^{136}Cs β^- decay (13.01 d) 1977OhZO,1975Gr31,1973Ba24

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. A. Mccutchan	NDS 152, 331 (2018)	1-Apr-2018

Parent: ^{136}Cs: E=0.0; J$^\pi$=5$^+$; T$_{1/2}$=13.01 d *5*; Q(β^-)=2548.2 *19*; %β^- decay=100.0

1979Oh03,1977OhZO: ^{136}Cs activity from the ^{138}Ba(γ,pn) reaction followed by chemical separation. Measured Eγ, Iγ, $\gamma\gamma(\theta)$, $\gamma(\theta$,H,t), and $\beta\gamma$(t) using plastic scintillator, NaI(Tl) detector and two Ge(Li) detectors. Deduced T$_{1/2}$ of 2140- and 2207-keV levels and g-factor of 2140-keV level.

1975Gr31: ^{136}Cs activity from two methods, 1) irradiation of ^{235}U in reactor followed by chemical separation 2) from the ^{138}Ba(d,α) reaction followed by chemical separation. Measured Eγ, Iγ using Compton-suppression spectrometer and large volume Ge(Li) detectors and x-rays using Ge(Li) x-ray detector.

1973Ba24: ^{136}Cs activity from the ^{138}Ba(d,α) reaction with E(d)=25 MeV. Measured Eγ, Iγ, $\gamma\gamma$, $\beta\gamma$(t), $\gamma\gamma$(t), $\gamma\gamma(\theta)$ using Ge(Li) and NaI(Tl) detectors and plastic scintillators.

1967Fu05: ^{136}Cs activity from U(p,f) reaction followed by chemical separation. Measured Eγ, Iγ using Ge(Li) detector, ce(K)′s using Si(Li) detector and $\beta\gamma$(t).

1965Re07:^{136}Cs activity from the ^{138}Ba(d,α) reaction with E(d)=20 MeV. Measured β^-′s and ce′s using double-focussing beta-ray spectrometer; Eγ, Iγ, $\gamma\gamma$-coincidences and γ-$\Sigma\gamma\gamma$ using NaI(Tl) detector; $\beta\gamma\gamma$-coincidences using anthracene beta detector.

Others: 1996Ch50, 1993Ya12.

T$_{1/2}$: Additional information 1.

α: Additional information 2.

^{136}Ba Levels

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$	Comments
0.0	0$^+$		
818.517 *12*	2$^+$		
1551.31 *17*	2$^+$		
1866.599 *19*	4$^+$		
2030.523 *19*	7$^-$		
2053.879 *19*	4$^+$		
2140.225 *20*	5$^-$	1.6 ns *1*	g=−0.38 *4* (1979Oh03) T$_{1/2}$: from $\gamma\gamma$(t) in 1973Ba24. Others: 1.5 ns *1* from $\beta\gamma$(t) (1979Oh03), <≈1 ns (1967Fu05). configuration: $\nu d^{-1}_{3/2}\nu h^{-1}_{11/2}$ (1979Oh03). configuration: from comparison of g-factor to theory. g: from IPAC method (1979Oh03).
2207.134 *19*	6$^+$	3.1 ns *1*	T$_{1/2}$: weighted average of 3.1 ns *1* from $\beta\gamma$(t) (1979Oh03), 3.1 ns *1* from $\beta\gamma$(t) (1973Ba24) and 3.3 ns *3* (1967Fu05).
2356.57 *13*	4$^+$		
2373.748 *20*	5$^+$		

[†] From a least-squares fit to Eγ, by evaluator.
[‡] From the Adopted Levels.

β^- radiations

E(decay)	E(level)	Iβ^-[†]	Log *ft*	Comments
(174.5 *19*)	2373.748	2.4 *1*	6.697 *24*	av Eβ=47.25 *56*
(191.6 *19*)	2356.57	0.21 *3*	7.88 *7*	av Eβ=52.29 *57*
(341.1 *19*)	2207.134	80.8 *11*	6.102 *10*	av Eβ=98.78 *63* E(decay),Iβ^-: other: 341 *2* with Iβ^-=92.6 % (1954Ol05).
(408.0 *19*)	2140.225	13.6 *10*	7.13 *4*	av Eβ=120.99 *65*
(494.3 *19*)	2053.879	1.3 *13*	8.4 *5*	av Eβ=150.76 *67*
(517.7[‡] *19*)	2030.523	≤0.6	≥8.9[1u]	av Eβ=175.63 *68*

Continued on next page (footnotes at end of table)

^{136}Cs β^- decay (13.01 d) 1977OhZO,1975Gr31,1973Ba24 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^- †	Log *ft*	Comments
(681.6 *19*)	1866.599	<5	>8.3	av Eβ=219.00 *72* E(decay),Iβ^-: other: 657 *3* with Iβ^-=7.4% (1954Ol05).

