^{237}Pu α decay (45.43 d) 1979El05

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	B. Singh, J. K. Tuli, E. Browne	NDS 170, 499 (2020)	8-Oct-2020

Parent: ^{237}Pu: E=0.0; J$^{\pi}$=7/2$^-$; $T_{1/2}$=45.43 d *13*; Q(α)=5747.6 *23*; %α decay=0.0042 *4*

^{237}Pu-J$^{\pi}$: Assignment in ^{237}Pu Adopted Levels in the ENSDF database (March 2006 update) is still valid. Configuration=ν7/2[743].

^{237}Pu-$T_{1/2}$: Unweighted average of 45.66 d *4* (1994Ta25, K x-ray decay curves); 45.12 d *3* (1981Ba15, x-ray and low-energy γ decay curves); 45.3 d *2* (1977Sm02, K x-ray decay curve); 45.63 d *20* (1957Ho68, γ decay curve). Weighted average is 45.32 d *15*, but reduced χ^2 is 39.7 as compared to critical χ^2=2.6. Value of 45.64 d *4* is given in ^{237}Pu Adopted Levels in the ENSDF database (March 2006 update). Others: 44 d *2* (1957Th10), 40 d (1949Ja01).

^{237}Pu-Q(α): From 2017Wa10.

^{237}Pu-%α decay: %α=0.0042 *4* measured by 1979El05. The same value is given in ^{237}Pu Adopted Levels in the ENSDF database (March 2006 update).

1979El05: ^{237}Pu source was prepared in ^{235}U(α,2n),E=30 MeV at ORNL isochronous cyclotron. Measured Eγ, Iγ using Ge(Li) detectors. Deduced levels, J^{π}, I(α)/I(ε) ratio, Nilsson assignments.

The decay scheme is basically from 1979El05.

^{233}U Levels

E(level)†	J$^{\pi}$‡
0.0#	5/2$^+$
40.349# *5*	7/2$^+$
92.17# *12*	9/2$^+$
155.31# *9*	11/2$^+$
298.75@ *13*	(5/2$^-$)
320.74@ *13*	7/2$^-$
353.81@ *13*	9/2$^-$
397.57@ *23*	11/2$^-$
503.61& *11*	7/2$^-$
561.4?& *20*	(9/2$^-$)

† From least squares fit to Eγ data.
‡ From the Adopted Levels.
# Band(A): ν5/2[633] band.
@ Band(B): ν5/2[752] band.
& Band(C): ν7/2[743] band.

α radiations

Two α groups at 5650 *20* and 5360 *20* keV with relative intensities 21 *4* and 79 *8*, respectively were observed by 1957Th10 (ce). The stronger α group was also seen by 1957Ho68 (ce) at 5340 keV *12*. The ratio of total α intensities to the g.s. and the 5/2[752] bands deduced here is ≈16/≈73, which is roughly consistent with the measurement by 1957Th10.

Eα†	E(level)	Iα‡&	HF@
5089.1 *31*	561.4?	≈0.5	≈17
5147.1 *24*	503.61	≈5.5	≈3.6
5253.2 *24*	397.57	≥0.7	≤140
5296.9 *24*	353.81	≈12.2	≈13

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^{237}Pu α decay (45.43 d) 1979El05 (continued)

α radiations (continued)

Eα[†]	E(level)	Iα[‡&]	HF[@]	Comments
5329.9 *24*	320.74	≈44.7	≈5.8	
5351.8 *24*	298.75	≈17.4	≈20	
5495.5 *24*	155.31	≈0.75[#]	313×10^{1} *40*	HF: deduced by evaluators from Iα=0.24 *3* (from ^{235}U α decay in ENSDF) and r_0=1.52410 *58* for ^{231}Th.
5558.6 *24*	92.17	≈2.8[#]	1860 *60*	HF: deduced by evaluators from Iα=1.28 *4* (from ^{235}U α decay in ENSDF) and r_0=1.52410 *58* for ^{231}Th.
5610.3 *23*	40.349	≈6.4[#]	1570 *30*	HF: deduced by evaluators from Iα=3.82 *6* (from ^{235}U α decay in ENSDF) and r_0=1.52410 *58* for ^{231}Th.
5650.6 *23*	0.0	≈6.6[#]	2550 *40*	HF: deduced by evaluators from Iα=4.77 *7* (from ^{235}U α decay in ENSDF, May 2013 update) and r_0=1.52410 *58* for ^{231}Th.

