^{244}Cm α decay (18.11 y) 2002Da21,1998Ya17,1972Sc01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, E. Browne	NDS 109, 2439 (2008)	31-Jul-2008

Parent: ^{244}Cm: E=0.0; $J^\pi=0^+$; $T_{1/2}$=18.11 y *3*; Q(α)=5901.74 *5*; %α decay=100.0

^{244}Cm-$T_{1/2}$: as recommended in DDEP evaluation (2006BeZL) based on the measurements of 1982Po14, 1972Ke29, 1968Be26, 1961Ca01. Others: 1954St33, 1954Fr19. 1989Ho24 evaluation gives 18.1 y *1* $T_{1/2}$(SF)=1.32E+7 y *2* (as recommended in the evaluation of 2000Ho27). The DDEP evaluation (2006BeZL) recommended 1.34E+7 y *8* from measurements by 1993Pa29, 1972Ha80, 1970Ba11, 1967Ar09, 1965Me02, 1963Ma56 and 1952Gh27.

^{244}Cm-%α decay: %α=100, %SF=1.37×10^{-4} *3* (As recommended by 2003Ak04), %SF=1.36×10^{-4} *1* (DDEP evaluation,2006BeZL).

The data set is adapted from evaluations by 2006BeZL (also 2006Ch34) and 1998Ak04.

Main references: 2002Da21, 1998Ya17, 1998Ga19, 1997Ka59, 1996Sa24, 1996Bu50, 1987Go21, 1972Sc01, 1971Gr17, 1966Ba07, 1963Bj03, 1963Dz07, 1960As11.

Compilations and evaluations: 2006BeZL (ddep evaluation, also 2006Ch34 by the same author), 2000Ho27, 1998Ak04, 1989Ho24, 1991Ry01 (also 1979Ry03 by the same author), 1986LoZT.

Others: 1995Jo23, 1992Fr04, 1991Sh06, 1991Jo07, 1990Pe03, 1987Ko14, 1986Ag04, 1984Sh32, 1984Hi09, 1984Gl03, 1984BuZJ, 1979Be58, 1974Ah02, 1972Ke29, 1972Ko04, 1971Bb10, 1970To08, 1969ScZZ, 1968Du06, 1968Be26, 1964Ma55, 1962Iv01, 1960Be25, 1958Wh09, 1956Hu96, 1956Sm18.

Additional information 1.

1990Pe03: Measured detailed subshell ce spectrum for 42.8 and 98.8 transitions and deduced conversion coefficients. The γ-ray energies and intensities of five transitions were also measured.

1974Ah02: measured ce data for 42.8 transition.

1972Sc01 (also 1971BeYT,1969ScZZ): Measured g rays with emphasis on g.s. band transitions.

Measurement of ternary α and triton emission in ^{244}Cm SF decay: Vermote et al., Nucl. Phys. A 806, 1 (2008). Emission probability for long-range α particles (LRA)/SF event=0.00316 *9*. Emission probability for triton emission per SF event=0.000198 *24*.

^{240}Pu Levels

E(level)	J^π[†]	$T_{1/2}$	Comments
0	0^+		
42.824 *8*	2^+	164 ps *5*	$T_{1/2}$: from 1970To08. Other: 173 ps *15* (1960Be25).
141.690 *15*	4^+		
294.319 *24*	6^+		
497.52 *21*	8^+		E(level): from 'Adopted Levels'.
597.34 *4*	1^-		
648.85 *4*	3^-		
860.71 *7*	0^+		
900.32 *4*	2^+		
937.6?			Population of this level in ^{244}Cm α decay is uncertain, thus no attempt has been made by the evaluators to deduce intensity of α feeding and/or γ-ray intensities. It should be mentioned that in earlier evaluations (2006BeZL,2006Ch34,2004Ch64), this level was considered as populated in this decay based primarily on the 894.7γ quoted in 1978LeZA. But the reported intensity of this γ ray relative to that of the 937.6γ disagrees by at least a factor of 20 with branching ratio in 'adopted gammas', thus invalidating the assignment of the main intensity of the 894.7γ to ^{244}Cm decay.

[†] From 'Adopted Levels'.

