^{233}Pa β^- decay (26.975 d) 2011Ko32,1990Ko41,2002Wo03

History

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

Parent: ^{233}Pa: E=0.0; J$^\pi$=3/2$^-$; T$_{1/2}$=26.975 d *13*; Q(β^-)=570.3 *20*; %β^- decay=100.0

^{233}Pa-J$^\pi$,T$_{1/2}$: From ^{233}Pa Adopted Levels.

^{233}Pa-Q(β^-): From 2017Wa10.

^{233}Pa isotope with T$_{1/2}\approx$27 d is relevant in U-Th fuel cycle, and important for reactor reactivity control. The isotope is formed in ^{232}Th+n → ^{233}Th, which decays through β^- to ^{233}Pa.

2012Le03: measurement of absolute intensities of 300.1, 312.0 and 1028.5-keV gamma rays using a new method: combination of pile oscillation and γ activation experiments at the MINERVE reactor, Cadarache, France.

2011Ko32, 2010Ko27: ^{233}Pa source was chemically separated from a ^{237}Np source in secular equilibrium with ^{233}Pa. Measured absolute intensities for x-rays and γ-rays using planar LEPS and coaxial Ge detectors. See 2010Ko27 for comparison with earlier measurements from 2008De10, 2004Sh07, 2002Lu01 (also 2000Lu01), 2000Sc04, 2000Wo01 (also 1988Wo01), 1990Ko41, 1984Va27, 1979Ge08 and 1973Va33. Measured value of absolute Iγ(28.6γ)=0.076% *3* in 2010Ko27 and 0.075% *4* in 2011Ko32 is in agreement with that from 1973Va33, 1988Wo01 and 1990Ko41, but differs significantly with that from 2004Sh07, 2002Lu01 and 1984Va27. The Iγ values in 2010Ko27 and 2011Ko32 for Eγ>40 are in good agreement with earlier measurements.

2008De10: chemically purified source obtained as ^{237}Np in equilibrium with ^{233}Pa. Measured absolute intensities of x-rays and γ-rays using HPGe detectors. The disintegration rates were measured using liquid scintillation counting.

2006Ha53: measured γ-emission probability of the 312-keV γ-ray.

2004Sh07: measured absolute intensities of x-rays and γ-rays using planar Ge detector using the full response function method.

2002Lu01: measured photon-emission probabilities of x-rays and low-energy γ rays up to ≈120 keV using planar Ge detector.

2002Wo03: summary of the measurements reported in 2000Wo01, 2004Sh07, 2002Lu01 (also 2000Lu01), 2000Sc04 from ^{237}Np-^{233}Pa source in equilibrium, as part of the EUROMET collaborative project (No. 416).

2000Lu01 (same group as 2002Lu01): measured photon-emission probabilities of x-rays and γ rays up to 416 keV using HPGe detector.

2000Wo01: measured γ-ray emission probabilities using HPGe detector, and 4π(PC)-γ counting for standardization.

2000Sc04: measured photon emission probabilities of x-rays and γ-rays using Ge(Li), two HPGe and Si(Li) detectors.

2000Us01: measured half-life of ^{233}Pa activity.

1993Pa12: measured angular correlations between Kα x-rays and subsequent L$_3$ x-ray transitions using HPGe and Si(Li) detectors.

1990Ko41: Source produced via ^{232}Th(n,γ) at Saclay and source separated at Nice; measured Eγ, Iγ, $\gamma\gamma$- and (x ray)γ-coin, HPGe detector.

1990Pe16: ce data, ^{237}Np-^{233}Pa source in equilibrium.

1989Br24: source was chemically separated from ^{237}Np parent activity by means of ion-exchange column techniques. Measured conversion coefficients for the 300-, 312-, and 340-keV γ-rays from simultaneous measurements of their γ-ray and conversion-electron intensities, the γ rays detected by an HPGe detector and conversion electrons, by a windowless Si(Li) detector. Deduced nuclear penetration effects for the three γ rays. The ce data were normalized to α(K)exp(392γ in ^{113}Sn)=0.437 *7*. Also measured β spectrum and deduced feeding to the ground state.

1988Wo01: measured ce, and absolute internal conversion coefficients for seven γ-ray transitions from the decay of ^{233}Pa; deduced Eγ values from the conversion electron lines for these transitions.

1985DeZR (thesis): measured Eγ, Iγ, ce, $\gamma\gamma$-coin. A large number of very weak transitions were reported only by 1985DeZR and many of these have been assigned to new levels and band structures. These have not been used in the present dataset due to reasons mentioned below. See 2005Si15 evaluation for some of the placement suggested by 1985DeZR, and a complete table of γ rays from 1985DeZR.

1987He11: measured $\gamma(\theta$,temp), low-temperature nuclear orientation for 340-keV gamma transition.

1986Kr10: measured $\gamma\gamma(\theta)$ for five $\gamma\gamma$-cascades using two Ge(Li) detectors, deduced mixing ratios by combining $\gamma\gamma(\theta)$ data with previous ce data, and with theoretical estimates from Nilsson model assignments.

1984Va27: measured Eγ, absolute Iγ, selected x rays using HPGe detector.

1979Ge08: measured Eγ,, Iγ, x rays, absolute intensity of 312-keV gamma ray using Ge(Li) detector.

1978-Poenitz: W.P. Poenitz and D.L. Smith, Rept. ANL/NDM-42 (March 1978), cited in 2010BeZQ and 2006Ch39 DDEP evaluation: measured photon emission probability of 312-keV γ ray.

1973Va33: measured Eγ, Iγ, $\gamma\gamma$-coin.

1972De67: measured Eγ, Iγ for four γ rays.

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1971Vo02: measured precise Eγ for seven γ rays using Riso bent crystal spectrometer.
1971Cl03: measured Eγ, Iγ using Ge(Li) detector.
1968Ma13: measured level half-lives by β(ce)(t).
1968Da24: measured Eγ for three γ rays.
1967Br20: measured Eγ.
1965Be38: measured x rays, Eγ and conversion lines using Si(Li) detector, 11 γ rays reported.
1963De22: measured Iγ of six gamma rays using NaI(Tl) detector.
1963Bi03 (also 1959Bi14): measured β spectra, ce, (ce)γ-coin using a six-gap and a single-gap beta ray spectrometer. Deduced end-point energies, K-conversion coefficient and multipolarity for 312γ. A total of 13 transitions assigned to the decay of ^{233}Pa, with Eγ, transition intensities, multipolarities and mixing ratios.
1962Sc03: measured conversion electrons using a wedge-shaped magnetic spectrometer. Deduced Eγ values, multipolarities and mixing ratios for 14 γ transitions assigned to the decay of ^{233}Pa.
1961Al19: measured β spectrum, conversion lines, Eγ, Iγ, and x rays using a high resolution permanent-magnet 180° electron spectrographs, an iron free double-focusing beta spectrometer, DuMond curved-crystal spectrometer, and a NaI(Tl) detector. Measured values of relative conversion electron and photon intensities. Deduced conversion coefficients, multipolarities and mixing ratios. A total of 13 γ rays were assigned to the decay of ^{233}Pa.
1960Al08, 1959Al02: measured conversion electrons and Auger lines.
1960Un01 (thesis): measured βγ-coin.
1958Hi78 (thesis): measured γ.
1955On05: measured conversion electron lines using a magnetic spectrograph, deduced Eγ for 15 transitions, intensities and multipolarities for some of these.
1954Br37: measured β spectrum and electron conversion lines using a magnetic spectrometer. Deduced Eγ values for 13 transitions.
1952Br84 (thesis): measured x rays and γ rays.
1952El26: measured gamma rays.
1950Ke54: measured conversion electrons using a permanent magnet-type photographic beta-spectrometer, deduced Eγ values for 13 transitions.
1947Le01, 1941Gr03, 1941Se09, 1941-Haggstrom (Phys. Rev. 59, 322), 1938Me04: discovery of ^{233}Pa activity and decay studies.