† Deduced from Q(α)=5747.6 *23* (2017Wa10), and level energies.

‡ Deduced by the evaluators from the γ intensities. The intensities of the α transitions to the 5/2[752] and 7/2[743] bands (levels above 155.1 keV) are given as approximate values since these intensities are expected to change somewhat by, as yet, unobserved intraband transitions. Exceptions are noted.

\# The α intensity to each member of the g.s. band is deduced by evaluators from the hindrance factors for the ^{235}U α transitions to the ^{231}Th g.s. band members 5/2^{+} to 11/2^{+}, which are believed to be analogous to those for ^{237}Pu decay to ^{233}U. The α decay intensities in ^{235}U decay have been taken from the ^{235}U α decay dataset in the ENSDF database (May 2013 update). Value of r_0=1.52410 *58* for ^{231}Th was used, based on r_0 parameters in 2020Si16. Total relative α intensity to the g.s. band members (5/2^{+}, 7/2^{+}, 9/2^{+}, 11/2^{+}) is ≈16.6, as compared to 10.1 *1* for ^{235}U α decay to g.s. members (5/2^{+}, 7/2^{+}, 9/2^{+}, 11/2^{+}) in ^{231}Th.

@ The nuclear radius parameter r_0(^{233}U)=1.50884 *18* is deduced from interpolation (or unweighted average) of radius parameters of the adjacent even-even nuclides (2020Si16).

& For absolute intensity per 100 decays, multiply by 0.000042 *4*.

γ(^{233}U)

Iγ normalization: Absolute intensities were obtained by 1979El05 from comparison of γ intensities measured in α and ε decays of ^{237}Pu.

E_γ[†]	I_γ[‡a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α[b]	Comments
(40.351[#] *10*)		40.349	7/2^{+}	0.0	5/2^{+}			
(51.5[#] *5*)		92.17	9/2^{+}	40.349	7/2^{+}			
(63.4[@] *2*)		155.31	11/2^{+}	92.17	9/2^{+}			
(92.1[#] *5*)		92.17	9/2^{+}	0.0	5/2^{+}			
(114.92[@] *10*)		155.31	11/2^{+}	40.349	7/2^{+}			
181.8[c] *10*	≈0.8[&]	503.61	7/2^{-}	320.74	7/2^{-}	[M1]	4.06 *9*	α(K)=3.22 *7*; α(L)=0.628 *14*; α(M)=0.152 *4* α(N)=0.0409 *9*; α(O)=0.00995 *21*; α(P)=0.00192 *4*; α(Q)=0.000153 *4*
198.61 *20*	7.3 *10*	353.81	9/2^{-}	155.31	11/2^{+}	[E1]	0.1001	α(K)=0.0786 *12*; α(L)=0.01625 *24*; α(M)=0.00394 *6* α(N)=0.001051 *15*; α(O)=0.000249 *4*; α(P)=4.51×10^{-5} *7*; α(Q)=2.63×10^{-6} *4*
205.05 *20*	3.2 *8*	503.61	7/2^{-}	298.75	(5/2^{-})	[M1]	2.89	α(K)=2.30 *4*; α(L)=0.447 *7*; α(M)=0.1080 *16* α(N)=0.0291 *5*; α(O)=0.00708 *11*; α(P)=0.001365 *20*; α(Q)=0.0001089 *16*

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^{237}Pu α decay (45.43 d) 1979El05 (continued)

γ(^{233}U) (continued)

