^{189}Ir ε decay (13.2 d) 1970Ma37,1969Gr10,1962Ha24

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	T. D. Johnson, Balraj Singh	NDS 142, 1 (2017)	15-Apr-2017

Parent: ^{189}Ir: E=0.0; J^π=3/2$^+$; $T_{1/2}$=13.2 d *1*; Q(ε)=537 *13*; %ε decay=100.0
^{189}Ir-J^π,$T_{1/2}$: From ^{189}Ir Adopted Levels.
^{189}Ir-Q(ε): From 2017Wa10.
1970Ma37: measured Eγ, Iγ, E(ce), I(ce), (ce)ce(t).
1969Gr10: measured Eγ, Iγ, (x ray)(ce)(t).
Others: 1971Be71 (γγ(θ)), 1966Sy01, 1963Cr06.

^{189}Os Levels

E(level)	J^π †	$T_{1/2}$ ‡	Comments
0.0	3/2$^-$		
30.79 *4*	9/2$^-$	5.81 h *10*	
36.173 *25*	1/2$^-$	0.53 ns *3*	
69.512 *24*	5/2$^-$	1.62 ns *4*	$T_{1/2}$: weighted average of delayed coincidence measurements 1.59 ns *8* (1970Ma37), 1.63 ns *4* (1969Gr10), and 1.7 ns *1* (1969An17) in ^{189}Ir ε decay.
95.23 *3*	3/2$^-$	0.23 ns *3*	$T_{1/2}$: other: <0.3 ns (1969Gr10).
216.64 *4*	7/2$^-$		
219.36 *5*	7/2$^-$		
233.53 *6*	5/2$^-$		
275.84 *5*	5/2$^-$	0.17 ns *3*	J^π: 3/2,5/2 from γγ(θ) in 1971Be71.
438.64 *6*	1/2$^-$,3/2$^-$		

† From Adopted Levels.
‡ From 1970Ma37, except where noted otherwise, based on γγ(t).

ε radiations

E(decay)	E(level)	Iε†	Log *ft*	Comments
(98 *13*)	438.64	0.076 *9*	7.8 *3*	εK=0.27 *17*; εL=0.53 *12*; εM+=0.20 *6*
(261 *13*)	275.84	10.1 *11*	7.0 *1*	εK=0.724 *8*; εL=0.206 *6*; εM+=0.0694 *22*
(303 *13*)	233.53	1.09 *12*	8.1 *1*	εK=0.743 *5*; εL=0.193 *4*; εM+=0.0642 *14*
(442 *13*)	95.23	11.6 *17*	7.5 *1*	εK=0.7740 *19*; εL=0.1705 *14*; εM+=0.0555 *6*
(467 *13*)	69.512	35 *5*	7.1 *1*	εK=0.7774 *17*; εL=0.1680 *12*; εM+=0.0546 *5*
(501 *13*)	36.173	2.0 *17*	8.4 *4*	εK=0.7811 *14*; εL=0.1653 *10*; εM+=0.0535 *4*
(537 *13*)	0.0	40 *7*	7.2 *1*	εK=0.7846 *12*; εL=0.1628 *9*; εM+=0.0526 *4*

† Absolute intensity per 100 decays.

γ(^{189}Os)

Iγ normalization: From I(K x ray)=1270 *70* (1970Ma37) and corrections for fluorescence yield, internal conversion, and I(K x ray)/Iε.

γγ(θ) angular correlations (1971Be71). NaI(Tl), resolving time of 50 ns, chemical separation of sources. Assignments below were made by evaluators assuming J^π(0)=3/2$^-$, J^π(69)=5/2$^-$, and J^π(95)=3/2$^-$ from Adopted Levels. All parities are from Adopted Levels.

Experimental conversion coefficients from 1970Ma37, 1962Ha24. Other: 1966Sy01. Normalized assuming α(K)exp(245γ)=0.101.

