^{180}Re ε decay 1980Ma14,1967Go22

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. A. Mccutchan	NDS 126, 151 (2015)	1-Feb-2015

Parent: ^{180}Re: E=0.0; J$^\pi$=(1)$^-$; $T_{1/2}$=2.46 min *3*; Q(ε)=3801 *21*; %ε+%β^+ decay=100.0

1980Ma14: ^{180}Re activity produced through the ^{182}W(p,3n) reaction with E(p)=27 MeV. Measured Eγ, Iγ, $\gamma\gamma$, and γ(t) using two coaxial Ge(Li) detectors and a LEPS detector.

1967Go22: ^{180}Re activity produced through the ^{182}W(p,3n) reaction (target of natural tungsten) with E(p)=35 MeV. Measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma(\theta)$, $\gamma\gamma$(t), E(ce), I(ce), γ-β, and γ-x-ray coincidences using Ge(Li) and NaI(Tl) detectors for γ-rays, a Si(Li) detector for electrons and a double focusing beta spectrometer for βs.

A total energy release of 3800 keV *150* is calculated for this decay scheme using the RADLST code, in good agreement with Q=3801 keV *21*.

Others: 1968Be53, 1968Ha39, 1967Ho12.

α: Additional information 1.

^{180}W Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#]	Comments
0.0	0$^+$		
103.54 *3*	2$^+$		
337.51 *4*	4$^+$		
1006.35 *3*	2$^-$	7.4 ns *4*	J$^\pi$: 2 from $\gamma\gamma(\theta)$ in 1967Go02, π from log *ft*=4.5 from (1)$^-$ parent.
1082.36 *4*	3$^-$		
1117.31 *3*	2$^+$		
1185.07 *6*	(4$^-$)		
1232.64 *4*	3$^+$		
1587.26 *5*	2$^+$		
1632.90 *6*	(1$^-$,2)		
1814.85 *12*	(2$^+$,3)		
1831.69 *4*	2$^-$		J$^\pi$: log *ft*=5.0 from (1)$^-$ parent, 599γ to 3$^+$.
2176.79 *6*			
2227.82 *9*			
2256.63? *6*			
2415.75 *4*	2$^-$		J$^\pi$: log *ft*=5.7 from (1)$^-$ parent, 1183γ to 3$^+$.
2435.21 *4*	2$^-$		J$^\pi$: log *ft*=5.8 from (1)$^-$ parent, 1203γ to 3$^+$.
2522.56 *7*			
2531.49 *9*			
2546.84 *10*			
2884.10 *6*	2$^-$		J$^\pi$: log *ft*=5.6 from (1)$^-$ parent, 1651γ to 3$^+$.
2909.99? *10*			

[†] From least-squares fit to Eγ by evaluator.
[‡] From the Adopted Levels. In cases where spin is constrained by data from ^{180}Re ε decay, details are included in the comments.
[#] From $\gamma\gamma$(t) in 1967Go22.

ε,β^+ radiations

E(decay)	E(level)	Iε[‡]	Log *ft*	I($\varepsilon+\beta^+$)[†‡]	Comments
(891 *21*)	2909.99?	0.07 *1*	6.45 *7*	0.07 *1*	εK=0.8074 *6*; εL=0.1466 *4*; εM+=0.04601 *15*
(917 *21*)	2884.10	0.505 *2*	5.617 *24*	0.505 *2*	εK=0.8080 *6*; εL=0.1462 *4*; εM+=0.04583 *14*
(1254 *21*)	2546.84	0.141 *21*	6.46 *7*	0.141 *21*	εK=0.8138 *3*; εL=0.14194 *20*; εM+=0.04426 *8*
(1270 *21*)	2531.49	0.18 *3*	6.36 *8*	0.18 *3*	εK=0.8139 *3*; εL=0.14180 *19*; εM+=0.04421 *7*
(1278 *21*)	2522.56	0.182 *15*	6.37 *4*	0.182 *15*	εK=0.8140 *3*; εL=0.14172 *19*; εM+=0.04418 *7*
(1366 *21*)	2435.21	0.75 *4*	5.81 *3*	0.75 *4*	εK=0.8148 *2*; εL=0.14099 *17*; εM+=0.04391 *7*

