^{237}U β^- decay **1966Ya05,1960Un01**

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	M. S. Basunia	NDS 107, 3323 (2006)	15-Mar-2006

Parent: ^{237}U: E=0.0; J$^\pi$=1/2$^+$; $T_{1/2}$=6.75 d *1*; Q(β^-)=518.6 *6*; %β^- decay=100.0

Other measurements: 1949Me43, 1953Wa05, 1956Ba39, 1957Bu42, 1957Ra04, 1966El12, 1968Da24, 1971Cl03, 1982BuZF,1985He02,1985Wi04.

1966Ya05: Source produced by ^{236}U(n,γ); Detector:Ge(Li) and Si(Li); Measured: Eγ, Iγ, α, deduced level scheme.

^{237}Np Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$	Comments
0.0[#]	5/2$^+$	2.14×10^6 y *1*	$T_{1/2}$: From Adopted Levels.
33.196[#] *9*	7/2$^+$		
59.545[@] *10*	5/2$^-$	63 ns *5*	$T_{1/2}$: From 208γ and 59.6γ $\gamma\gamma$(t) in 1960Un01.
75.91[#] *5*	9/2$^+$		
102.965[@] *13*	7/2$^-$		
267.561[&] *14*	3/2$^-$	5.2 ns *2*	$T_{1/2}$: Weighted average of 5.2 ns *5* (208γ(t) − 1957Bu42), 5.2 ns *2* (208γ(t) − 1960Un01), and 5.0 ns *2* (268γ(t) − 1960Un01).
281.368[&] *20*	1/2$^-$		
332.385[a] *19*	1/2$^+$	≤1.0 ns	$T_{1/2}$: From 332γ(t) in 1960Un01.
368.59[a] *3*	5/2$^+$		
370.93[a] *3*	3/2$^+$		

[†] From a least square fit to the γ-ray energies.
[‡] From Adopted Levels.
[#] 5/2[642] band.
[@] 5/2[523] band.
[&] 1/2[530] band.
[a] 1/2[400] band.

β^- radiations

β intensities shown on the decay scheme have been deduced from intensity balance at each level. Measured β energies and intensities are:

Nuclear finite size effects on the absolute ft values were reported in 1966Bo08. For calculations of screening corrections to the Fermi function for allowed β decay, see 1966Ma57.

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                 1956Ba39              1957Ra04
               Eβ     Iβ             Eβ    Iβ
             -----------           ---------
               84 5   26%
              249 5   74%           248   96%
       no Eβ⁻>266             no Eβ⁻=450  < 1%
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Other measurements: 1949Me43, 1953Wa05.

Continued on next page (footnotes at end of table)

^{237}U β^- decay 1966Ya05,1960Un01 (continued)

β^- radiations (continued)

E(decay)	E(level)	$I\beta^{-\dagger}$	Log *ft*	Comments
(147.7 *6*)	370.93	≈0.8	≈7.5	av Eβ=38.98 *17*
(186.2 *6*)	332.385	3.4 *3*	7.21 *4*	av Eβ= 49.83 *17*
(237.2 *6*)	281.368	51 *4*	6.37 *4*	av Eβ=64.54 *18*
(251.0 *6*)	267.561	42 *3*	6.53 *4*	av Eβ=68.59 *18*
(459.1‡ *6*)	59.545	3.0 *23*	8.5^{1u} *2*	av Eβ=137.57 *19* Intensity balance at the 59-keV level yields Iβ=4±7 for the possible β^- feeding. Sum of γ transitions decaying from higher levels to the 5/2[642] and 5/2[523] bands is 97.0% 23, which suggests that, unless there are additional (as yet unobserved) γ's decaying to these bands, 3.0% 23 b- feeds the levels below 267 keV. The $5/2^-$ state at 59 keV is the most likely candidate for such a feeding; however, 1957Ra04 did not observe this possible β^- transition and set an upper limit of 1%.

† Absolute intensity per 100 decays.

‡ Existence of this branch is questionable.