Results from 1985DeZR have not been used here for the following reasons: 1. many gamma rays are multiply placed without separation of intensities into the components; 2. a significant number of low-energy transitions are given without any knowledge of multipolarities and associated conversion coefficients; 3. with Q(β^-)=570.1 *20*, the levels proposed by the author at 570.2 and 571.3 keV would be unlikely to be populated; 4. several high-spin (J>7/2) levels are shown as populated, which would be unlikely from 3/2$^-$ parent state.
Evaluations: 2010BeZQ (DDEP), 2006Ch39 (related to DDEP), 2005Hu06.
The decay scheme has been known since detailed studies by 1961Al19, 1960Al08 and 1959Al02. However, it has gone through some modifications and improvements in energies of radiations since then, as a result of a large number of publications using Ge and Si(Li) detectors. The last detailed study was by 2011Ko32.

^{233}U Levels

E(level)[†]	Jπ[‡]	$T_{1/2}$	Comments
0.0[#]	5/2+		
40.350[#] *7*	7/2+		
92.13[#] *4*	9/2+		
298.815[@] *10*	(5/2−)		
301.93 *10*	(5/2−)		
311.905[&] *6*	3/2+	0.120 ns *15*	$T_{1/2}$: βce(K 312γ)(t) (1968Ma13). Other: 0.20 ns *3* (1960Jo15).
320.76[@] *5*	7/2−		
340.478[&] *6*	5/2+	52 ps *10*	$T_{1/2}$: βce(K 340γ)(t) (1968Ma13).
380.37[&] *8*	(7/2+)		
398.496[a] *8*	1/2+	55 ps *20*	$T_{1/2}$: βce(L 86.6γ)(t) (1968Ma13).

Continued on next page (footnotes at end of table)

^{233}Pa β^- decay (26.975 d) 2011Ko32,1990Ko41,2002Wo03 (continued)

^{233}U Levels (continued)

E(level)[†]	J^{π}[‡]	$T_{1/2}$	Comments
415.761[a] *7*	3/2$^+$	≤30 ps	$T_{1/2}$: βce(L 75.3γ)(t), βce(L 104γ)(t) (1968Ma13).
455.96[a] *10*	(5/2$^+$)		

[†] From least-squares fit to Eγ data.
[‡] From the Adopted Levels.
[#] Band(A): ν5/2[633].
[@] Band(B): ν5/2[752].
[&] Band(C): ν3/2[631].
[a] Band(D): ν1/2[631].

β^- radiations

E(decay)	E(level)	Iβ^-[†‡]	Log *ft*	Comments
(114.3 *20*)	455.96	0.0013 *3*	10.6 *1*	av Eβ=29.78 *55*
(154.5 *20*)	415.761	28 *3*	6.62 *5*	av Eβ=40.86 *56* E(decay): measurements: 140 *14* (1954Br37), 145 *10* (1955On05), 155 *7* (1960Un01), 154 *5* (1963Bj03). Iβ^-: measurements: 50 (1954Br37), 37 (1955On05), 32 (1963Bj03).
(171.8 *20*)	398.496	12.9 *23*	7.1 *1*	av Eβ=45.71 *57* E(decay): measurement: 175 *8* (1960Un01).
(189.9[#] *20*)	380.37	0.037 *10*	9.3[1u] *1*	av Eβ=55.84 *62*
(229.8 *20*)	340.478	27 *6*	7.2 *1*	av Eβ=62.36 *59*
(249.5[#] *20*)	320.76	0.024 *2*	10.3	av Eβ=68.14 *59* Iβ^-: no β feeding is expected for ΔJ=2, Δπ=no.
(258.4 *20*)	311.905	25 *4*	7.4 *1*	av Eβ=70.75 *60* E(decay): measurements: 256 *4* (1954Br37), 257 *5* (1955On05), 250 *5* (1960Un01), 254 *5* (1963Bj03). Iβ^-: measurements: 45 (1954Br37), 58 (1955On05), 56 (1963Bj03).
(268.4 *20*)	301.93	0.014 *4*	10.7 *1*	av Eβ=73.71 *60*
(271.5 *20*)	298.815	0.127 *20*	9.7 *1*	av Eβ=74.64 *60*
(530.0[#] *20*)	40.350			Iβ^-: −1.9 *16* from intensity balance, consistent with no β feeding to this level.
(570.3 *20*)	0.0	8.8 *14*	8.9 *1*	av Eβ=169.55 *67* E(decay): measurements: 568 *5* (1954Br37,1955On05), 578 *10* (1963Bj03). Iβ^-: from 1989Br24, for the g.s. and 40.4-keV level from β^- spectrum above 420 keV, taken in anticoincidence mode. Other measurements: 5 (1954Br37,1955On05), 12 (1963Bj03). As no significant feeding is expected to the 40.4, 7/2$^+$ level, consistent with Iβ=−1.9 *16* from the present level scheme, evaluators assign the feeding measured by 1989Br24 to the g.s. only. The analysis of the present decay scheme with γ-normalization factor of 0.3818 *23* and transition intensity balance at each level gives Iβ(g.s.)=8.8% *20*, consistent with the measurement of 1989Br24.

[†] Deduced from in-out transition intensity balances. The feeding to ground state is from measurement of β spectrum by 1989Br24.
[‡] Absolute intensity per 100 decays.
[#] Existence of this branch is questionable.

$\gamma(^{233}U)$

Iγ normalization: From %Iγ(311.9γ)=38.18 *23*, weighted average of the following measurements: 37.79 *64* (2012Le03), 37.8 *8* (2011Ko32), 38.08 *29* (2008De10), 37.5 *24* (2004Sh07), 37.80 *23* (2002Lu01), 38.5 *4* (2000Sc04), 38.7 *4* (2000Wo01), 38.65 *39* (1984Va27), 38.6 *5* (1979Ge08), and 38.6 *15* (1978-Poenitz). Other: %Iγ(311.9γ)=41.6 *9* (2006Ha53) seems discrepant.

A 145.42 *5* γ with an intensity of ≈1.3 (relative to 100 for 312γ) was reported only by 1961Al19 in the curved crystal spectrometer. Another transition at 57.9 keV was seen by 1961Al19 in their ce spectra. Authors discussed in detail the existence and possible placement of the 145-keV transition. Weak 57.9-keV was placed by the authors from 399-keV to 340-keV level. Both these γ rays are omitted here for lack of confirmation in other studies.

