^{230}Pa $\varepsilon+\beta^+$ decay 1994Ac02,1972Va24

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	C. Morse	NDS 197,259 (2024).	26-Sep-2023

Parent: ^{230}Pa: E=0.0; $J^\pi=2^-$; $T_{1/2}$=17.4 d *4*; Q(ε)=1311 *3*; %ε+%β^+ decay=92.3 *7*

^{230}Pa-Q(ε): From 2021Wa16.

1994Ac02: ^{230}Pa mass separated sources produced by ^{232}Th(p,3n). Measured Eγ, Iγ, conversion electrons. Detectors: Hyper pure germanium detectors for γ rays; magnetic iron-free orange spectrometer. Measured $\gamma\gamma(\theta,H)$ nuclear orientation.

1972Va24: ^{230}Pa mass separated sources produced by ^{232}Th(p,3n). Measured Eγ, Iγ, conversion electrons, $\gamma\gamma$ coin. Detectors: Ge(Li) and Si(Li) detectors for γ- and x-rays. NaI(Tl) crystal and Ge(Li) for $\gamma\gamma$ coin. Si(Au) detector for conversion electrons.

^{230}Th Levels

E(level)†	J^π	E(level)†	J^π	E(level)†	J^π	E(level)†	J^π
0.0	0^+	571.755 *15*	3^-	825.664 *21*	3^+	1012.46 *3*	3^-
53.232 *12*	2^+	634.914 *18*	0^+	951.892 *12*	1^-	1052.384 *23*	3^+
174.107 *20*	4^+	677.514 *17*	2^+	971.728 *17*	2^-	1079.218 *15*	2^-
508.150 *13*	1^-	781.376 *13*	2^+	1009.598 *14*	2^+	1127.790 *15*	3^-

† Deduced by evaluators from a least-squares fit to γ-ray energies.

ε,β^+ radiations

E(decay)	E(level)	Iε†	Log *ft*	I($\varepsilon+\beta^+$)†	Comments
(183.2 *32*)	1127.790	1.39 *6*	7.85 *4*	1.39 *6*	εK=0.431 *12*; εL=0.405 *8*; εM+=0.164 *4*
(231.8 *32*)	1079.218	2.85 *10*	7.874 *25*	2.84 *9*	εK=0.556 *6*; εL=0.320 *4*; εM+=0.1247 *17*
(258.6 *32*)	1052.384	0.088 *9*	9.53 *5*	0.088 *9*	εK=0.595 *4*; εL=0.292 *3*; εM+=0.1123 *12*
(298.5 *32*)	1012.46	0.66 *7*	8.83 *5*	0.66 *7*	εK=0.6355 *25*; εL=0.2645 *17*; εM+=0.0999 *8*
(301.4 *32*)	1009.598	2.88 *14*	8.20 *3*	2.87 *14*	εK=0.6378 *24*; εL=0.2629 *17*; εM+=0.0992 *8*
(339.3 *32*)	971.728	10.2 *4*	7.791 *23*	10.2 *4*	εK=0.6630 *17*; εL=0.2455 *12*; εM+=0.0915 *6*
(359.1 *32*)	951.892	43.4 *19*	7.228 *23*	43.3 *18*	εK=0.6733 *15*; εL=0.2383 *11*; εM+=0.0884 *5*
(485.3 *32*)	825.664	0.074 *9*	10.33 *6*	0.074 *9*	εK=0.7140 *7*; εL=0.2099 *5*; εM+=0.07603 *20*
(529.6 *32*)	781.376	3.56 *13*	8.736 *20*	3.55 *13*	εK=0.7226 *6*; εL=0.2039 *4*; εM+=0.07346 *16*
(739.2 *32*)	571.755	2.65 *16*	9.20 *3*	2.65 *16*	εK=0.7469 *3*; εL=0.1869 *2*; εM+=0.06619 *7*
(802.9 *32*)	508.150	1.3 *5*	9.59 *17*	1.3 *5*	εK=0.7514 *2*; εL=0.1838 *2*; εM+=0.06486 *6*
(1257.8 *32*)	53.232	24 *5*	8.75 *10*	24 *5*	εK=0.7689; εL=0.17144 *5*; εM+=0.05966 *2*

† Absolute intensity per 100 decays.