$\gamma(^{237}$Np)

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γγ: 1953Wa05, 1957Ra04.
βγ: 1953Wa05
γγ(θ,t):
 (208γ)(59γ)(θ):  A2=-(0.046±0.005); δ(208γ)>0  1968Hr01
                  A2=-(0.07±0.02)   ; δ(208γ)>0  1980An23
            A2 value constant for T1/2<250 Ns    1968Hr01, 1980An23
                                      others:   1960Un01, 1960St18

     X rays (Np):
       E(x-ray)                        I(x-ray)
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 1966Ya05 1982Ba56   1976GuZN      1966Ya05   1976GuZN
 (semi)   (cryst)    (semi)        rel to     (%)
         from (n,γ)                I(208γ)
                                    =21.2
 ======  ========== ==========    ========= ==========
  11.9                              1.38 15            L1 x ray
  14.0                             24.4 26             Lα x ray
  17.8                             25.9 26             Lβ x ray
  20.8                              7.0 7              Lγ x ray
  97.0    97.069 3    97.071 5     16.1 17    15.8 7   Kα2 x ray
 101.0   101.057 3   101.066 5     22.5 24    25.2 8   Kα1 x ray
         113.308 4   113.300                   3.04 16 Kβ3 x ray
 113.5                              9.8 10             Kβ1' x ray
         114.244 3   114.230                   5.85 18 Kβ1 x ray
                     114.950                   0.335 34 Kβ5 x ray
                     117.340                   0.790   Kβ4 x ray
                     117.580                   1.56    Kβ2 x ray
 117.5                              3.1 4              Kβ2' x ray

other measurements: 1957Ra04, 1990Po14, 1992Ba08.
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E_γ[†]	I_γ[#c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ[@]	α[d]	Comments
(2.3)		370.93	3/2$^+$	368.59	5/2$^+$				E_γ: from level scheme; transition has not been observed. I_γ: if there is no β^- feeding to the 368.59-keV level, the intensity balance at that level suggests that Ti(2.3γ)=0.235 *11*.
13.81[‡] *2*	0.099 *4*	281.368	1/2$^-$	267.561	3/2$^-$	M1+E2	0.0321 *10*	518 *16*	α(M)= 390 *13* I_γ: calculated by the evaluator from Ice(M1)=29.9 *3* and α(M1)=303 *9*.
26.3446 *2*	2.43 *6*	59.545	5/2$^-$	33.196	7/2$^+$	E1[&]		8[a] *2*	α(L)exp=6 *2*; α(M)exp=1.6 *2* B(E1)(W.u.)=3.9$\times10^{-6}$ *13* E_γ: 26.3448 *2* from ^{241}Am α decay.
33.196 *1*	0.130 *5*	33.196	7/2$^+$	0.0	5/2$^+$	M1+E2	0.13 *3*	185 *23*	α(L)=138 *18*; α(M)=35 *5*

From ENSDF

$^{237}_{93}$Np$_{144}$-3

$\gamma(^{237}Np)$ (continued)

