.

^{138}Cs Levels

E(level)†	J$^\pi$‡	T$_{1/2}$	Comments
0.0	3$^-$	32.5 min *2*	T$_{1/2}$: from Adopted Levels.
10.86 *3*	2$^-$		
15.750 *21*	(1)$^-$		
258.405 *19*	1$^-$,2$^-$		
335.37 *8*			
403.72 *15*			
412.263 *19*	1$^-$		
450.33 *5*	0$^-$,1$^-$		
540.99 *4*			
555.98? *9*	1$^-$,2$^-$		
691.16 *11*	1$^-$,2$^-$		
912.48 *4*	(1$^-$,2)		
952.09 *6*	(0$^-$,1)		
1109.59 *5*	(0$^-$,1)		
1157.39 *6*			
1160.93 *7*	(1$^-$,2)		
1205.25 *10*	(1$^-$,2$^-$)		
1372.14? *18*			
1488.88 *11*			
1537.92 *21*			
1559.57 *13*			

Continued on next page (footnotes at end of table)

^{138}Xe β^- decay (14.14 min) 1974Ca02,1975ScZZ (continued)

^{138}Cs Levels (continued)

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
1794.07 *12*	(0^-,1)	2026.73 *5*	1^+	2337.65 *7*	1^+
2022.22 *16*	(0^-,1)	2263.13 *7*	1^+	2491.01 *14*	1^+
				2508.43? *14*	1^+

† From a least-squares fit to γ-ray energies.
‡ From Adopted Levels.

β^- radiations

E(decay)	E(level)	Iβ^-†‡	Log *ft*	Comments
(407 *10*)	2508.43?	0.25 *2*	5.72 *5*	av Eβ=120.7 *34*
(424 *10*)	2491.01	0.49 *4*	5.48 *5*	av Eβ=126.6 *35*
(577 *10*)	2337.65	3.31 *14*	5.11 *4*	av Eβ=180.7 *37*
(652 *10*)	2263.13	10.3 *4*	4.80 *3*	av Eβ=208.2 *38*
(888 *10*)	2026.73	35.3 *13*	4.74 *3*	av Eβ=299.5 *40*
(893 *10*)	2022.22	0.30 *3*	6.82 *5*	av Eβ=301.3 *40*
(1121 *10*)	1794.07	0.25 *3*	7.26 *6*	av Eβ=394.2 *42*
(1377 *10*)	1537.92	0.04 *3*	8.4 *4*	av Eβ=502.4 *43*
(1543 *10*)	1372.14?	0.17 *3*	8.0 *1*	av Eβ=574.1 *44*
(1710 *10*)	1205.25	0.21 *4*	8.0 *1*	av Eβ=647.4 *45*
(1805 *10*)	1109.59	0.08 *7*	8.6 *4*	av Eβ=689.8 *45*
(1963 *10*)	952.09	0.30 *4*	8.12 *6*	av Eβ=760.2 *45*
(2224 *10*)	691.16	0.06 *3*	9.0 *2*	av Eβ=878.0 *46*
(2359 *10*)	555.98?	0.05 *2*	9.2 *2*	av Eβ=939.5 *46*
(2465 *10*)	450.33	21.7 *9*	6.66 *2*	av Eβ=987.8 *46*
(2503 *10*)	412.263	15.0 *8*	6.85 *3*	av Eβ=1005.2 *46*
(2580 *10*)	335.37	<0.04	>9.5	av Eβ=1040.5 *46*
(2657 *10*)	258.405	5.6 *11*	7.4 *1*	av Eβ=1075.9 *46*
(2899 *10*)	15.750	<11	>7.2	av Eβ=1187.9 *47*
(2904 *10*)	10.86	<8	>8.7^{1u}	av Eβ=1178.1 *46*

† From I(γ+ce) intensity balance at each level, with conversion coefficients calculated using the BrIcc program.
‡ Absolute intensity per 100 decays.