E_γ[†]	I_γ[@b]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[&]	δ[&]	α[a]	$I_{(\gamma+ce)}$[b]	Comments
25.65[‡] *10*	0.40 *5*	95.23	3/2$^-$	69.512	5/2$^-$	M1+E2	0.11 *+5−3*	84 *34*		α(L)=64 *26*; α(M)=15.3 *65* α(N)=3.7 *16*; α(O)=0.60 *23*; α(P)=0.0293 *6* α(L1)exp=55 *18*; L1:L2:L3=22 *7*:12.5 *38*:4.2 *+70−42*
30.80[‡] *4*		30.79	9/2$^-$	0.0	3/2$^-$	M3+E4	0.04 *2*	3.13×10^5 *10*	124 *4*	ce(L)/(γ+ce)=0.707 *19*; ce(M)/(γ+ce)=0.227 *11* ce(N)/(γ+ce)=0.057 *3*; ce(O)/(γ+ce)=0.0085 *5*; ce(P)/(γ+ce)=0.000152 *6* α(L)=2.21×10^5 *6*; α(M)=7.1×10^4 *4* α(N)=1.79×10^4 *9*; α(O)=2.66×10^3 *10*; α(P)=47.6 *8* L1:L2:L3:M1:M3=17.4 *10*:1.8 *30*:90 *6*:6.0 *15*:26 *8*. Others: 1962Ha24, 1966Sy01. $I_{(\gamma+ce)}$: from intensity balance assuming no direct ε feeding. Other: I(γ+ce)=153 *10* from ce(L3)(30.8γ)/Iγ(69.5γ)=90 *5*/59 *6*.
33.31[‡] *4*	0.113 *14*	69.512	5/2$^-$	36.173	1/2$^-$	E2		723		α(L)=546 *9*; α(M)=138.5 *21* α(N)=33.0 *5*; α(O)=4.83 *8*; α(P)=0.00382 *6* L2/L3=0.94 *8* (1970Ma37) I_γ: from ce(L3)(33γ)/Iγ(69.6)=33 *2*/59 *6*.
36.17[‡] *4*	11.2 *10*	36.173	1/2$^-$	0.0	3/2$^-$	M1+E2	0.046 *5*	20.2 *4*		α(L)=15.6 *3*; α(M)=3.60 *7* α(N)=0.877 *17*; α(O)=0.150 *3*; α(P)=0.01064 *16* α(L1)exp=12 *1*; L1:L2:L3=135 *6*:21.3 *6*:4.4 *20* L1:L2:L3:M:N=360:50:13:140:45 (1962Ha24).
56.50[‡] *4*	2.5 *5*	275.84	5/2$^-$	219.36	7/2$^-$	M1		5.17		α(L)=3.99 *6*; α(M)=0.916 *13* α(N)=0.224 *4*; α(O)=0.0386 *6*; α(P)=0.00287 *4* α(L1)exp=3.5 (1962Ha24); L1:L2:M=39:5:10 (56γ)(219γ)(θ): A_2=−0.075 *25*, A_4=+0.031 *30*; J(276)=3/2,7/2 and J(219)=5/2; sign of δ(56) not determined; or J(276)=5/2 and J(219)=7/2$^-$, δ(56)=−0.09 *4*.
59.05[c‡] *2*	20[c] *2*	95.23	3/2$^-$	36.173	1/2$^-$	M1+E2	0.085 *10*	4.83 *10*		α(L1)exp=3.6 *4*; L1:L2:L3:M1=75 *8*:8.8 *10*:3.0 *30*:25 *19* α(L)=3.72 *8*; α(M)=0.860 *19* α(N)=0.210 *5*; α(O)=0.0358 *7*; α(P)=0.00250 *4* δ: other: 0.06 *4* from ε decay. I_γ: Iγ(59.0γ+59.3γ)=21 *2*. See comment on 59.3γ.