U x-rays (2010Ko27)

E(x-ray)	U(x-rays)	I(x-ray)@
13.64 *15*	L_α	39.7 *41*
15.46 *15*	L_η	1.00 *11*
15.79 *13*	Lβ6	1.35 *14*
16.53 *6*	$L_{\beta 2,15,4}$	18.9 *20*
17.27 *6*	$L_{\beta 1,5,3}$	35.3 *37*
18.04 *10*	$L_{L1,M4,5}$	0.712 *42*
19.48 *10*	$L_{L1,N1}$	0.462 *27*
20.22 *6*	$L_{\gamma 1}$	7.05 *29*
20.75 *7*	$L_{\gamma 2,3,6}$	3.84 *16*
21.56 *9*	$L_{L1,O2,4}$	0.958 *40*
94.64 *7*	$K_{\alpha 2,3}$	22.97 *66*
98.42 *6*	$K_{\alpha 1}$	37.0 *11*
110.41 *8*	$K_{\beta 3}$	4.46 *13*
111.30 *8*	$K_{\beta 1,5}$	9.30 *27*
114.48 *7*	$K_{\beta 2,4}$	3.66 *11*
115.38 *9*	$K_{O2,3,P2,3}$	1.256 *37*

@: I(x-ray) is relative to 100 for Iγ(312γ)

U x-rays (2008De10)

E(x-ray)	U(x-rays)	I(x-ray)@
11.62	L_l	1.19 *4*
13.93	L_α	21.46 *23*
15.73	Lβ6	0.89 *2*
16.41	$L_{\beta 2,15,4}$	8.93 *11*
17.22	$L_{\beta 1,5}$	16.23 *19*
17.45	$L_{\beta 3}$	0.22 *2*
20.17	$L_{\gamma 1}$	3.38 *5*
20.49	$L_{\gamma 2}$	1.83 *3*
20.84	$L_{\gamma 3,6}$	0.520 *11*
94.65	$K_{\alpha 2,3}$	8.50 *11*
98.43	$K_{\alpha 1}$	14.2 *19*
110.43	$K_{\beta 3}$	1.694 *26*

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  111.30            Kβ1                3.24 5
  111.98            Kβ5                0.139 18
  114.46            Kβ2,4             1.317 21
  115.42            KOP                0.406 11
 @: I(x-ray) is relative to 38.08 29    for Iγ(312γ)

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                  U x-rays (1990Ko41)

    E(x-ray)      U(x-rays)          I(x-ray) @
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    93.967 10       Kα3                0.17 2
    94.656 4        Kα2                8.4 4
    98.434 4        Kα1               13.5 7
   110.431 5        Kβ3                1.62 8
   111.303 5        Kβ1                3.14 15
   111.984 10       Kβ5                0.15 1
   114.339 8        Kβ2                0.52 7
   114.602 8        Kβ4                0.79 7
   115.419 10       KO23,KP23          0.39 2
 @: I(x-ray) is relative to 38.6 for I(312γ)
Other x-ray measurements: 1984Va27, 1979Ge08, 1967Br20, 1961Al19.
The x-ray intensities from 2004Sh07, 2002Wo03, 2002Lu01 and 2000Sc04
are also available from 237Np-233Pa       equilibrium source, but
generally the peaks are complex structures with x-rays contributed
by 237Np    decay.
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E_γ[†]	I_γ[‡b]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[@]	δ	α[c]	Comments
17.26 *4*	0.025 *10*	415.761	3/2$^+$	398.496	1/2$^+$	M1+E2	0.13 *2*	5.0×10^2 *10*	α(M1)=130.9 *21*; α(M2)=120 *40*; α(M3)=110 *40* α(M)=370 *80*; α(N)=100 *20*; α(O)=23 *5*; α(P)=4.1 *8*; α(Q)=0.1521 *24* Transition seen in conversion electron spectra by 1961Al19, 1962Sc03 and 1966Ze02. I_γ: deduced from Ice(M1+M2)=5.4 relative to Ice(K)=100, and α(K)=0.710 *10* for 311.9γ (1962Sc03), and α(M1+M2)(theory)=151 *40* for transition energy of 17.26 keV *4* and δ(E2/M1)=0.13 *2*. Uncertainty of 25% is assumed in measured Ice(M1+M2). E_γ: from observation of M1, M2, M3, N1 and N2 conversion lines by 1961Al19. Uncertainty is not given in 1961Al19. However, from the spread of energies of several conversion lines, it is estimated as 0.04 keV. Other: 17.2 (1962Sc03, from M1 and M2 lines). δ: from M1:M2:M3=20:18:16 (1966Ze02), assuming 25% uncertainty in the subshell ratios. Others: M1/M2=2.0/3.4, 8% *5* E2 or δ=0.30 *+8−12* (1962Sc03).
28.562 *11*	0.192 *11*	340.478	5/2$^+$	311.905	3/2$^+$	M1+E2	0.16 *2*	3.2×10^2 *4*	α(M1)exp=23 *6*; α(M2)exp=17 *8*; α(N+...)exp=11 *2* (1988Wo01)

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$\gamma(^{233}$U) (continued)

E_γ [†]	I_γ [‡b]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [@]	δ	α [c]	Comments
									α(L)=2.4×10^2 *3*; α(M)=60 *7* α(N)=16.3 *19*; α(O)=3.9 *5*; α(P)=0.69 *7*; α(Q)=0.0336 *5* E_γ: weighted average (NRM) of 28.57 *8* (2011Ko32), 28.559 *10* (1990Ko41), 28.6 *1* (1972De67), 28.54 *3* (1961Al19, crystal), 28.67 *2* (1952Br84). Other: 28.375 *5* (1988Wo01), seems discrepant. I_γ: weighted average of 0.198 *11* (2011Ko32), 0.194 *21* (1990Ko41), 0.180 *24* (1988Wo01), 0.18 *2* (1973Va33). Others: 0.051 *5* (2004Sh07), 0.090 *26* (2002Lu01), 0.388 *26* (1984Va27); all seem discrepant. L1/(M1+M2)=2.7 *3* (1990Pe16); L1:L2:L3:M1:M2:M3:N:O+P=51.6:26.2:20.0:8.3:4.3:3.1:4.8:1.4 (1966Ze02), %E2=2.4 *2* or δ=0.16 *1*; L3:M2:M3=9.3:4.7:3.1 (1962Sc03), %E2=1.02 *8* or δ=0.10 *1*; M1:M2:M3=8.0:2.9:3.1 (1961Al19), %E2=3.0 *5* or δ=0.18 *1*; M1:M2:N+=88 *21*:64 *30*:40.6 *51* (1988Wo01); %E2=2% *1* or δ=0.14 *3* in 1963Bi03 from ce; %E2=4 or δ=0.20 (1959Al02) from ce. Others: δ=0.14 *1* (1985DeZR). δ: deduced by evaluators using BrIccMixing code on all the L- and M-subshell ratios given above, assuming 20% uncertainty on the ratio when not given.
40.351 *10*	0.0597 *32*	40.350	7/2$^+$	0.0	5/2$^+$	M1+E2	0.93 *11*	5.1×10^2 *6*	α(L)=3.7×10^2 *5*; α(M)=102 *13* α(N)=28 *4*; α(O)=6.4 *8*; α(P)=1.04 *12*; α(Q)=0.0087 *5* E_γ: weighted average of 40.33 *10* (2011Ko32), 40.349 *5* (1990Ko41), 40.5 *1* (1972De67), 40.35 *1* (1961Al19, crystal), 40.47 *10* (1952Br84). I_γ: weighted average of 0.0582 *26* (2011Ko32), 0.085 *11* (2004Sh07), 0.074 *11* (2002Lu01), 0.056 *4* (2000Wo01), 0.062 *10* (1990Ko41), 0.10 *2* (1973Va33). Triple placement in 1985DeZR, but from other studies the main placement is from 40.3 level. L1:L2:L3:M1:M2:M3:N:O+P=13:100:91:5:20:16:12:3.4 (1966Ze02), %E2=54 *5* or δ=1.08 *10*; L1:L2:M1:M2:M3:M4=14:100:4:39:29:2 (1962Sc03), %E2=54 *4* or δ=1.08 *+10−8*; L1:L2:L3:M2:M3=30:100:80:25:23 (1961Al19), %E2=30 *10* or δ=0.65 *16*; %E2=31 *2* or δ=0.67 *3* from ce data (1963Bi03); δ=1.23 from ce data (1959Al02). Other: 1985DeZR. δ: deduced by evaluators using BrIccMixing code on all the L- and M-subshell ratios quoted above, assuming 20% uncertainty in each ratio.
41.660 *10*	0.0346 *27*	340.478	5/2$^+$	298.815	(5/2$^-$)	[E1]		1.254	α(L)=0.940 *14*; α(M)=0.236 *4* α(N)=0.0621 *9*; α(O)=0.01399 *20*; α(P)=0.00219 *3*; α(Q)=7.52×10^{-5} *11*