$\gamma(^{138}Cs)$

Iγ normalization: 0.0349 *11* deduced from measured absolute γ-ray emission probabilities in 2013Xi08: I(258.4γ)=34.9 *10*, I(434.6γ)=22.2 *6* and I(1768.3γ)=18.8 *5*, versus corresponding relative intensities in this dataset; 0.0325 *16* from absolute Iγ(258.4γ)=32.5 *15* in 1972Mo33. The adopted value 0.0341 *11* is the weighted average of these two values. The absolute Iγ(258.4γ) in 1972Mo33 was deduced based on I(258.4γ)/I(1436γ in ^{138}Cs decay) in equilibrium, with absolute Iγ(1436γ) obtained using data of ^{138}Cs decay in 1971Ca21.

E_γ[‡]	I_γ[‡@]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	α[†]	$I_{(\gamma+ce)}$[@]	Comments
4.85 *5*	5.9 *8*	15.750	(1)$^-$	10.86	2$^-$	M1	202 *7*	1.20×10^3 *15*	ce(M)/(γ+ce)=0.802 *18* ce(N)/(γ+ce)=0.169 *8*; ce(O)/(γ+ce)=0.0234 *12*; ce(P)/(γ+ce)=0.00113 *6* α(M)=163 *6* α(N)=34.3 *12*; α(O)=4.74 *17*; α(P)=0.229 *8* E_γ: from 1972Mo33. $I_{(\gamma+ce)}$: from intensity balance at 10.9 and 15.8 levels. The combined β feeding to 10.9 and 15.8 level is 7.1% *26* from intensity balances. I_γ: deduced from I(γ+ce) and α(total). Mult.: from ce(M1)/ce(M2)>11 (1972Mo33).
10.85 *5*	20.2 *9*	10.86	2$^-$	0.0	3$^-$	M1	89.7 *18*	1836 *74*	ce(L)/(γ+ce)=0.788 *10*; ce(M)/(γ+ce)=0.162 *5* ce(N)/(γ+ce)=0.0341 *10*; ce(O)/(γ+ce)=0.00472 *13*; ce(P)/(γ+ce)=0.000229 *7* α(L)=71.5 *14*; α(M)=14.7 *3* α(N)=3.10 *7*; α(O)=0.428 *9*; α(P)=0.0207 *4* E_γ: from 1972Mo33. $I_{(\gamma+ce)}$: from γ+ce intensity imbalance at ground state assuming no g.s. β feeding. The total γ+ce feeding to g.s. from levels above 10.86 keV is 37.4% *15* with total relative I(γ+ce)=1096 *22*, leaving the rest 62.6% *15* feeding to be accounted for by γ+ce intensity of this transition. I_γ: deduced from I(γ+ce) and α(total). Mult.: from L1:L2:L3=100:7 *2*:1.5 *10* (1972Mo33) and α(L)=150 *70* (1973Ac01) based on X(L)/γ. (authors′ value in 1973Ac01 is obtained using ω(L)=0.143 from 1970Ma01 (Appendix III). Additional information 1.
68.3 *2*	1.5 *5*	403.72		335.37					E_γ: from 1972Mo33.
137.20 *20*	2.2 *11*	540.99		403.72					
153.858 *3*	189 *4*	412.263	1$^-$	258.405	1$^-$,2$^-$	M1,E2	0.34 *8*		α(K)=0.27 *4*; α(L)=0.06 *3*; α(M)=0.012 *6* α(N)=0.0025 *12*; α(O)=0.00031 *13*; α(P)=9.16×10^{-6} *18* E_γ: from 1979Bo26. Mult.: α(K)exp=0.29 *3* (1973Ac01), 0.31 *10* (1972Mo33).
197		1109.59	(0$^-$,1)	912.48	(1$^-$,2)				

γ(^{138}Cs) (continued)

