^{176}Re ε decay 2001Ki10,1977Be72,1977Ha24

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	M. S. Basunia	NDS 107, 791 (2006)	15-Sep-2005

Parent: ^{176}Re: E=0.0; $J^\pi=3^+$; $T_{1/2}$=5.3 min *3*; Q(ε)=5580 *40*; %ε+%β^+ decay=100.0

Others: 1972Be89, 1970Go20, 1967Na17.

2001Ki10: ^{176}Re produced from an ^{176}Ir grandparent activity made in the ^{149}Sm(^{31}P,4n) reaction. Measured: Eγ, Iγ, γ-γ coin, γ(θ), α, and M. Detector: CAESAR array of six Compton-suppressed Ge detectors, and electron spectrometer.

1977Be72: measured Eγ, Iγ, γγ coin. Detectors:Ge(Li).

1977Ha24: activity produced by ^{181}Ta(α,9n), E(α)=133 MeV. Measured Eγ, Iγ. Detector:Ge(Li).

1970Go20: activity produced by ^{180}W(p,5n), E(p)=54 MeV. Measured Eγ, Iγ. Detector:Ge(Li).

^{176}W Levels

E(level)[†]	J^π[‡]	$T_{1/2}$	Comments
0.0[#]	0^+	2.5 h *1*	
109.1[#] *8*	2^+		
349.4[#] *9*	4^+		J^π: 240.3γ E2 to the inband 2^+ state.
700.8[#] *10*	6^+		J^π: 351.4γ E2 to the inband 4^+ state.
844.1[&] *13*	0^+		J^π: Supported by the γ-γ angular correlation of the 735 keV transition and consistent with the 0^+ to 2^+ state transition in 2001Ki10.
931.4[&] *10*	2^+		J^π: 582.0γ E2 to the 4^+ state.
1041.6[@] *8*	2^+		
1118.1[&] *10*	4^+		J^π: 768.7γ E0+E2+M1 to the 4^+ state at 349.3 keV level. 1009.0γ E2 to the 2^+ state at 109.1 keV level.
1128.9[a] *9*	2^-		J^π: 1019.9γ E1 to the 2^+ state at 109.1 keV level.
1180.3[@] *10*	3^+		
1198.3[a] *10*	3^-		J^π: 849.1γ E1 to the 4^+ state at 349.3 keV level.
1303.2[a] *10*	4^-		
1322.4[@] *11*	4^+		
1397.6[&] *11*	6^+		J^π: 696.6γ E0+E2+M1 to the 6^+ state at 700.7 keV level. The E0 component supports the assignment as J^+_β to J^+_g transition.
1402.0[a] *10*	5^-		
1438.2 *13*			
1497.4 *10*			
1519.2[@] *11*	5^+		
1526.4 *13*			
1539.2 *13*			
1586.4 *14*			
1587.8 *11*			
1591.0 *14*			
1595.4 *12*			
1658.9 *14*			
1661.0 *11*	$(3,4,5)^-$		J^π: 1311.8γ E1 to the 4^+ state at 349.5 keV level.
1683.9 *13*			
1686.5 *11*			
1701.6 *13*			
1709.7 *11*			
1736.7 *13*			
1745.4 *14*			
1887.1 *11*			
1924.1 *14*			

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^{176}Re ε decay 2001Ki10,1977Be72,1977Ha24 (continued)

^{176}W Levels (continued)

† Deduced by evaluator from a least-squares fit to γ-ray energies assuming ΔE=1 keV.
‡ From multipolarity, rotational band assignment, and energy systematics (2001Ki10).
# $K^{\pi}=0^{+}$ g.s. rotational band.
@ $K^{\pi}=2^{+}$ quasi γ-vibrational band.
& $K^{\pi}=0^{+}$ quasi β^{-}vibrational band.
a $K^{\pi}=(2^{-})$.