† Absolute intensity per 100 decays.

‡ Existence of this branch is questionable.

γ(^{136}Ba)

Iγ normalization: From ΣI(γ +c.e.)(to g.s.)=100.

1977OhZO, 1975Gr31 and 1973Ba24 all provide detailed Iγ information. Particularly below 300 keV, there is considerable differences among the different measurements. As 1975Gr31 and 1973Ba24 are in closest agreement, and since 1977OhZO is a secondary publication, the evaluator adopts an average of the 1975Gr31 and 1973Ba24 values. Results from 1977OhZO are indicated in the comments.

Iγ(K x ray)=22% *4* (1959Gi50; NaI).

α(K)exp,α(L)exp,K/L,L23/L1: from 1977OhZO and in agreement with results of 1967Fu05 and 1965Re07, except as noted and for the 67γ and 86γ where 1965Re07 apparently had source thickness and other problems. 1965Re07 also measured ce(M)′s.

E_γ [†]	I_γ [‡b]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [@]	δ [&]	α	Comments
66.881 *17*	4.8 *2*	2207.134	6$^+$	2140.225	5$^-$	E1(+M2)	≤0.008	0.689	α(L)exp=0.150 *11* (1977OhZO) α(K)=0.584 *9*; α(L)=0.0836 *12*; α(M)=0.01715 *25*; α(N)=0.00362 *6*; α(O)=0.000521 *8* α(P)=2.88×10^{-5} *5* Mult.: from α(L)exp. δ: from comparison to RUL. BrIcc mixing using α(L)exp and L23/L1 ratio gives δ=0.100 *6*. I_γ: other: 12.5 *1* (1975Gr31), 7.3 *11* 1973Ba24). L23/L1=0.353 *11* (1977OhZO).
86.36 *3*	5.9 *7*	2140.225	5$^-$	2053.879	4$^+$	E1		0.341	α(K)exp=0.291 *20* (1977OhZO) α(K)=0.291 *4*; α(L)=0.0401 *6*; α(M)=0.00823 *12*; α(N)=0.001743 *25*; α(O)=0.000254 *4* α(P)=1.482×10^{-5} *21* I_γ: weighted average of 6.3 *3* (1975Gr31) and 4.8 *5* (1973Ba24). Other: 5.2 *2* (1977OhZO). K/L=7.24 *3* (1977OhZO).
109.681 *7*	0.41 *2*	2140.225	5$^-$	2030.523	7$^-$	E2		1.39 *2*	α(K)exp=0.91 *7* (1977OhZO) α(K)=0.96 *5*; α(L)=0.392 *20*; α(M)=0.086 *5*; α(N)=0.0178 *10*; α(O)=0.00238 *14* α(P)=4.9×10^{-5} *7* I_γ: weighted average of 0.40 *4* (1975Gr31) and 0.41 *2* (1973Ba24). Other: 0.21 *3* (1977OhZO). K/L=2.45 *15* (1977OhZO). δ: δ(O/Q)<0.05.
153.246 *4*	7.7 *5*	2207.134	6$^+$	2053.879	4$^+$	E2		0.430	α(K)exp=0.260 *17* (1977OhZO) α(K)=0.316 *5*; α(L)=0.0896 *13*; α(M)=0.0193 *3*; α(N)=0.00404 *6*; α(O)=0.000552 *8* α(P)=1.589×10^{-5} *23* α(K)exp: Other: 0.15 *3* (1965Re07). I_γ: weighted average of 7.48 *16* (1975Gr31) and 9.0 *4* (1973Ba24). Other: 5.77 *18* (1977OhZO). K/L=3.60 *10* (1977OhZO).

$\gamma(^{136}$Ba) (continued)