Continued on next page (footnotes at end of table)

^{180}Re ε decay 1980Ma14,1967Go22 (continued)

ϵ,β^+ radiations (continued)

E(decay)	E(level)	Iβ^+ [‡]	Iε[‡]	Log *ft*	I($\varepsilon+\beta^+$)[†‡]	Comments
(1385 *21*)	2415.75		0.95 *4*	5.72 *3*	0.95 *4*	εK=0.8150 *2*; εL=0.14084 *17*; εM+=0.04386 *6*
(1544 *21*)	2256.63?	0.00021 *4*	0.14 *1*	6.65 *4*	0.14 *1*	av Eβ=253.3 *94*; εK=0.8154; εL=0.13965 *16*; εM+=0.04343 *6*
(1573 *21*)	2227.82	0.00026 *5*	0.14 *1*	6.67 *4*	0.14 *1*	av Eβ=266.1 *94*; εK=0.81537 *9*; εL=0.13944 *16*; εM+=0.04335 *6*
(1624 *21*)	2176.79	0.00047 *7*	0.18 *1*	6.59 *3*	0.18 *1*	av Eβ=288.8 *93*; εK=0.8151 *2*; εL=0.13906 *16*; εM+=0.04322 *6*
(1969 *21*)	1831.69	0.164 *14*	11.5 *4*	4.953 *21*	11.7 *4*	av Eβ=440.6 *93*; εK=0.8077 *9*; εL=0.13602 *23*; εM+=0.04219 *8*
(1986 *21*)	1814.85	0.00052 *16*	0.034 *10*	7.49 *13*	0.035 *10*	av Eβ=447.9 *93*; εK=0.8071 *9*; εL=0.13584 *23*; εM+=0.04213 *8*
(2168 *21*)	1632.90	0.0076 *9*	0.27 *3*	6.67 *5*	0.28 *3*	av Eβ=527.8 *93*; εK=0.7980 *13*; εL=0.1336 *3*; εM+=0.04141 *10*
(2214 *21*)	1587.26	0.0052 *10*	0.16 *3*	6.90 *8*	0.17 *3*	av Eβ=547.8 *93*; εK=0.7951 *15*; εL=0.1330 *3*; εM+=0.04120 *10*
(2684 *21*)	1117.31	0.011 *5*	0.12 *5*	7.22 *20*	0.13 *6*	av Eβ=754.9 *93*; εK=0.750 *3*; εL=0.1243 *5*; εM+=0.03846 *15*
(2795 *21*)	1006.35	8.3 *5*	71 *4*	4.48 *3*	79 *4*	av Eβ=804.1 *94*; εK=0.736 *3*; εL=0.1217 *6*; εM+=0.03765 *17* Eβ=1800 keV *60* $\beta\gamma$ coin (1967Go22), 1760 keV *40* (1967Ho12).
(3697[#] *21*)	103.54	≤3.2	≤7.8	≥5.7	≤11	av Eβ=1208.4 *95*; εK=0.581 *4*; εL=0.0952 *7*; εM+=0.02940 *21*

† From an intensity balance at each level by evaluator. The Iγ normalization of 0.91 *3* is used which assumes no ε branch to the g.s. An upper limit on the intensity to the g.s. of I($\varepsilon+\beta^+$)=8% is obtained from a lower limit of log *ft*=5.9. Such a branch would change the log *ft* values by a maximum of 0.1 units.

‡ Absolute intensity per 100 decays.

Existence of this branch is questionable.

$\gamma(^{180}$W)

Iγ normalization: From ΣI(γ+ce)(to g.s.)=100% and assuming no ε population of the g.s. An upper limit on the intensity to the g.s. of I(ε+β^+)=8% is obtained from a lower limit of log *ft*=5.9. The corresponding normalization would become 0.84 *3*.

K x-ray relative intensity=87 *15* (1967Go22). Other: 105 (1967Ho12).

