^{146}Ce β^- decay 1968Ho16,1980Ya07,1997Gr09

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Yu. Khazov, A. Rodionov and G. Shulyak	NDS 136, 163 (2016)	14-Jul-2016

Parent: ^{146}Ce: E=0.0; $J^\pi=0^+$; $T_{1/2}$=13.49 min *16*; Q(β^-)=1050 *30*; %β^- decay=100.0

^{146}Ce-$T_{1/2}$ from 'Adopted Levels'.

1967Ho19,1968Ho16,1964Da06: ^{146}Ce β^- decay [from ^{235}U(n,F) product]; measured Eγ, Iγ, ce, (X-ray)γ, (ce)γ coin. ^{146}Pr; deduced levels, J^π, α(exp), log *ft*.

1980Ya07: ^{146}Ce β^- decay [from ^{235}U(n,F) product]; measured Eγ, Iγ, β^-, $\gamma\gamma$, $\beta\gamma$ coin., $T_{1/2}$. ^{146}Pr; deduced levels, J^π, log *ft*, Q_β.

1983Ge11: ^{146}Ce β^- decay [from ^{252}Cf(SF) product]; measured Eγ, Iγ. ^{146}Pr; deduced γ ray absolute and relative intensities.

1997Gr09: ^{146}Ce β^- decay [from ^{252}Cf(SF) product]; measured Eγ, Iγ. ^{146}Pr; deduced β^- intensity populations. He gas-jet arrangement, mass-separator, total absorption spectrometer system.

Others: 1977Bj02, 1979Bo26, 1984So18, 1972Oh08.

Decay scheme is that from 1968Ho16, 1980Ya07 and 1997Gr09.

^{146}Pr Levels

E(level)[†]	J^π[‡]
0.0	(2^-)
12.221 *19*	$(1,2,3)^-$
35.05 *3*	$1^-,2^-$
87.22 *4*	$1^-,2^-$
100.88 *5*	$1^+,2^+$
133.55 *3*	$1^-,2^-$
141.28 *4*	$1^-,2^-$
351.78 *3*	1^+
502.95 *5*	1^+
878.60 *11*	1^+

[†] From a least-squares fit to Eγ's, normalized χ^2=0.9.

[‡] From 'Adopted Levels'.

β^- radiations

β and $\beta\gamma$ reveal the β components: 830 keV *50*, 600 keV *50* (from coin with 317γ and 218γ 1980Ya07), 748 keV *109* (1981Eb01), 750 keV *80* (1967Ho19).

E(decay)	E(level)	Iβ^-[†‡]	Log *ft*	Comments
(1.7×10^2 *3*)	878.60	0.199 *13*	4.7 *3*	av Eβ=46.3 *88* Iβ^-: 0.163 (1997Gr09).
(5.5×10^2 *3*)	502.95	3.47 *9*	5.07 *9*	av Eβ=169 *11* Iβ^-: 5.89 (1997Gr09).
750 *8*	351.78	94.3 *24*	4.00 *7*	av Eβ=224 *12* Iβ^-: 93.36 (1997Gr09). Eβ from 1967Ho19.
(9.1×10^2 *3*)	141.28	0.76 *22*	6.50 *14*	av Eβ=306 *12*
(9.2×10^2 *3*)	133.55	1.6 *4*	6.19 *12*	av Eβ=309 *12*
(9.5×10^2 *3*)	100.88	0.36 *9*	6.89 *12*	av Eβ=322 *12*
(9.6×10^2 *3*)	87.22	2.0 *4*	6.17 *10*	av Eβ=327 *12*

Continued on next page (footnotes at end of table)

^{146}Ce β^- decay 1968Ho16,1980Ya07,1997Gr09 (continued)

β^- radiations (continued)

† From the balance of intensities at the levels (multipolarities are from 1968Ho16). Iβ's to low-energy levels with E<100 keV equal 2.6% *17* (1997Gr09), no β^- feedings to the 87-, 35-, 12-keV levels and g.s. were determined in 1980Ya07.

