^{148}Ce β^- decay 2004Ko05,1983Ar15,1997Gr09

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 117, 1 (2014)	1-Oct-2013

Parent: ^{148}Ce: E=0.0; J$^\pi$=0$^+$; T$_{1/2}$=56.8 s *3*; Q(β^-)=2137 *13*; %β^- decay=100.0

2004Ko05: ^{148}Ce produced by on-line spectrometer KUR-ISOL following the ^{235}U(n,F) E=thermal reaction, implanted In tape and transported periodically to the measuring location equipped with three Si(Li) detectors, HPGE, and plastic scintillator detectors. Measured ce (FWHM=1.8 eV At 258 keV), γ, β-gated ce and γ, ce-γ coin, T$_{1/2}$.

1997Gr09,1996Gr20: total absorption γ-ray spectrometer (TAGS) system used to measure β^- decay intensities, and the g.s. β^- feeding when operated in the 4$\pi\gamma$-β coin mode.

Measured: γ, $\gamma\gamma$, K x ray (1983Ar15,1977Bj02,1974Ar25,1973SeYX), $\beta\gamma$ (1978St03,1981Eb01), γ (1979Bo26), see 1986BuZV.

Level scheme is that of 1983Ar15. TAGS data with a number of pseudolevels with a substantial β^- feeding to them indicates that the level scheme has large uncertainties associated with it.

^{148}Pr Levels

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$	Comments
0.0	1$^-$	2.29 min *2*	%β^-=100 (adopted value). T$_{1/2}$: adopted value.
98.166 *3*	1$^-$,2$^-$,3$^-$		
98.967 *20*	0$^-$,1$^-$,2$^-$		
105.161 *19*	(0,1,2)$^-$		
121.169 *3*	0$^-$,1$^-$,2$^-$		
195.993 *13*	1		
273.744 *25*	0$^+$,1$^+$,2$^+$		
287.20 *5*			
289.656 *19*	+		
332.75 *9*			
352.70 *8*	−		
390.684 *19*	1$^+$		J$^\pi$: log *ft*=4.5 for β^- decay from 0$^+$.
467.77 *9*			
520.83 *4*	1$^+$		J$^\pi$: log *ft*=5.0 for β^- decay from 0$^+$.
626.36 *20*			
765.45 *11*	1$^+$		J$^\pi$: log *ft*=5.6 for β^- decay from 0$^+$.

† From a least-squares fit to Eγ data (normalized χ^2=1.95>critical χ^2=1.76).
‡ Adopted Levels; supported by log *ft* values, level decay patterns and level systematics (1983Ar15).

β^- radiations

When the calculated feeding overlaps zero within three standard deviations, the code GTOL (part of ENSDF Analysis Programs) calculates estimated upper limits (90% confidence level) which are given by evaluator In the table comments (see "Statistics for Nuclear and Particle Physics", Louis Lyons, Cambridge University Press, 1986).

E(decay)	E(level)	Iβ^-[†‡@]	Log *ft*	Comments
(1372 *13*)	765.45	2.1 *3*	5.57 *7*	av Eβ=496.4 *56* Iβ^-: 5.31-7.08 from TAGS (1997Gr09).
(1511 *13*)	626.36	0.70 *16*	6.20 *10*	av Eβ=556.0 *57* Iβ^-: 2.48 from TAGS (1997Gr09).
(1616 *13*)	520.83	16.3 *9*	4.95 *3*	av Eβ=601.7 *57* Iβ^-: 16.68 from TAGS (1997Gr09).
(1669 *13*)	467.77	3.3 *3*	5.70 *5*	av Eβ=624.9 *57*