E_γ[†]	I_γ[‡a]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	α[b]	Comments
228.56 *20*	36.2 *15*	320.74	7/2⁻	92.17	9/2⁺	[E1]	0.0723	α(K)=0.0571 *8*; α(L)=0.01151 *17*; α(M)=0.00279 *4* α(N)=0.000744 *11*; α(O)=0.000177 *3*; α(P)=3.22×10^{-5} *5*; α(Q)=1.94×10^{-6} *3*
241[c] *2*	≈0.5[&]	561.4?	(9/2⁻)	320.74	7/2⁻	[M1]	1.84 *5*	α(K)=1.46 *4*; α(L)=0.284 *8*; α(M)=0.0686 *19* α(N)=0.0185 *5*; α(O)=0.00449 *13*; α(P)=0.000866 *24*; α(Q)=6.91×10^{-5} *19*
258.46 *20*	16.1 *12*	298.75	(5/2⁻)	40.349	7/2⁺	[E1]	0.0547	α(K)=0.0433 *7*; α(L)=0.00857 *12*; α(M)=0.00207 *3* α(N)=0.000553 *8*; α(O)=0.0001318 *19*; α(P)=2.41×10^{-5} *4*; α(Q)=1.496×10^{-6} *21*
261.66 *20*	18.1 *11*	353.81	9/2⁻	92.17	9/2⁺	[E1]	0.0532	α(K)=0.0422 *6*; α(L)=0.00832 *12*; α(M)=0.00201 *3* α(N)=0.000537 *8*; α(O)=0.0001280 *18*; α(P)=2.35×10^{-5} *4*; α(Q)=1.458×10^{-6} *21*
280.40 *20*	100 *2*	320.74	7/2⁻	40.349	7/2⁺	[E1]	0.0456	α(K)=0.0362 *5*; α(L)=0.00707 *10*; α(M)=0.001705 *24* α(N)=0.000456 *7*; α(O)=0.0001088 *16*; α(P)=2.00×10^{-5} *3*; α(Q)=1.262×10^{-6} *18*
298.89 *20*	72.2 *18*	298.75	(5/2⁻)	0.0	5/2⁺	[E1]	0.0396	α(K)=0.0315 *5*; α(L)=0.00609 *9*; α(M)=0.001468 *21* α(N)=0.000393 *6*; α(O)=9.37×10^{-5} *14*; α(P)=1.728×10^{-5} *25*; α(Q)=1.105×10^{-6} *16*
305.4 *2*	2.9 *9*	397.57	11/2⁻	92.17	9/2⁺	[E1]	0.0377	α(K)=0.0301 *5*; α(L)=0.00579 *9*; α(M)=0.001396 *20* α(N)=0.000373 *6*; α(O)=8.92×10^{-5} *13*; α(P)=1.645×10^{-5} *24*; α(Q)=1.057×10^{-6} *15*
313.34 *20*	27.8 *14*	353.81	9/2⁻	40.349	7/2⁺	[E1]	0.0357	α(K)=0.0284 *4*; α(L)=0.00546 *8*; α(M)=0.001316 *19* α(N)=0.000352 *5*; α(O)=8.41×10^{-5} *12*; α(P)=1.553×10^{-5} *22*; α(Q)=1.003×10^{-6} *15*
320.75 *20*	59.6 *18*	320.74	7/2⁻	0.0	5/2⁺	[E1]	0.0339	α(K)=0.0270 *4*; α(L)=0.00518 *8*; α(M)=0.001247 *18* α(N)=0.000333 *5*; α(O)=7.97×10^{-5} *12*; α(P)=1.473×10^{-5} *21*; α(Q)=9.56×10^{-7} *14*
411.1 *2*	1.7 *5*	503.61	7/2⁻	92.17	9/2⁺	[E1]	0.0200	α(K)=0.01610 *23*; α(L)=0.00298 *5*; α(M)=0.000715 *10* α(N)=0.000191 *3*; α(O)=4.59×10^{-5} *7*; α(P)=8.56×10^{-6} *12*; α(Q)=5.83×10^{-7} *9*
463.1 *2*	3.4 *10*	503.61	7/2⁻	40.349	7/2⁺	[E1]	0.01572	α(K)=0.01267 *18*; α(L)=0.00231 *4*; α(M)=0.000553 *8* α(N)=0.0001480 *21*; α(O)=3.56×10^{-5} *5*; α(P)=6.66×10^{-6} *10*; α(Q)=4.63×10^{-7} *7*
503.9 *2*	6.9 *13*	503.61	7/2⁻	0.0	5/2⁺	[E1]	0.01328	α(K)=0.01073 *15*; α(L)=0.00193 *3*; α(M)=0.000463 *7* α(N)=0.0001239 *18*; α(O)=2.98×10^{-5} *5*; α(P)=5.59×10^{-6} *8*; α(Q)=3.95×10^{-7} *6*
521.1[c] *20*	≈0.8	561.4?	(9/2⁻)	40.349	7/2⁺	[E1]	0.01244 *20*	α(K)=0.01005 *16*; α(L)=0.00180 *3*; α(M)=0.000432 *7* α(N)=0.0001156 *19*; α(O)=2.78×10^{-5} *5*; α(P)=5.22×10^{-6} *9*; α(Q)=3.71×10^{-7} *6*