E_γ ‡	I_γ ‡@	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	α †	Comments
242.56 *5*	111 *2*	258.405	1⁻,2⁻	15.750	(1)⁻	M1,E2	0.082 *5*	α(K)=0.0684 *18*; α(L)=0.0112 *25*; α(M)=0.0023 *6* α(N)=0.00048 *11*; α(O)=6.4×10^{-5} *12*; α(P)=2.46×10^{-6} *17* Mult.: α(K)exp=0.062 *14* (1973Ac01).
258.411 *20*	1000 *20*	258.405	1⁻,2⁻	0.0	3⁻	E2	0.0706	α(K)=0.0570 *8*; α(L)=0.01077 *15*; α(M)=0.00226 *4* α(N)=0.000467 *7*; α(O)=5.99×10^{-5} *9*; α(P)=1.89×10^{-6} *3* E_γ: from 1979Bo26. I_γ: 2013Xi08 measured absolute emission probability=34.9 *10*, 1972Mo33 report 32.5 *15*. Mult.: α(K)exp=0.056 *5* (1973Ac01), 0.058 *20* (1972Mo33).
282.51 *6*	13.6 *4*	540.99		258.405	1⁻,2⁻			
325.3 *3*	0.74 *25*	335.37		10.86	2⁻			
ˣ329.4 *5*	0.49 *24*							
335.28 *9*	3.4 *3*	335.37		0.0	3⁻			
371.44 *5*	15.9 *8*	912.48	(1⁻,2)	540.99				
396.513 *10*	200 *4*	412.263	1⁻	15.750	(1)⁻	M1,E2	0.0200 *17*	α(K)=0.0170 *17*; α(L)=0.00241 *4*; α(M)=0.000496 *10* α(N)=0.0001042 *16*; α(O)=1.42×10^{-5} *4*; α(P)=6.3×10^{-7} *10* E_γ: from 1979Bo26. Mult.: α(K)exp=0.016 *3* (1973Ac01).
401.36 *5*	69 *3*	412.263	1⁻	10.86	2⁻	M1	0.0210	α(K)=0.0181 *3*; α(L)=0.00232 *4*; α(M)=0.000474 *7* α(N)=0.0001004 *14*; α(O)=1.403×10^{-5} *20*; α(P)=7.02×10^{-7} *10* Mult.: α(K)exp=0.037 *8* (1973Ac01).
403		403.72		0.0	3⁻			
412.8 *7*	2 *1*	412.263	1⁻	0.0	3⁻			E_γ: observed by 1973Ac01, difficult to detect due to ^{138}Cs contaminant, this g.s. feeding γ-ray helps to define J^π(412)=1⁻ and M(401)=M1.
434.562 *41*	645 *13*	450.33	0⁻,1⁻	15.750	(1)⁻	M1,E2	0.0156 *16*	α(K)=0.0133 *16*; α(L)=0.00185 *6*; α(M)=0.000381 *9* α(N)=8.00×10^{-5} *23*; α(O)=1.09×10^{-5} *6*; α(P)=5.0×10^{-7} *8* E_γ: from 1979Bo26. I_γ: 2013Xi08 measured absolute emission probability=22.2 *6*. Mult.: α(K)exp=0.015 *2* (1973Ac01).
500.22 *6*	11.5 *4*	912.48	(1⁻,2)	412.263	1⁻			
530.07 *7*	8.0 *4*	540.99		10.86	2⁻			
534.0 *6*	0.47 *19*	2022.22	(0⁻,1)	1488.88				
537.76 *13*	3.7 *5*	2026.73	1⁺	1488.88				
540.8 *6*	0.7 *4*	540.99		0.0	3⁻			
555.95 *9*	3.7 *4*	555.98?	1⁻,2⁻	0.0	3⁻			
568.53 *6*	9.7 *5*	1109.59	(0⁻,1)	540.99				
ˣ579.68 *14*	2.4 *4*							
586.0 *4*	0.60 *22*	1537.92		952.09	(0⁻,1)			
588.84 *8*	3.9 *3*	1794.07	(0⁻,1)	1205.25	(1⁻,2⁻)			
619.7 *5*	0.7 *4*	1160.93	(1⁻,2)	540.99				
647.2 *5*	0.5 *3*	1559.57		912.48	(1⁻,2)			
654.08 *8*	4.6 *4*	912.48	(1⁻,2)	258.405	1⁻,2⁻			
675.37 *15*	2.3 *4*	691.16	1⁻,2⁻	15.750	(1)⁻			

