^{227}Ra β^- decay (42.2 min) 1971Lo15

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Ictp-2014 Workshop Group	NDS 132, 257 (2016)	15-Jan-2016

Parent: ^{227}Ra: E=0.0; $J^\pi=3/2^+$; $T_{1/2}$=42.2 min *5*; Q(β^-)=1328.4 *23*; %β^- decay=100.0

^{227}Ra-J^π,$T_{1/2}$: From ^{227}Ra Adopted Levels.

^{227}Ra-Q(β^-): From 2012Wa38.

1971Lo15: measured $T_{1/2}$, Eβ, Iβ, Eγ, Iγ, $\gamma\gamma$-coin; deduced Q value, log *ft* values, levels, J, π. Sources were produced in neutron irradiation of ^{226}Ra and of about 30 μCi strength were used.

Others:

1953Bu63: measured Eβ, Eγ. Three γ rays were reported.

1982Ba56: precise measurements of ^{227}Ac KL_3 x-ray energy a Dumond-type curved crystal spectrometer. Value=90.895 keV *12*.

^{227}Ac Levels

E(level)[†]	J^π[‡]	$T_{1/2}$	E(level)[†]	J^π[‡]
0.0	$3/2^-$	21.772 y *3*	428.39? *18*	
27.372 *19*	$3/2^+$	38.3 ns *3*	435.37 *8*	$1/2^+$
29.95 *4*	$5/2^-$		501.27 *8*	$(1/2^-,3/2,5/2^-)$
46.40 *4*	$5/2^+$		514.37 *9*	$(3/2,5/2)^+$
74.29 *9*	$7/2^-$		537.01 *11*	$(3/2^+)$
84.61 *8*	$7/2^+$		562.81 *14*	$(3/2^+,5/2^+)$
273.13 *5*	$(5/2)^-$		639.09 *15*	$1/2^+$
304.73 *7*	$(5/2^+)$		698.59 *15*	$(3/2)^+$
330.09 *5*	$3/2^-$		790.11 *17*	$(1/2^-,3/2,5/2)$
354.59 *15*	$1/2^-$		863.64 *22*	(1/2,3/2,5/2)
425.75 *8*	$5/2^+$		874.69 *18*	$(1/2^+,3/2,5/2)$

[†] Deduced by evaluators from a least-squares fit to γ-ray energies, reduced χ^2=1.1.

[‡] From Adopted Levels. See also Adopted Levels for band structures, Nilsson assignments and parity doublet bands.

β^- radiations

E(decay)	E(level)	Iβ^-[†#]	Log *ft*[‡]	Comments
(453.7 *23*)	874.69	0.13	7.4	av Eβ=131.78 *75*
(464.8 *23*)	863.64	0.22	7.2	av Eβ=135.40 *78*
(538.3 *23*)	790.11	0.25	7.4	av Eβ=159.63 *77*
				Eβ=550 keV *80*, Iβ(rel)=10 *5*, semi.
(629.8 *23*)	698.59	0.34	7.4	av Eβ=190.66 *80*
(689.3 *23*)	639.09	1.3	7.0	av Eβ=211.26 *81*
(765.6 *23*)	562.81	1.9	7.0	av Eβ=238.15 *82*
				Eβ=745 keV *50*, Iβ(rel)=20 *10*, semi.
(791.4 *23*)	537.01	0.38	7.7	av Eβ=247.36 *83*
(814.0 *23*)	514.37	2.4	7.0	av Eβ=255.49 *83*
(827.1 *23*)	501.27	1.5	7.2	av Eβ=260.21 *83*
(893.0 *23*)	435.37	2.9	7.0	av Eβ=284.15 *85*
(900.0 *23*)	428.39?	0.15	8.3	av Eβ=286.70 *85*
(902.7 *23*)	425.75	0.79	7.6	av Eβ=287.67 *85*
(973.8 *23*)	354.59	1.0	7.6	av Eβ=313.87 *86*
(998.3 *23*)	330.09	19.0	6.4	av Eβ=322.98 *86*
(1023.7 *23*)	304.73	4.0	7.1	av Eβ=332.44 *86*
				Eβ=1026 keV *20*, Iβ(rel)=45 *5*, semi.
(1055.3 *23*)	273.13	2.0	7.5	av Eβ=344.29 *87*
(1254.1[@] *23*)	74.29	<9	>7.7[1u]	av Eβ=406.61 *83*