From ENSDF

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$\gamma(^{233}U)$ (continued)

E_γ[†]	I_γ[‡b]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[@]	δ	α[c]	Comments
									E_γ: weighted average of 41.65 *10* (2011Ko32), 41.663 *10* (1990Ko41), 41.65 *2* (1961Al19, crystal). I_γ: weighted average of 0.0344 *27* (2011Ko32), 0.036 *8* (1990Ko41), 0.035 *10* (1973Va33).
51.5[e] *5*	<0.0026[#]	92.13	$9/2^+$	40.350	$7/2^+$	[M1+E2]		1.7×10^2 *15*	α(L)=1.3×10^2 *11*; α(M)=35 *29* α(N)=9.4 *79*; α(O)=2.2 *18*; α(P)=0.36 *29*; α(Q)=0.0038 *22* E_γ: from Adopted Gammas.
57.9[e]	≈0.0024	398.496	$1/2^+$	340.478	$5/2^+$	[E2]		178 *4*	α(L)=130 *3*; α(M)=36.0 *8*; α(N)=9.76 *22*; α(O)=2.24 *5*; α(P)=0.363 *8*; α(Q)=0.000975 *20* L2 and L3 conversion lines reported by 1961Al19, but no intensities were given. 1962Sc03 reported Ice(L3)=0.2 relative to Ice(K)=100 for 311.9γ. Using theoretical K-conversion coefficient of 0.71 *1* for 311.9γ and L3 conversion coefficient of 57.4 *13* for 57.9-keV transition (with assumed uncertainty of 0.2 keV), Iγ(57.9)=0.0024. 1973Va33 reported Iγ<0.01. α: assuming $\Delta E\gamma$=0.2 keV.
75.274 *10*	3.37 *6*	415.761	$3/2^+$	340.478	$5/2^+$	M1+E2	+0.15[&] *8*	11.4 *12*	α(L)=8.6 *9*; α(M)=2.11 *24* α(N)=0.57 *7*; α(O)=0.138 *15*; α(P)=0.0261 *23*; α(Q)=0.00192 *6* α(L1)exp=8.0 *6*; α(L2)exp=0.85 *9*; α(L3)exp<0.14; α(N)exp+α(O)exp=0.7 *1* (1988Wo01) E_γ: weighted average of 75.26 *5* (2010Ko27), 75.269 (1991Ko41), 75.27 *3* (1972De67), 75.28 *1* (1961Al19, crystal), 75.4 *2* (1952Br84). Uncertainty is not given in 1990Ko41, assumed by evaluators as 0.010 in averaging, based on uncertainties in this for other γ rays. I_γ: unweighted average of 3.36 *13* (2011Ko32), 3.01 *10* (2004Sh07), 3.360 *21* (2002Lu01), 3.59 *10* (2000Sc04), 3.62 *7* (2000Wo01), 3.26 *23* (1990Ko41), 3.27 *24* (1988Wo01), 3.36 *10* (1984Va27), 3.6 *2* (1979Ge08), 3.26 *20* (1973Va33). Weighted average is 3.39 *5*, but reduced χ^2 is 3.6. δ: other: 0.090 *5* (1985DeZR) from ce data. (75.27γ)(300.1γ)(θ): A_2=−0.008 *10*, A_4=+0.015 *15* (liquid,1986Kr10). (75.27γ)(300.1γ)(θ): A_2=−0.001 *10*, A_4=+0.019 *14* (solid,1986Kr10); A_2=+0.010 *10* (liquid), +0.003 *9* (solid), for assumed A_4=0 (1986Kr10). (75.27γ)(340.5γ)(θ): A_2=−0.140 *10*, A_4=+0.020 *13* (liquid,1986Kr10). (75.27γ)(340.5γ)(θ): A_2=−0.128 *13*, A_4=+0.022 *19* (solid,1986Kr10); A_2=−0.133 *9* (liquid), −0.123 *11* (solid) for assumed A_4=0 (1986KR10). (75.27γ)[28.6γ](311.9γ)(θ): A_2=−0.014 *13*, A_4=0.000 *18*

From ENSDF

$^{233}_{92}U_{141}$-7

$\gamma(^{233}$U) (continued)

E_γ [†]	I_γ [‡b]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [@]	δ	α [c]	Comments
									(liquid,1986Kr10); A_2=−0.015 *13* (liquid) for assumed A_4=0 (1986Kr10). L1:L2:L3:N:O+=550 *18*:58.4 *45*:36.9 *52*:<0.14:9.8 *19* (1988Wo01); L1:L2:M1:M2:N1:O=100:12:22:3:7:1.5 (1966Ze02), δ<0.07; L1:L2:M1:M2:N1=100:6:19:2:5 (1962Sc03), δ<0.02; L1:L2:M1:N1:O=100:14:24:8:3 (1961Al19), δ=0.10 *1*; M1 in 1963Bi03 from ce data. Other: 1985DeZR.
86.591 *10*	5.26 *18*	398.496	1/2$^+$	311.905	3/2$^+$	M1(+E2)	<0.09 [&]	7.09 *13*	α(L1)exp=5.6 *7*; α(L2)exp=1.0 *2*; α(L3)exp=0.3 *2* (1988Wo01); α(L1)exp=5.2 *5* (1966Ze02) α(L)=5.34 *10*; α(M)=1.296 *25* α(N)=0.350 *7*; α(O)=0.0849 *16*; α(P)=0.0163 *3*; α(Q)=0.001292 *19* E_γ: weighted average of 86.57 *5* (2011Ko32), 86.595 *5* (1990Ko41), 86.58 *3* (1972De67), 86.59 *1* (1961Al19, crystal). Others: 86.814 *3* (1988Wo01, seems discrepant), 87.0 *3* (1952Br84). I_γ: weighted average of 5.34 *19* (2011Ko32), 6.9 *6* (2002Lu01), 4.99 *28* (1990Ko41), 4.9 *7* (1988Wo01), 5.1 *3* (1979Ge08), 4.9 *6* (1973Va33). (86.6γ)(311.9γ)(θ): A_2=−0.008 *4*, A_4=+0.008 *5* (liquid,1986Kr10). (86.6γ)(311.9γ)(θ): A_2=−0.006 *3*, A_4=+0.003 *5* (solid,1986Kr10); A_2=−0.008 *4* (liquid), −0.005 *3* (solid), for assumed A_4=0 (1986Kr10). L1:L2:M1:M2:N1:O=100:12:25:3.3:6.9:1.7 (1966Ze02), δ<0.08; L1:L2:M1:M2:N1:O=100:7:22:2.3:4.4:1.5 (1962Sc03), δ<0.05; L1:L2:L3:M1:M2:N1:O=100:14:3:28:6.2:6.9:1.7 (1961Al19), δ=0.14 *2*; L1:L2:L3=573 *14*:105.0 *98*:34 *16* (1988Wo01); δ=0.10 *+4−10* in 1963Bi03 and δ<0.1 in 1959Al02 from ce data. Other: 1985DeZR. δ: deduced by evaluators using BrIccMixing code on all the L- and M-subshell ratios, assuming 20% uncertainty on ratio when not given. This values agrees with <0.1 based on $\gamma\gamma(\theta)$ data in 1986Kr10. Other: 0.07 *1* (1985DeZR).
92.1 [e] *5*	<0.0052 [#]	92.13	9/2$^+$	0.0	5/2$^+$	[E2]		19.6 *6*	α(L)=14.3 *5*; α(M)=3.96 *12* α(N)=1.07 *4*; α(O)=0.247 *8*; α(P)=0.0403 *12*; α(Q)=0.000148 *4* E_γ: average of 92.1 *5* (1990Ko41) and 92.0 *5* (1973Va33). I_γ: <0.01 (1973Va33).
103.860 *10*	2.226 *22*	415.761	3/2$^+$	311.905	3/2$^+$	M1(+E2)	+0.1 [&] *1*	4.21 *21*	α(L)=3.17 *15*; α(M)=0.77 *5* α(N)=0.208 *12*; α(O)=0.050 *3*; α(P)=0.0097 *4*; α(Q)=0.000758 *22* α(L1)exp=2.9 *6* (1966Ze02) E_γ: weighted average of 103.84 *8* (2010Ko27), 103.860 *10* (1991Ko41), 103.862 *10* (1971Cl03), 103.86 *2* (1961Al19, crystal). I_γ: weighted average of 2.25 *8* (2011Ko32), 2.20 *7* (2004Sh07),