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^{237}Pu α decay (45.43 d) 1979El05 (continued)

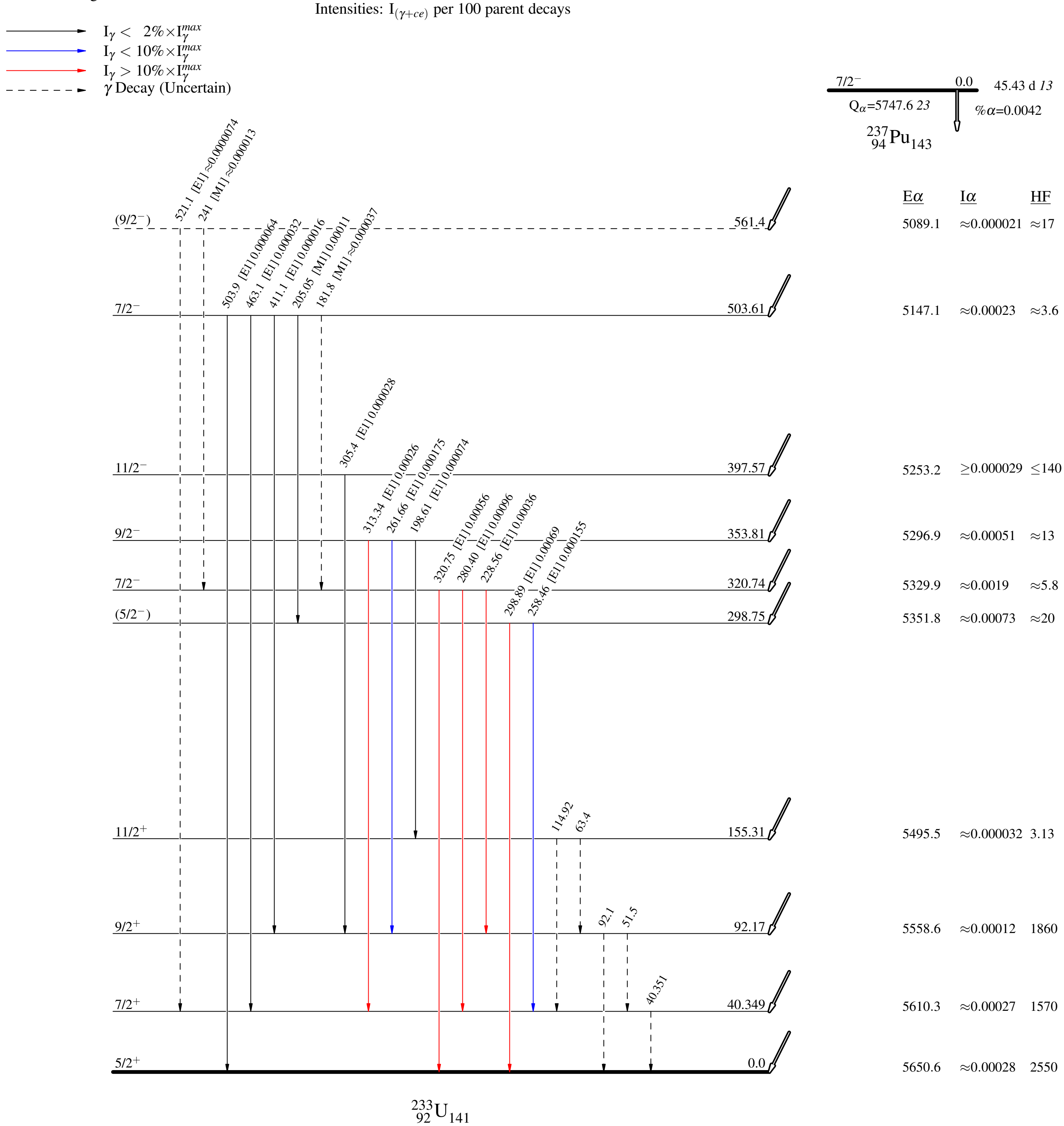
γ(^{233}U) (continued)