ε,β^{+} radiations

E(decay)	E(level)	Iβ^{+} †	Iε †	Log *ft*	I($\varepsilon+\beta^{+}$) †	Comments
(3.66×10^3 *4*)	1924.1	0.19 *5*	0.46 *12*	7.23 *12*	0.65 *17*	av Eβ=1190 *18*; εK=0.589 *8*; εL=0.0965 *13*; εM+=0.0298 *4*
(3.69×10^3 *4*)	1887.1	0.16 *3*	0.37 *8*	7.34 *10*	0.53 *11*	av Eβ=1206 *18*; εK=0.582 *8*; εL=0.0953 *13*; εM+=0.0294 *4*
(3.83×10^3 *4*)	1745.4	0.17 *4*	0.35 *7*	7.40 *10*	0.52 *11*	av Eβ=1270 *19*; εK=0.555 *8*; εL=0.0907 *13*; εM+=0.0280 *4*
(3.84×10^3 *4*)	1736.7	0.59 *5*	1.21 *10*	6.86 *5*	1.80 *15*	av Eβ=1274 *19*; εK=0.553 *8*; εL=0.0905 *13*; εM+=0.0279 *4*
(3.87×10^3 *4*)	1709.7	0.32 *6*	0.65 *13*	7.14 *9*	0.97 *19*	av Eβ=1287 *19*; εK=0.548 *8*; εL=0.0896 *13*; εM+=0.0277 *4*
(3.88×10^3 *4*)	1701.6	0.27 *4*	0.52 *7*	7.23 *7*	0.79 *11*	av Eβ=1290 *19*; εK=0.546 *8*; εL=0.0893 *13*; εM+=0.0276 *4*
(3.89×10^3 *4*)	1686.5	0.20 *4*	0.40 *7*	7.36 *9*	0.60 *11*	av Eβ=1297 *19*; εK=0.544 *8*; εL=0.0889 *13*; εM+=0.0274 *4*
(3.90×10^3 *4*)	1683.9	0.29 *4*	0.57 *7*	7.20 *7*	0.86 *11*	av Eβ=1298 *19*; εK=0.543 *8*; εL=0.0888 *13*; εM+=0.0274 *4*
(3.92×10^3 *4*)	1661.0	1.5 *1*	2.8 *2*	6.51 *5*	4.3 *3*	av Eβ=1309 *19*; εK=0.539 *8*; εL=0.0880 *13*; εM+=0.0272 *4*
(3.92×10^3 *4*)	1658.9	0.19 *3*	0.36 *5*	7.41 *7*	0.55 *8*	av Eβ=1310 *19*; εK=0.538 *8*; εL=0.0880 *13*; εM+=0.0272 *4*
(3.98×10^3 *4*)	1595.4	0.34 *6*	0.61 *10*	7.19 *8*	0.95 *16*	av Eβ=1338 *19*; εK=0.526 *8*; εL=0.0860 *13*; εM+=0.0265 *4*
(3.99×10^3 *4*)	1591.0	0.13 *2*	0.23 *3*	7.62 *7*	0.36 *5*	av Eβ=1340 *19*; εK=0.525 *8*; εL=0.0858 *13*; εM+=0.0265 *4*
(3.99×10^3 *4*)	1587.8	0.43 *6*	0.76 *10*	7.10 *7*	1.19 *15*	av Eβ=1342 *19*; εK=0.525 *8*; εL=0.0857 *13*; εM+=0.0265 *4*
(3.99×10^3 *4*)	1586.4	0.16 *4*	0.27 *6*	7.54 *11*	0.43 *10*	av Eβ=1342 *19*; εK=0.525 *8*; εL=0.0857 *13*; εM+=0.0264 *4*
(4.04×10^3 *4*)	1539.2	0.42 *5*	0.69 *8*	7.15 *6*	1.11 *13*	av Eβ=1364 *19*; εK=0.516 *8*; εL=0.0842 *13*; εM+=0.0260 *4*
(4.05×10^3 *4*)	1526.4	0.15 *5*	0.26 *8*	7.59 *14*	0.41 *13*	av Eβ=1370 *19*; εK=0.513 *8*; εL=0.0838 *13*; εM+=0.0259 *4*
(4.06×10^3 *4*)	1519.2	0.58 *5*	0.94 *8*	7.02 *5*	1.52 *13*	av Eβ=1373 *19*; εK=0.512 *8*; εL=0.0836 *13*; εM+=0.0258 *4*
(4.08×10^3 *4*)	1497.4	0.57 *6*	0.92 *9*	7.04 *6*	1.49 *15*	av Eβ=1383 *19*; εK=0.508 *8*; εL=0.0829 *13*; εM+=0.0256 *4*
(4.14×10^3 *4*)	1438.2	0.41 *7*	0.61 *10*	7.22 *8*	1.02 *17*	av Eβ=1410 *19*; εK=0.497 *8*; εL=0.0810 *13*; εM+=0.0250 *4*
(4.18×10^3 *4*)	1402.0	0.76 *9*	1.12 *13*	6.97 *6*	1.88 *21*	av Eβ=1426 *19*; εK=0.490 *8*; εL=0.0799 *13*; εM+=0.0247 *4*
(4.18×10^3 *4*)	1397.6	0.32 *5*	0.47 *8*	7.35 *8*	0.79 *13*	av Eβ=1428 *19*; εK=0.489 *8*; εL=0.0798 *13*; εM+=0.0246 *4*
(4.26×10^3 *4*)	1322.4	1.5 *1*	2.0 *2*	6.73 *5*	3.5 *3*	av Eβ=1463 *19*; εK=0.475 *8*; εL=0.0775 *13*; εM+=0.0239 *4*
(4.28×10^3 *4*)	1303.2	1.7 *1*	2.2 *2*	6.69 *5*	3.9 *3*	av Eβ=1471 *19*; εK=0.472 *8*; εL=0.0769 *12*; εM+=0.0237 *4*
(4.38×10^3 *4*)	1198.3	2.1 *2*	2.6 *2*	6.65 *5*	4.7 *4*	av Eβ=1519 *19*; εK=0.453 *8*; εL=0.0738 *12*; εM+=0.0228 *4*
(4.40×10^3 *4*)	1180.3	2.4 *1*	2.9 *2*	6.60 *4*	5.3 *3*	av Eβ=1528 *19*; εK=0.450 *8*; εL=0.0733 *12*; εM+=0.0226 *4*
(4.45×10^3 *4*)	1128.9	1.4 *1*	1.7 *2*	6.86 *5*	3.1 *3*	av Eβ=1551 *19*; εK=0.441 *7*; εL=0.0718 *12*; εM+=0.0221 *4*
(4.46×10^3 *4*)	1118.1	3.5 *2*	4.0 *3*	6.48 *4*	7.5 *5*	av Eβ=1556 *19*; εK=0.439 *7*; εL=0.0715 *12*; εM+=0.0221 *4*