γ(^{138}Cs) (continued)

E_γ ‡	I_γ ‡@	E_i(level)	J^π_i	E_f	J^π_f
680.24 *19*	1.7 *4*	691.16	$1^-,2^-$	10.86	2^-
691.5 *4*	1.0 *4*	691.16	$1^-,2^-$	0.0	3^-
693.53 *16*	2.8 *4*	952.09	$(0^-,1)$	258.405	$1^-,2^-$
697.6 *4*	0.7 *3*	1109.59	$(0^-,1)$	412.263	1^-
703.58 *17*	1.8 *3*	2263.13	1^+	1559.57	
^{x}733.9 *4*	1.0 *3*				
746		1157.39		412.263	1^-
755.0 *6*	0.8 *4*	1205.25	$(1^-,2^-)$	450.33	$0^-,1^-$
774.21 *15*	2.1 *3*	1109.59	$(0^-,1)$	335.37	
778.10 *19*	1.4 *3*	2337.65	1^+	1559.57	
792.9 *4*	0.7 *3*	1205.25	$(1^-,2^-)$	412.263	1^-
799.6 *6*	0.5 *3*	2337.65	1^+	1537.92	
816.06 *18*	2.3 *4*	1372.14?		555.98?	$1^-,2^-$
848.7 *3*	1.4 *4*	2337.65	1^+	1488.88	
851.30 *17*	2.2 *4*	1109.59	$(0^-,1)$	258.405	$1^-,2^-$
865.82 *7*	9.4 *6*	2026.73	1^+	1160.93	$(1^-,2)$
869		1205.25	$(1^-,2^-)$	335.37	
869.35 *6*	19.7 *11*	2026.73	1^+	1157.39	
896.87 *12*	4.2 *4*	912.48	$(1^-,2)$	15.750	$(1)^-$
902.3 *3*	1.4 *4*	1160.93	$(1^-,2)$	258.405	$1^-,2^-$
912.51 *7*	10.4 *6*	912.48	$(1^-,2)$	0.0	3^-
917.13 *6*	29.2 *12*	2026.73	1^+	1109.59	$(0^-,1)$
936.36 *11*	4.3 *4*	952.09	$(0^-,1)$	15.750	$(1)^-$
941.25 *8*	7.3 *5*	952.09	$(0^-,1)$	10.86	2^-
946.63 *20*	2.0 *4*	1205.25	$(1^-,2^-)$	258.405	$1^-,2^-$
953.1 *5*	0.9 *4*	2491.01	1^+	1537.92	
996.8 *3*	2.0 *5*	1537.92		540.99	
1076.38 *22*	2.8 *5*	1488.88		412.263	1^-
1093.87 *9*	13.0 *8*	1109.59	$(0^-,1)$	15.750	$(1)^-$
1098.77 *11*	6.8 *5*	1109.59	$(0^-,1)$	10.86	2^-
1102.24 *17*	3.4 *4*	2263.13	1^+	1160.93	$(1^-,2)$
1114.29 *10*	46.8 *22*	2026.73	1^+	912.48	$(1^-,2)$
1141.64 *9*	16.3 *9*	1157.39		15.750	$(1)^-$
1145.44 *18*	4.2 *6*	1160.93	$(1^-,2)$	15.750	$(1)^-$
1153.6 *5*	1.0 *5*	2263.13	1^+	1109.59	$(0^-,1)$
1160.96 *18*	3.1 *4*	1160.93	$(1^-,2)$	0.0	3^-
1189.54 *21*	2.6 *4*	1205.25	$(1^-,2^-)$	15.750	$(1)^-$
1194.94 *20*	2.8 *4*	1205.25	$(1^-,2^-)$	10.86	2^-
1204.5 *4*	1.1 *4*	1205.25	$(1^-,2^-)$	0.0	3^-
^{x}1218.7 *5*	1.2 *5*				
1228.3 *4*	2.0 *7*	2337.65	1^+	1109.59	$(0^-,1)$
1311.07 *24*	2.7 *5*	2263.13	1^+	952.09	$(0^-,1)$
1356.6 *4*	1.6 *5*	1372.14?		15.750	$(1)^-$