^{230}Pa $\varepsilon+\beta^+$ decay 1994Ac02,1972Va24 (continued)

$\gamma(^{230}Th)$

Iγ normalization: Decay-scheme normalization as well as β and ε branchings have been deduced by evaluator using relative γ-ray intensities, conversion coefficients, assuming no β^- or ε direct feeding to the g.s. of ^{230}Th and ^{230}U, respectively, and Σ(Iγ to g.s.)=100%.

E_γ[†]	I_γ[†‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[b]	Comments
53.22 *5*	42[@] *4*	53.232	2^+	0.0	0^+	E2	227.5 *33*	%Iγ=0.244 *23* α(L)=166.5 *25*; α(M)=45.6 *7*; α(N)=12.20 *18*; α(O)=2.71 *4*; α(P)=0.447 *7*; α(Q)=0.001238 *18* E_γ,I_γ: From 1972Va24. Mult.: From α(L)exp=200, K/L=2.9 (1972Va24).
120.90 *5*	61.7 *6*	174.107	4^+	53.232	2^+	E2	4.94 *7*	%Iγ=0.359 *4* α(K)=0.257 *4*; α(L)=3.42 *5*; α(M)=0.940 *13*; α(N)=0.252 *4*; α(O)=0.0562 *8*; α(P)=0.00936 *13* α(Q)=5.21×10^{-5} *7* I_γ: From 1972Va24. Other:67 *5* (1994Ac02).
126.7[f] *calc*	≤0.3[@]	634.914	0^+	508.150	1^-	[E1]		%Iγ=0.001744 *13*
169.39[f] *calc*	≤0.3[@]	677.514	2^+	508.150	1^-	[E1]		%Iγ=0.001744 *13*
170.53 *5*	1.0[@] *2*	951.892	1^-	781.376	2^+	E1[a]	0.1377 *19*	%Iγ=0.0058 *12* α(K)=0.1083 *15*; α(L)=0.02226 *31*; α(M)=0.00537 *8*; α(N)=0.001417 *20*; α(O)=0.000326 *5* α(P)=5.94×10^{-5} *8*; α(Q)=4.00×10^{-6} *6*
175.84 *5*	0.9[@] *2*	1127.790	3^-	951.892	1^-	E2[a]	1.069 *15*	%Iγ=0.0052 *12* α(K)=0.1962 *27*; α(L)=0.639 *9*; α(M)=0.1747 *25*; α(N)=0.0468 *7*; α(O)=0.01048 *15* α(P)=0.001762 *25*; α(Q)=1.723×10^{-5} *24*
183.90 *11*	0.5[@] *2*	1009.598	2^+	825.664	3^+	M1+E2[a]	2.1 *12*	%Iγ=0.0029 *12* α(K)=1.4 *12*; α(L)=0.513 *15*; α(M)=0.132 *12*; α(N)=0.0353 *33*; α(O)=0.0081 *5* α(P)=0.001462 *23*; α(Q)=8.E−5 *6*
228.23 *5*	1.1[@] *2*	1009.598	2^+	781.376	2^+	E0+M1+E2	1.1 *7*	%Iγ=0.0064 *12* α(K)=0.8 *7*; α(L)=0.241 *31*; α(M)=0.061 *4*; α(N)=0.0164 *11*; α(O)=0.00378 *35* α(P)=0.00069 *11*; α(Q)=4.2×10^{-5} *34* Mult.: From α(K)exp=77 *12*/1.1 *2*=70 *17*, and α(L)exp=14 *2*/1.1 *2*=13 *3*, deduced by evaluator from data reported in 1994Ac02. ce(L1)/ce(L3)≥35 (1994Ac02). See also 1970Lo02, 1971Ku25.
253.55 *2*	3.4 *2*	1079.218	2^-	825.664	3^+	E1[a]	0.0544 *8*	%Iγ=0.0198 *12* α(K)=0.0433 *6*; α(L)=0.00834 *12*; α(M)=0.002002 *28*; α(N)=0.000530 *7* α(O)=0.0001228 *17*; α(P)=2.276×10^{-5} *32*; α(Q)=1.687×10^{-6} *24*