E$_\gamma$[‡]	I$_\gamma$[#@]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.	α	Comments
75.99 *5*	0.196 *10*	1082.36	3$^-$	1006.35	2$^-$	[M1,E2]	11.3 *9*	α(K)=5 *4*; α(L)=5 *4*; α(M)=1.2 *9*; α(N)=0.29 *21*; α(O)=0.04 *3*; α(P)=0.0005 *4* I$_\gamma$: other: ≈0.7 (1967Go22).
103.57 *5*	24.7 *7*	103.54	2$^+$	0.0	0$^+$	E2	3.40	α(K)=0.827 *12*; α(L)=1.95 *3*; α(M)=0.492 *7*; α(N)=0.1159 *17*; α(O)=0.01587 *23* α(P)=6.54×10^{-5} *10* Mult.: from ce(K):ce(L1):ce(L2):ce(L3)=19.3:2.55:25.1:23.2 (1968Ha39). Other: 1968Be53.
^{x}131.5 *14*	0.121 *5*							
^{x}173.91 *10*	0.10 *2*							
178.74 *10*	0.079 *8*	1185.07	(4$^-$)	1006.35	2$^-$	[E2]	0.452	α(K)=0.228 *4*; α(L)=0.1702 *25*; α(M)=0.0425 *6*; α(N)=0.01005 *15*; α(O)=0.001407 *20* α(P)=1.766×10^{-5} *25*
233.99 *5*	0.88 *3*	337.51	4$^+$	103.54	2$^+$	[E2]	0.184	α(K)=0.1106 *16*; α(L)=0.0558 *8*; α(M)=0.01379 *20*; α(N)=0.00327 *5*; α(O)=0.000466 *7* α(P)=9.03×10^{-6} *13* I$_\gamma$: other: 0.5 *1* (1967Go22).
550.52 *6*	0.187 *15*	1632.90	(1$^-$,2)	1082.36	3$^-$			
580.8 *1*	0.124 *21*	1587.26	2$^+$	1006.35	2$^-$			
599.0 *2*	0.165 *21*	1831.69	2$^-$	1232.64	3$^+$			
626.7 *2*	0.066 *24*	1632.90	(1$^-$,2)	1006.35	2$^-$			
668.80 *6*	0.45 *3*	1006.35	2$^-$	337.51	4$^+$	[M2]	0.0736	α(K)=0.0599 *9*; α(L)=0.01053 *15*; α(M)=0.00243 *4*; α(N)=0.000588 *9*; α(O)=9.55×10^{-5} *14* α(P)=6.62×10^{-6} *10*
699.7[&] *2*	0.10 *3*	2531.49		1831.69	2$^-$			
714.43 *6*	0.310 *21*	1831.69	2$^-$	1117.31	2$^+$			
744.84 *6*	0.289 *21*	1082.36	3$^-$	337.51	4$^+$	[E1]	0.00312	α(K)=0.00263 *4*; α(L)=0.000380 *6*; α(M)=8.55×10^{-5} *12*; α(N)=2.05×10^{-5} *3*; α(O)=3.32×10^{-6} *5* α(P)=2.29×10^{-7} *4* I$_\gamma$: other: 0.7 *2* (1967Go22).
749.34 *5*	1.24 *4*	1831.69	2$^-$	1082.36	3$^-$			
782.6 *2*	0.030 *10*	2415.75	2$^-$	1632.90	(1$^-$,2)			
808.9 *3*	0.032 *6*	1814.85	(2$^+$,3)	1006.35	2$^-$			
825.36 *5*	11.0 *3*	1831.69	2$^-$	1006.35	2$^-$	M1	0.01564	α(K)=0.01308 *19*; α(L)=0.00198 *3*; α(M)=0.000449 *7*; α(N)=0.0001080 *16* α(O)=1.768×10^{-5} *25*; α(P)=1.282×10^{-6} *18* α(K)exp=0.014 *3* (1967Go22).