$\gamma(^{138}Cs)$ (continued)

E_γ[‡]	I_γ[‡@]	E_i(level)	J^π_i	E_f	J^π_f	Comments
1361.9 *6*	1.1 *5*	1372.14?		10.86	2^-	
1381.4 *3*	2.2 *5*	1794.07	$(0^-,1)$	412.263	1^-	
1385.5 *3*	2.4 *5*	2337.65	1^+	952.09	$(0^-,1)$	
1473.2 *3*	2.2 *4*	1488.88		15.750	$(1)^-$	
1548.9 *4*	2.4 *6*	1559.57		10.86	2^-	
1571.84 *16*	8.4 *8*	2022.22	$(0^-,1)$	450.33	$0^-,1^-$	
1578.1 *5*	1.6 *6*	2491.01	1^+	912.48	$(1^-,2)$	
1614.57 *18*	7.5 *8*	2026.73	1^+	412.263	1^-	
1646.5 *3*	2.1 *4*	2337.65	1^+	691.16	$1^-,2^-$	
1768.26 *13*	531 *11*	2026.73	1^+	258.405	$1^-,2^-$	I_γ: 2013Xi08 measured absolute emission probability=18.8 *5*.
1783.4 *6*	1.2 *5*	1794.07	$(0^-,1)$	10.86	2^-	
1799.4 *6*	1.1 *4*	2491.01	1^+	691.16	$1^-,2^-$	
1812.54 *18*	5.7 *6*	2263.13	1^+	450.33	$0^-,1^-$	
1850.86 *13*	45.2 *15*	2263.13	1^+	412.263	1^-	
1887.3 *3*	2.2 *4*	2337.65	1^+	450.33	$0^-,1^-$	
1925.36 *14*	17.9 *10*	2337.65	1^+	412.263	1^-	
2004.75 *14*	170 *4*	2263.13	1^+	258.405	$1^-,2^-$	
2015.82 *14*	389 *8*	2026.73	1^+	10.86	2^-	
2041.2 *5*	1.0 *3*	2491.01	1^+	450.33	$0^-,1^-$	
2079.17 *14*	45.8 *14*	2337.65	1^+	258.405	$1^-,2^-$	
2252.26 *14*	72.6 *21*	2263.13	1^+	10.86	2^-	
[x]2266.8 *5*	1.2 *4*					
2321.90 *16*	19.7 *9*	2337.65	1^+	15.750	$(1)^-$	
2326.9 *3*	1.8 *3*	2337.65	1^+	10.86	2^-	
2475.26 *16*	9.9 *5*	2491.01	1^+	15.750	$(1)^-$	
2492.61 *24*	1.7 *2*	2508.43?	1^+	15.750	$(1)^-$	
2497.56 *17*	5.5 *4*	2508.43?	1^+	10.86	2^-	

† Additional information 2.

‡ Quoted values of Eγ are from 1974Ca02 and values of Iγ are from 1975ScZZ, unless otherwise noted. Data are also available in 1972Mo33 and 1973Ac01 that agree well with quoted values but less precise and complete. Quoted values of Iγ are relative intensities normalized to Iγ(258.31γ)=1000.

\# From α(K)exp data of 1973Ac01 (except for 10.85γ) normalized to α(K)(E2)=0.00074 for the 1436γ in ^{138}Cs β^- decay. The same values are adopted in Adopted Gammas.