Continued on next page (footnotes at end of table)

^{227}Ra β^- decay (42.2 min) 1971Lo15 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^-[†#]	Log ft[‡]	Comments
(1282.0 *23*)	46.40	25.2	6.7	av Eβ=430.92 *90*
(1301.0 *23*)	27.372	37.2	6.5	av Eβ=438.30 *90* Eβ=1300 keV *15*, Iβ(rel)=100, semi.

† The β^- feedings to the individual levels were deduced by the evaluators from γ-ray transition intensity balances. Such feedings should be considered approximate because the uncertainties in the γ-ray intensities are unknown.

‡ Values considered as approximate since β feedings are approximate.

Absolute intensity per 100 decays.

@ Existence of this branch is questionable.

$\gamma(^{227}Ac)$

Iγ normalization: 1971Lo15 presented γ-ray intensities on an absolute scale, but the normalization method was not given. The normalization shown here assumes no β^- feeding to the g.s. and thus ΣI(γ+ce) (γ rays to g.s.)=100%. The corresponding absolute γ-ray intensities are ≈15% lower than those reported by 1971Lo15.

E_γ[†]	I_γ[†a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[&]	Comments
16.5 *1*	0.26	46.40	$5/2^+$	29.95	$5/2^-$	[E1]		8.58 *12*	E_γ,I_γ: from Adopted Gammas. α(L)=2.34 *4*; α(M)=82.5 *12*; α(N)=21.9 *3*; α(O)=5.09 *8*; α(P)=0.942 *14*; α(Q)=0.0840 *12*
19.6	0.32	46.40	$5/2^+$	27.372	$3/2^+$	[M1]		112.8	E_γ,I_γ: from Adopted Gammas. α(L)=153 *3*; α(M)=37.0 *7* α(N)=9.81 *18*; α(O)=2.28 *5*; α(P)=0.422 *8*; α(Q)=0.0376 *7*
24.9[c] *1*	≈0.038	354.59	$1/2^-$	330.09	$3/2^-$	[M1]		203 *4*	I_γ: from Adopted Gammas. Iγ≈0.3 (1971Lo15). α(L)=2.0×10^2 *4*; α(M)=52 *9* α(N)=13.8 *23*; α(O)=3.1 *5*; α(P)=0.52 *8*; α(Q)=0.0213 *4*
27.37 *2*	17.4	27.372	$3/2^+$	0.0	$3/2^-$	E1(+M2)	<0.0020	4.5 *4*	
29.95 *4*	0.036	29.95	$5/2^-$	0.0	$3/2^-$	M1+E2	0.22 *3*	2.7×10^2 *5*	α(L)=69 *28*; α(M)=17.4 *76* α(N)=4.6 *20*; α(O)=1.04 *44*; α(P)=0.180 *67*; α(Q)=0.0104 *3*
(38.2[#])	<0.02	84.61	$7/2^+$	46.40	$5/2^+$	M1+E2	0.19 *9*	92 *38*	α(L)=28.2 *4*; α(M)=6.77 *10* α(N)=1.80 *3*; α(O)=0.418 *6*; α(P)=0.0774 *11*; α(Q)=0.00689 *10*
(44.2[#])	<0.27	74.29	$7/2^-$	29.95	$5/2^-$	[M1]		37.3	α(L)=0.662 *10*; α(M)=0.1631 *24* α(N)=0.0423 *6*; α(O)=0.00912 *13*; α(P)=0.001415 *20*; α(Q)=5.88×10^{-5} *9*
46.38 *4*	0.19	46.40	$5/2^+$	0.0	$3/2^-$	(E1)		0.878	α(L)=0.429 *6*; α(M)=0.1052 *15* α(N)=0.0273 *4*; α(O)=0.00594 *9*; α(P)=0.000940 *14*; α(Q)=4.17×10^{-5} *6*
54.6[c]	<0.01	84.61	$7/2^+$	29.95	$5/2^-$	[E1]		0.569	α(L)=109.4 *18*; α(M)=29.8 *5* α(N)=7.93 *13*; α(O)=1.72 *3*; α(P)=0.268 *5*; α(Q)=0.000693 *11*
57.1[b@] *1*	<0.004[b]	84.61	$7/2^+$	27.372	$3/2^+$	(E2)		149.1 *25*	I_γ: from Adopted Gammas. E_γ: placement from the 330 level is considered as questionable since not confirmed in ^{231}Pa α decay. α(L)=31.1 *6*; α(M)=8.49 *17* α(N)=2.26 *5*; α(O)=0.491 *10*; α(P)=0.0766 *15*; α(Q)=0.000233 *5*
57.1[b@] *1*	0.024[b]	330.09	$3/2^-$	273.13	$(5/2)^-$	[M1+E2]		83 *66*	I_γ: from I(γ+ce)=0.7 and α(E2)=42.4.
74.2 *2*	0.016	74.29	$7/2^-$	0.0	$3/2^-$	[E2]		42.4 *8*	
146.9[c] *5*	<0.3	501.27	$(1/2^-,3/2,5/2^-)$	354.59	$1/2^-$				
198.9 *2*	0.03	273.13	$(5/2)^-$	74.29	$7/2^-$	[M1+E2]		1.5 *9*	