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^{148}Ce β^- decay 2004Ko05,1983Ar15,1997Gr09 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^-[†‡@]	Log *ft*	Comments
				Iβ^-: 3.34 from TAGS (1997Gr09).
(1746 *13*)	390.684	59 *4*	4.52 *4*	av Eβ=658.7 *58* Iβ^-: 51.09 from TAGS (1997Gr09).
(1784 *13*)	352.70	2.1 *3*	6.01 *7*	av Eβ=675.4 *58* Iβ^-: 2.19 from TAGS (1997Gr09).
(1804[&] *13*)	332.75			Iβ^-: 0.0 from TAGS (1997Gr09); 0.00 *19* from I(γ+ce) imbalance; GTOL upper limit (method 1): 0.3.
(1847 *13*)	289.656	0.1 *16*	7 *7*	av Eβ=703.2 *58* Iβ^-: 5.84 from TAGS (1997Gr09); GTOL upper limit (method 1): 2.7.
(1850 *13*)	287.20	0.1 *7*	7 *3*	av Eβ=704.3 *58* Iβ^-: 0.73 from TAGS (1997Gr09); GTOL upper limit (method 1): 1.1.
(1863[&] *13*)	273.744			Iβ^-: 1.67 from TAGS (1997Gr09); −2.1 *10* from I(γ+ce) imbalance; GTOL upper limit (method 1): 0.7.
(1941 *13*)	195.993	5.8 *17*	5.71 *13*	av Eβ=744.8 *58* Iβ^-: 1.88 from TAGS (1997Gr09); GTOL upper limit (method 1): 9.2.
(2016[#&] *13*)	121.169			Iβ^-: 6 *3* from I(γ+ce) imbalance; GTOL upper limit (method 1): 9.2.
(2032[#&] *13*)	105.161			Iβ^-: 1 *3* from I(γ+ce) imbalance; GTOL upper limit (method 1): 5.3.
(2038[#&] *13*)	98.967			Iβ^-: 5.6 *19* from I(γ+ce) imbalance.
(2039[#&] *13*)	98.166			Iβ^-: 0.0 *4* from I(γ+ce) imbalance; GTOL upper limit (method 1): 0.6.
(2137[#&] *13*)	0.0			Iβ^-: 4 *5* (1983Ar15); 0 *6* from I(γ+ce) imbalance; GTOL upper limit (method 1): 0.7.

[†] From I(γ+ce) imbalances at each level, unless indicated otherwise. In computing I(γ+ce), 1983Ar15 assumed that γ's from E(level)<380 keV were M1, and γ's from E(level)>380 keV were E1 in general. The evaluator has changed these assumed multipolarities to be consistent with ΔJ^{π}.

[‡] TAGS analysis gives the following pseudolevels and associated Iβ (in %) in addition to the discrete levels listed. 880 keV 1.56; 970 keV 1.15-2.29; 1060 keV 0.73; 1150 keV 2.35; 1260 keV≤1.33; 1360 keV 0.31; and 1430 keV 0.57. The TAGS spectrum of ^{148}Ce 56s decay, while predominantly ^{148}Ce, is estimated to contain<10% contribution from ^{148}Pr 2.0 min decay. A simultaneous analysis of both these nuclides was done, and the authors feel that in the energy range from≈750 keV to≈1300 keV, there is some ambiguity in the final results because of overlapping peaks. Since the resolution of the TAGS system is typically 50-100 keV, the intensity assigned to a pseudolevel may represent β^- feeding to a single level or a group of levels. The same limitation applies to the intensity assigned to a known level, since it could include feeding to known or unknown levels in the resolution energy range.

[#] Σ Iβ over g.s. and first four excited states is 0.0% 21 from TAGS analysis (1997Gr09).

[@] Absolute intensity per 100 decays.

[&] Existence of this branch is questionable.

γ(^{148}Pr)

Iγ normalization: from Σ I(γ+ce)=100% to g.s. and assuming no β^- feeding to g.s. as found by TAGS analysis (1997Gr09).
α(K)exp were derived from Iγ and I(K x ray) for the same transition (1983ChZG).