‡ Absolute intensity per 100 decays.

^{146}Ce β^- decay 1968Ho16,1980Ya07,1997Gr09 (continued)

$\gamma(^{146}Pr)$

Iγ normalization: from I(316.7γ)=55.3% *13* (weighted average of values of 55.0% *15* (1983Ge11) and 56.2% *30* (1984So18)) assuming no feeding to g.s.

E_γ [†]	I_γ [‡ h]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [@]	δ [&]	α [g]	$I_{(\gamma+ce)}$ [# i]	Comments
12.23 *2*	0.31 [d] *2*	12.221	(1,2,3)$^-$	0.0	(2$^-$)	M1		94.1	21 *12*	ce(L)/(γ+ce)=0.781 *8*; ce(M)/(γ+ce)=0.165 *4* ce(N)/(γ+ce)=0.0369 *8*; ce(O)/(γ+ce)=0.00591 *13*; ce(P)/(γ+ce)=0.000429 *9* α(L)=74.3 *11*; α(M)=15.70 *24* α(N)=3.51 *6*; α(O)=0.562 *9*; α(P)=0.0408 *6* I_γ: 0.22 *12* from intensity balance; no β^- feeding. α(exp): 67 *38* deduced by the evaluators from I(γ+ce)=21 *12*; value of α is consistent with M1 mult.
22.88 *5*	1.4 *7*	35.05	1$^-$,2$^-$	12.221	(1,2,3)$^-$	M1		14.60	21 *11*	ce(L)/(γ+ce)=0.739 *8*; ce(M)/(γ+ce)=0.156 *3* ce(N)/(γ+ce)=0.0348 *8*; ce(O)/(γ+ce)=0.00559 *12*; ce(P)/(γ+ce)=0.000406 *9* α(L)=11.53 *18*; α(M)=2.43 *4* α(N)=0.543 *9*; α(O)=0.0871 *14*; α(P)=0.00634 *10* I_γ: from I(γ+ce); 2.0 *1* from 1980Ya07. α(exp): α(L)exp=9.1 *30*, α(M)exp=1.9 *7* (from L/M=4.8 *1*, α(L)exp+α(M)exp=11 *4* (1968Ho16)).
35.05 *8*	2.0 [d] *1*	35.05	1$^-$,2$^-$	0.0	(2$^-$)	M1+E2	0.87 [a] *14*	59 *11*	118 *11*	ce(L)/(γ+ce)=0.77 *10*; ce(M)/(γ+ce)=0.17 *4* ce(N)/(γ+ce)=0.037 *10*; ce(O)/(γ+ce)=0.0051 *13*; ce(P)/(γ+ce)=2.1×10^{-5} *5* α(L)=46 *9*; α(M)=10.4 *19* α(N)=2.2 *4*; α(O)=0.31 *6*; α(P)=0.00126 *11*
52.19 *10*	1.85 [f] *4*	87.22	1$^-$,2$^-$	35.05	1$^-$,2$^-$	M1		8.48		α(L)exp=1.2 *3* α(K)=7.21 *11*; α(L)=1.007 *16*; α(M)=0.212 *4* α(N)=0.0475 *8*; α(O)=0.00762 *12*; α(P)=0.000557 *9* I_γ: 0.94 *5* from 1980Ya07.
87.19 *17*	1.24 *6*	87.22	1$^-$,2$^-$	0.0	(2$^-$)	E2+M1	3.1 *13*	3.33 *23*		α(K)exp=2.1 *7*; α(L)exp=1.2 *4* α(K)=1.77 *4*; α(L)=1.22 *16*; α(M)=0.27 *4* α(N)=0.059 *8*; α(O)=0.0082 *11*; α(P)=9.4×10^{-5} *5*
98.55 *6*	6.90 *14*	133.55	1$^-$,2$^-$	35.05	1$^-$,2$^-$	M1		1.350		α(K)exp=1.2 *4*; α(L)exp=0.13 *4*; K/L=9 α(K)=1.150 *17*; α(L)=0.1587 *23*; α(M)=0.0335 *5* α(N)=0.00748 *11*; α(O)=0.001203 *17*; α(P)=8.83×10^{-5} *13*
100.88 *7*	4.88 *7*	100.88	1$^+$,2$^+$	0.0	(2$^-$)	(E1)		0.245		α(K)=0.208 *3*; α(L)=0.0294 *5*; α(M)=0.00616 *9* α(N)=0.001355 *20*; α(O)=0.000209 *3*; α(P)=1.238×10^{-5} *18*