$^{227}_{89}Ac_{138}$-3

^{227}Ra β^- decay (42.2 min) 1971Lo15 (continued)

$\gamma(^{227}Ac)$ (continued)

E_γ[†]	I_γ[†a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[&]	Comments
209.6 *2*	0.11	514.37	$(3/2,5/2)^+$	304.73	$(5/2^+)$				
[x]218.19 *10*	0.21								
219.90 *15*	0.21	304.73	$(5/2^+)$	84.61	$7/2^+$	[M1+E2]		1.1 *7*	
226.6 *1*	0.03	273.13	$(5/2)^-$	46.40	$5/2^+$	[E1]		0.0688	α(K)=0.0548 *8*; α(L)=0.01057 *15*; α(M)=0.00253 *4* α(N)=0.000666 *10*; α(O)=0.0001511 *22*; α(P)=2.65×10^{-5} *4*; α(Q)=1.81×10^{-6} *3*
228.00 *10*	0.42	501.27	$(1/2^-,3/2,5/2^-)$	273.13	$(5/2)^-$				
232.20 *10*	0.30	537.01	$(3/2^+)$	304.73	$(5/2^+)$	[M1+E2]		0.97 *61*	
[x]242.1 *2*	0.03								
243.15 *10*	0.54	273.13	$(5/2)^-$	29.95	$5/2^-$	M1+E2	1.1 *3*	0.80 *17*	α(K)=0.56 *16*; α(L)=0.176 *10*; α(M)=0.0445 *16* α(N)=0.0118 *5*; α(O)=0.00268 *12*; α(P)=0.00046 *3*; α(Q)=2.60×10^{-5} *70*
245.9 *1*	0.03	273.13	$(5/2)^-$	27.372	$3/2^+$	[E1]		0.0569	α(K)=0.0455 *7*; α(L)=0.00865 *13*; α(M)=0.00207 *3* α(N)=0.000545 *8*; α(O)=0.0001239 *18*; α(P)=2.18×10^{-5} *3*; α(Q)=1.517×10^{-6} *22*
255.76 *10*	0.20	330.09	$3/2^-$	74.29	$7/2^-$	E2		0.265	α(K)=0.0993 *14*; α(L)=0.1219 *18*; α(M)=0.0328 *5* α(N)=0.00872 *13*; α(O)=0.00192 *3*; α(P)=0.000311 *5*; α(Q)=5.37×10^{-6} *8*
258.30 *10*	2.0	304.73	$(5/2^+)$	46.40	$5/2^+$	[M1+E2]		0.7 *5*	
[x]259.7 *2*	0.03								
273.15 *10*	0.96	273.13	$(5/2)^-$	0.0	$3/2^-$	M1+E2	0.7 *3*	0.74 *15*	α(K)=0.57 *14*; α(L)=0.131 *11*; α(M)=0.0323 *21* α(N)=0.0086 *6*; α(O)=0.00197 *15*; α(P)=0.00035 *4*; α(Q)=2.6×10^{-5} *6*