E$_\gamma$	I$_\gamma$[&]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.[‡]	α[†]	Comments
74.5 *5*	8 *4*	195.993	1	121.169	0$^-$,1$^-$,2$^-$	[M1]	3.02 *8*	α(K)=2.57 *7*; α(L)=0.356 *9*; α(M)=0.0751 *19*; α(N+..)=0.0197 *5* α(N)=0.0168 *4*; α(O)=0.00270 *7*; α(P)=0.000198 *5*
90.89 *3*	123 *7*	195.993	1	105.161	(0,1,2)$^-$	M1,E2[@]	2.3 *7*	α(K)=1.52 *8*; α(L)=0.6 *5*; α(M)=0.14 *11*;

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^{148}Ce β^- decay 2004Ko05,1983Ar15,1997Gr09 (continued)

γ(^{148}Pr) (continued)

E_γ	I_γ[&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	α[†]	Comments
								α(N+..)=0.036 *25* α(N)=0.031 *22*; α(O)=0.004 *3*; α(P)=9.7×10^{-5} *15* Mult.: α(K)exp=1.11 *10* (2004Ko05); α(K)exp=1.4 *1* (1983ChZG).
98.0 *1*	77 *5*	195.993	1	98.166	1$^-$,2$^-$,3$^-$	[M1]	1.372	α(K)=1.168 *17*; α(L)=0.1612 *23*; α(M)=0.0340 *5*; α(N+..)=0.00891 *13* α(N)=0.00760 *11*; α(O)=0.001223 *18*; α(P)=8.97×10^{-5} *13*
98.166 *3*	93 *5*	98.166	1$^-$,2$^-$,3$^-$	0.0	1$^-$	E2[#]	2.26	α(K)=1.279 *18*; α(L)=0.770 *11*; α(M)=0.1735 *25*; α(N+..)=0.0428 *6* α(N)=0.0375 *6*; α(O)=0.00523 *8*; α(P)=6.65×10^{-5} *10* E_γ: from 1979Bo26. Mult.: α(K)exp=1.3 *2*, α=2.6 *3* (1983ChZG).
98.99 *3*	742 *40*	98.967	0$^-$,1$^-$,2$^-$	0.0	1$^-$	M1[#]	1.333	α(K)=1.135 *16*; α(L)=0.1566 *22*; α(M)=0.0330 *5*; α(N+..)=0.00866 *13* α(N)=0.00738 *11*; α(O)=0.001188 *17*; α(P)=8.72×10^{-5} *13* Mult.: α(K)exp=0.9 *2* (1983ChZG).
101.029 *4*	215 *11*	390.684	1$^+$	289.656	$^+$	M1,E2[@]	1.7 *4*	α(K)=1.12 *6*; α(L)=0.4 *3*; α(M)=0.09 *6*; α(N+..)=0.023 *15* α(N)=0.020 *13*; α(O)=0.0029 *18*; α(P)=7.2×10^{-5} *11* E_γ: from 1979Bo26. Mult.: α(K)exp=0.94 *6* (2004Ko05); α(K)exp=0.5 *2* (1983ChZG).
103.2 *1*	15 *15*	390.684	1$^+$	287.20		[M1]	1.184	α(K)=1.008 *15*; α(L)=0.1390 *20*; α(M)=0.0293 *5*; α(N+..)=0.00768 *11* α(N)=0.00655 *10*; α(O)=0.001054 *15*; α(P)=7.74×10^{-5} *11*
105.20 *3*	314 *15*	105.161	(0,1,2)$^-$	0.0	1$^-$	M1,E2[@]	1.4 *4*	α(K)=1.00 *5*; α(L)=0.35 *22*; α(M)=0.08 *5*; α(N+..)=0.019 *12* α(N)=0.017 *11*; α(O)=0.0024 *15*; α(P)=6.4×10^{-5} *10* Mult.: α(K)exp=0.75 *6* (2004Ko05); α(K)exp=0.9 *1* (1983ChZG).
116.92 *3*	225 *12*	390.684	1$^+$	273.744	0$^+$,1$^+$,2$^+$	M1,E2[@]	1.02 *20*	α(K)=0.73 *3*; α(L)=0.23 *13*; α(M)=0.05 *3*; α(N+..)=0.013 *8* α(N)=0.011 *7*; α(O)=0.0016 *9*; α(P)=4.8×10^{-5} *7* E_γ: 117.336 *7* (1979Bo26) probably belongs to another nuclide (1983Ar15). Mult.: α(K)exp=0.98 *9* (2004Ko05); α(K)exp=0.6 *2* (1983ChZG).
121.169 *3*	790 *38*	121.169	0$^-$,1$^-$,2$^-$	0.0	1$^-$	M1,E2[@]	0.91 *16*	α(K)=0.661 *25*; α(L)=0.20 *11*; α(M)=0.043 *25*; α(N+..)=0.011 *6* α(N)=0.009 *6*; α(O)=0.0014 *7*; α(P)=4.3×10^{-5} *6* E_γ: from 1979Bo26. Mult.: α(K)exp=0.53 *4* (2004Ko05); α(K)exp=0.5 *2* (1983ChZG).
167.8 *2*	66 *7*	520.83	1$^+$	352.70	$^-$	[E1]	0.0607	α(K)=0.0519 *8*; α(L)=0.00703 *11*;