$^{230}_{90}Th_{140}$-2

^{230}Pa $\varepsilon+\beta^+$ decay 1994Ac02,1972Va24 (continued)

$\gamma(^{230}Th)$ (continued)

E_γ[†]	I_γ[†‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[b]	Comments
274.38 *2*	12.6[@] *11*	951.892	1^-	677.514	2^+	E1[a]		0.0454 *6*	%Iγ=0.073 *6* α(K)=0.0363 *5*; α(L)=0.00690 *10*; α(M)=0.001656 *23*; α(N)=0.000438 *6* α(O)=0.0001017 *14*; α(P)=1.891×10^{-5} *26*; α(Q)=1.426×10^{-6} *20* I_γ: Other: 24.6 *6* (1972Va24).
294.23 *2*	9.6 *5*	971.728	2^-	677.514	2^+	E1[a]		0.0388 *5*	%Iγ=0.0558 *29* α(K)=0.0311 *4*; α(L)=0.00585 *8*; α(M)=0.001403 *20*; α(N)=0.000371 *5*; α(O)=8.63×10^{-5} *12* α(P)=1.609×10^{-5} *23*; α(Q)=1.231×10^{-6} *17* I_γ: Weighted average of 9.3 *13* (1972Va24) and 9.6 *5* (1994Ac02).
297.86 *2*	15 *1*	1079.218	2^-	781.376	2^+	E1[a]		0.0378 *5*	%Iγ=0.087 *6* α(K)=0.0303 *4*; α(L)=0.00569 *8*; α(M)=0.001363 *19*; α(N)=0.000361 *5*; α(O)=8.39×10^{-5} *12* α(P)=1.564×10^{-5} *22*; α(Q)=1.200×10^{-6} *17*
302.16 *4*	2.0[@] *2*	1127.790	3^-	825.664	3^+	E1[a]		0.0366 *5*	%Iγ=0.0116 *12* α(K)=0.0293 *4*; α(L)=0.00550 *8*; α(M)=0.001318 *18*; α(N)=0.000349 *5*; α(O)=8.11×10^{-5} *11* α(P)=1.514×10^{-5} *21*; α(Q)=1.164×10^{-6} *16*
316.99 *2*	29 *2*	951.892	1^-	634.914	0^+	[E1]		0.0329 *5*	%Iγ=0.169 *12* α(K)=0.0264 *4*; α(L)=0.00492 *7*; α(M)=0.001179 *17*; α(N)=0.000312 *4*; α(O)=7.26×10^{-5} *10* α(P)=1.357×10^{-5} *19*; α(Q)=1.054×10^{-6} *15*
332.07 *5*	8.0 *2*	1009.598	2^+	677.514	2^+	M1+E2	≤−0.4[&]	0.60 *4*	%Iγ=0.0465 *12* α(K)=0.479 *32*; α(L)=0.0925 *35*; α(M)=0.0223 *8*; α(N)=0.00595 *20*; α(O)=0.00141 *5* α(P)=0.000272 *11*; α(Q)=2.51×10^{-5} *16*
346.39 *3*	2.2[@] *2*	1127.790	3^-	781.376	2^+	E1[a]		0.0271 *4*	%Iγ=0.0128 *12* α(K)=0.02181 *31*; α(L)=0.00402 *6*; α(M)=0.000961 *13*; α(N)=0.000254 *4*; α(O)=5.93×10^{-5} *8* α(P)=1.111×10^{-5} *16*; α(Q)=8.78×10^{-7} *12*
374.67[d] *2*	8.4[d] *4*	1009.598	2^+	634.914	0^+	E2[a]		0.0888 *12*	%Iγ=0.0488 *24* α(K)=0.0470 *7*; α(L)=0.0309 *4*; α(M)=0.00818 *11*; α(N)=0.002188 *31*; α(O)=0.000497 *7* α(P)=8.69×10^{-5} *12*; α(Q)=2.75×10^{-6} *4*
374.67[d]	8.4[d] *4*	1052.384	3^+	677.514	2^+	M1+E2[a]		0.27 *18*	%Iγ=0.0488 *24* α(K)=0.21 *16*; α(L)=0.050 *19*; α(M)=0.012 *4*; α(N)=0.0033 *11*; α(O)=7.7×10^{-4} *27* α(P)=1.4×10^{-4} *6*; α(Q)=1.1×10^{-5} *8* Eγ=374.77 (possibly a typographical error) in 1972Va24.