E_γ[†]	I_γ[#c]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[@]	δ[@]	α[d]	$I_{(\gamma+ce)}$[c]	Comments
38.54[‡] *3*	<0.021	370.93	3/2⁺	332.385	1/2⁺	(M1+E2)	>0.65	>492	≈0.4	$I_{(\gamma+ce)}$: from measured Ice′s. Iγ(38.54γ)<0.001 Iγ(208γ) (1966Ya05).
(42.704[b] *5*)		75.91	9/2⁺	33.196	7/2⁺	(M1+E2)	≈0.13	≈80		α(L)≈59; α(M)≈15
43.420 *3*	0.0240 *20*	102.965	7/2⁻	59.545	5/2⁻	M1+E2	0.41 *2*	167 *9*		α(L)=124 *7*; α(M)=32.8 *18*
51.01[‡] *3*	0.340 *10*	332.385	1/2⁺	281.368	1/2⁻	E1		0.767		α(L)= 0.574; α(M)= 0.143; α(N+..)= 0.0502 B(E1)(W.u.)=0.0001195 *16*
59.5409 *1*	34.5 *8*	59.545	5/2⁻	0.0	5/2⁺	E1[&]		1.16[a] *7*		α(L)exp=0.84 *6*; α(M)exp=0.226 *7*; α(N+...)exp=0.094 *10* B(E1)(W.u.)=4.8×10^{-6} *6* E_γ: 59.5412 *2* from ^{241}Am α decay. α: obtained from measured Ice′s and Iγ′s. See also ^{241}Am α decay.
64.83[‡] *2*	1.282 *17*	332.385	1/2⁺	267.561	3/2⁻	E1		0.408		α(L)= 0.306; α(M)= 0.075; α(N+..)= 0.027 B(E1)(W.u.)=0.0002195 *20* I_γ: from 314 *3* per 1000 ^{241}Pu decays (1985Wi04). 1.28 *2* per 100 ^{237}U β^- decays (1976GuZN).
(69.76[b] *3*)	0.00095 *19*	102.965	7/2⁻	33.196	7/2⁺	(E1)		0.336		α(L)=0.252; α(M)=0.0621; α(N+..)=0.0219 I_γ: calculated by the evaluator from Iγ(69.76γ)/Iγ(43.423γ)=2.9 *4*/73 *8*, as measured in ^{241}Am α decay.
(75.8[b] *2*)		75.91	9/2⁺	0.0	5/2⁺					
(102.98[b] *2*)	0.0064 *9*	102.965	7/2⁻	0.0	5/2⁺	E1		0.121		α(L)=0.091; α(M)=0.022; α(N+..)=0.0080 I_γ: calculated by the evaluator from Iγ(102.98γ)/Iγ(43.423γ)=19.5 *1*/73 *8*, as measured in ^{241}Am α decay.
[x]114.09 *5*										Photon was masked by Kβ x ray; three conversion lines were identified in 1966Ya05: L1:L2:L3=20 *4*:20 *4*:22 *4*; Ice(L3)=0.022% 4.
164.61[‡] *2*	1.86 *3*	267.561	3/2⁻	102.965	7/2⁻	E2		1.74		α(K)= 0.199; α(L)= 1.12; α(M)= 0.309; α(N+..)= 0.117 B(E2)(W.u.)=0.201 *12* I_γ: 1.865 *23* (from 457 *4* per 1000 ^{241}Pu decays; 1985He02), 1.853 *23* (from 454 *4* per 1000 ^{241}Pu decays; 1985Wi04). Iγ=1.84 *5* per 100 ^{237}U β^- decays (1976GuZN).
208.005[‡] *23*	21.2 *3*	267.561	3/2⁻	59.545	5/2⁻	M1+E2	+0.156 *5*	3.18		α(K)= 2.504 *4*; α(L)=0.504; α(M)=0.123; N+=0.046 B(M1)(W.u.)=0.000102 *6*; B(E2)(W.u.)=0.0169 *15* I_γ: 21.2 *3* (from 5200 *50* per 1000 ^{241}Pu

$^{237}_{93}Np_{144}$-4

γ(^{237}Np) (continued)