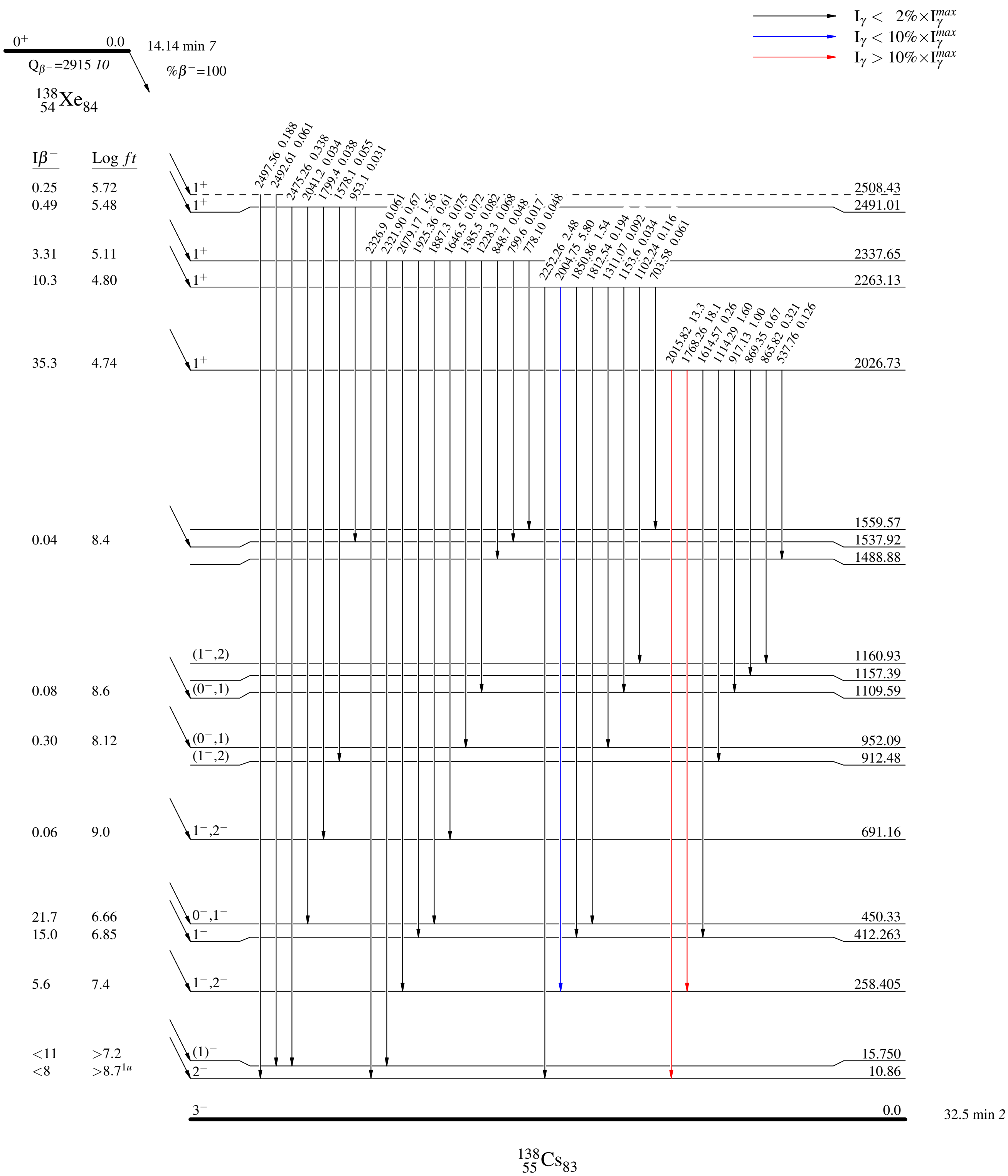
@ For absolute intensity per 100 decays, multiply by 0.0341 *11*.

x γ ray not placed in level scheme.