^{244}Cm α decay (18.11 y) 2002Da21,1998Ya17,1972Sc01 (continued)

α radiations

Eα[†]	E(level)	Iα[‡&]	HF[@]	Comments
4920 *3*	900.32	5.0×10^{-5} *5*	5.7 *6*	Iα: 5.0×10^{-5} *5* (1960As11), 1.3×10^{-4} (1966Ba07), 4.9×10^{-5} *8* (1997Ka59).
4960 *3*	860.71	1.49×10^{-4} *16*	3.5 *4*	Iα: 1.55×10^{-4} *16* (1960As11), 3×10^{-4} (1966Ba07), 1.42×10^{-4} *16* (1997Ka59).
5166.64 *7*	648.85	4×10^{-6} *3*	3.3×10^{3} *25*	Iα: from γ-intensity balance; no direct Iα measurement available.
5215 *3*	597.34	5.6×10^{-5} *5*	500 *82*	Iα: deduced from transition-intensity balance. Measured Iα: 15×10^{-5} (1960As11), 10×10^{-5} (1966Ba07), 4.2×10^{-5} *9* (1997Ka59) are not in good agreement.
5315	497.52	4×10^{-5}	2847	Eα: average of 5316 (1960As11) and 5313 (1966Ba07). Iα: from 1966Ba07. Other:≈15×10^{-5} (1960As11).
5513 *3*	294.319	0.00352 *18*	516 *27*	Eα: 5515 *3* (1998Ga19), 5516.2 (2002Da21). Iα: 0.0036 *3* (1960As11); 0.003 *1* (1963Dz07); 0.0034 (1966Ba07); 0.0035 (1986LoZT), 0.00342 *9* (1997Ka59), 0.0038 *5* (1998Ga19). Value of 0.012 *1* (2002Da21) is not used in averaging.
5664 *3*	141.690	0.0204 *15*	644 *48*	Eα: 5664 *2* (1998Ga19). Iα: 0.020 *1* (2002Da21), 0.0205 *15* (1996Ga19), 0.0135 *3* (1996Sa24), 0.0163 *7* (1984BuZJ) see 1986LoZT; 0.02 (1966Ba07), 0.021 *2* (1963Dz07); 0.023 *2* (1960As11); 0.017 *3* (1956Hu96).
5762.64[#] *3*	42.824	23.1 *1*	1.966 *10*	Iα: weighted average (using LWM, normalized residuals and Rajeval′s technique) of 22.80 *5* (2002Da21), 23.34 *18* (1998Ga19), 23.69 *6* (1998Ya17), 23.1 *5* (1996Sa24), 23.2 *5* (1996Bu50); 23.00 *5* (1984BuZJ,1986LoZT); 23.6 (1966Ba07); 23.8 *9* (1963Dz07); 23.3 *6* (1956Hu96), assuming minimum uncertainty of 0.10. The DDEP evaluation (2006BeZL) gives 23.3 *4*.
5804.77[#] *5*	0	76.9 *1*	1.00	Eα: other: 5803.6 *22* (1992Fr04). Iα: weighted average (using LWM, normalized residuals and Rajeval′s technique) of 77.16 *11* (2002Da21), 76.31 *5* (1998Ya17), 76.63 *18* (1998Ga19), 76.9 *5* (1996Sa24), 76.8 *7* (1996Bu50), 76.98 *5* (1984BuZJ,1986LoZT); 73.3 (1987Go21); 76.4 (1966Ba07); 76.2 *20* (1963Dz07); 76.7 *6* (1956Hu96), assuming minimum uncertainty of 0.10. The DDEP evaluation (2006BeZL) gives 76.7 *4*.

[†] From 1966Ba07, 1963Dz07 and 1960As11, unless otherwise noted. A few values are also given by 1998Ga19, 1992Fr04 and 1971Gr17.
[‡] Unless otherwise stated, the values are from the DDEP evaluation (2006BeZL) based on measurements of 2002Da21, 1998Ya17, 1998Ga19, 1997Ka59, 1996Sa24, 1996Bu50, 1984BuZJ, 1966Ba07, 1963Dz07, 1960As11, 1956Hu96.
[#] From 1971Gr17, with values adjusted as recommended by 1991Ry01 and 1998Ak04.
[@] From 1998Ak04, with $r_0(^{240}Pu)=1.4979$ *7*.
[&] Absolute intensity per 100 decays.