$^{230}_{90}Th_{140}$-3

^{230}Pa $\varepsilon+\beta^+$ decay 1994Ac02,1972Va24 (continued)

$\gamma(^{230}Th)$ (continued)

E_γ [†]	I_γ [†‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[b]	Comments
380.12 *2*	57 *3*	951.892	1^-	571.755	3^-	E2		0.0854 *12*	%Iγ=0.331 *18* α(K)=0.0457 *6*; α(L)=0.0293 *4*; α(M)=0.00776 *11*; α(N)=0.002077 *29*; α(O)=0.000472 *7* α(P)=8.26×10^{-5} *12*; α(Q)=2.67×10^{-6} *4* Mult.: From Adopted Gammas.
397.62 *2*	324 *15*	571.755	3^-	174.107	4^+	E1		0.02019 *28*	%Iγ=1.88 *9* α(K)=0.01630 *23*; α(L)=0.00295 *4*; α(M)=0.000704 *10*; α(N)=0.0001866 *26* α(O)=4.36×10^{-5} *6*; α(P)=8.20×10^{-6} *11*; α(Q)=6.65×10^{-7} *9*
399.95 *2*	112 *7*	971.728	2^-	571.755	3^-	M1+E2	1.4[&] *6*	0.18 *8*	%Iγ=0.65 *4* α(K)=0.13 *7*; α(L)=0.036 *9*; α(M)=0.0089 *20*; α(N)=0.0024 *5*; α(O)=0.00056 *13* α(P)=1.03×10^{-4} *27*; α(Q)=7.E−6 *4* Mult.: From α(K)exp=0.41, K/L=8.5 (1972Va24).
401.62 *10*	3.0[@] *5*	1079.218	2^-	677.514	2^+	E1[a]		0.01977 *28*	%Iγ=0.0174 *29* α(K)=0.01596 *22*; α(L)=0.00289 *4*; α(M)=0.000689 *10*; α(N)=0.0001825 *26* α(O)=4.26×10^{-5} *6*; α(P)=8.03×10^{-6} *11*; α(Q)=6.52×10^{-7} *9*
440.78 *10*	17[@] *3*	1012.46	3^-	571.755	3^-	M1+E2[a]		0.18 *12*	%Iγ=0.099 *17* α(K)=0.14 *10*; α(L)=0.031 *13*; α(M)=0.0076 *30*; α(N)=0.0020 *8*; α(O)=4.7×10^{-4} *19* α(P)=9.E−5 *4*; α(Q)=7.E−6 *5*
443.74 *2*	1.00×10^3 *5*	951.892	1^-	508.150	1^-	M1+E2	0.55[&] *2*	0.236 *4*	%Iγ=5.81 *29* α(K)=0.186 *4*; α(L)=0.0373 *6*; α(M)=0.00903 *15*; α(N)=0.00241 *4*; α(O)=0.000568 *9* α(P)=0.0001091 *18*; α(Q)=9.72×10^{-6} *19* Mult.: From α(K)exp=0.22, K/L/M=113/20/8 (1972Va24). δ: δ=1.80 *7* is also possible from γγ(θ,T,H).
450.22	≈2[@]	1127.790	3^-	677.514	2^+	E1		0.01560 *22*	%Iγ≈0.01163 α(K)=0.01263 *18*; α(L)=0.002252 *32*; α(M)=0.000537 *8*; α(N)=0.0001422 *20* α(O)=3.33×10^{-5} *5*; α(P)=6.29×10^{-6} *9*; α(Q)=5.21×10^{-7} *7* Seen only in a coincident spectrum (1971Ko25).
454.92 *2*	1164 *57*	508.150	1^-	53.232	2^+	E1		0.01528 *21*	%Iγ=6.77 *34* α(K)=0.01237 *17*; α(L)=0.002202 *31*; α(M)=0.000525 *7*; α(N)=0.0001391 *19* α(O)=3.25×10^{-5} *5*; α(P)=6.15×10^{-6} *9*; α(Q)=5.10×10^{-7} *7* Mult.: From α(K)exp=0.013 (1972Va24).
463.59 *6*	148 *10*	971.728	2^-	508.150	1^-	M1+E2	−0.28[&] *3*	0.242 *5*	%Iγ=0.86 *6* α(K)=0.194 *4*; α(L)=0.0368 *6*; α(M)=0.00884 *15*;