$^{146}_{59}Pr_{87}$-3

^{146}Ce β^- decay 1968Ho16,1980Ya07,1997Gr09 (continued)

$\gamma(^{146}Pr)$ (continued)

E_γ [†]	I_γ [‡h]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [@]	δ [&]	α [g]	Comments
									α(exp): 0.203 *23* deduced by the evaluators from intensities balance at 100.88 keV level which is consistent with E1.
106.17 *8*	1.11 *5*	141.28	1$^-$,2$^-$	35.05	1$^-$,2$^-$	M1		1.092	α(K)exp=1.2 *4* α(K)=0.930 *14*; α(L)=0.1282 *19*; α(M)=0.0270 *4* α(N)=0.00604 *9*; α(O)=0.000972 *14*; α(P)=7.14×10^{-5} *11*
[x]132 [c]	0.24 [c] *4*								
133.52 *4*	14.89 *23*	133.55	1$^-$,2$^-$	0.0	(2$^-$)	M1		0.571	α(K)exp≈0.6; ce(L)=0.073 *22*; K/L=8.3 α(K)=0.486 *7*; α(L)=0.0668 *10*; α(M)=0.01407 *20* α(N)=0.00315 *5*; α(O)=0.000507 *8*; α(P)=3.73×10^{-5} *6* Iγ=8.8% *5* (1984So18).
141.29 *5*	6.15 *8*	141.28	1$^-$,2$^-$	0.0	(2$^-$)	M1+E2	0.6 *6*	0.52 *5*	α(K)exp=0.36 *10*; α(L)exp=0.085 *25*; K/L=4.3 α(K)=0.418 *7*; α(L)=0.08 *4*; α(M)=0.018 *8* α(N)=0.0040 *16*; α(O)=0.00060 *21*; α(P)=3.0×10^{-5} *3*
[x]173.84 *15*	0.47 [e] *7*								
210.46 *6*	9.96 *15*	351.78	1$^+$	141.28	1$^-$,2$^-$	E1		0.0329	α(K)exp=0.047 *15* α(K)=0.0282 *4*; α(L)=0.00377 *6*; α(M)=0.000790 *11* α(N)=0.0001751 *25*; α(O)=2.76×10^{-5} *4*; α(P)=1.83×10^{-6} *3* Iγ=5.6% *6* (1984So18).
[x]216 [c]	0.49 [c] *4*								
218.23 *3*	35.3 *4*	351.78	1$^+$	133.55	1$^-$,2$^-$	E1		0.0299	α(K)exp=0.032 *15* α(K)=0.0256 *4*; α(L)=0.00342 *5*; α(M)=0.000716 *10* α(N)=0.0001588 *23*; α(O)=2.50×10^{-5} *4*; α(P)=1.667×10^{-6} *24* Iγ=22.4% *8* (1984So18).
[x]245.50 *10*	0.54 [e] *6*								
250.89 *6*	4.92 *11*	351.78	1$^+$	100.88	1$^+$,2$^+$	M1		0.1009	α(K)exp≈0.1 α(K)=0.0861 *12*; α(L)=0.01166 *17*; α(M)=0.00245 *4* α(N)=0.000549 *8*; α(O)=8.85×10^{-5} *13*; α(P)=6.57×10^{-6} *10*
264.56 *4*	16.58 *19*	351.78	1$^+$	87.22	1$^-$,2$^-$	E1		0.0180	α(K)exp≤0.036 α(K)=0.01540 *22*; α(L)=0.00204 *3*; α(M)=0.000427 *6* α(N)=9.49×10^{-5} *14*; α(O)=1.503×10^{-5} *21*; α(P)=1.022×10^{-6} *15* Iγ=8.8% *8* (1984So18).
316.74 *3*	100.0 *11*	351.78	1$^+$	35.05	1$^-$,2$^-$	E1		0.01132	α(K)=0.00971 *14*; α(L)=0.001277 *18*; α(M)=0.000267 *4* α(N)=5.94×10^{-5} *9*; α(O)=9.44×10^{-6} *14*; α(P)=6.53×10^{-7} *10* Iγ=56.2% *30* (1984So18), Iγ=55.0% *18* (1983Ge11). α(K)=0.00971 used for the normalization. Mult.: from ce measurement by1968Ho16.
351.49 *13*	0.61 *5*	351.78	1$^+$	0.0	(2$^-$)				I$_\gamma$: 4.1 *2* in 1980Ya07.
369.23 *10*	0.36 *2*	502.95	1$^+$	133.55	1$^-$,2$^-$				
375.65 [b] *13*	0.220 *14*	878.60	1$^+$	502.95	1$^+$				
415.71 *6*	2.45 *3*	502.95	1$^+$	87.22	1$^-$,2$^-$				
[x]462.7 *2*	0.06 [d] *1*								E$_\gamma$: not observed in 1983Ge11.
468.02 *15*	1.48 *2*	502.95	1$^+$	35.05	1$^-$,2$^-$				
490.8 *4*	0.26 *2*	502.95	1$^+$	12.221	(1,2,3)$^-$				I$_\gamma$: from 1983Ge11, ≈0.06 (1968HO16), 0.11 *2* (1980Ya07).