γ(^{240}Pu)

Iγ normalization: from measured Iα for 860 and 900 levels and corresponding relative γ+ce intensities from these levels.
There seems no detailed γ-ray study published in the open literature. Three main γ rays of 42.8, 98.8 and 152.6 keV were measured precisely by 1972Sc01. Higher energy gamma rays were reported in two separate compilations: 1978LeZA reported results from a 1967 priv. comm. from C.M. Lederer and 1970Sc39 reported gamma-ray data from 1969ScZZ conference paper by Schmorak et al. Five gamma rays from 42.8 to 554.5 keV were reported by 1990Pe03 with energies and intensities.
916γ was neither seen by 1969ScZZ nor reported by 1978LeZA. Upper limit of intensity: <0.4 (1969ScZZ).

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^{244}Cm α decay (18.11 y) 2002Da21,1998Ya17,1972Sc01 (continued)

γ(^{240}Pu) (continued)

E_γ [†]	I_γ [#a]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [&]	α [b]	Comments
42.824 [‡] *8*	3.1×10^4 *3*	42.824	2$^+$	0	0$^+$	E2	906	α(L1)exp=15 *2*; α(L2)exp=474 *51*; α(L3)exp=466 *50*; α(M1)exp=3.1 *4*; α(M2)exp=76 *9* α(M3)exp=70 *9*; α(M4)exp+α(M5)exp=0.9 *2*; α(N1)exp<1.9; α(N2)exp=22 *3*; α(N3)exp=23 *3* α(O)exp=10 *1*; epc=3.0 *4*; α(exp)=1200 *200* α(L)=658 *10*; α(M)=183 *3*; α(N+..)=64.1 *9* α(N)=50.4 *7*; α(O)=11.84 *17*; α(P)=1.85 *3*; α(Q)=0.00390 *6* I_γ: deduced by the evaluators from %Iα and α(42.8γ); γ feeding to 42.8 level from higher level is only ≈0.1% of the total transition intensity of 42.8γ. Mult.: from experimental conversion coefficients quoted above from 1990Pe03. Other: α(exp)=845 *93* (1968Du06).
98.860 [‡] *13*	16.7×10^2 *20*	141.690	4$^+$	42.824	2$^+$	E2	16.65	α(L1)exp<3.0; α(L2)exp=6.0 *8*; α(L3)exp=3.1 *7*; α(M1)exp<1.0; α(M2)exp=1.8 *6* α(M3)exp<1.9; α(exp)=13 *2* α(L)=12.08 *17*; α(M)=3.38 *5*; α(N+..)=1.185 *17* α(N)=0.930 *13*; α(O)=0.219 *3*; α(P)=0.0349 *5*; α(Q)=0.0001222 *18* I_γ: deduced by the evaluators from %Iα, α(98.8γ) and γ feeding to 141.7 level from higher level. Other: Iγ(98.9γ)/Iγ(42.8γ)=0.067 *7* (1972Sc01) compares with 0.054 *8* given here. Experimental conversion coefficients given above are from 1990Pe03. Additional information 2.
152.630 [‡] *20*	1.24×10^3 *12*	294.319	6$^+$	141.690	4$^+$	E2	2.49	α(K)=0.196 *3*; α(L)=1.665 *24*; α(M)=0.465 *7*; α(N+..)=0.1629 *23* α(N)=0.1278 *18*; α(O)=0.0302 *5*; α(P)=0.00488 *7*; α(Q)=2.76×10^{-5} *4* I_γ: from average of measured 1240 *120* (1969ScZZ) and 1237 *136* deduced from %Iα, α(152.6γ) and γ feeding from higher levels. Other: measured Iγ(152.6γ)/Iγ(42.8γ)=0.044 *1* (1990Pe03) and 0.041 *1* (1972Sc01) are consistent with 0.040 *4* from intensities given here. 1254 *140* deduced from %Iα, α(152.6γ) and γ feeding from higher levels. Mult.: measured Ice(K) and Ice(L) (1990Pe03) are consistent with E2.
(203.2)	≈28	497.52	8$^+$	294.319	6$^+$	[E2]	0.805	α(K)=0.1470 *21*; α(L)=0.479 *7*; α(M)=0.1329 *19*; α(N+..)=0.0466 *7* α(N)=0.0365 *6*; α(O)=0.00865 *13*; α(P)=0.001416 *20*; α(Q)=1.199×10^{-5} *17* I_γ: deduced by evaluators from Iα and α(203.2γ).
251.20 *20*	13.1 *19*	900.32	2$^+$	648.85	3$^-$	[E1]	0.0612	α(K)=0.0481 *7*; α(L)=0.00986 *14*; α(M)=0.00240 *4*; α(N+..)=0.000834 *12*