E_γ [†]	I_γ [‡b]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [@]	δ [&]	α	Comments
163.920 *2*	4.7 *2*	2030.523	7⁻	1866.599	4⁺	E3		2.23	α(K)exp=1.12 *5* (1977OhZO) α(K)=1.104 *16*; α(L)=0.881 *13*; α(M)=0.198 *3*; α(N)=0.0411 *6*; α(O)=0.00537 *8* α(P)=5.35×10^{-5} *8* α(K)exp: Other: 0.46 *4* (1965Re07). I_γ: weighted average of 4.62 *10* (1975Gr31) and 5.2 *3* (1973Ba24). Other: 3.40 *12* (1977OhZO). K/L=1.25 *3* (1977OhZO).
166.576 [a] *6*	0.63 *3*	2373.748	5⁺	2207.134	6⁺	M1(+E2)	0.3 *3*	0.243 *16*	α(K)exp=0.23 *3* (1977OhZO) α(K)=0.205 *8*; α(L)=0.030 *7*; α(M)=0.0062 *15*; α(N)=0.0013 *3*; α(O)=0.00020 *4* α(P)=1.32×10^{-5} *3* I_γ: weighted average of 0.63 *3* (1975Gr31) and 0.62 *5* (1973Ba24). Other: 0.37 *4* (1977OhZO). K/L=6.9 *9* (1977OhZO).
176.602 *4*	13.7 *3*	2207.134	6⁺	2030.523	7⁻	E1+M2	0.07 *5*	0.053 *12*	α(K)exp=0.036 *3* (1977OhZO) α(K)=0.045 *10*; α(L)=0.0062 *17*; α(M)=0.0013 *4*; α(N)=0.00027 *8*; α(O)=4.1×10^{-5} *12* α(P)=2.6×10^{-6} *8* α(K)exp: Other: 0.011 *8* (1965Re07). I_γ: weighted average of 13.6 *2* (1975Gr31) and 14.9 *7* (1973Ba24). Other: 10.0 *4* (1977OhZO). K/L=8.8 *7* (1977OhZO).
187.285 *6*	0.54 *5*	2053.879	4⁺	1866.599	4⁺	M1+E2	0.8 *4*	0.188 *12*	α(K)exp=0.155 *20* (1977OhZO) α(K)=0.154 *6*; α(L)=0.027 *6*; α(M)=0.0058 *12*; α(N)=0.00122 *24*; α(O)=0.00018 *3* α(P)=9.2×10^{-6} *3* I_γ: weighted average of 0.60 *6* (1975Gr31) and 0.50 *5* (1973Ba24). Other: 0.36 *4* (1977OhZO). K/L=5.7 *7* (1977OhZO).
233.5 [#] *4*	0.08 [#] *1*	2373.748	5⁺	2140.225	5⁻	[E1]		0.0221	α(K)=0.0190 *3*; α(L)=0.00245 *4*; α(M)=0.000503 *8*; α(N)=0.0001076 *16*; α(O)=1.618×10^{-5} *24* α(P)=1.085×10^{-6} *16*
273.646 *8*	12.7 *2*	2140.225	5⁻	1866.599	4⁺	E1+M2	0.07 *5*	0.016 *3*	α(K)exp=0.0137 *9* (1977OhZO) α(K)=0.0136 *21*; α(L)=0.0018 *4*; α(M)=0.00037 *8*; α(N)=7.8×10^{-5} *16*; α(O)=1.18×10^{-5} *24* α(P)=8.1×10^{-7} *16* I_γ: weighted average of 12.7 *2* (1975Gr31) and 12.6 *5* (1973Ba24). Other: 11.1 *4* (1977OhZO). K/L=7.50 *26* (1977OhZO). α(K)exp: other: 0.011 *4* (1967Fu05).
302.4 [#] *4*	0.03 [#] *1*	2356.57	4⁺	2053.879	4⁺	M1(+E2)	+0.3 *+5−3*	0.0472 *13*	α(K)=0.0404 *17*; α(L)=0.0054 *4*; α(M)=0.00112 *9*;

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γ(^{136}Ba) (continued)