γ(^{233}U) (continued)

E_γ[†]	I_γ[‡b]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[@]	α[c]	Comments
								2.262 *16* (2002Lu01), 2.192 *44* (2000Sc04), 2.204 *21* (2000Wo01), 2.22 *16* (1990Ko41), 1.90 *24* (1988Wo01), 2.25 *8* (1984Va27), 2.25 *8* (1979Ge08), 1.92 *20* (1973Va33). δ: other: 0.15 *1* from ce data (1985DeZR). (103.86γ)(311.9γ)(θ): A_2=+0.005 *5*, A_4=−0.008 *8* (liquid,1986Kr10). (103.86γ)(311.9γ)(θ): A_2=−0.001 *6*, A_4=+0.012 *8* (solid,1986Kr10); A_2=+0.002 *5* (liquid), +0.001 *4* (solid) FOR A_4=0 (1986Kr10). L1:L2:M1:M2:M3:N:O=100:15:24:4.2:1.2:7.0:1.6 (1966Ze02), δ=0.14 *7*; L1:L2:M1:M2:N:O=100:7:24:7.1:4.7:1.2 (1962Sc03), δ<0.17; L1:L2:L3:M1:N=100:18:4:30:13 (1961Al19), δ=0.20 *3*; 1% *1* E2 or δ=0.10 *+4−10* in 1963Bi03, and δ<0.1 (1959Al02) from ce. Other: 1985DeZR.
228.57[#] *5*	0.0109[#] *18*	320.76	7/2$^-$	92.13	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)=0.0001769 *25*; α(P)=3.22×10^{-5} *5*; α(Q)=1.94×10^{-6} *3*
248.37 *4*	0.158 *3*	340.478	5/2$^+$	92.13	9/2$^+$	[E2]	0.346	α(K)=0.1065; α(L)=0.1755 *25*; α(M)=0.0480 *7* α(N)=0.01301 *19*; α(O)=0.00301 *5*; α(P)=0.000509 *8*; α(Q)=7.17×10^{-6} *10* E_γ: weighted average of 248.35 *12* (2011Ko32), 248.38 *4* (1990Ko41), 248.0 *2* (1973Va33), 248.69 *24* (1968Ma13), 248.3 *3* (1967Br20). I_γ: weighted average of 0.164 *11* (2011Ko32), 0.151 *16* (2002Lu01), 0.161 *3* (2000Sc04), 0.157 *3* (2000Wo01), 0.150 *10* (1990Ko41), 0.155 *26* (1984Va27), 0.154 *6* (1979Ge08). Other: 0.010 *3* (1973Va33). K, L2, L3, M2, N2 lines seen in ce (1985DeZR).
258.45 *3*	0.073 *5*	298.815	(5/2$^-$)	40.350	7/2$^+$	[E1]	0.0547	α(K)=0.0433 *6*; 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* E_γ: weighted average of 258.63 *12* (2011Ko32), 258.45 *2* (1990Ko41), 258.2 *2* (1973Va33). I_γ: weighted average of 0.077 *5* (2011Ko32), 0.071 *8* (2000Sc04), 0.070 *5* (1990Ko41). Other: 0.010 *4* (1973Va33).
271.556 *10*	0.840 *8*	311.905	3/2$^+$	40.350	7/2$^+$	E2	0.258	α(K)=0.0904 *13*; α(L)=0.1226 *18*; α(M)=0.0334 *5* α(N)=0.00905 *13*; α(O)=0.00210 *3*; α(P)=0.000357 *5*; α(Q)=5.77×10^{-6} *8* E_γ: weighted average of 271.57 *8* (2011Ko32), 271.555 *10* (1990Ko41), 271.48 *8* (1971Vo02, crystal), 271.58 *4* (1971Cl03), 271.62 *23* (1961Al19, crystal). I_γ: weighted average of 0.847 *26* (2011Ko32), 0.77 *15* (2004Sh07), 0.855 *13* (2002Lu01), 0.839 *10* (2000Sc04), 0.834 *8* (2000Wo01), 0.88 *4* (1990Ko41), 0.828 *26* (1984Va27), 0.85 *3* (1979Ge08), 0.79 *8* (1973Va33). K:L1:L2:L3:M1+M2=100:21:84:35:33 (1966Ze02); K:L2:L3:M2=100:75:19:38 (1962Sc03); K:L1:L3=100:98:≈7 (1961Al19); E2 in all including ce in 1963Bi03. Others: 1985DeZR, 1959Al02.
280.58 *8*	0.035 *4*	320.76	7/2$^-$	40.350	7/2$^+$	[E1]	0.0455	α(K)=0.0362 *5*; α(L)=0.00706 *10*; α(M)=0.001703 *24* α(N)=0.000455 *7*; α(O)=0.0001086 *16*; α(P)=2.00×10^{-5} *3*; α(Q)=1.260×10^{-6} *18* E_γ: weighted average of 280.37 *14* (2011Ko32), 280.61 *5* (1990Ko41). I_γ: weighted average of 0.0370 *26* (2011Ko32), 0.028 *5* (1990Ko41).