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^{244}Cm α decay (18.11 y) 2002Da21,1998Ya17,1972Sc01 (continued)

γ(^{240}Pu) (continued)

E_γ[†]	I_γ[#a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[&]	α[b]	$I_{(\gamma+ce)}$[a]	Comments
									α(N)=0.000647 *10*; α(O)=0.0001575 *23*; α(P)=2.82×10^{-5} *4*; α(Q)=1.409×10^{-6} *20* Additional information 8.
263.34 *15*	70 *4*	860.71	0$^+$	597.34	1$^-$	[E1]	0.0551		α(K)=0.0434 *6*; α(L)=0.00882 *13*; α(M)=0.00214 *3*; α(N+..)=0.000746 *11* α(N)=0.000578 *9*; α(O)=0.0001409 *20*; α(P)=2.53×10^{-5} *4*; α(Q)=1.278×10^{-6} *18* Additional information 6.
302.99 *15*	21.4 *16*	900.32	2$^+$	597.34	1$^-$	[E1]	0.0405		α(K)=0.0320 *5*; α(L)=0.00637 *9*; α(M)=0.001543 *22*; α(N+..)=0.000538 *8* α(N)=0.000417 *6*; α(O)=0.0001018 *15*; α(P)=1.84×10^{-5} *3*; α(Q)=9.59×10^{-7} *14* Additional information 9.
506.9[@] *3*	10 *3*	648.85	3$^-$	141.690	4$^+$	[E1]	0.01402		α(K)=0.01127 *16*; α(L)=0.00208 *3*; α(M)=0.000501 *7*; α(N+..)=0.0001751 *25* α(N)=0.0001353 *19*; α(O)=3.33×10^{-5} *5*; α(P)=6.14×10^{-6} *9*; α(Q)=3.53×10^{-7} *5*
554.5 *2*	100	597.34	1$^-$	42.824	2$^+$	E1	0.01179		α(K)=0.00950 *14*; α(L)=0.001734 *25*; α(M)=0.000417 *6*; α(N+..)=0.0001458 *21* α(N)=0.0001127 *16*; α(O)=2.77×10^{-5} *4*; α(P)=5.13×10^{-6} *8*; α(Q)=3.00×10^{-7} *5* Additional information 3.
597.2 *2*	61 *2*	597.34	1$^-$	0	0$^+$	E1	0.01024		α(K)=0.00826 *12*; α(L)=0.001496 *21*; α(M)=0.000359 *5*; α(N+..)=0.0001257 *18* α(N)=9.71×10^{-5} *14*; α(O)=2.39×10^{-5} *4*; α(P)=4.43×10^{-6} *7*; α(Q)=2.62×10^{-7} *4* Additional information 4.
605.8 *2*	9.3 *9*	648.85	3$^-$	42.824	2$^+$	[E1]	0.00997		α(K)=0.00805 *12*; α(L)=0.001454 *21*; α(M)=0.000349 *5*; α(N+..)=0.0001222 *18* α(N)=9.44×10^{-5} *14*; α(O)=2.33×10^{-5} *4*; α(P)=4.31×10^{-6} *6*; α(Q)=2.55×10^{-7} *4* Additional information 5.
758.6 *2*	16.1 *11*	900.32	2$^+$	141.690	4$^+$	E2	0.0212		α(K)=0.01484 *21*; α(L)=0.00474 *7*; α(M)=0.001212 *17*; α(N+..)=0.000427 *6* α(N)=0.000331 *5*; α(O)=8.06×10^{-5} *12*; α(P)=1.453×10^{-5} *21*; α(Q)=6.09×10^{-7} *9* Additional information 10.
817.8 *2*	80 *7*	860.71	0$^+$	42.824	2$^+$	E2	0.0183		α(K)=0.01303 *19*; α(L)=0.00389 *6*;