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^{148}Ce β^- decay 2004Ko05,1983Ar15,1997Gr09 (continued)

$\gamma(^{148}Pr)$ (continued)

E_γ	I_γ[&]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	α[†]	Comments
								α(M)=0.001473 *22*; α(N+..)=0.000380 *6* α(N)=0.000326 *5*; α(O)=5.11×10^{-5} *8*; α(P)=3.29×10^{-6} *5*
168.52 *4*	20 *3*	273.744	0$^+$,1$^+$,2$^+$	105.161	(0,1,2)$^-$	[E1]	0.0600	α(K)=0.0513 *8*; α(L)=0.00695 *10*; α(M)=0.001455 *21*; α(N+..)=0.000376 *6* α(N)=0.000322 *5*; α(O)=5.05×10^{-5} *7*; α(P)=3.25×10^{-6} *5*
184.53 *4*	99 *5*	289.656	+	105.161	(0,1,2)$^-$	E1[@]	0.0469	α(K)=0.0401 *6*; α(L)=0.00541 *8*; α(M)=0.001132 *16*; α(N+..)=0.000293 *5* α(N)=0.000251 *4*; α(O)=3.94×10^{-5} *6*; α(P)=2.57×10^{-6} *4* Mult.: α(K)exp=0.021 *7* (2004Ko05).
187.9 *2*	90 *5*	520.83	1$^+$	332.75		[E1]	0.0447	α(K)=0.0382 *6*; α(L)=0.00514 *8*; α(M)=0.001077 *16*; α(N+..)=0.000279 *4* α(N)=0.000239 *4*; α(O)=3.75×10^{-5} *6*; α(P)=2.45×10^{-6} *4*
188.5 *3*	69 *7*	287.20		98.967	0$^-$,1$^-$,2$^-$	[E1]	0.0443	α(K)=0.0379 *6*; α(L)=0.00510 *8*; α(M)=0.001068 *16*; α(N+..)=0.000276 *4* α(N)=0.000237 *4*; α(O)=3.72×10^{-5} *6*; α(P)=2.43×10^{-6} *4*
191.6 *1*	99 *6*	289.656	+	98.166	1$^-$,2$^-$,3$^-$	[M1]	0.209	α(K)=0.179 *3*; α(L)=0.0243 *4*; α(M)=0.00513 *8*; α(N+..)=0.001345 *19* α(N)=0.001147 *17*; α(O)=0.000185 *3*; α(P)=1.366×10^{-5} *20* E_γ: 190.839 *6* (1979Bo26) probably belongs to another nuclide (1983Ar15).
193.8 *2*	20 *4*	467.77		273.744	0$^+$,1$^+$,2$^+$	[E1]	0.0411	α(K)=0.0351 *5*; α(L)=0.00472 *7*; α(M)=0.000989 *15*; α(N+..)=0.000256 *4* α(N)=0.000219 *4*; α(O)=3.45×10^{-5} *5*; α(P)=2.26×10^{-6} *4*
194.69 *5*	240 *3*	390.684	1$^+$	195.993	1	[E1]	0.0406	α(K)=0.0347 *5*; α(L)=0.00467 *7*; α(M)=0.000977 *14*; α(N+..)=0.000253 *4* α(N)=0.000217 *3*; α(O)=3.41×10^{-5} *5*; α(P)=2.24×10^{-6} *4*
195.977 *14*	390 *20*	195.993	1	0.0	1$^-$	[M1]	0.197	α(K)=0.1679 *24*; α(L)=0.0229 *4*; α(M)=0.00482 *7*; α(N+..)=0.001264 *18* α(N)=0.001078 *15*; α(O)=0.0001736 *25*; α(P)=1.284×10^{-5} *18* E_γ: from 1979Bo26.
231.6 *2*	20 *4*	352.70	−	121.169	0$^-$,1$^-$,2$^-$	M1,E2[@]	0.121 *5*	α(K)=0.098 *9*; α(L)=0.018 *4*; α(M)=0.0038 *8*; α(N+..)=0.00098 *19* α(N)=0.00084 *17*; α(O)=0.000129 *20*; α(P)=6.9×10^{-6} *13* Mult.: α(K)exp=0.119 *20* (2004Ko05).