γ(^{189}Os) (continued)

E_γ[†]	I_γ[@b]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[&]	δ[&]	α[a]	Comments
59.05[c] *2*	≈1[c]	275.84	5/2⁻	216.64	7/2⁻	(M1+E2)	≈0.9	≈22.1	α(L)≈16.70; α(M)≈4.22 α(N)≈1.011; α(O)≈0.1510; α(P)≈0.001547 L1/L2≈5 (1962Ha24) L1 not completely resolved. I_γ: from ce(L3)(59.3γ)/Iγ(245γ)≈0.03. δ: estimated from intensity balance through 216.7 level assuming no feeding to that level. E_γ: note that this transition is not confirmed in (n,γ) $\gamma\gamma$ coin measurements.
69.52[‡] *3*	59 *6*	69.512	5/2⁻	0.0	3/2⁻	M1+E2	+0.683 *25*	8.3 *3*	α(L2)exp=3.0 *3* L1:L2:L3=100 *5*:180 *5*:169 *5* α(L)=6.26 *23*; α(M)=1.56 *6* α(N)=0.375 *14*; α(O)=0.0573 *20*; α(P)=0.00113 *3* L1:L2:L3:M:N=490:830:780:570:180 (1962Ha24). δ: other: 0.70 *3* from ce data in ε decay. Sign from 1968Ku17, 1968Pe09, 1972Wa24.
95.23[‡] *4*	6.4 *5*	95.23	3/2⁻	0.0	3/2⁻	M1+E2	+0.32 *2*	6.37	α(K)exp=5.3 *6* α(K)=4.93 *9*; α(L)=1.10 *4*; α(M)=0.262 *8* α(N)=0.0635 *20*; α(O)=0.0105 *3*; α(P)=0.000577 *10* δ: other: 0.29 *4* from ε decay. K:L1:L2:L3=33.8 *8*:4.8 *8*:1.35 *15*:0.97 *20*.
ˣ97.8	<0.01								
138.3 *1*	1.14 *13*	233.53	5/2⁻	95.23	3/2⁻	M1+E2	−0.8 *2*	1.84 *13*	α(K)=1.29 *18*; α(L)=0.42 *4*; α(M)=0.102 *11* α(N)=0.025 *3*; α(O)=0.0039 *4*; α(P)=0.000146 *23* α(K)exp=0.22; K:L12:L3=16 *8*:2.0 *10*:0.8 (138γ)(95γ)(θ): A_2=−0.123 *19*, A_4=−0.004 *9*; for δ(95)=+0.32: J(233)=1/2, δ(138)=+0.19; J(233)=3/2, δ(138)=−0.37; J(233)=5/2, δ(138)=+0.043. K,L12 from 1966Sy01 and L3 from 1962Ha24. From 1962Ha24 K=13, and L1,L2 were reported as a composite of 2 different lines and M was observed but not completely resolved. α(K)exp calculated using intensities from 1962Ha24.
147.1 *1*	1.80 *14*	216.64	7/2⁻	69.512	5/2⁻	M1+E2	−1.0 *+4−3*	1.43 *21*	α(K)exp=0.73 α(K)=0.96 *28*; α(L)=0.36 *5*; α(M)=0.088 *15* α(N)=0.021 *4*; α(O)=0.0033 *5*; α(P)=1.07×10^{-4} *35* (147γ)(69γ)(θ): A_2=−0.184 *34*, A_4=+0.049 *19*; J(217)=7/2. K:L1:L2:L3=130:≈25:≈20:≈15. Intensities obtained by multiplying by a factor of 10 to compare with γ intensity from 1970Ma37. δ: other: −1.2 *+34−4* from ε decay.
149.9 *1*	1.41 *10*	219.36	7/2⁻	69.512	5/2⁻	E2		0.915	α(K)=0.352 *5*; α(L)=0.425 *6*; α(M)=0.1082 *16*

$^{189}_{76}$Os$_{113}$-3

γ(^{189}Os) (continued)