$^{230}_{90}Th_{140}$-4

^{230}Pa $\varepsilon+\beta^+$ decay 1994Ac02,1972Va24 (continued)

$\gamma(^{230}Th)$ (continued)

E_γ[†]	I_γ[†‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[b]	Comments
									α(N)=0.00236 *4*; α(O)=0.000557 *9* α(P)=0.0001079 *18*; α(Q)=1.008×10^{-5} *20* δ: δ=−1.23 *7* is also possible from $\gamma\gamma(\theta$,T,H). Mult.: From α(K)exp=0.15 (1972Va24).
503.55[e] *10*	9.5[e@] *15*	677.514	2$^+$	174.107	4$^+$	E2[a]		0.0420 *6*	%Iγ=0.055 *9* α(K)=0.0266 *4*; α(L)=0.01141 *16*; α(M)=0.00296 *4*; α(N)=0.000792 *11*; α(O)=0.0001813 *25* α(P)=3.24×10^{-5} *5*; α(Q)=1.463×10^{-6} *20*
503.6[e] *10*	≤3[e@]	1012.46	3$^-$	508.150	1$^-$	[E2]		0.0420 *6*	%Iγ=0.01744 *13* α(K)=0.0266 *4*; α(L)=0.01141 *18*; α(M)=0.00296 *5*; α(N)=0.000791 *12*; α(O)=0.0001812 *28* α(P)=3.24×10^{-5} *5*; α(Q)=1.463×10^{-6} *21* E_γ: 503.55 keV *10* as measured in 1994Ac02 is inconsistent with final-state energy. Therefore, and in light of the fact that this γ ray is multiply placed, the evaluator has increased the uncertainty to 1 keV.
507.48[f]		1079.218	2$^-$	571.755	3$^-$				Possibly masked by a strong unresolved γ ray (1994Ac02).
508.15 *2*	705 *34*	508.150	1$^-$	0.0	0$^+$	E1		0.01222 *17*	%Iγ=4.10 *20* α(K)=0.00992 *14*; α(L)=0.001743 *24*; α(M)=0.000415 *6*; α(N)=0.0001099 *15* α(O)=2.57×10^{-5} *4*; α(P)=4.88×10^{-6} *7*; α(Q)=4.13×10^{-7} *6* Mult.: From α(K)exp=0.0061 (1972Va24).
518.54 *2*	374 *18*	571.755	3$^-$	53.232	2$^+$	E1		0.01174 *16*	%Iγ=2.17 *11* α(K)=0.00953 *13*; α(L)=0.001671 *23*; α(M)=0.000398 *6*; α(N)=0.0001054 *15* α(O)=2.468×10^{-5} *35*; α(P)=4.68×10^{-6} *7*; α(Q)=3.97×10^{-7} *6* Mult.: From α(K)exp=0.0075 (1970Lo02).
556.06 *2*	35 *2*	1127.790	3$^-$	571.755	3$^-$	M1+E2		0.10 *6*	%Iγ=0.204 *12* α(K)=0.07 *5*; α(L)=0.016 *8*; α(M)=0.0039 *17*; α(N)=0.0010 *5*; α(O)=2.4×10^{-4} *11* α(P)=4.7×10^{-5} *23*; α(Q)=3.9×10^{-6} *27* Mult.: α(L)exp=0.018 (1971Ku25).
571.08 *2*	190 *10*	1079.218	2$^-$	508.150	1$^-$	M1+E2	0.11[&] *2*	0.1457 *21*	%Iγ=1.10 *6* α(K)=0.1169 *17*; α(L)=0.02174 *31*; α(M)=0.00521 *7*; α(N)=0.001389 *20*; α(O)=0.000329 *5* α(P)=6.38×10^{-5} *9*; α(Q)=6.05×10^{-6} *9* Mult.: From α(K)exp=0.018 (1972Va24).
581.65 *10*	21 *1*	634.914	0$^+$	53.232	2$^+$	E2		0.0302 *4*	%Iγ=0.122 *6* α(K)=0.02029 *28*; α(L)=0.00735 *10*; α(M)=0.001884 *26*; α(N)=0.000503 *7*