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^{176}Re ε decay 2001Ki10,1977Be72,1977Ha24 (continued)

ϵ,β^+ radiations (continued)

E(decay)	E(level)	Iβ^+ †	Iε†	Log *ft*	I($\varepsilon+\beta^+$)†	Comments
(4.54×10^3 *4*)	1041.6	0.48 *11*	0.52 *12*	7.38 *11*	1.00 *23*	av Eβ=1591 *19*; εK=0.426 *7*; εL=0.0693 *12*; εM+=0.0214 *4*
(4.65×10^3 *4*)	931.4	2.7 *2*	2.7 *2*	6.69 *5*	5.4 *4*	av Eβ=1642 *19*; εK=0.407 *7*; εL=0.0662 *11*; εM+=0.0204 *4*
(4.74×10^3 *4*)	844.1	0.40 *5*	0.36 *5*	7.57 *7*	0.76 *10*	av Eβ=1682 *19*; εK=0.393 *7*; εL=0.0639 *11*; εM+=0.0197 *4*
(4.88×10^3 *4*)	700.8	2.0 *3*	1.7 *3*	6.94 *8*	3.7 *6*	av Eβ=1748 *19*; εK=0.371 *7*; εL=0.0602 *11*; εM+=0.0186 *4*
(5.23×10^3 *4*)	349.4	16.0	10.2	6.2	26.2	av Eβ=1910 *19*; εK=0.320 *6*; εL=0.0519 *9*; εM+=0.0160 *3*
(5.47×10^3 *4*)	109.1	6 *3*	3.5 *18*	6.71 *22*	10 *5*	av Eβ=2021 *19*; εK=0.290 *5*; εL=0.0469 *8*; εM+=0.01447 *25*

† Absolute intensity per 100 decays.