277.39 *10*	2.9	304.73	$(5/2^+)$	27.372	$3/2^+$	[M1+E2]		0.6 *4*	
283.68 *10*	3.4	330.09	$3/2^-$	46.40	$5/2^+$	E1		0.0410	α(K)=0.0329 *5*; α(L)=0.00614 *9*; α(M)=0.001468 *21* α(N)=0.000386 *6*; α(O)=8.81×10^{-5} *13*; α(P)=1.561×10^{-5} *22*; α(Q)=1.117×10^{-6} *16*
300.09 *10*	5.1	330.09	$3/2^-$	29.95	$5/2^-$	M1+E2	−0.12 *7*	0.764 *17*	α(K)=0.613 *15*; α(L)=0.1145 *20*; α(M)=0.0274 *5* α(N)=0.00728 *12*; α(O)=0.00169 *3*; α(P)=0.000313 *6*; α(Q)=2.75×10^{-5} *7*
302.68 *10*	4.8	330.09	$3/2^-$	27.372	$3/2^+$	E1		0.0355	α(K)=0.0285 *4*; α(L)=0.00527 *8*; α(M)=0.001260 *18* α(N)=0.000331 *5*; α(O)=7.56×10^{-5} *11*; α(P)=1.344×10^{-5} *19*; α(Q)=9.74×10^{-7} *14*
327.2 *2*	0.30	354.59	$1/2^-$	27.372	$3/2^+$	(E1)		0.0298	α(K)=0.0240 *4*; α(L)=0.00440 *7*; α(M)=0.001050 *15* α(N)=0.000276 *4*; α(O)=6.31×10^{-5} *9*; α(P)=1.125×10^{-5} *16*; α(Q)=8.28×10^{-7} *12*
330.08 *10*	3.0	330.09	$3/2^-$	0.0	$3/2^-$	M1+E2	+0.36 *7*	0.540 *21*	α(K)=0.430 *19*; α(L)=0.0836 *22*; α(M)=0.0202 *5* α(N)=0.00535 *13*; α(O)=0.00124 *3*; α(P)=0.000228 *6*; α(Q)=1.93×10^{-5} *8*
341.1 *1*	0.22	425.75	$5/2^+$	84.61	$7/2^+$	[M1+E2]		0.33 *22*	E_γ: this γ is not confirmed in ^{231}Pa α decay.
354.6 *2*	0.75	354.59	$1/2^-$	0.0	$3/2^-$	M1+E2	2.8 *+14−6*	0.142 *24*	α(K)=0.090 *21*; α(L)=0.0391 *24*; α(M)=0.0101 *5* α(N)=0.00269 *14*; α(O)=0.00060 *4*; α(P)=0.000102 *7*; α(Q)=4.2×10^{-6} *9*

$^{227}_{89}Ac_{138}$-4

^{227}Ra β^- decay (42.2 min) 1971Lo15 (continued)

$\gamma(^{227}Ac)$ (continued)