From ENSDF

γ(^{180}W) (continued)

$E_γ$ ‡	$I_γ$ #@	E_i(level)	$J^π_i$	E_f	$J^π_f$	Mult.	δ	α	Comments
									Mult.: from α(K)exp. δ: <0.6 from α(K)exp.
828.5& 2	0.04 2	2415.75	2⁻	1587.26	2⁺				
847.80 10	0.031 10	1185.07	(4⁻)	337.51	4⁺	[E1]		0.00243	α(K)=0.00205 3; α(L)=0.000294 5; α(M)=6.61×10^{-5} 10; α(N)=1.584×10^{-5} 23; α(O)=2.57×10^{-6} 4 α(P)=1.80×10^{-7} 3
847.80 10	0.031 10	2435.21	2⁻	1587.26	2⁺				
902.84 5	100 3	1006.35	2⁻	103.54	2⁺	E1+M2	−0.31 5	0.0047 8	α(K)=0.0039 7; α(L)=0.00062 12; α(M)=0.00014 3; α(N)=3.4×10^{-5} 7; α(O)=5.5×10^{-6} 10 α(P)=3.9×10^{-7} 7 α(K)exp=0.0040 6 (1967Go22). Mult.,δ: from α(K)exp and A_2=+0.47 7, A_4=−0.10 15 for 902γ-103γ(θ), assuming a J=2-2-0 cascade.
935.2 2	0.036 9	2522.56		1587.26	2⁺				
995.14 9	0.078 8	2227.82		1232.64	3⁺				
1006.31 5	0.547 21	1006.35	2⁻	0.0	0⁺	[M2]		0.0236	α(K)=0.0195 3; α(L)=0.00321 5; α(M)=0.000736 11; α(N)=0.0001776 25; α(O)=2.90×10^{-5} 4 α(P)=2.05×10^{-6} 3
1013.73 5	0.82 3	1117.31	2⁺	103.54	2⁺	[M1,E2]		0.0069 25	α(K)=0.0057 22; α(L)=0.0009 3; α(M)=0.00020 7; α(N)=4.9×10^{-5} 16; α(O)=8.E−6 3 α(P)=5.5×10^{-7} 22 $I_γ$: other: 1.2 3 (1967Go22).
ˣ1024.9† 19	0.15 5								
ˣ1036.0 4	0.011 4								
1059.42 6	0.131 7	2176.79		1117.31	2⁺				
1069.4 2	0.034 6	2884.10	2⁻	1814.85	(2⁺,3)				
ˣ1082.6 4	0.015 5								
1110.7 2	0.061 7	2227.82		1117.31	2⁺				
1117.28 5	0.691 21	1117.31	2⁺	0.0	0⁺	[E2]		0.00362	α(K)=0.00299 5; α(L)=0.000486 7; α(M)=0.0001112 16; α(N)=2.67×10^{-5} 4; α(O)=4.28×10^{-6} 6 α(P)=2.77×10^{-7} 4
1129.14 5	0.495 21	1232.64	3⁺	103.54	2⁺				
1145.4 4	0.011 6	2227.82		1082.36	3⁻				
1183.11 7	0.124 10	2415.75	2⁻	1232.64	3⁺				
1202.6 1	0.089 7	2435.21	2⁻	1232.64	3⁺				$I_γ$: other: 0.27 8 (1967Go22).
ˣ1228† 3	0.3 1								
1250.22 6	0.062 10	2256.63?		1006.35	2⁻				
1250.22 6	0.062 10	2435.21	2⁻	1185.07	(4⁻)				
1290.0 1	0.043 6	2522.56		1232.64	3⁺				
1298.44 5	0.382 10	2415.75	2⁻	1117.31	2⁺				
1314.2 1	0.041 10	2546.84		1232.64	3⁺				
1317.85 6	0.196 10	2435.21	2⁻	1117.31	2⁺				$I_γ$: other: 0.30 7 (1967Go22).

From ENSDF

$\gamma(^{180}W)$ (continued)