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^{148}Ce β^- decay 2004Ko05,1983Ar15,1997Gr09 (continued)

$\gamma(^{148}Pr)$ (continued)

E_γ	I_γ[&]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	α[†]	Comments
233.71 *5*	60 *6*	520.83	1^+	287.20		[M1]	0.1221	α(K)=0.1042 *15*; α(L)=0.01413 *20*; α(M)=0.00297 *5*; α(N+..)=0.000780 *11* α(N)=0.000665 *10*; α(O)=0.0001072 *15*; α(P)=7.95×10^{-6} *12* E_γ: 233.844 *13* (1979Bo26) probably belongs to another nuclide (1983Ar15).
247.52 *9*	56 *6*	352.70	$^-$	105.161	$(0,1,2)^-$	[M1]	0.1046	α(K)=0.0893 *13*; α(L)=0.01209 *17*; α(M)=0.00254 *4*; α(N+..)=0.000668 *10* α(N)=0.000569 *8*; α(O)=9.18×10^{-5} *13*; α(P)=6.81×10^{-6} *10* E_γ: 247.086 *25* (1979Bo26) probably belongs to another nuclide (1983Ar15).
269.52 *5*	1018 *51*	390.684	1^+	121.169	$0^-,1^-,2^-$	E1[@]	0.01713	α(K)=0.01468 *21*; α(L)=0.00194 *3*; α(M)=0.000407 *6*; α(N+..)=0.0001057 *15* α(N)=9.04×10^{-5} *13*; α(O)=1.431×10^{-5} *20*; α(P)=9.75×10^{-7} *14* E_γ: from 1979Bo26. Mult.: α(K)exp=0.0097 *8* (2004Ko05); α(K)exp=0.022 *8* (1983ChZG).
271.5 *2*	40 *6*	467.77		195.993	1	[E1]	0.01681	α(K)=0.01440 *21*; α(L)=0.00191 *3*; α(M)=0.000399 *6*; α(N+..)=0.0001036 *15* α(N)=8.86×10^{-5} *13*; α(O)=1.404×10^{-5} *20*; α(P)=9.58×10^{-7} *14*
273.77 *5*	326 *16*	273.744	$0^+,1^+,2^+$	0.0	1^-	E1[@]	0.01645	α(K)=0.01409 *20*; α(L)=0.00187 *3*; α(M)=0.000390 *6*; α(N+..)=0.0001014 *15* α(N)=8.67×10^{-5} *13*; α(O)=1.374×10^{-5} *20*; α(P)=9.38×10^{-7} *14* Mult.: α(K)exp=0.0086 *18* (2004Ko05).
285.5 *1*	48 *5*	390.684	1^+	105.161	$(0,1,2)^-$	[E1]	0.01476	α(K)=0.01265 *18*; α(L)=0.001671 *24*; α(M)=0.000350 *5*; α(N+..)=9.09×10^{-5} *13* α(N)=7.77×10^{-5} *11*; α(O)=1.232×10^{-5} *18*; α(P)=8.44×10^{-7} *12*
287.17 *10*	110 *10*	287.20		0.0	1^-	[E1]	0.01454	α(K)=0.01246 *18*; α(L)=0.001646 *23*; α(M)=0.000344 *5*; α(N+..)=8.95×10^{-5} *13* α(N)=7.65×10^{-5} *11*; α(O)=1.214×10^{-5} *17*; α(P)=8.32×10^{-7} *12*
289.64 *6*	340 *20*	289.656	$^+$	0.0	1^-	[M1]	0.0689	α(K)=0.0588 *9*; α(L)=0.00793 *12*; α(M)=0.001667 *24*; α(N+..)=0.000438 *7* α(N)=0.000373 *6*; α(O)=6.01×10^{-5} *9*; α(P)=4.47×10^{-6} *7*
291.724 *17*	1000 *50*	390.684	1^+	98.967	$0^-,1^-,2^-$	E1[@]	0.01396	α(K)=0.01197 *17*; α(L)=0.001579 *23*; α(M)=0.000331 *5*; α(N+..)=8.59×10^{-5} *12* α(N)=7.35×10^{-5} *11*; α(O)=1.165×10^{-5} *17*; α(P)=8.00×10^{-7} *12* E_γ: from 1979Bo26. Mult.: α(K)exp=0.0086 *9* (2004Ko05).
324.85 *5*	453 *20*	520.83	1^+	195.993	1	[E1]	0.01062	α(K)=0.00911 *13*; α(L)=0.001197 *17*;