$^{230}_{90}Th_{140}$-5

^{230}Pa $\varepsilon+\beta^+$ decay 1994Ac02,1972Va24 (continued)

$\gamma(^{230}Th)$ (continued)

E_γ[†]	I_γ[†‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[b]	Comments
									α(O)=0.0001158 *16*; α(P)=2.094×10^{-5} *29*; α(Q)=1.089×10^{-6} *15* Mult.: From α(K)exp=0.019 (1971Ku25).
607.41 *8*	9.5 *2*	781.376	2$^+$	174.107	4$^+$	E2[a]		0.0274 *4*	%Iγ=0.0552 *12* α(K)=0.01873 *26*; α(L)=0.00647 *9*; α(M)=0.001654 *23*; α(N)=0.000442 *6* α(O)=0.0001018 *14*; α(P)=1.846×10^{-5} *26*; α(Q)=9.98×10^{-7} *14*
619.66 *2*	31 *2*	1127.790	3$^-$	508.150	1$^-$	E2		0.0263 *4*	%Iγ=0.180 *12* α(K)=0.01805 *25*; α(L)=0.00611 *9*; α(M)=0.001559 *22*; α(N)=0.000417 *6*; α(O)=9.60×10^{-5} *13* α(P)=1.744×10^{-5} *24*; α(Q)=9.59×10^{-7} *13*
624.33 *7*	9.7 *5*	677.514	2$^+$	53.232	2$^+$	E0+M1+E2		0.07 *5*	%Iγ=0.0564 *29* α(K)=0.06 *4*; α(L)=0.012 *6*; α(M)=0.0028 *13*; α(N)=7.5×10^{-4} *35*; α(O)=1.8×10^{-4} *8* α(P)=3.4×10^{-5} *17*; α(Q)=2.9×10^{-6} *19* Mult.: From α(K)exp=4.1, K/L=5.7 (1972Va24).
634.9 *2*		634.914	0$^+$	0.0	0$^+$	E0			Only electrons were observed, I(ce(K))=21, Ice=29 *6* (1972Va24).
651.61 *6*	4.1 *6*	825.664	3$^+$	174.107	4$^+$	M1+E2[a]		0.06 *4*	%Iγ=0.0238 *35* α(K)=0.050 *33*; α(L)=0.010 *5*; α(M)=0.0025 *12*; α(N)=6.7×10^{-4} *31*; α(O)=1.6×10^{-4} *7* α(P)=3.0×10^{-5} *15*; α(Q)=2.6×10^{-6} *17*
677.53 *6*	11 *1*	677.514	2$^+$	0.0	0$^+$	E2[a]		0.02170 *30*	%Iγ=0.064 *6* α(K)=0.01533 *21*; α(L)=0.00475 *7*; α(M)=0.001204 *17*; α(N)=0.000322 *5*; α(O)=7.43×10^{-5} *10* α(P)=1.359×10^{-5} *19*; α(Q)=8.03×10^{-7} *11* %Iγ=0.064 *7*, using the calculated normalization.
728.13 *2*	349 *17*	781.376	2$^+$	53.232	2$^+$	M1+E2	12[&] *2*	0.01908 *32*	%Iγ=2.03 *10* α(K)=0.01378 *24*; α(L)=0.00396 *6*; α(M)=0.000998 *15*; α(N)=0.000266 *4*; α(O)=6.17×10^{-5} *9* α(P)=1.135×10^{-5} *17*; α(Q)=7.14×10^{-7} *13* Mult.: From α(K)exp=0.019 (1972Va24).
772.41 *6*	15 *1*	825.664	3$^+$	53.232	2$^+$	M1+E2[a]		0.041 *25*	%Iγ=0.087 *6* α(K)=0.033 *20*; α(L)=0.0066 *32*; α(M)=0.0016 *7*; α(N)=4.2×10^{-4} *20*; α(O)=1.0×10^{-4} *5* α(P)=1.9×10^{-5} *10*; α(Q)=1.7×10^{-6} *11* Mult.: α(K)exp=0.022 (1971Ku25).
781.39 *2*	263 *13*	781.376	2$^+$	0.0	0$^+$	E2		0.01618 *23*	%Iγ=1.53 *8* α(K)=0.01184 *17*; α(L)=0.00325 *5*; α(M)=0.000815 *11*; α(N)=0.0002174 *30* α(O)=5.04×10^{-5} *7*; α(P)=9.32×10^{-6} *13*; α(Q)=6.08×10^{-7} *9*