E_γ [‡]	I_γ [#@]	E_i(level)	J^π_i	E_f	J^π_f	Comments
1333.4 *2*	0.060 *6*	2415.75	2⁻	1082.36	3⁻	
1352.80 *5*	0.310 *21*	2435.21	2⁻	1082.36	3⁻	
1405.2 *1*	0.069 *7*	2522.56		1117.31	2⁺	
1409.40 *5*	0.516 *21*	2415.75	2⁻	1006.35	2⁻	I_γ: other: 1.2 *1* (1967Go22).
1428.8 *1*	0.041 *10*	2435.21	2⁻	1006.35	2⁻	
1429.5 *2*	0.114 *21*	2546.84		1117.31	2⁺	
1449.2 *2*	0.018 *6*	2531.49		1082.36	3⁻	
1477.3 *3*	0.014 *5*	1814.85	(2⁺,3)	337.51	4⁺	
1483.69 *6*	0.114 *10*	1587.26	2⁺	103.54	2⁺	I_γ: other: 0.29 *6* (1967Go22).
1516.0 *5*	0.052 *10*	2522.56		1006.35	2⁻	
1525.14 *11*	0.084 *5*	2531.49		1006.35	2⁻	
1529.30 *11*	0.087 *5*	1632.90	(1⁻,2)	103.54	2⁺	
x1545 [†&] *4*	0.14 *14*					
x1561.0 *6*	0.006 *4*					
1587.2 *3*	0.020 *4*	1587.26	2⁺	0.0	0⁺	
x1595.5 *4*	0.011 *4*					
1651.45 *11*	0.073 *5*	2884.10	2⁻	1232.64	3⁺	
1678.0 *3*	0.023 *6*	2909.99?		1232.64	3⁺	
1711.3 *2*	0.026 *4*	1814.85	(2⁺,3)	103.54	2⁺	
1727.8 *1*	0.063 *8*	1831.69	2⁻	103.54	2⁺	
1766.74 *11*	0.095 *9*	2884.10	2⁻	1117.31	2⁺	
1792.3 *3*	0.019 *5*	2909.99?		1117.31	2⁺	
1801.75 *11*	0.157 *10*	2884.10	2⁻	1082.36	3⁻	
x1815.6 *4*	0.018 *4*					
x1820.5 [†] *22*	0.10 *5*					
x1838.4 [†] *22*	0.13 *4*					
x1839.6 *3*	0.018 *4*					
x1867.4 [†] *22*	0.05 *3*					
1877.70 *10*	0.231 *10*	2884.10	2⁻	1006.35	2⁻	
1903.6 *1*	0.032 *4*	2909.99?		1006.35	2⁻	
x1939.1 *3*	0.011 *3*					
x1991.1 *3*	0.021 *4*					
x2027.2 *5*	0.014 *4*					
x2034 [†] *3*	0.05 *2*					
x2066.9 *5*	0.013 *3*					
2073.5 *2*	0.026 *4*	2176.79		103.54	2⁺	
x2096.0 *3*	0.013 *3*					
x2142.2 *4*	0.017 *3*					
2153.24 *11*	0.095 *6*	2256.63?		103.54	2⁺	
x2165.7 *5*	0.004 *2*					
2176.9 *1*	0.037 *4*	2176.79		0.0	0⁺	
x2182.30 *14*	0.029 *3*					

$\gamma(^{180}W)$ (continued)

E_γ [‡]	I_γ [#@]	E_i(level)	J^π_i	E_f	J^π_f
^{x}2196.0 *6*	0.003 *2*				
^{x}2204.64 *11*	0.153 *7*				
^{x}2232.9 *3*	0.013 *3*				
^{x}2242[†] *4*	0.03 *2*				
^{x}2258.40 *14*	0.044 *4*				
2312.1 *2*	0.020 *4*	2415.75	2^-	103.54	2^+
2331.87 *11*	0.094 *5*	2435.21	2^-	103.54	2^+
^{x}2341 *4*	<0.1				
^{x}2408.4 *4*	0.006 *2*				
^{x}2475.5 *4*	0.007 *2*				
2780.6 *2*	0.0144 *21*	2884.10	2^-	103.54	2^+
^{x}2889.8 *3*	0.017 *3*				
^{x}3340.7 *5*	0.006 *2*				

† Observed only by 1967Go22. γ-rays were not confirmed by 1980Ma14.
‡ From 1980Ma14.
# From 1980Ma14. These are in general in agreement with the results of 1967Go22. In cases where the measured values differ by more than 1σ, the values from 1967Go22 are included in the comments.
@ For absolute intensity per 100 decays, multiply by 0.91 *3*.
& Placement of transition in the level scheme is uncertain.
^{x} γ ray not placed in level scheme.