$\gamma(^{176}W)$

Iγ normalization: From decay scheme assuming no ε population to the g.s. from ^{176}Re (J$^\pi$=3$^+$), and Ti(109γ + 844γ + 1040γ + 1117γ)=100%.

E$_\gamma$†	I$_\gamma$†#	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.†	α@	Comments
87.1	4.1 *10*	1128.9	2$^-$	1041.6	2$^+$			
109.1	465 *16*	109.1	2$^+$	0.0	0$^+$	E2	2.81	α(K)=0.760 *23*; α(L)=1.55 *5*; α(M)=0.389 *12*; α(N+..)=0.114 *4* %Iγ=25.81 *56*. Mult.: from adopted gammas.
122.8	4.7 *17*	1303.2	4$^-$	1180.3	3$^+$			
156.9	12.0 *17*	1198.3	3$^-$	1041.6	2$^+$			
174.3	6.6 *17*	1303.2	4$^-$	1128.9	2$^-$			
186.5	2.1 *4*	1118.1	4$^+$	931.4	2$^+$			
203.9	2.3 *10*	1402.0	5$^-$	1198.3	3$^-$			
240.3	1000 *29*	349.4	4$^+$	109.1	2$^+$	E2	0.171	α(K)=0.104 *4*; α(L)=0.0508 *16*; α(M)=0.0125 *4*; α(N+..)=0.00363 *11* Mult.: from α(K)exp=0.104 *7*, α(L)exp=0.045 *3*, and α(M)exp=0.0123 *11*.
292.1	6.2 *12*	1595.4		1303.2	4$^-$			
351.4	151 *8*	700.8	6$^+$	349.4	4$^+$	E2	0.0540	α(K)=0.0381 *12*; α(L)=0.0122 *4*; α(M)=0.00294 *9*; α(N+..)=0.00086 *3* Mult.: from α(K)exp=0.050 *4*.
368.5	9.1 *16*	1497.4		1128.9	2$^-$			
388.1	7.6 *16*	1586.4		1198.3	3$^-$			Mult.: E2 from α(K)exp=0.027 *7* in 2001Ki10, but no J$^\pi$ for 1586.4 keV level was reported.
397.2	11.4 *25*	1595.4		1198.3	3$^-$			
417.3	11.0 *16*	1118.1	4$^+$	700.8	6$^+$			
488.2	3.9 *12*	1686.5		1198.3	3$^-$			
542.7	9.7 *19*	1661.0	(3,4,5)$^-$	1118.1	4$^+$			
557.5	7.2 *14*	1686.5		1128.9	2$^-$			
582.0	36.8 *19*	931.4	2$^+$	349.4	4$^+$	E2	0.0147	α(K)=0.0115 *4*; α(L)=0.00245 *8* Mult.: from α(K)exp=0.002 *1*.
627.3	9.7 *19*	1745.4		1118.1	4$^+$			
659.6	6.6 *8*	1591.0		931.4	2$^+$			

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^{176}Re ε decay 2001Ki10,1977Be72,1977Ha24 (continued)

γ(^{176}W) (continued)