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^{230}Pa $\varepsilon+\beta^+$ decay 1994Ac02,1972Va24 (continued)

$\gamma(^{230}Th)$ (continued)

E_γ [†]	I_γ [†‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[b]	Comments
									%Iγ=1.53 *12*, using the calculated normalization. Mult.: From α(K)exp=0.0089 (1972Va24).
835.59 *8*	10 *1*	1009.598	2+	174.107	4+	E2[a]		0.01415 *20*	%Iγ=0.058 *6* α(K)=0.01050 *15*; α(L)=0.00274 *4*; α(M)=0.000683 *10*; α(N)=0.0001823 *26* α(O)=4.24×10^{-5} *6*; α(P)=7.86×10^{-6} *11*; α(Q)=5.35×10^{-7} *7*
838.45 *5*	6 *2*	1012.46	3−	174.107	4+	E1[a]		0.00473 *7*	%Iγ=0.035 *12* α(K)=0.00388 *5*; α(L)=0.000649 *9*; α(M)=0.0001534 *21*; α(N)=4.07×10^{-5} *6*; α(O)=9.57×10^{-6} *13* α(P)=1.837×10^{-6} *26*; α(Q)=1.659×10^{-7} *23* I_γ: From 1972Va24.
878.02 *10*	1.6[@] *2*	1052.384	3+	174.107	4+	M1+E2[a]		0.030 *17*	%Iγ=0.0093 *12* α(K)=0.024 *14*; α(L)=0.0047 *23*; α(M)=0.0011 *5*; α(N)=3.0×10^{-4} *14*; α(O)=7.1×10^{-5} *34* α(P)=1.4×10^{-5} *7*; α(Q)=1.2×10^{-6} *7*
898.66 *2*	1.00×10^3 *6*	951.892	1−	53.232	2+	E1		0.00418 *6*	%Iγ=5.81 *35* α(K)=0.00343 *5*; α(L)=0.000570 *8*; α(M)=0.0001347 *19*; α(N)=3.57×10^{-5} *5*; α(O)=8.41×10^{-6} *12* α(P)=1.617×10^{-6} *23*; α(Q)=1.471×10^{-7} *21* Mult.: From α(K)exp=0.0028 (1972Va24).
918.50 *2*	1.43×10^3 *7*	971.728	2−	53.232	2+	E1		0.00402 *6*	%Iγ=8.3 *4* α(K)=0.00330 *5*; α(L)=0.000548 *8*; α(M)=0.0001294 *18*; α(N)=3.43×10^{-5} *5*; α(O)=8.08×10^{-6} *11* α(P)=1.553×10^{-6} *22*; α(Q)=1.417×10^{-7} *20* Mult.: From α(K)exp=0.0026 (1972Va24).
951.88 *2*	5.1×10^3 *3*	951.892	1−	0.0	0+	E1		0.00377 *5*	%Iγ=29.7 *18* α(K)=0.00310 *4*; α(L)=0.000513 *7*; α(M)=0.0001211 *17*; α(N)=3.21×10^{-5} *4*; α(O)=7.57×10^{-6} *11* α(P)=1.456×10^{-6} *20*; α(Q)=1.333×10^{-7} *19* %Iγ=29.6 *21*, using the calculated normalization. Mult.: From α(K)exp=0.0033, K/L=9.5 (1972Va24).
953.66	30 *7*	1127.790	3−	174.107	4+	E1[a]		0.00376 *5*	%Iγ=0.17 *4* α(K)=0.00309 *4*; α(L)=0.000511 *7*; α(M)=0.0001207 *17*; α(N)=3.20×10^{-5} *4*; α(O)=7.54×10^{-6} *11* α(P)=1.451×10^{-6} *20*; α(Q)=1.328×10^{-7} *19* Not reported in 1972Va24.
956.38 *2*	270 *22*	1009.598	2+	53.232	2+	M1+E2	6.1[&] *4*	0.01157 *19*	%Iγ=1.57 *13* α(K)=0.00883 *15*; α(L)=0.002063 *32*; α(M)=0.000509 *8*;