$^{180}_{74}W_{106}$-6

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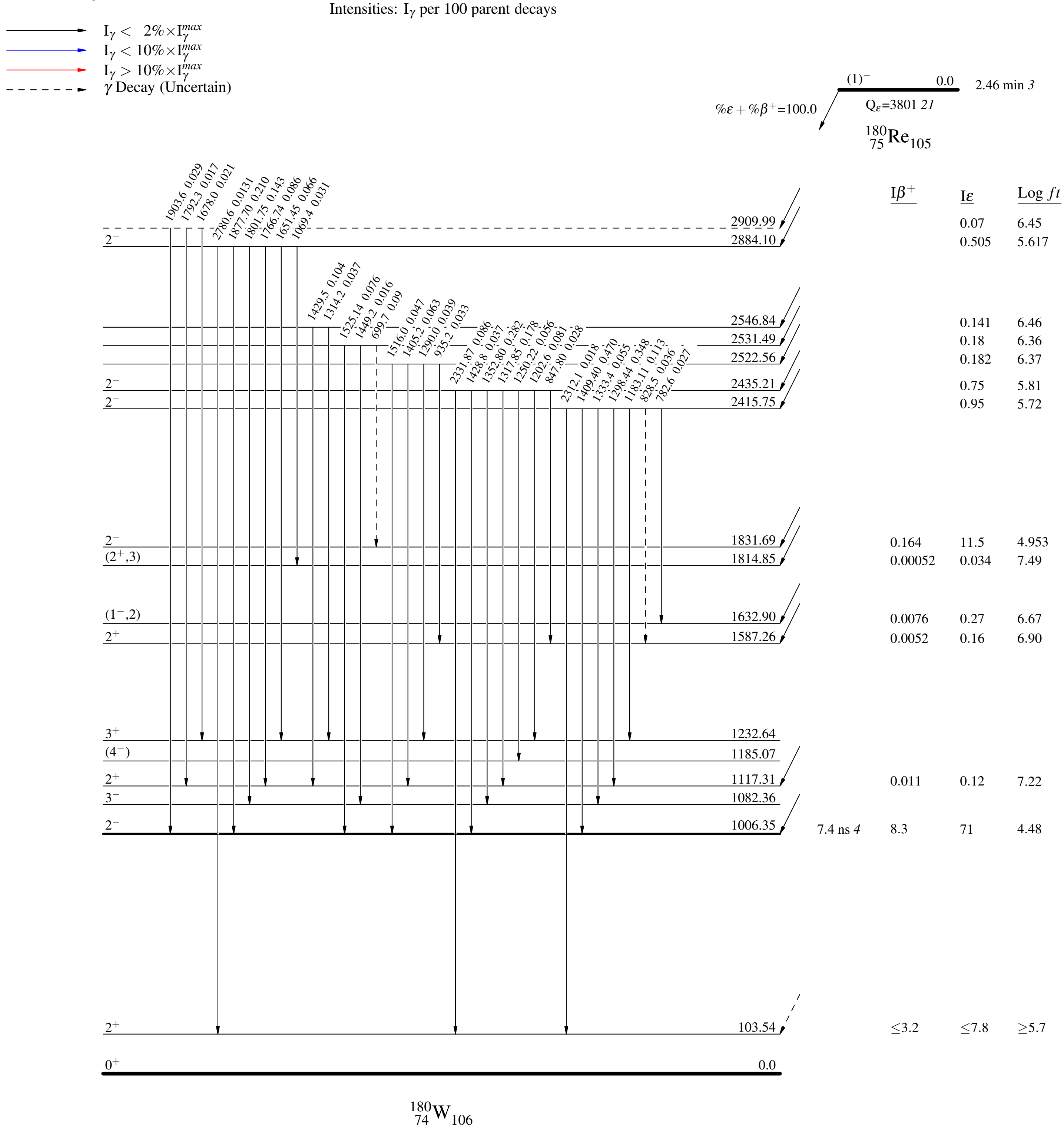
Decay Scheme

Intensities: I_γ per 100 parent decays



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Decay Scheme (continued)

Intensities: I_γ per 100 parent decays