$\gamma(^{233}U)$ (continued)

E_γ[†]	I_γ[‡b]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[@]	δ	α[c]	Comments
288.33 *10*	0.050 *5*	380.37	(7/2$^+$)	92.13	9/2$^+$	[M1+E2]		0.67 *46*	α(K)=0.49 *41*; α(L)=0.134 *38*; α(M)=0.034 *8* α(N)=0.0092 *21*; α(O)=0.0022 *6*; α(P)=4.0×10^{-4} *13*; α(Q)=2.3×10^{-5} *19* E_γ: weighted average of 288.17 *13* (2011Ko32), 288.42 *10* (1990Ko41). I_γ: weighted average of 0.053 *5* (2011Ko32), 0.041 *8* (1990Ko41).
298.81 *2*	0.32 *5*	298.815	(5/2$^-$)	0.0	5/2$^+$	[E1]		0.0396	α(K)=0.0315 *5*; α(L)=0.00609 *9*; α(M)=0.001469 *21* α(N)=0.000393 *6*; α(O)=9.38×10^{-5} *14*; α(P)=1.729×10^{-5} *25*; α(Q)=1.106×10^{-6} *16* E_γ: weighted average of 298.81 *9* (2011Ko32), 298.81 *2* (1990Ko41), 298.89 *20* (1973Va33). I_γ: unweighted average of 0.357 *13* (2011Ko32), 0.39 *8* (2002Lu01), 0.223 *18* (1990Ko41). Weighted average is 0.31 *5* but reduced χ^2=19. Other: 0.09 (1973Va33). Observed by 1973Va33 in $\gamma\gamma$-coin.
300.128 *10*	17.14 *17*	340.478	5/2$^+$	40.350	7/2$^+$	M1+E2	−0.08[&] *2*	0.87[a] *3*	α(K)exp=0.70 *2*; α(L1)exp+α(L2)exp=0.128 *4* (1989Br24) α(K)exp=0.83 *7*; α(L)exp=0.15 *2* (1988Wo01) E_γ: weighted average of 300.16 *6* (2011Ko32), 300.129 *5* (1990Ko41), 300.12 *3* (1971Vo02, crystal), 300.124 *20* (1971Cl03), 300.20 *24* (1961Al19, crystal). Other: 300.34 *2* (1988Wo01), seems discrepant. I_γ: weighted average of 16.88 *50* (2011Ko32), 16.99 *13* (2008De10), 16.8 *5* (2004Sh07), 16.90 *16* (2002Lu01), 17.01 *18* (2000Sc04), 17.21 *16* (2000Wo01), 17.67 *18* (1990Ko41), 17.2 *12* (1988Wo01), 17.18 *16* (1984Va27), 17.14 *15* (1979Ge08), 17.2 *8* (1973Va33). Mult.,α: from α(K)exp and α(L1+L2)exp (1989Br24). Deduced penetration parameter λ=2.6 *9* (1989Br24), assuming pure M1. K:L1:L2:M1+M2:N=100:16:1.9:4.6:1.1 (1966Ze02), δ=0; K:L1:L2:M1:N1=100:15:1.3:3.8:1.5 (1962Sc03), δ<0.18; K:L1:L2:M1:N1=100:16:2.3:4.4:1.4 (1961Al19), δ=0.37 *+16−23* K/L=301 *13*/53.4 *73* (1988Wo01). M1 in 1963Bi03 and 1959Al02 from ce. Other: δ=0.16 *2* (1985DeZR).
301.93 *10*	0.036 *9*	301.93	(5/2$^-$)	0.0	5/2$^+$	[E1]		0.0387	α(K)=0.0308 *5*; α(L)=0.00595 *9*; α(M)=0.001434 *21* α(N)=0.000384 *6*; α(O)=9.16×10^{-5} *13*; α(P)=1.689×10^{-5} *24*; α(Q)=1.083×10^{-6} *16* E_γ: weighted average of 301.85 *12* (2011Ko32), 301.99 *10* (1990Ko41). I_γ: unweighted average of 0.045 *5* (2011Ko32), 0.026 *5* (1990Ko41).
311.901 *11*	100.0 *10*	311.905	3/2$^+$	0.0	5/2$^+$	M1+E2	−0.10[&] *1*	0.80[a] *3*	α(K)exp=0.64 *2*; α(L1)exp+α(L2)exp=0.123 *4*; α(M1)exp=0.029 *1* (1989Br24)

γ(^{233}U) (continued)

E_γ[†]	I_γ[‡b]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[@]	δ	α[c]	Comments
									α(K)exp=0.69 *7* (1963Bi03); α(K)exp=0.70 *7* (1966Ze02) E_γ: weighted average of 311.94 *5* (2011Ko32), 311.904 *5* (1990Ko41), 311.887 *10* (1971Cl03), 311.98 *3* (1971Vo02, crystal), 311.91 *13* (1961Al19, crystal). Other: 312.17 *12* (1988Wo01), seems somewhat discrepant. I_γ: 100.0 *21* (2011Ko32), 100.0 *8* (2008De10), 100 *6* (2004Sh07), 100.0 *6* (2002Lu01), 100.0 *10* (2000Sc04), 100.0 *10* (2000Wo01), 100.0 *10* (1990Ko41), 100 *5* (1988Wo01), 100.0 *10* (1984Va27), 100 (1979Ge08), 100 (1973Va33). Mult.,α: from measured α(K)exp, α(L1+L2)exp and α(M1)exp (1989Br24). Deduced penetration parameter λ=2.3 *4* (1989Br24), assuming pure M1. K:L1:L2:M:N:O=100:17:2.0:4.3:1.1:0.3 (1966Ze02); K:L1:L2:M:N=100:15:1.5:4.3:1.1 (1962Sc03); K:L1:L2:M:N:O=100:17:1.6:3.7:1.7:0.4; K/L=1653 *82*/311 *28* (1988Wo01). M1 in 1963Bi03 and 1959Al02 from ce; %E2<1.6 (1966Ze02), <3 (1962Sc03), <2 (1961Al19). Other: δ=0.26 *2* (1985DeZR).
320.73[#] *10*	0.0132[#] *8*	320.76	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)=0.000334 *5*; α(O)=7.97×10^{-5} *12*; α(P)=1.474×10^{-5} *21*; α(Q)=9.57×10^{-7} *14*
340.477 *10*	11.63 *12*	340.478	5/2$^+$	0.0	5/2$^+$	M1+E2	−0.23[&] *5*	0.62[a] *3*	α(K)exp=0.50 *2*; α(L1)exp+α(L2)exp=0.090 *3*; α(M1)exp=0.022 *1* (1989Br24) α(K)exp=0.62 *9* (1988Wo01) E_γ: weighted average of 340.55 *12* (2011Ko32), 340.476 *5* (1990Ko41), 340.50 *4* (1971Vo02, crystal), 340.47 *2* (1971Cl03), 340.51 *18* (1961Al19, crystal). Other: 340.81 *3* (1988Wo01), seems discrepant. I_γ: weighted average of 11.46 *37* (2011Ko32), 11.65 *9* (2008De10), 11.6 *12* (2004Sh07), 11.67 *8* (2002Lu01), 11.69 *13* (2000Sc04), 11.68 *10* (2000Wo01), 10.92 *13* (1990Ko41), 11.7 *13* (1988Wo01), 11.69 *13* (1984Va27), 11.57 *10* (1979Ge08), 11.7 *12* (1973Va33). Uncertainty was doubled in 1990Ko41 in the averaging procedure. Mult.,α: from α(K)exp, α(L12)exp and α(M1)exp (1989Br24). Deduced penetration parameter λ=2.4 *8* (1989Br24), assuming pure M1. K:L1:L2:M:N:O=100:16:2.1:4.6:1.4:0.4 (1966Ze02), δ<0.25; K:L1:L2:L3:M:N:O=100:17:1.0:0.2:3.5:1.4:0.2 (1962Sc03), δ=0.29 *9*; K:L1:L2:M:N=100:22:2.8:7.0:2.8 (1961Al19), δ=0.3 *+2−3*; M1 in 1963Bi03 and 1959Al02 from ce data. Other: δ=0.4 *1* (1985DeZR).
375.407 *10*	1.781 *18*	415.761	3/2$^+$	40.350	7/2$^+$	E2		0.0981	α(K)=0.0491 *7*; α(L)=0.0360 *5*; α(M)=0.00963 *14* α(N)=0.00261 *4*; α(O)=0.000610 *9*; α(P)=0.0001058 *15*;

γ(^{233}U) (continued)

