^{244}Cm α decay 2002Da21,1998Ya17,1972Sc01

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	C. Morse	NDS 206,359 (2025)	27-Sep-2024

Parent: ^{244}Cm: E=0.0; $J^\pi=0^+$; $T_{1/2}$=18.11 y *3*; Q(α)=5901.60 *3*; %α decay=100

^{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)=1.32×10^7 y *2* (as recommended in the evaluation of 2000Ho27). The DDEP evaluation (2006BeZL) recommended 1.34×10^7 y *8* from measurements by 1993Pa29, 1972Ha80, 1970Ba11, 1967Ar09, 1965Me02, 1963Ma56 and 1952Gh27.

^{244}Cm-Q(α): From 2021Wa16.

^{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.

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.

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 γ rays with emphasis on g.s. band transitions.

2008Ve05: Measurement of ternary α and triton emission in ^{244}Cm SF decay. 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).
141.684 *16*	4^+		
294.31 *3*	6^+		
497.5 *10*	8^+		
597.25 *11*	1^-		
648.77 *14*	3^-		
860.60 *14*	0^+		
900.21 *11*	2^+		
937.6?	(1^-)		Population of this level in ^{244}Cm α decay is uncertain, thus no attempt has been made 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.

‡ From a least-squares fit to E_γ.

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

α radiations

Eα[†]	E(level)	Iα[‡&]	HF[@]	Comments
4920 *3*	900.21	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*	860.60	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).
5166.72 *14*	648.77	4×10^{-6} *3*	3.3×10^{3} *25*	Iα: from γ-intensity balance; no direct Iα measurement available. Eα: Calculated based on level energy.
5215 *3*	597.25	5.6×10^{-5} *5*	491 *44*	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	497.5	4×10^{-5}	2847	Eα: average of 5316 (1960As11) and 5313 (1966Ba07). Iα: from 1966Ba07. Other: ≈15×10^{-5} (1960As11).
5513 *3*	294.31	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*	141.684	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*	1.000	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.

[@] The nuclear radius parameter $r_0(^{240}Pu)$=1.498180 *88* is deduced by assuming HF=1.0 for the ground-state to ground-state alpha decay branch.

[&] 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 to be 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).

Additional information 1.

E_γ †	I_γ #b	E_i(level)	J_i^π	E_f	J_f^π	Mult.&	α[a]	Comments
42.824‡ *8*	3.1×10^4 *3*	42.824	2$^+$	0	0$^+$	E2	905 *13*	α(exp)=1200 *200*; α(L1)exp=15 *2*; α(L2)exp=474 *51*; α(L3)exp=466 *50*; α(O)exp=10 *1*; epc=3.0 *4* %Iγ=0.026 *4* α(L)=658 *9*; α(M)=183.4 *26*; α(N)=50.4 *7*; α(O)=11.83 *17*; α(P)=1.850 *26*; α(Q)=0.00390 *5* B(E2)(W.u.)=299 *10* I_γ: Deduced during evaluation from %I_α 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*	141.684	4$^+$	42.824	2$^+$	E2	16.65 *23*	α(exp)=13 *2* (1990Pe03); α(L1)exp< 3.0 (1990Pe03); α(L2)exp=6.0 *8* (1990Pe03) α(L3)exp=3.1 *7* (1990Pe03); %Iγ=0.00142 *23* α(L)=12.08 *17*; α(M)=3.38 *5*; α(N)=0.930 *13*; α(O)=0.2191 *31*; α(P)=0.0349 *5* α(Q)=0.0001221 *17* I_γ: Deduced during evaluation from %I_α, α(98.8γ) and γ feeding to 141.7 level from higher level. Other: Iγ(98.9γ)/Iγ(42.8γ)=0.067 *7* (1972Sc01).
152.63‡ *2*	1.24×10^3 *12*	294.31	6$^+$	141.684	4$^+$	E2	2.488 *35*	%Iγ=0.00105 *15* α(K)=0.1960 *27*; α(L)=1.664 *23*; α(M)=0.465 *7*; α(N)=0.1278 *18*; α(O)=0.0302 *4* α(P)=0.00487 *7*; α(Q)=2.76×10^{-5} *4* I_γ: From average of measured 1240 *120* (1969ScZZ) and 1237 *136* deduced from %I_α, 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. Mult.: Measured Ice(K) and Ice(L) (1990Pe03) are consistent with E2.
(203.2)	≈28	497.5	8$^+$	294.31	6$^+$	[E2]	0.805 *11*	%Iγ≈2.38×10^{-5} α(K)=0.1470 *21*; α(L)=0.479 *7*; α(M)=0.1329 *19*; α(N)=0.0365 *5*; α(O)=0.00865 *12*

γ(^{240}Pu) (continued)