E_γ[†]	I_γ[†#]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[†]	δ	α[@]	Comments
692.1	2.1 *8*	1041.6	2+	349.4	4+				
695.1	33.5 *23*	1736.7		1041.6	2+				
696.6	10.3 *16*	1397.6	6+	700.8	6+	E0+E2+M1			Mult.: from α(K)exp=0.049 *9*.
701.3	24 *3*	1402.0	5−	700.8	6+				
735.0	14.1 *16*	844.1	0+	109.1	2+				
768.7	96 *4*	1118.1	4+	349.4	4+	E0+E2+M1	−2.2		Mult.: from α(K)exp=0.066 *7*, α(L)exp=0.0122 *16*, α(M)exp=0.0033 *8*. M1 is 21%. δ: uncertainty +0.6 −1.2. A_{22}=+0.05 *7*, A_{44}=+0.23 *8*.
818.4	8.1 *10*	1519.2	5+	700.8	6+				
822.2	71 *3*	931.4	2+	109.1	2+	E0+E2+M1	−2.7		Mult.: from α(K)exp=0.056 *4*, and α(L)exp=0.0034 *4*. M1 is 13.7%. δ: uncertainty +0.4 −0.5. A_{22}=+0.21 *8*, and A_{44}=+0.2 *9*.
830.9	19.0 *17*	1180.3	3+	349.4	4+				α(K)exp=0.0034 *12*.
844.0[a]	0.24 *6*	844.1	0+	0.0	0+	E0			I_γ: K conversion electron intensity.
849.1	100 *5*	1198.3	3−	349.4	4+	E1		0.00243	α=0.00243; α(K)=0.00204 *7*; α(L)=0.00029 *1* Mult.: from α(K)exp=0.0026 *8*.
932.4	36.4 *17*	1041.6	2+	109.1	2+	E0+E2+M1	+3.0		Mult.: from α(K)exp=0.0083 *16*. M1 is 11.1%. δ: uncertainty +1.0 −0.7. A_{22}=−0.22 *14* and A_{44}=+0.24 *16*.
953.9	67 *4*	1303.2	4−	349.4	4+				
958.1	10.3 *14*	1658.9		700.8	6+				
973.0	39.9 *21*	1322.4	4+	349.4	4+	E2+M1	>30	0.00481	α=0.00481; α(K)=0.00392; α(L)=0.00067 A_{22}=−0.14 *8* A_{44}=+0.22 *10*.
1009.0[&]	50[&] *3*	1118.1	4+	109.1	2+	E2		0.00447	α=0.00447; α(K)=0.00365 *11*; α(L)=0.00061 *2* Mult.: from α(K)exp=0.45 *10*.
1009.0[&]	14[&] *3*	1709.7		700.8	6+				
1019.9	76 *4*	1128.9	2−	109.1	2+	E1		0.00173	α=0.00173; α(K)=0.00145 *5*; α(L)=0.00021 *1* Mult.: from α(K)exp<0.001.
1041.6	29.7 *21*	1041.6	2+	0.0	0+				%Iγ=1.65 *13*.
1048.4	4.3 *16*	1397.6	6+	349.4	4+				
1052.3	8.7 *16*	1402.0	5−	349.4	4+				
1071.0	84 *3*	1180.3	3+	109.1	2+				Mult.: 1071γ E2 assignment from α(K)exp=0.0032 *7* in 2001Ki10 is not consistent with the J^π assignment of the depopulating level.
1117.0[‡a]	56[‡] *14*	1118.1	4+	0.0	0+				%Iγ=3.02 *74*.
1148.1	4.8 *11*	1497.4		349.4	4+				
1169.8	20.2 *19*	1519.2	5+	349.4	4+				
1189.8	20.7 *21*	1539.2		349.4	4+				
1213.2	26 *4*	1322.4	4+	109.1	2+				
1223.3	12 *3*	1924.1		700.8	6+				
1238.2	13.6 *19*	1587.8		349.4	4+				
1311.8	70 *4*	1661.0	(3,4,5)−	349.4	4+	E1		0.00110	α=0.00110; α(K)=0.00093 *3*; α(L)=0.00013 Mult.: from α(K)exp=0.0012 *2*.
1329.1	19 *3*	1438.2		109.1	2+				

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^{176}Re ε decay 2001Ki10,1977Be72,1977Ha24 (continued)

$\gamma(^{176}W)$ (continued)

E_γ [†]	I_γ [†#]	E_i(level)	J^π_i	E_f	J^π_f	E_γ [†]	I_γ [†#]	E_i(level)	J^π_i	E_f	J^π_f
1334.5	15.9 *19*	1683.9		349.4	4^+	1417.3	7.6 *23*	1526.4		109.1	2^+
1352.2	14.7 *19*	1701.6		349.4	4^+	1478.8	8.5 *16*	1587.8		109.1	2^+
1360.2	4.1 *14*	1709.7		349.4	4^+	1537.8	3.1 *12*	1887.1		349.4	4^+
1388.3	13.8 *16*	1497.4		109.1	2^+	1777.9	6.8 *15*	1887.1		109.1	2^+

[†] From 2001Ki10, unless otherwise specified.

[‡] From 1977Be72. Iγ multiplied by 10 to normalize to the 240.3γ Iγ.

[#] For absolute intensity per 100 decays, multiply by .0538 *21*.

[@] 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.