$^{230}_{90}Th_{140}$-7

^{230}Pa $\varepsilon+\beta^+$ decay 1994Ac02,1972Va24 (continued)

$\gamma(^{230}Th)$ (continued)

E_γ [†]	I_γ [†‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	α [b]	Comments
								α(N)=0.0001357 *21* α(O)=3.17×10^{-5} *5*; α(P)=5.94×10^{-6} *9*; α(Q)=4.43×10^{-7} *7* Mult.: α(K)exp=0.0052 (1971Ku25).
959.28 *4*	85 *11*	1012.46	3$^-$	53.232	2$^+$	[E1]	0.00372 *5*	%Iγ=0.49 *6* α(K)=0.00305 *4*; α(L)=0.000506 *7*; α(M)=0.0001194 *17*; α(N)=3.17×10^{-5} *4*; α(O)=7.46×10^{-6} *10* α(P)=1.435×10^{-6} *20*; α(Q)=1.315×10^{-7} *18*
999.16 *2*	2.8[@] *2*	1052.384	3$^+$	53.232	2$^+$	[E2]	0.01000 *14*	%Iγ=0.0163 *12* α(K)=0.00764 *11*; α(L)=0.001776 *25*; α(M)=0.000438 *6*; α(N)=0.0001168 *16* α(O)=2.73×10^{-5} *4*; α(P)=5.11×10^{-6} *7*; α(Q)=3.81×10^{-7} *5* Mult.: Assumed E2. M1 would be a K-forbidden transition.
1009.59 *2*	184 *10*	1009.598	2$^+$	0.0	0$^+$	E2[a]	0.00980 *14*	%Iγ=1.07 *6* α(K)=0.00750 *10*; α(L)=0.001734 *24*; α(M)=0.000427 *6*; α(N)=0.0001139 *16* α(O)=2.66×10^{-5} *4*; α(P)=4.99×10^{-6} *7*; α(Q)=3.74×10^{-7} *5* %Iγ=1.07 *9*, using the calculated normalization. Mult.: α(K)exp=0.008 (1972Va24).
1025.96 *2*	249 *11*	1079.218	2$^-$	53.232	2$^+$	E1	0.00330 *5*	%Iγ=1.45 *6* α(K)=0.00272 *4*; α(L)=0.000448 *6*; α(M)=0.0001056 *15*; α(N)=2.80×10^{-5} *4*; α(O)=6.60×10^{-6} *9* α(P)=1.272×10^{-6} *18*; α(Q)=1.173×10^{-7} *16* Mult.: From α(K)exp=0.0023 (1970Lo02).
1074.52 *2*	130 *7*	1127.790	3$^-$	53.232	2$^+$	E1	0.00305 *4*	%Iγ=0.76 *4* α(K)=0.002506 *35*; α(L)=0.000412 *6*; α(M)=9.71×10^{-5} *14*; α(N)=2.58×10^{-5} *4*; α(O)=6.08×10^{-6} *9* α(P)=1.171×10^{-6} *16*; α(Q)=1.084×10^{-7} *15* Mult.: From α(K)exp=0.0021 (1970Lo02).

† From 1994Ac02, unless otherwise specified.
‡ Weighted average of values from 1972Va24 and 1994Ac02.
# From conversion electron data reported in 1972Va24, using conversion coefficients normalized to α(L)exp(121γ, E2)=3.4 (theory), unless otherwise specified.
@ From 1994Ac02.
& From $\gamma\gamma(\theta$,H) in 1994Ac02.
a From conversion electron data (1994Ac02).
b Additional information 1.
c For absolute intensity per 100 decays, multiply by 0.0058.
d Multiply placed with undivided intensity.
e Multiply placed with intensity suitably divided.
f Placement of transition in the level scheme is uncertain.

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