E_γ[†]	I_γ[‡b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ	α[c]	Comments
									α(Q)=2.72×10^{-6} *4* α(L3)exp=0.40 *8*; α(M1)exp=1.0 *1* (1988Wo01) E_γ: weighted average of 375.48 *16* (2010Ko27), 375.404 *5* (1990Ko41), 375.45 *4* (1971Vo02, crystal), 375.40 *5* (1971Cl03), 375.35 *32* (1961Al19, crystal). I_γ: weighted average of 1.75 *8* (2011Ko32), 1.55 *21* (2004Sh07), 1.817 *16* (2002Lu01), 1.782 *18* (2000Sc04), 1.783 *16* (2000Wo01), 1.604 *26* (1990Ko41), 1.785 *26* (1984Va27), 1.76 *2* (1979Ge08), 1.6 *3* (1973Va33). Uncertainty was doubled in 1990Ko41 in the averaging procedure. L3:M1:M2=15.8 *23*:40.9 *22*:<0.32 (1988Wo01); K:L1:L2:L3:M1+M2:N=100:20:46:16:16:11 (1966Ze02); K:L2:L3:M2:N2=100:70:22:4:2 (1962Sc03); E2 in all including 1963Bi03 from ce data. Other: 1985DeZR.
380.28[#] *10*	0.0096[#] *23*	380.37	(7/2$^+$)	0.0	5/2$^+$	[M1+E2]		0.31 *22*	α(K)=0.23 *19*; α(L)=0.057 *23*; α(M)=0.0143 *51* α(N)=0.0038 *14*; α(O)=9.2×10^{-4} *35*; α(P)=1.73×10^{-4} *72*; α(Q)=1.11×10^{-5} *84*
398.494 *10*	3.55 *6*	398.496	1/2$^+$	0.0	5/2$^+$	E2		0.0835	α(K)=0.0439 *7*; α(L)=0.0291 *4*; α(M)=0.00777 *11* α(N)=0.00210 *3*; α(O)=0.000492 *7*; α(P)=8.58×10^{-5} *12*; α(Q)=2.39×10^{-6} *4* E_γ: weighted average of 398.58 *12* (2011Ko32), 398.492 *5* (1990Ko41), 398.62 *8* (1971Vo02), 398.49 *2* (1971Cl03), 398.57 *40* (1961Al19, crystal). I_γ: unweighted average of 3.52 *13* (2011Ko32), 3.55 *27* (2004Sh07), 3.685 *34* (2002Lu01), 3.652 *39* (2000Sc04), 3.636 *28* (2000Wo01), 3.29 *5* (1990Ko41), 3.70 *5* (1984Va27), 3.60 *3* (1979Ge08), 3.35 *40* (1973Va33). Weighted average is 3.61 *4*, but reduced χ^2 is 6.4. K:L1:L2:L3:M:N=100:17:38:11:11:5 (1966Ze02); K:L1:L2:L3=100:22:37:13(1962Sc03); L2/L3=100/31 (1961Al19); E2 in 1966Ze02, 1963Bi03, 1962Sc03 and 1961Al19 from ce data. Other: 1985DeZR.
415.767[d] *10*	4.55 *5*	415.761	3/2$^+$	0.0	5/2$^+$	M1+E2	2.5 *1*	0.121 *4*	α(K)=0.080 *3*; α(L)=0.0303 *6*; α(M)=0.00785 *14* α(N)=0.00212 *4*; α(O)=0.000502 *9*; α(P)=9.03×10^{-5} *18*; α(Q)=3.98×10^{-6} *15* E_γ: weighted average of 415.87 *12* (2011Ko32), 415.764 *5* (1990Ko41), 415.76 *4* (1971Vo02, crystal), 415.78 *2* (1971Cl03), 415.87 *42* (1961Al19, crystal). I_γ: weighted average of 4.44 *16* (2011Ko32), 4.53 *5* (2008De10), 4.24 *27* (2004Sh07), 4.603 *19* (2002Lu01), 4.58 *5* (2000Sc04), 4.576 *36* (2000Wo01), 4.50 *5* (1984Va27), 4.52 *4* (1979Ge08), 4.2 *4* (1973Va33). Other: 4.11 *5* (1990Ko41), seems discrepant. I_γ: most of the intensity belongs with placement from 415.77 level. K:L1:L2:L3:M:N=100:22:14:4:9.1:3.2 (1966Ze02), δ=1.78 *15*;

$^{233}_{92}U_{141}$-12

$\gamma(^{233}$U) (continued)

E_γ †	I_γ ‡b	E_i(level)	J_i^π	E_f	J_f^π	Mult.@	α c	Comments
								K:L2:L3:M2=100:43:6.5:13 (1962Sc03), δ=4.9 +∞−*15*; K:L1:L2:L3=100:22:16:3.8 (1961Al19), δ=2.1 +*7*−*4*; 78% *8* E2 or δ=1.9 *5* in 1963Bi03 from ce. Other: 1985DeZR. δ: deduced by evaluators using BrIccMixing code on ce data listed above from 1966Ze02, 1962Sc03 and 1961Al19, except the L2/K ratio from 1962Sc03 which seems discrepant. Uncertainty of 20% was assumed in each ratio.
415.767 [de]		455.96	(5/2$^+$)	40.350	7/2$^+$			
455.96 [#] *10*	0.0028 [#] *5*	455.96	(5/2$^+$)	0.0	5/2$^+$	[M1+E2]	0.19 *13*	α(K)=0.14 *11*; α(L)=0.034 *16*; α(M)=0.0083 *35* α(N)=0.00224 *93*; α(O)=5.4×10^{-4} *23*; α(P)=1.01×10^{-4} *47*; α(Q)=6.8×10^{-6} *51*

† Weighted averages of values from several studies as indicated in a comment for each γ ray. In 1990Ko41, some of the uncertainties were 0.005 keV, evaluators considered a minimum uncertainty of 0.010 keV in the averaging procedure, with the same restriction on the final value.

‡ Weighted or unweighted averages of values from several studies as indicated in a comment for each γ ray. Some of the uncertainties were lower than 1%, evaluators considered a minimum uncertainty of 1% in the averaging procedure, with the same restriction on the final value. All the intensities are expressed as relative to 100.0 for the 311.9γ.

Weak γ from 1990Ko41 only.

@ From ce data of 1961Al19, 1962Sc03, 1963Bi03, 1966Ze02, and 1988Wo01. Multipolarities in square brackets are assumed, as expected from ΔJ^π. The δ(E2/M1) values given in comments have been taken from %E2 values listed in Table 1 in 1986Kr10, which were deduced from ce data in 1966Ze02, 1963Bi03, 1962Sc03 and 1961Al19.

& From $\gamma\gamma(\theta)$ data of 1986Kr10. As the measured angular correlation coefficients in most cases were close to zero, the authors, in their analysis, considered available conversion electron data (e.g. from 1966Ze02), as well as theoretical estimates based on B(E2)/B(M1) calculations from Nilsson band assignments and K^π assignments.

a From measured conversion coefficient (1989Br24) for the transition with a significant penetration effect, resulting in the reduction of the theoretical conversion coefficients.

b For absolute intensity per 100 decays, multiply by 0.3818 *23*.

c 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.