E_γ[†]	I_γ[†a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[&]	Comments
379.4 *1*	0.47	425.75	5/2$^+$	46.40	5/2$^+$	M1(+E2)	0.5 *6*	0.34 *12*	α(K)=0.270 *99*; α(L)=0.054 *12*; α(M)=0.013 *3* α(N)=0.0034 *7*; α(O)=0.00080 *17*; α(P)=0.00015 *4*; α(Q)=1.21×10^{-5} *44*
390.4[c] *6*	0.078	435.37	1/2$^+$	46.40	5/2$^+$				E$_\gamma$: ΔE=0.06 keV given by 1971Lo15 is too low to be realistic and is probably a typographical error.
398.4[b] *4*	0.089[b]	425.75	5/2$^+$	27.372	3/2$^+$				I$_\gamma$: from ^{231}Pa α decay relative to I(379.4γ).
398.4[bc] *4*	0.09[b]	428.39?		29.95	5/2$^-$				I$_\gamma$: from experimental Iγ(398γ doublet) minus Iγ(398.4γ) from 425 level.
407.97 *10*	2.4	435.37	1/2$^+$	27.372	3/2$^+$	M1		0.334	α(K)=0.269 *4*; α(L)=0.0496 *7*; α(M)=0.01186 *17* α(N)=0.00314 *5*; α(O)=0.000731 *11*; α(P)=0.0001353 *19*; α(Q)=1.199×10^{-5} *17*
428.4[c] *2*	0.093	428.39?		0.0	3/2$^-$				
435.4 *1*	0.25	435.37	1/2$^+$	0.0	3/2$^-$				
468.5 *5*	0.27	514.37	(3/2,5/2)$^+$	46.40	5/2$^+$				
471.3 *5*	0.27	501.27	(1/2$^-$,3/2,5/2$^-$)	29.95	5/2$^-$				
478.4 *4*	0.09	562.81	(3/2$^+$,5/2$^+$)	84.61	7/2$^+$				
486.98 *10*	2.5	514.37	(3/2,5/2)$^+$	27.372	3/2$^+$				
490.5 *5*	0.15	537.01	(3/2$^+$)	46.40	5/2$^+$				
501.4 *1*	1.05	501.27	(1/2$^-$,3/2,5/2$^-$)	0.0	3/2$^-$				
510.0 *2*		537.01	(3/2$^+$)	27.372	3/2$^+$				
516.2 *2*	1.5	562.81	(3/2$^+$,5/2$^+$)	46.40	5/2$^+$				
535.6 *2*	0.66	562.81	(3/2$^+$,5/2$^+$)	27.372	3/2$^+$				
[x]543.1 *1*	0.27								
611.4 *2*	1.3	639.09	1/2$^+$	27.372	3/2$^+$				
639.4 *2*	0.24	639.09	1/2$^+$	0.0	3/2$^-$				
652.2 *2*	0.24	698.59	(3/2)$^+$	46.40	5/2$^+$				
671.2 *2*	0.16	698.59	(3/2)$^+$	27.372	3/2$^+$				
760.3 *2*	0.13	790.11	(1/2$^-$,3/2,5/2)	29.95	5/2$^-$				
789.8 *3*	0.16	790.11	(1/2$^-$,3/2,5/2)	0.0	3/2$^-$				
828.9 *3*	0.03	874.69	(1/2$^+$,3/2,5/2)	46.40	5/2$^+$				
836.4 *3*	0.10	863.64	(1/2,3/2,5/2)	27.372	3/2$^+$				
846.7 *3*	<0.06	874.69	(1/2$^+$,3/2,5/2)	27.372	3/2$^+$				
863.5 *3*	0.16	863.64	(1/2,3/2,5/2)	0.0	3/2$^-$				
874.7 *3*	0.09	874.69	(1/2$^+$,3/2,5/2)	0.0	3/2$^-$				

[†] From 1971Lo15.
[‡] From Adopted Gammas.
[#] γ ray not observed. Iγ is an upper limit.
[@] Doublet.