E_γ [†]	I_γ [#b]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [&]	α [a]	Comments
								α(P)=0.001415 *20*; α(Q)=1.198×10^{-5} *17* I_γ: deduced by evaluators from Iα and α(203.2γ).
251.20 *20*	13.1 *19*	900.21	2$^+$	648.77	3$^-$	[E1]	0.0612 *9*	%Iγ=1.11×10^{-5} *20* α(K)=0.0481 *7*; α(L)=0.00986 *14*; α(M)=0.002396 *34*; α(N)=0.000647 *9* α(O)=0.0001575 *22*; α(P)=2.82×10^{-5} *4*; α(Q)=1.409×10^{-6} *20*
263.34 *15*	70 *4*	860.60	0$^+$	597.25	1$^-$	[E1]	0.0551 *8*	%Iγ=5.9×10^{-5} *7* α(K)=0.0434 *6*; α(L)=0.00882 *12*; α(M)=0.002141 *30*; α(N)=0.000578 *8* α(O)=0.0001409 *20*; α(P)=2.53×10^{-5} *4*; α(Q)=1.278×10^{-6} *18*
302.99 *15*	21.4 *16*	900.21	2$^+$	597.25	1$^-$	[E1]	0.0405 *6*	%Iγ=1.82×10^{-5} *24* α(K)=0.0320 *4*; α(L)=0.00637 *9*; α(M)=0.001543 *22*; α(N)=0.000417 *6*; α(O)=0.0001018 *14* α(P)=1.837×10^{-5} *26*; α(Q)=9.59×10^{-7} *13*
506.9[@] *3*	10 *3*	648.77	3$^-$	141.684	4$^+$	[E1]	0.01402 *20*	%Iγ=8.5×10^{-6} *27* α(K)=0.01127 *16*; α(L)=0.002081 *29*; α(M)=0.000501 *7*; 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	597.25	1$^-$	42.824	2$^+$	E1	0.01179 *17*	%Iγ=8.5×10^{-5} *9* α(K)=0.00949 *13*; α(L)=0.001734 *24*; α(M)=0.000417 *6*; α(N)=0.0001127 *16* α(O)=2.77×10^{-5} *4*; α(P)=5.13×10^{-6} *7*; α(Q)=3.00×10^{-7} *4*
597.2 *2*	61 *2*	597.25	1$^-$	0	0$^+$	E1	0.01024 *14*	%Iγ=5.2×10^{-5} *6* α(K)=0.00826 *12*; α(L)=0.001496 *21*; α(M)=0.000359 *5*; α(N)=9.71×10^{-5} *14* α(O)=2.393×10^{-5} *34*; α(P)=4.43×10^{-6} *6*; α(Q)=2.62×10^{-7} *4*
605.8 *2*	9.3 *9*	648.77	3$^-$	42.824	2$^+$	[E1]	0.00997 *14*	%Iγ=7.9×10^{-6} *11* α(K)=0.00804 *11*; α(L)=0.001454 *20*; α(M)=0.000349 *5*; α(N)=9.44×10^{-5} *13* α(O)=2.326×10^{-5} *33*; α(P)=4.31×10^{-6} *6*; α(Q)=2.55×10^{-7} *4*
758.6 *2*	16.1 *11*	900.21	2$^+$	141.684	4$^+$	E2	0.02121 *30*	%Iγ=1.37×10^{-5} *17* α(K)=0.01484 *21*; α(L)=0.00473 *7*; α(M)=0.001211 *17*; α(N)=0.000331 *5*; α(O)=8.05×10^{-5} *11* α(P)=1.452×10^{-5} *20*; α(Q)=6.09×10^{-7} *9*
817.8 *2*	80 *7*	860.60	0$^+$	42.824	2$^+$	E2	0.01825 *26*	%Iγ=6.8×10^{-5} *9* α(K)=0.01302 *18*; α(L)=0.00389 *5*; α(M)=0.000990 *14*; α(N)=0.000270 *4*; α(O)=6.59×10^{-5} *9* α(P)=1.194×10^{-5} *17*; α(Q)=5.27×10^{-7} *7*
857.5[@] *2*	6.6 *4*	900.21	2$^+$	42.824	2$^+$	[M1,E2]	0.043 *26*	%Iγ=5.6×10^{-6} *7* α(K)=0.034 *22*; α(L)=0.007 *4*; α(M)=0.0017 *9*; α(N)=4.7×10^{-4} *23*;

$^{240}_{94}Pu_{146}$-4

γ(^{240}Pu) (continued)

E_γ †	I_γ #b	E_i(level)	J_i^π	E_f	J_f^π	Mult.&	α a	$I_{(\gamma+ce)}$ b	Comments
									α(O)=1.2×10^{-4} *6* α(P)=2.2×10^{-5} *11*; α(Q)=1.3×10^{-6} *9* I_γ: <7.4 (1969ScZZ).
860.7		860.60	0$^+$	0	0$^+$	E0		12 *3*	%Iγ=1.02×10^{-5} *11* E_γ,Mult.,$I_{(\gamma+ce)}$: from 1963Bj03.
894.7@c *5*		937.6?	(1$^-$)	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*	900.21	2$^+$	0	0$^+$	[E2]	0.01512 *21*		%Iγ=1.3×10^{-6} *5* α(K)=0.01102 *15*; α(L)=0.00305 *4*; α(M)=0.000771 *11*; α(N)=0.0002103 *30* α(O)=5.14×10^{-5} *7*; α(P)=9.38×10^{-6} *13*; α(Q)=4.38×10^{-7} *6* I_γ: <1.7 (1969ScZZ).
937.6@c *10*	0.5 *5*	937.6?	(1$^-$)	0	0$^+$				%Iγ=4 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 Additional information 2.
b For absolute intensity per 100 decays, multiply by 8.5×10^{-7} *9*.
c Placement of transition in the level scheme is uncertain.

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^{244}Cm α decay 2002Da21,1998Ya17,1972Sc01

Decay Scheme

Intensities: I_γ per 100 parent decays