E_γ[†]	I_γ[‡b]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[@]	δ[&]	α	Comments
									α(N)=0.000241 *17*; α(O)=3.68×10^{-5} *18* α(P)=2.61×10^{-6} *20*
315.5[#c] *5*	0.020[#] *18*	1866.599	4$^+$	1551.31	2$^+$	[E2]		0.0385	α(K)=0.0315 *5*; α(L)=0.00559 *9*; α(M)=0.001177 *18*; α(N)=0.000249 *4*; α(O)=3.60×10^{-5} *6* α(P)=1.80×10^{-6} *3*
319.911[a] *8*	0.50 *7*	2373.748	5$^+$	2053.879	4$^+$	M1+E2	0.30 *1*	0.0407	α(K)exp=0.032 *4* (1977OhZO) α(K)=0.0348 *5*; α(L)=0.00466 *7*; α(M)=0.000961 *14*; α(N)=0.000207 *3*; α(O)=3.16×10^{-5} *5* α(P)=2.25×10^{-6} *4* I_γ: weighted average of 0.60 *6* (1975Gr31) and 0.45 *4* (1973Ba24). Other: 0.50 *5* (1977OhZO). Mult.: from α(K)exp.
340.547 *8*	46.9 *5*	2207.134	6$^+$	1866.599	4$^+$	E2		0.0304	α(K)exp=0.0233 *16* (1977OhZO) α(K)=0.0250 *4*; α(L)=0.00429 *6*; α(M)=0.000901 *13*; α(N)=0.000191 *3*; α(O)=2.77×10^{-5} *4* α(P)=1.441×10^{-6} *21* I_γ: weighted average of 46.8 *5* (1975Gr31) and 49 *2* (1973Ba24). Other: 42.3 *13* (1977OhZO). K/L=5.94 *11* (1977OhZO).
490.0[#] *2*	0.08[#] *2*	2356.57	4$^+$	1866.599	4$^+$	M1+E2		0.0121 *18*	
507.188[a] *10*	1.00 *5*	2373.748	5$^+$	1866.599	4$^+$	M1+E2	0.70 *1*	0.01164	α(K)exp=0.0130 *9* (1977OhZO) α(K)=0.00996 *14*; α(L)=0.001337 *19*; α(M)=0.000276 *4*; α(N)=5.93×10^{-5} *9*; α(O)=9.02×10^{-6} *13* α(P)=6.33×10^{-7} *9* I_γ: weighted average of 0.98 *5* (1975Gr31) and 1.1 *1* (1973Ba24). Other: 0.97 *3* (1977OhZO). Mult.: from α(K)exp.
733.0[#] *5*	0.02[#]	1551.31	2$^+$	818.517	2$^+$	M1+E2	−1.00 *4*	0.00443	α(K)=0.00380 *6*; α(L)=0.000499 *8*; α(M)=0.0001028 *16*; α(N)=2.21×10^{-5} *4*; α(O)=3.37×10^{-6} *6* α(P)=2.40×10^{-7} *4*
818.514 *12*	100	818.517	2$^+$	0.0	0$^+$	E2		0.00283	α(K)=0.00242 *4*; α(L)=0.000327 *5*; α(M)=6.75×10^{-5} *10*; α(N)=1.449×10^{-5} *21*; α(O)=2.19×10^{-6} *3* α(P)=1.495×10^{-7} *21* Mult.: from K/L=7.7 *2* (1977OhZO).
1048.073 *20*	80 *3*	1866.599	4$^+$	818.517	2$^+$	E2		1.64×10^{-3}	α(K)exp=0.00150 *12* (1977OhZO) α(K)=0.001406 *20*; α(L)=0.000183 *3*; α(M)=3.77×10^{-5} *6*; α(N)=8.11×10^{-6} *12* α(O)=1.234×10^{-6} *18*; α(P)=8.73×10^{-8} *13* I_γ: weighted average of 79.9 *8* (1975Gr31) and 81 *4* (1973Ba24). Other: 80 *3* (1977OhZO). α(K)exp: other: 0.0016 *2* (1967Fu05). K/L=7.50 *26* (1977OhZO).

$\gamma(^{136}$Ba) (continued)

E_γ[†]	I_γ[‡b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	α	Comments
1235.362 *23*	20.1 *7*	2053.879	4^+	818.517	2^+	E2	1.17×10^{-3}	α(K)exp=0.00098 *6* (1977OhZO) α(K)=0.001001 *14*; α(L)=0.0001281 *18*; α(M)=2.63×10^{-5} *4*; α(N)=5.66×10^{-6} *8* α(O)=8.65×10^{-7} *13*; α(P)=6.22×10^{-8} *9* I_γ: weighted average of 19.8 *8* (1975Gr31) and 19 *1* (1973Ba24). Other: 80 *3* (1977OhZO). α(K)exp: other: 0.00089 *14* (1967Fu05). K/L=7.8 *6* (1977OhZO).
1321.58[#c] *40*	0.05[#] *2*	2140.225	5^-	818.517	2^+	[E3]	0.0019 *8*	
1538.09[#] *20*	0.10[#] *2*	2356.57	4^+	818.517	2^+	E2	8.45×10^{-4}	α(K)=0.000650 *10*; α(L)=8.16×10^{-5} *12*; α(M)=1.672×10^{-5} *24*; α(N)=3.61×10^{-6} *5*; α(O)=5.52×10^{-7} *8* α(P)=4.05×10^{-8} *6* Mult.: Q from $\gamma\gamma(\theta)$ in 1973Ba24.
1551.3[#] *2*	0.015[#] *5*	1551.31	2^+	0.0	0^+	E2	8.37×10^{-4}	α(K)=0.000640 *9*; α(L)=8.03×10^{-5} *12*; α(M)=1.644×10^{-5} *23*; α(N)=3.54×10^{-6} *5*; α(O)=5.43×10^{-7} *8* α(P)=3.98×10^{-8} *6*

[†] From 1977OhZO, except where noted.
[‡] Weighted average of 1975Gr31 and 1973Ba24, except where noted.
[#] Observed only in 1975Gr31.
[@] From the Adopted Gammas. Support for multipolarities from this dataset indicated in the comments. In general, multipolarities are derived from α(K)exp and K/L ratios, except where noted.
[&] From the Adopted Gammas. For cases where α(K)exp and K/L ratio are known, value is derived by evaluator using BrIcc mixing code.
[a] Eγ differ by 3 to 5 σ's from results of least-squares adjustment.
[b] For absolute intensity per 100 decays, multiply by 0.997 *1*.
[c] Placement of transition in the level scheme is uncertain.

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