$^{146}_{59}Pr_{87}$-4

^{146}Ce β^- decay 1968Ho16,1980Ya07,1997Gr09 (continued)

$\gamma(^{146}Pr)$ (continued)

E_γ [†]	I_γ [‡ h]	E_i(level)	J_i^π	E_f	J_f^π	Comments
503.00 *6*	1.94 *3*	502.95	1^+	0.0	(2^-)	
526.83 [b] *15*	0.140 *17*	878.60	1^+	351.78	1^+	

† From 1980Ya07, except as noted.
‡ Weighted average of Iγ′s from 1968Ho16, 1983Ge11 and 1980Ya07 except as noted. Iγ′s are normalized to Iγ(316.7)=100.
# From the intensities balance at the level.
@ From α(exp) (1968Ho16) which were renormalized by the evaluators to I(316.7γ, E1)=100, α(K)=0.00971 (2008Ki07) except as noted.
& Calculated using BrIccMixing code from α(exp)′s except as noted.
a Deduced by the evaluators from intensity balance at the level (no β^- feeding) using α′s for M1 and E2 from 2008Ki07.
b Inserted by 1997Gr09 from unplaced γ′s (1980Ya07) on the basis of comparison of measured and simulated γ spectra.
c Observed by 1983Ge11 only.
d From 1980Ya07.
e Weighted average of Iγ′s from 1983Ge11 and 1980Ya07.
f Weighted average of Iγ′s from 1968Ho16 and 1983Ge11.
g Additional information 1.
h For absolute intensity per 100 decays, multiply by 0.553 *13*.
i For absolute intensity per 100 decays, multiply by 0.559 *13*.
x γ ray not placed in level scheme.

$^{146}_{59}Pr_{87}$-5

^{146}Ce β^- decay 1968Ho16,1980Ya07,1997Gr09

Decay Scheme

Intensities: I_γ per 100 parent decays