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^{148}Ce β^- decay 2004Ko05,1983Ar15,1997Gr09 (continued)

$\gamma(^{148}Pr)$ (continued)

E_γ	I_γ [&]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [‡]	α [†]	Comments
								α(M)=0.000250 *4*; α(N+..)=6.51×10^{-5} *10* α(N)=5.57×10^{-5} *8*; α(O)=8.85×10^{-6} *13*; α(P)=6.14×10^{-7} *9*
332.7 *1*	90 *9*	332.75		0.0	1^-	[M1]	0.0478	α(K)=0.0409 *6*; α(L)=0.00549 *8*; α(M)=0.001154 *17*; α(N+..)=0.000303 *5* α(N)=0.000258 *4*; α(O)=4.16×10^{-5} *6*; α(P)=3.10×10^{-6} *5*
346.3 *2*	35 *4*	467.77		121.169	$0^-,1^-,2^-$	[E1]	0.00905 *13*	α=0.00905 *13*; α(K)=0.00776 *11*; α(L)=0.001017 *15*; α(M)=0.000213 *3*; α(N+..)=5.54×10^{-5} *8* α(N)=4.73×10^{-5} *7*; α(O)=7.53×10^{-6} *11*; α(P)=5.25×10^{-7} *8*
352.4 *2*	106 *12*	352.70	$^-$	0.0	1^-	[M1]	0.0412	α(K)=0.0352 *5*; α(L)=0.00472 *7*; α(M)=0.000991 *14*; α(N+..)=0.000260 *4* α(N)=0.000222 *4*; α(O)=3.58×10^{-5} *5*; α(P)=2.67×10^{-6} *4*
369.09 *12*	97 *13*	467.77		98.967	$0^-,1^-,2^-$			
375.0 *2*	41 *9*	765.45	1^+	390.684	1^+			
390.79 *16*	79 *14*	390.684	1^+	0.0	1^-			
399.43 *19*	46 *12*	520.83	1^+	121.169	$0^-,1^-,2^-$			
421.78 *6*	218 *11*	520.83	1^+	98.967	$0^-,1^-,2^-$			E_γ: from 1979Bo26.
478.17 *12*	80 *12*	765.45	1^+	287.20				
521.2 *2*	41 *9*	626.36		105.161	$(0,1,2)^-$			

† Additional information 1.
‡ γ's from E(level)<380 keV were assumed to be M1, and γ's from E(level)>380 keV were assumed to be E1 in general by 1983Ar15, except as indicated otherwise. The evaluator has changed these multipolarities to be consistent with ΔJ^π.
# From α(K)exp (1983ChZG).
@ From α(K)exp (2004Ko05).
& For absolute intensity per 100 decays, multiply by 0.0171 *7*.

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Decay Scheme

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