E$_\gamma$[†]	I$_\gamma$[@b]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.[&]	δ[&]	α[a]	Comments
									α(N)=0.0260 *4*; α(O)=0.00388 *6*; α(P)=3.20×10^{-5} *5* α(K)exp=0.43 (1962Ha24) K:L2:L3:M:N=6:3.5:2.4:2.2:6.3. L2 not completely resolved.
164.0 *1*	1.23 *6*	233.53	5/2$^-$	69.512	5/2$^-$	M1+E2	<1.7	1.1 *3*	α(K)=0.82 *32*; α(L)=0.22 *4*; α(M)=0.054 *12* α(N)=0.013 *3*; α(O)=0.0021 *4*; α(P)=9.3×10^{-5} *40* K/L1=7.3; α(K)exp=1.1 (1962Ha24) δ: deduced assuming 50% uncertainty for α(K)exp and K/L1.
180.5 *1*	0.49 *5*	275.84	5/2$^-$	95.23	3/2$^-$	M1+E2	>0.2	0.75 *28*	α(K)=0.53 *32*; α(L)=0.166 *24*; α(M)=0.040 *8* α(N)=0.0098 *18*; α(O)=0.00155 *19*; α(P)=5.9×10^{-5} *39* α(K)exp=0.86 (1966Sy01) (180γ)(95γ)(θ): A$_2$=−0.087 *15*, A$_4$=+0.066 *63*; J(276)=1/2,3/2,5/2; δ(95γ)=+0.32. K/L=3.0 *15*/2.8 *10*. α(K)exp is calculated using intensities from 1962Ha24 where K=3.2.
185.85 *1*	3.0 *3*	216.64	7/2$^-$	30.79	9/2$^-$	M1+E2	<0.5	0.91 *6*	K/L1≈7.2; α(K)exp=0.82 (1962Ha24) α(K)=0.74 *6*; α(L)=0.133 *5*; α(M)=0.0309 *14* α(N)=0.0075 *4*; α(O)=0.00128 *4*; α(P)=8.6×10^{-5} *8* δ: deduced assuming 50% uncertainty for α(K)exp and K/L1.
188.6 *1*	0.86 *7*	219.36	7/2$^-$	30.79	9/2$^-$	M1+E2	1.5 *+10−4*	0.57 *9*	α(K)=0.373 *97*; α(L)=0.147 *6*; α(M)=0.0362 *20* α(N)=0.0087 *5*; α(O)=0.00137 *5*; α(P)=4.0×10^{-5} *12* K/L3≈10; α(K)exp=0.39 (1962Ha24) δ: deduced assuming α(K)exp and K/L3 uncertainties are 50%.
197.4 *1*	4.4 *2*	233.53	5/2$^-$	36.173	1/2$^-$	E2		0.347	α(K)=0.1755 *25*; α(L)=0.1298 *19*; α(M)=0.0327 *5* α(N)=0.00787 *12*; α(O)=0.001189 *17*; α(P)=1.642×10^{-5} *23* K/L2≈5.3; α(K)exp=0.40 (1962Ha24) (197γ)(36γ)(θ): isotropic; J(36 level)=1/2. L2 was not completely resolved.
206.3 *1*	1.33 *5*	275.84	5/2$^-$	69.512	5/2$^-$	M1+E2	>1.9	0.35 *5*	α(K)=0.20 *5*; α(L)=0.1067 *20*; α(M)=0.0266 *7* α(N)=0.00641 *16*; α(O)=0.000984 *16*; α(P)=2.07×10^{-5} *60* K/L≈2.6; α(K)exp=0.15 (1962Ha24) (206γ)(69γ)(θ): A$_2$=−0.100 *20*, A$_4$=+0.058 *38*; J(276)=3/2,5/2,7/2. δ: deduced assuming uncertainties for α(K)exp and K/L to be 50% percent.
216.7 *1*	8.6 *4*	216.64	7/2$^-$	0.0	3/2$^-$	E2		0.254	α(K)=0.1376 *20*; α(L)=0.0881 *13*; α(M)=0.0221 *4* α(N)=0.00532 *8*; α(O)=0.000809 *12*; α(P)=1.307×10^{-5} *19* α(K)exp=0.14 (1962Ha24) K:L2:L3:M=15:4.5:3.1:2; L2 not completely resolved.
219.4 *1*	8.8 *4*	219.36	7/2$^-$	0.0	3/2$^-$	E2		0.244	α(K)=0.1332 *19*; α(L)=0.0837 *12*; α(M)=0.0210 *3* α(N)=0.00506 *8*; α(O)=0.000769 *11*; α(P)=1.268×10^{-5} *18* α(K)exp=0.93 (1962Ha24) K:L1:L2:L3:M=13:≈1.5:4.5:2.4:2.1. L2 was not completely resolved.
233.5 *1*	5.0 *2*	233.53	5/2$^-$	0.0	3/2$^-$	M1+E2	1.7 *+6−3*	0.28 *4*	K/L3=16; α(K)exp=0.22 (1962Ha24) α(K)=0.19 *3*; α(L)=0.0658 *10*; α(M)=0.01612 *24*