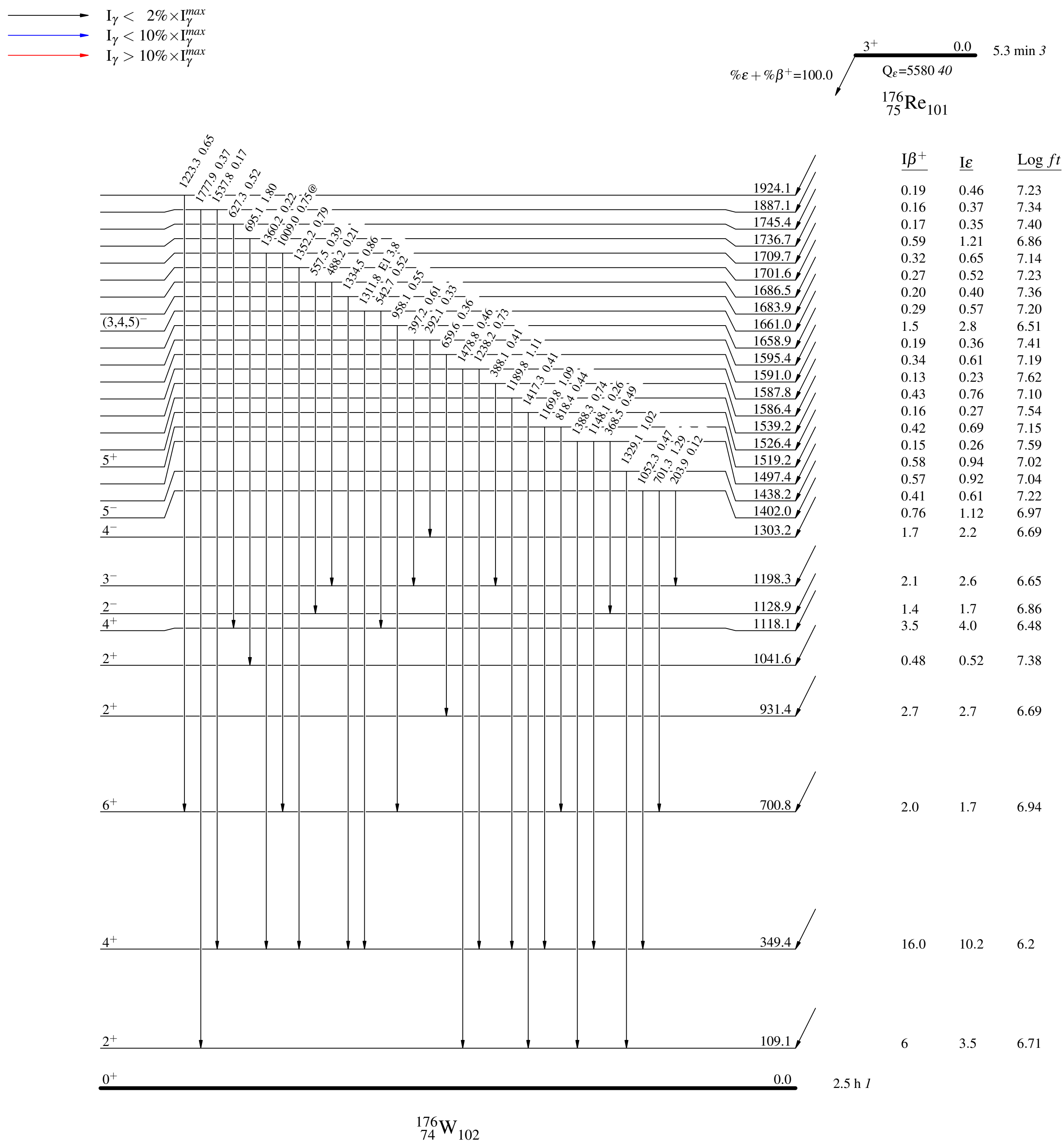
[&] Multiply placed with intensity suitably divided.

[a] Placement of transition in the level scheme is uncertain.

^{176}Re ε decay 2001Ki10,1977Be72,1977Ha24

Decay Scheme

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



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Decay Scheme (continued)

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

@ Multiply placed: intensity suitably divided