^{138}Xe β^- decay (14.14 min) 1974Ca02,1975ScZZ

Decay Scheme

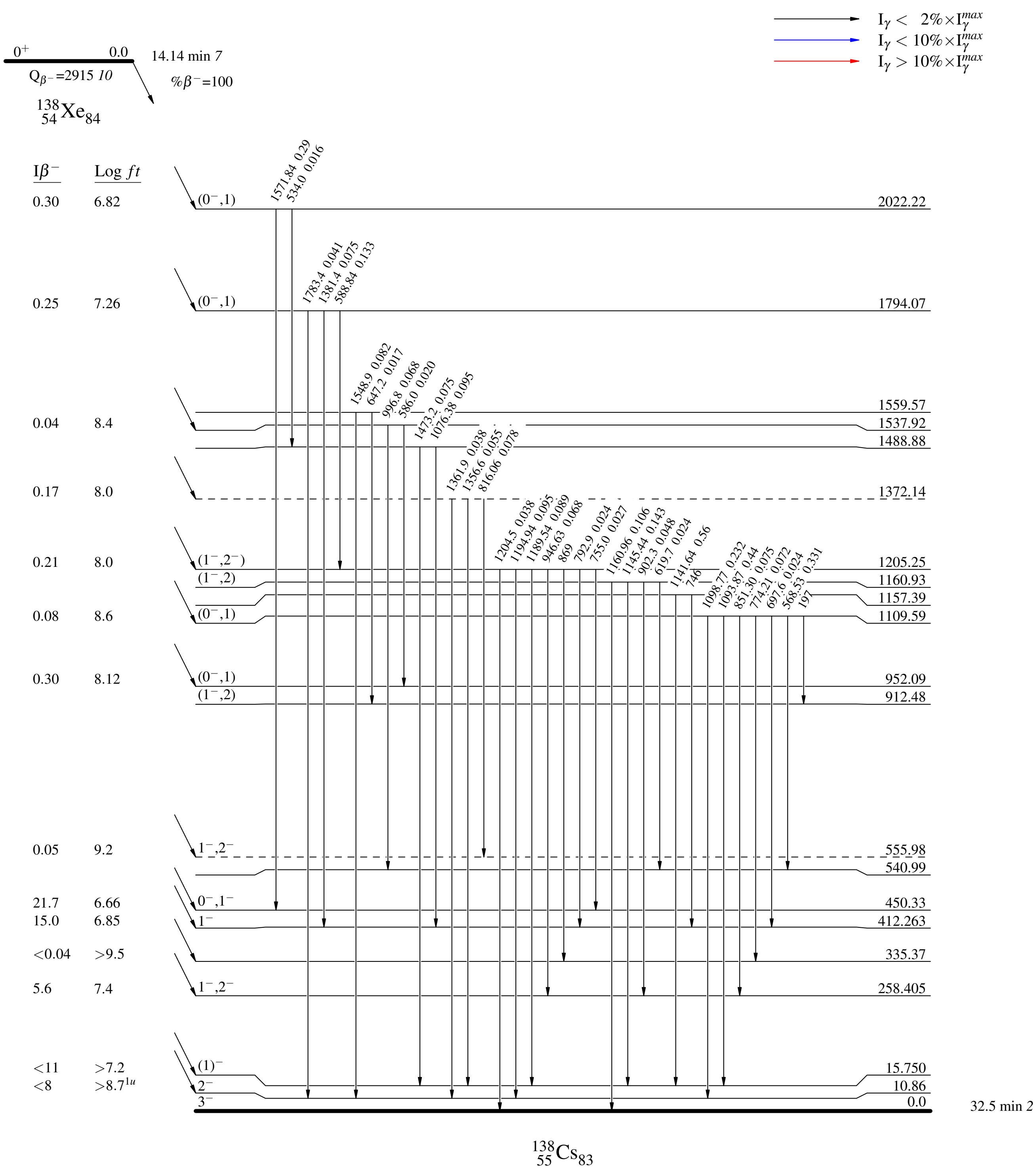
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{138}Xe β^- decay (14.14 min) 1974Ca02,1975ScZZ

Decay Scheme (continued)

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



^{138}Xe β^- decay (14.14 min) 1974Ca02,1975ScZZ

Decay Scheme (continued)

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