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γ(^{189}Os) (continued)

E_γ[†]	I_γ[@b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[&]	δ[&]	α[a]	Comments
									α(N)=0.00389 *6*; α(O)=0.000614 *11*; α(P)=2.1×10^{-5} *4* δ: other: 1.4 +*10*−*4* from ε decay.
245.1 *1*	100	275.84	5/2$^-$	30.79	9/2$^-$	E2		0.1703	α(K)=0.0997 *14*; α(L)=0.0535 *8*; α(M)=0.01338 *19* α(N)=0.00322 *5*; α(O)=0.000493 *7*; α(P)=9.67×10^{-6} *14* α(K)exp=0.59 (1962Ha24) K:L1:L2:L3:M:N=100:≈15:25:18:14:4. 1962Ha24 note this a recurring transition listed twice.
275.8 *1*	9.0 *5*	275.84	5/2$^-$	0.0	3/2$^-$	M1+E2	1.8 *2*	0.167 *10*	α(K)=0.120 *9*; α(L)=0.0360 *7*; α(M)=0.00874 *14* α(N)=0.00211 *4*; α(O)=0.000337 *7*; α(P)=1.29×10^{-5} *11* α(K)exp=0.2 K:L1:L2:L3:M1=14:2.7:≈1.3:0.8:1. δ: deduced assuming 50 percent uncertainty for α(K)exp and all ratios.
343.2[#] *1*	0.91 *6*	438.64	1/2$^-$,3/2$^-$	95.23	3/2$^-$	[M1]		0.180	α(K)=0.1491 *21*; α(L)=0.0237 *4*; α(M)=0.00543 *8* α(N)=0.001327 *19*; α(O)=0.000229 *4*; α(P)=1.717×10^{-5} *24*
[x]369.1	<0.01								
402.8[#] *1*	0.11 *1*	438.64	1/2$^-$,3/2$^-$	36.173	1/2$^-$	[M1]		0.1173	α(K)=0.0973 *14*; α(L)=0.01541 *22*; α(M)=0.00353 *5* α(N)=0.000861 *12*; α(O)=0.0001489 *21*; α(P)=1.117×10^{-5} *16* E_γ: somewhat poor fit, level-energy difference=402.46.
438.5[#] *1*	0.06 *2*	438.64	1/2$^-$,3/2$^-$	0.0	3/2$^-$	[M1]		0.0936	α(K)=0.0777 *11*; α(L)=0.01228 *18*; α(M)=0.00281 *4* α(N)=0.000686 *10*; α(O)=0.0001186 *17*; α(P)=8.91×10^{-6} *13*

[†] Weighted average of 1963Cr06 and 1970Ma37 (from ^{189}Ir ε decay), and 1973Ho27 and 1979Sa18 (from ^{189}Re β^- decay), unless otherwise noted. Uncertainty of 0.1 keV assumed when not available.
[‡] From electron measurements in 1970Ma37.
[#] Only in 1970Ma37.
[@] From 1970Ma37.
[&] From Adopted Gammas.
[a] From BrIcc v2.3b (16-Dec-2014) 2008Ki07, “Frozen Orbitals” appr.
[b] For absolute intensity per 100 decays, multiply by 0.060 *6*.
[c] Multiply placed with intensity suitably divided.
[x] γ ray not placed in level scheme.

$^{189}_{76}$Os$_{113}$-5

^{189}Ir ε decay (13.2 d) 1970Ma37,1969Gr10,1962Ha24

Decay Scheme

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