† Measurements of 1979El05 (semi).
‡ Measurements of 1979El05. Iγ=100 corresponds to 21.8 *17* photons per 100 α decays.
# From the Adopted Gammas.
@ This γ is shown in the decay scheme of 1979El05, as expected, but not observed. Evaluators do not include this γ in the Adopted dataset, as it is not confirmed in any other study.
& γ ray was obscured by the presence of neighboring background radiation (1979El05).
[a] For absolute intensity per 100 decays, multiply by 9.2×10^{-6} *11*.
[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.

^{237}Pu α decay (45.43 d) 1979El05

Decay Scheme

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



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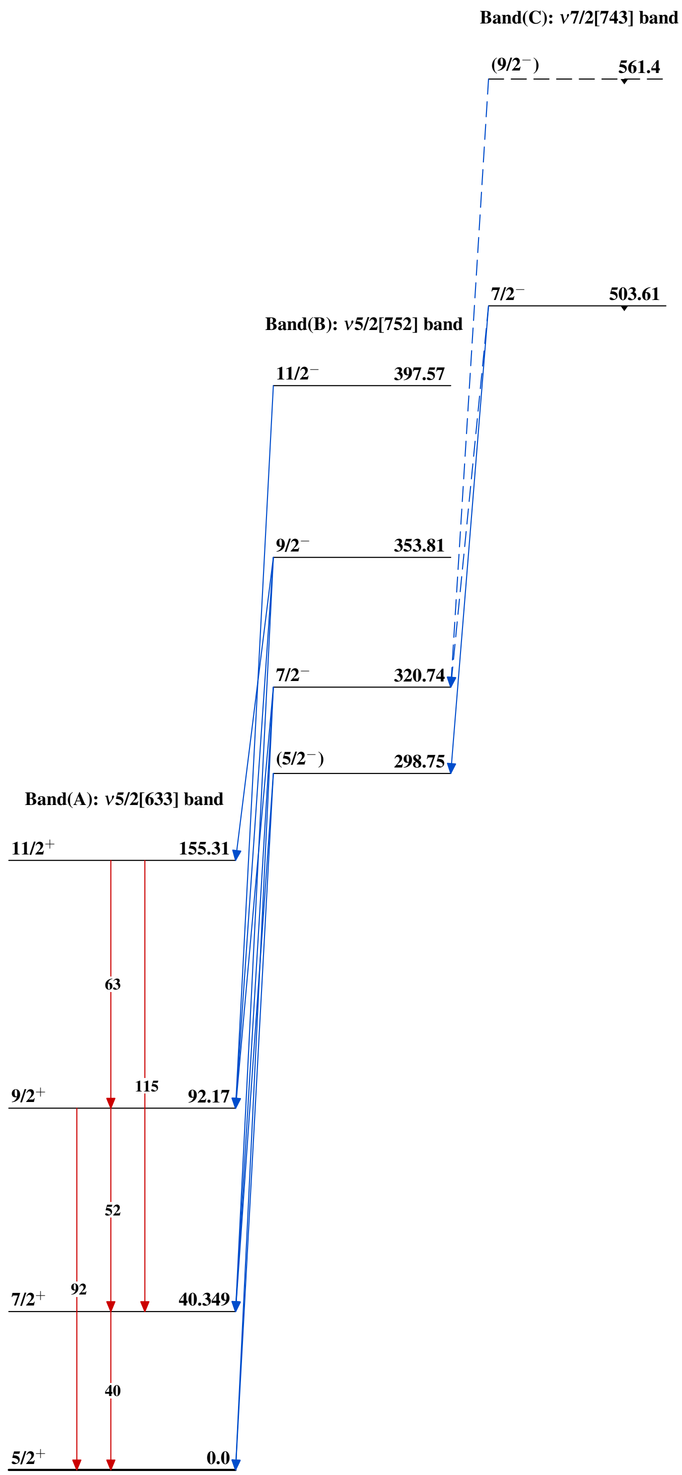

$^{233}_{92}U_{141}$