$^{227}_{89}Ac_{138}$-5

γ(^{227}Ac) (continued)

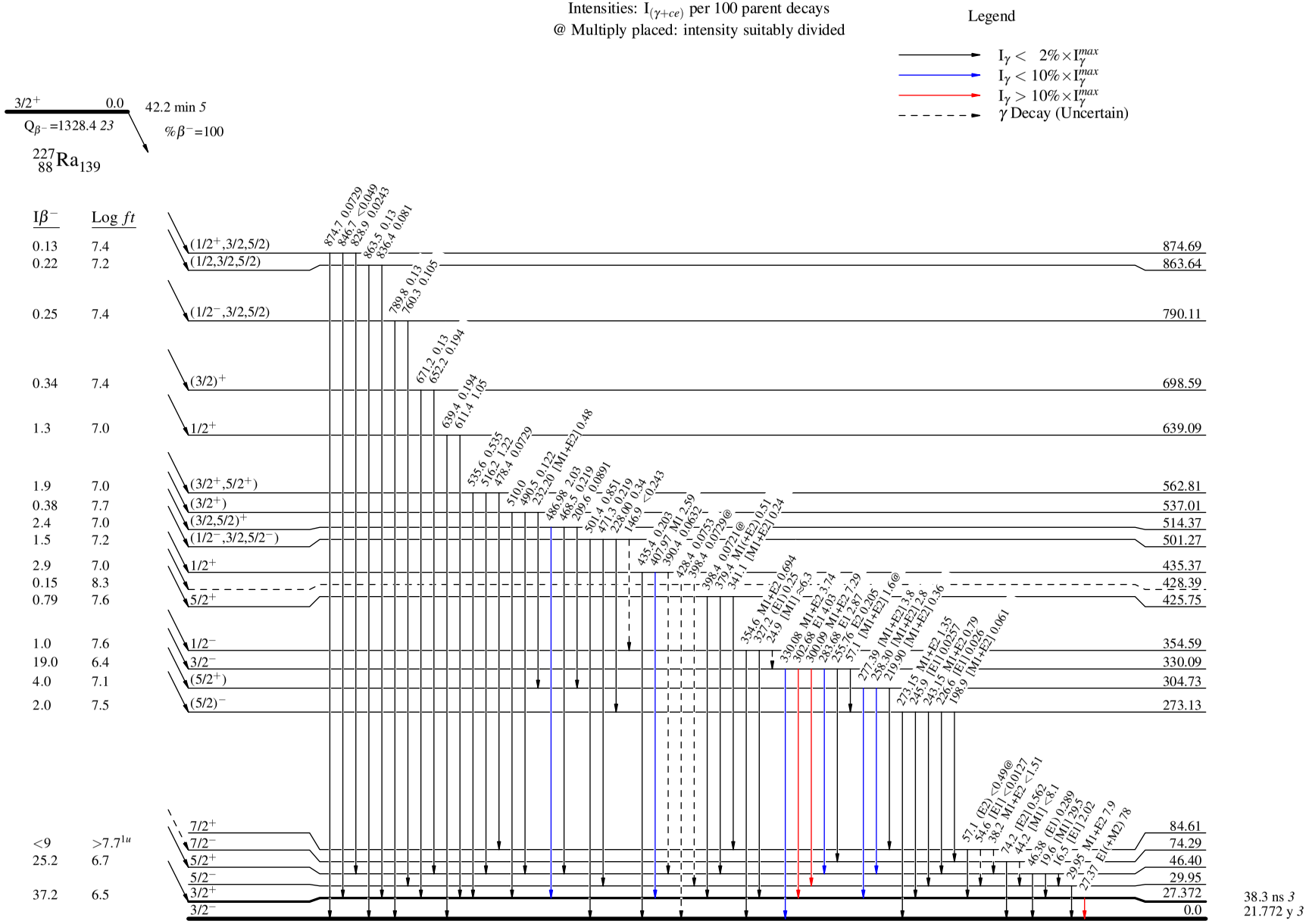
[&] From BrIcc v2.3b (16-Dec-2014) 2008Ki07, "Frozen Orbitals" appr.
[a] For absolute intensity per 100 decays, multiply by 0.81.
[b] Multiply placed with intensity suitably divided.
[c] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

$^{227}_{89}$Ac$_{138}$-6

^{227}Ra β^- decay (42.2 min) 1971Lo15

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
@ Multiply placed: intensity suitably divided



$^{227}_{89}Ac_{138}$

$^{227}_{89}Ac_{138}$-7