E_γ[†]	I_γ[#c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ[@]	α[d]	Comments
									decays; 1985He02, 1985Wi04). Iγ=21.7 *5* per 100 ^{237}U β^- decays (1976GuZN). α(K)exp=2.30 *12* determined in 1966Ya05 by comparing ce and γ intensities of 208γ with those of 411.8γ from ^{198}Au taking α(K)=0.0302 *5* for the 411.8γ. δ: positive sign for δ is from γγ(θ) measurements.
221.80[‡] *4*	0.0212 *7*	281.368	1/2⁻	59.545	5/2⁻	E2		0.560	α(K)= 0.132; α(L)= 0.310; α(M)= 0.0853; α(N+..)= 0.0323
234.40[‡] *4*	0.0205 *7*	267.561	3/2⁻	33.196	7/2⁺	M2		8.66	α(K)= 5.87; α(L)= 2.05; α(M)= 0.537; α(N+..)= 0.205 B(M2)(W.u.)=0.047 *4*
267.54[‡] *4*	0.712 *10*	267.561	3/2⁻	0.0	5/2⁺	E1+M2	0.490 *15*	1.11 *6*	α(K)= 0.77 *4*; α(L)= 0.250 *12*; α(M)= 0.065 *4*; α(N+..)=0.0246 *12* B(E1)(W.u.)=1.07×10^{-8} *8*; B(M2)(W.u.)=0.164 *14* I_γ: from 0.714 *22* (1.75 *5* per 1000 ^{241}Pu decays, 1985He02) and 0.711 *10* (1.741 *15* per 1000 ^{241}Pu decays, 1985Wi04). Iγ=0.740 *18* per 100 ^{237}U β^- decays (1976GuZN).
292.77 *6*	0.0025 *7*	368.59	5/2⁺	75.91	9/2⁺	[E2]		0.220	α(K)=0.0808; α(L)=0.101; α(M)=0.0275; α(N+..)=0.0104 E_γ: 292.77 *6* from ^{241}Am α decay. I_γ: from Iγ(292.7γ)/Iγ(208.0γ)=0.00012 *3*, as measured in 1966Ya05.
(309.1[b] *3*)	0.00027	368.59	5/2⁺	59.545	5/2⁻				I_γ: from Iγ(309γ)/Iγ(335γ)=0.14/49.6, as measured in ^{241}Am decay.
332.35 *3*	1.200 *16*	332.385	1/2⁺	0.0	5/2⁺	E2		0.150	α(K)= 0.0640; α(L)= 0.0624; α(M)=0.0169; α(N+..)=0.0064 B(E2)(W.u.)=0.5077 *20* I_γ: from Iγ=294 *3* per 1000 ^{241}Pu decays (1985Wi04). Iγ=1.21 *3* per 100 ^{237}U β^- decays (1976GuZN).
335.37 *3*	0.0951 *22*	368.59	5/2⁺	33.196	7/2⁺	M1+E2	0.46 *17*	0.74 *9*	α(K)= 0.57 *8*; α(L)= 0.121 *9*; α(M)= 0.0296 *20*; α(N+..)=0.0110 *8* I_γ: from Iγ=23.3 *5* per 1000 ^{241}Pu decays (1985Wi04). Iγ=0.097 *3* per 100 ^{237}U β^- decays (1976GuZN).
337.7[‡] *5*	0.0089 *5*	370.93	3/2⁺	33.196	7/2⁺	(E2)		0.143	α(K)= 0.0622; α(L)= 0.0588; α(M)=0.0159; α(N+..)=0.0060
[x]340.45	0.00165 *33*								Seen only in 1976GuZN.
368.62 *3*	0.0392 *17*	368.59	5/2⁺	0.0	5/2⁺	M1(+E2)	<0.31	0.64 *2*	α(K)=0.51 *2*; α(L)=0.100 *3*; α(M)=0.0244 *6*; α(N+..)=0.0091 *2* I_γ: from Iγ=9.6 *4* per 1000 ^{241}Pu decays (1985Wi04). Iγ=0.043 *2* per 100 ^{237}U β^- decays (1976GuZN).
370.94 *3*	0.1073 *17*	370.93	3/2⁺	0.0	5/2⁺	M1+E2	0.43 +*7*−*21*	0.57 *6*	α(K)= 0.45 *5*; α(L)= 0.092 *7*; α(M)= 0.0225 *15*; α(N+..)=0.0084 *5* I_γ: from Iγ=26.3 *4* per 1000 ^{241}Pu decays (1985Wi04). Iγ=0.110 *4* per 100 ^{237}U β^- decays in 1976GuZN.

From ENSDF

$^{237}_{93}$Np$_{144}$-5

γ(^{237}Np) (continued)

† From Adopted Levels, except otherwise noted.

‡ From 1966Ya05.

From 1976GuZN, 1985He02, and 1985Wi04, except where indicated. Intensities of the strong transitions were only measured in 1985He02 and 1985Wi04. These intensities are converted by the evaluator from per 100 ^{241}Pu decays to per 100 ^{237}U β^- decays by using the adopted α branching of 2.45×10^{-3}% *2* for ^{241}Pu decay. The Iγ′s of 1976GuZN were measured as absolute intensities. The Iγ′s recommended in 1986LoZT were obtained from the weighted average of intensities in 1985Wi04, 1985He02, 1984BaYS, 1966Ya05, 1971Cl03, 1976GuZN and 1982BuZF. The Iγ′s of 1985He02 and 1985Wi04 were recalculated by taking the α branching for ^{241}Pu as 2.41×10^{-3}% *4*, and relative intensities of 1966Ya05, 1971Cl03 and 1984BaYS were renormalized in 1986LoZT at Iγ(208γ) to 21.6. See also 1966El12 for the absolute photon intensities measured using 4π($\beta\gamma$) technique.

@ From ce measurements in 1966Ya05. See also ^{241}Am α decay. The Ice′s given in 1966Ya05 are renormalized (by a factor of 0.96 *2*) at L-subshells of 164.61-keV E2 transition by using the adopted Iγ=1.86 *3* and the theoretical L1, L2, L3 conversion coefficients.

& Anomalously converted. See 1960As02 and 1966Ya05 for discussions.

[a] Experimental conversion coefficient, from 1966Ya05. α(K)(412γ of ^{198}Au β^- decay)=0.0302 *5* (1990Zh04 recommend 0.0302 *3*) was used to normalize their measured Ice and Iγ′s.

[b] Not observed in ^{237}U β^- decay. Energy from ^{241}Am α decay.

[c] Absolute intensity per 100 decays.

[d] 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.

[x] γ ray not placed in level scheme.

^{237}U β^- decay 1966Ya05,1960Un01

Decay Scheme

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