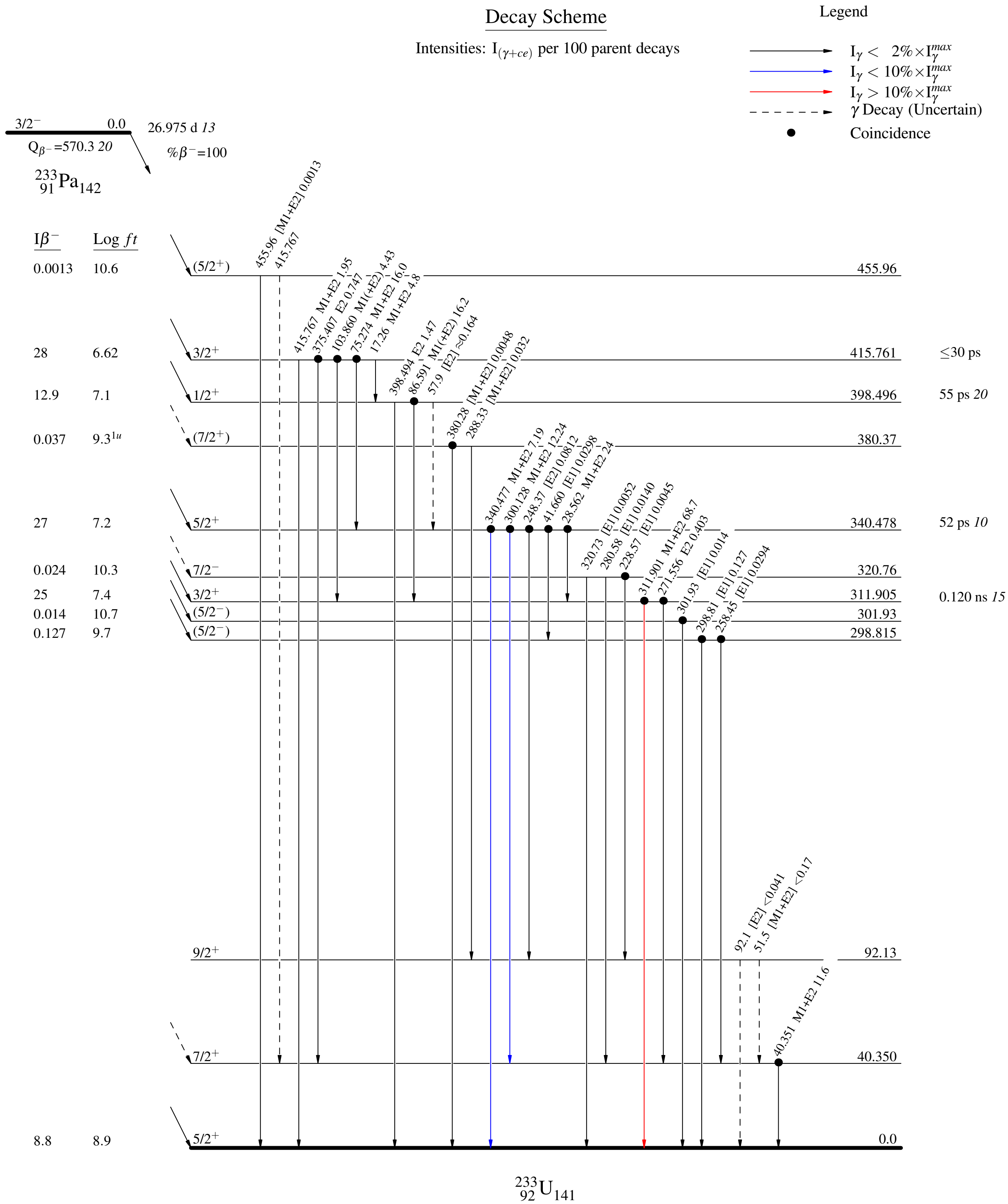
d Multiply placed.

e Placement of transition in the level scheme is uncertain.

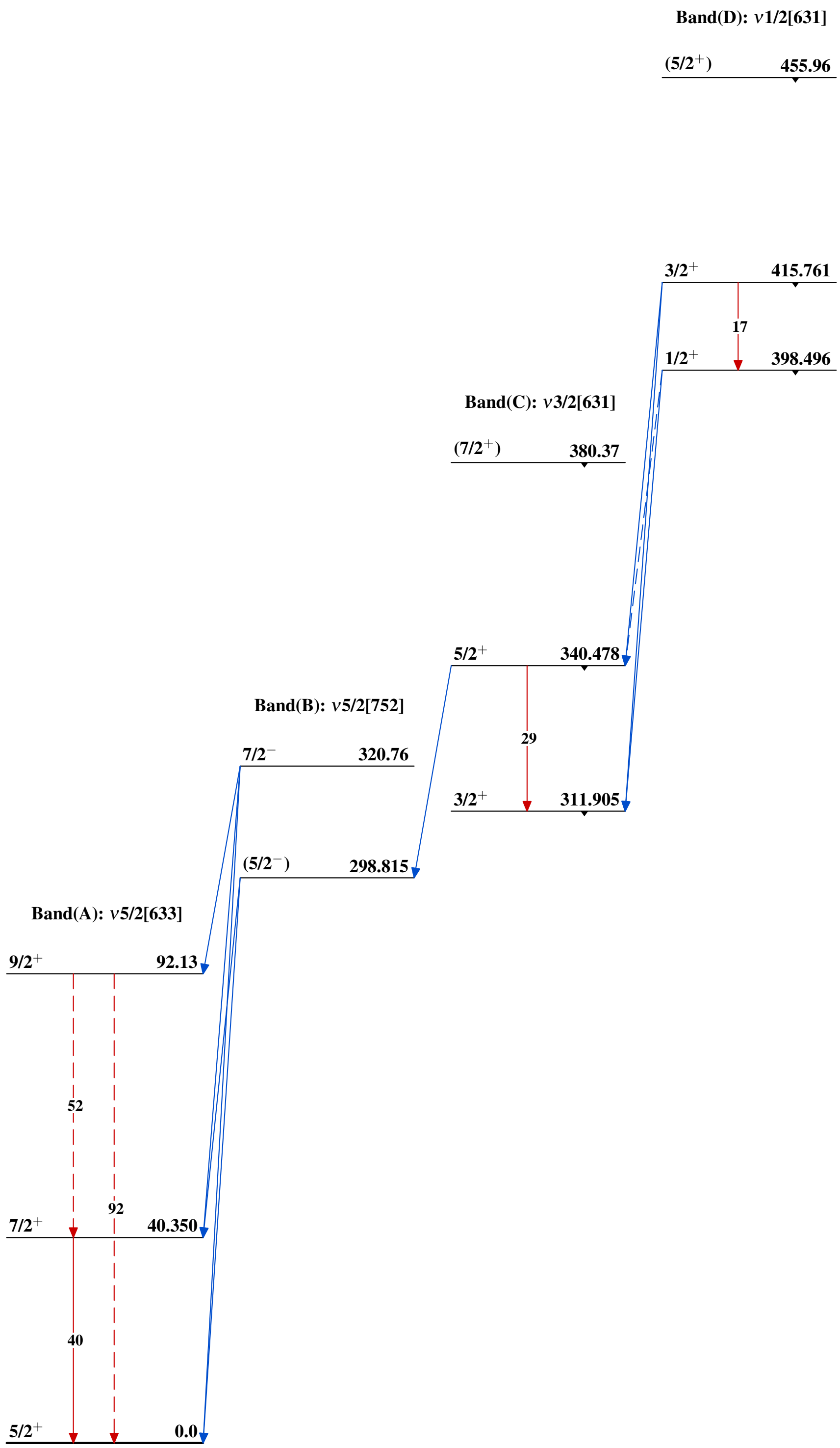
From ENSDF

$^{233}_{92}$U$_{141}$-13

^{233}Pa β^- decay (26.975 d) 2011Ko32,1990Ko41,2002Wo03



^{233}Pa β^- decay (26.975 d) 2011Ko32,1990Ko41,2002Wo03



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