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^{244}Cm α decay (18.11 y) 2002Da21,1998Ya17,1972Sc01 (continued)

γ(^{240}Pu) (continued)

E_γ [†]	I_γ [#a]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [&]	α [b]	$I_{(\gamma+ce)}$ [a]	Comments
									α(M)=0.000990 *14*; α(N+..)=0.000348 *5* α(N)=0.000270 *4*; α(O)=6.59×10^{-5} *10*; α(P)=1.195×10^{-5} *17*; α(Q)=5.27×10^{-7} *8* Additional information 7.
857.5[@] *2*	6.6 *4*	900.32	2$^+$	42.824	2$^+$	[M1,E2]	0.04 *3*		α(K)=0.034 *22*; α(L)=0.007 *4*; α(M)=0.0017 *9*; α(N+..)=0.0006 *3* α(N)=0.00047 *24*; α(O)=0.00012 *6*; α(P)=2.2×10^{-5} *12*; α(Q)=1.3×10^{-6} *9* I_γ: <7.4 (1969ScZZ).
860.7		860.71	0$^+$	0	0$^+$	E0		12 *3*	E_γ,Mult.,$I_{(\gamma+ce)}$: from 1963Bj03.
894.7[@c] *5*		937.6?		42.824	2$^+$				I_γ: 2.1 *6* (1978LeZA) is too high by at least a factor of 20 with branching ratio in 'adopted gammas'. In 1969ScZZ, this γ was not seen, the authors quoted an upper limit of Iγ<1.2.
900.1[@] *5*	1.5 *6*	900.32	2$^+$	0	0$^+$	[E2]	0.01513		α(K)=0.01103 *16*; α(L)=0.00306 *5*; α(M)=0.000772 *11*; α(N+..)=0.000272 *4* α(N)=0.000210 *3*; α(O)=5.15×10^{-5} *8*; α(P)=9.38×10^{-6} *14*; α(Q)=4.39×10^{-7} *7* I_γ: <1.7 (1969ScZZ).
937.6[@c] *10*	0.5 *5*	937.6?		0	0$^+$				I_γ: <0.75 (1969ScZZ).

† From 1978LeZA compilation (who quoted priv comm from C.M. Lederer In 1967), unless otherwise stated. Others: 1990Pe03, 1969ScZZ (conference paper, results quoted in 1970Sc39 evaluation), 1963Bj03, 1956Sm18, 1956Hu96.

‡ From 1972Sc01.

From weighted average of values from 1978LeZA and 1969ScZZ, unless otherwise noted.

@ γ not seen by 1969ScZZ, upper intensity limit given most of the γ rays.

& From 'adopted gammas', unless otherwise noted.

a For absolute intensity per 100 decays, multiply by 8.5×10^{-7} *9*.

b 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.

c Placement of transition in the level scheme is uncertain.

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Decay Scheme

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

Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)

$^{244}_{96}Cm_{148}$: 0^+ 0.0 18.11 y *3*; Q_α=5901.74 *5*; %α=100.0

	Eα	Iα	HF
937.6			
2^+ 900.32	4920	0.000050	5.7
0^+ 860.71	4960	0.000149	3.5
3^- 648.85	5166.64	4×10^{-6}	3300
1^- 597.34	5215	0.000056	500
8^+ 497.52	5315	0.0000004	2847
6^+ 294.319	5513	0.00352	516
4^+ 141.690	5664	0.0204	644
2^+ 42.824 164 ps *5*	5762.64	23.1	1.966
0^+ 0	5804.77	76.9	1.00

937.6 0.0000004; 894.7; 900.1 [E2] 0.0000013; 857.5 [M1,E2] 0.0000058; 758.6 E2 0.0000140; 302.99 [E1] 0.0000189; 251.20 [E1] 0.0000118; 860.7 E0 0.000010; 817.8 E2 0.000069; 263.34 [E1] 0.000063; 605.8 [E1] 0.0000080; 506.9 [E1] 0.000009; 597.2 E1 0.000053; 554.5 E1 0.000086; 203.2 [E2] ≈0.000043; 152.630 E2 0.0037; 98.860 E2 0.025; 42.824 E2 24

$^{240}_{94}Pu_{146}$