^{170}Re ε decay 2001Ki10,1992Me10

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	C. M. Baglin[1], E. A. Mccutchan[2], S. Basunia[1]	NDS 153, 1 (2018)	1-Oct-2018

Parent: ^{170}Re: E=0.0; J$^{\pi}$=(5^{+}); $T_{1/2}$=9.2 s *2*; Q(ε)=8378 *27*; %ε+%β^{+} decay=100.0

Sources produced by ^{159}Tb(^{20}Ne,9n), E≈180 MeV (1975St02); 1-GeV protons on Tl (1974Be59); ^{141}Pr+^{32}S, E(^{32}S)≈178 MeV (1992Me10); granddaughter of ^{170}Ir produced via ^{144}Sm(^{31}P,5n) at 150 MeV (2001Ki10).

2001Ki10: source from decay of ^{170}Ir produced In ^{144}Sm(^{31}P,5n), E=150 MeV; CAESAR array of six Compton-suppressed Ge detectors, superconducting solenoid electron spectrometer; measured Eγ (Eγ=30-2000), Iγ, Ice, $\gamma\gamma$ coin, $\gamma\gamma$(t) and $\gamma\gamma(\theta)$ (6 angles); band-mixing model calculations. See also 1998Ki14 for preliminary report of this study.

1992Me10: measured Eγ, Iγ, $\gamma\gamma$ coin, γ-K x ray coin.

The adopted decay scheme is that of 2001Ki10; it is much more extensive than and consistent with those of 1992Me10 and 1975St02, but differs from that of 1974Be59. The ε branching deduced from intensity imbalance at each level in this decay scheme is clearly an unreliable predictor of level J$^{\pi}$, since it varies greatly depending on the number of transitions included in the scheme, and is also somewhat dependent on whether Iγ is taken from 1992Me10 or from 2001Ki10. The range of J$^{\pi}$ values that appear to be fed is inconsistent with the assumption of a unique J$^{\pi}$ for the parent, but no isomer of ^{170}Re is known at present. Q(ε) is large (8.4 MeV) but the highest-energy level known to be populated lies at 2650 keV. This, combined with the exclusion of Eγ>2000 transitions probably results in a very incomplete decay scheme, rendering the deduced log *ft* values meaningless. A remeasurement of this decay including Eγ>2 MeV appears to be needed.

^{170}W Levels

E(level)[†]	J$^{\pi}$[‡]	Comments
0.0[#]	0^{+}	
156.52[#] *16*	2^{+}	Intensity balance of −6 *4* to this level probably results from missing γ-ray intensity feeding this level.
462.11[#] *19*	4^{+}	
875.28[#] *22*	6^{+}	
936.96[b] *17*	(2^{+})	
952.29[a] *23*	(2^{+})	
1073.36[b] *22*	(3^{+})	
1152.82 *22*	(2^{+},3,4^{+})	
1201.96[a] *23*	4^{+}	
1219.77[b] *21*	(4^{+})	
1314.22[&] *22*	(3^{-})	
1327.3[@] *3*	(2^{-})	
1363.1[#] *3*	8^{+}	
1492.33[@] *24*	(4^{-})	
1517.04[&] *24*	5^{-}	
1578.07[a] *25*	6^{+}	
1718.59 *24*	(4^{+},5,6^{+})	
1791.4[&] *3*	7^{-}	
1810.9[@] *3*	(6^{-})	
1875.4 *3*		
1974.5 *3*		
2079.8 *3*		
2344.6 *3*		
2442.6 *3*		
2480.9 *3*		
2552.6 *3*		
2650.1 *3*		

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^{170}Re ε decay 2001Ki10,1992Me10 (continued)

^{170}W Levels (continued)

† From least-squares fit to Eγ.
‡ From Adopted Levels.
# Band(A): $K^{\pi}=0^{+}$ g.s. band.
@ Band(B): π=−, α=0 octupole band. Probably predominantly (π 9/2[514])⊗(π 5/2[402]), for which $K^{\pi}=2^{-}$ is favored, but 2-quasineutron admixtures may also be present (2001Ki10), and Coriolis mixing of different K components of the octupole vibration may render K a poor quantum number.
& Band(b): Possible π=−, α=1 octupole band. signature partner of π=−, α=0 band; see comments on that band.
a Band(C): $K^{\pi}=0^{+}$ β band (2001Ki10). Assignment supported by γ decay pattern, particularly the strong E0 component in the 740γ and 703γ to the 4^{+} and 6^{+} states, respectively, of the g.s. band. From systematics, the J=0 member is expected at≈750 keV.
b Band(D): $K^{\pi}=2^{+}$ γ band. The energies of the J=2 and 4 members differ only by≈20 keV from their counterparts in the β band, so significant βγ mixing is expected.

ε,β^{+} radiations

E(decay)	E(level)	Iβ^{+} ‡	Iε†‡	Log *ft*†	I(ε+β^{+})‡	Comments
(5.73×10^{3} *3*)	2650.1	1.7 *4*	0.79 *19*	5.86 *11*	2.5 *6*	av Eβ=2140 *13*; εK=0.260 *3*; εL=0.0420 *5*; εM+=0.01296 *15* Additional information 1.
(5.83×10^{3} *3*)	2552.6	1.2 *6*	0.51 *24*	6.06 *21*	1.7 *8*	av Eβ=2186 *13*; εK=0.249 *3*; εL=0.0403 *5*; εM+=0.01244 *15* Additional information 2.
(5.90×10^{3} *3*)	2480.9	1.6 *5*	0.67 *21*	5.96 *14*	2.3 *7*	av Eβ=2219 *13*; εK=0.242 *3*; εL=0.0392 *5*; εM+=0.01207 *14* Additional information 3.
(5.94×10^{3} *3*)	2442.6	3.0 *7*	1.2 *3*	5.71 *11*	4.2 *10*	av Eβ=2237 *13*; εK=0.238 *3*; εL=0.0385 *5*; εM+=0.01188 *14* Additional information 4.
(6.03×10^{3} *3*)	2344.6	5.0 *7*	1.9 *3*	5.52 *7*	6.9 *10*	av Eβ=2283 *13*; εK=0.229 *3*; εL=0.0370 *5*; εM+=0.01140 *13* Additional information 5.
(6.30×10^{3}# *3*)	2079.8	1.3 *2*	0.42 *7*	6.22 *8*	1.7 *3*	av Eβ=2407 *13*; εK=0.2054 *23*; εL=0.0332 *4*; εM+=0.01023 *12*
(6.40×10^{3}# *3*)	1974.5	1.2 *4*	0.38 *12*	6.27 *14*	1.6 *5*	av Eβ=2456 *13*; εK=0.1968 *22*; εL=0.0318 *4*; εM+=0.00980 *11*
(6.50×10^{3}# *3*)	1875.4	0.8 *3*	0.25 *9*	6.47 *16*	1.1 *4*	av Eβ=2502 *13*; εK=0.1891 *21*; εL=0.0305 *4*; εM+=0.00941 *11*
(6.57×10^{3}# *3*)	1810.9	1.4 *3*	0.40 *9*	6.27 *10*	1.8 *4*	av Eβ=2533 *13*; εK=0.1843 *20*; εL=0.0298 *4*; εM+=0.00917 *10*
(6.59×10^{3} *3*)	1791.4	5.8 *10*	1.7 *3*	5.66 *8*	7.5 *13*	av Eβ=2542 *13*; εK=0.1829 *20*; εL=0.0295 *4*; εM+=0.00910 *10* Additional information 6.
(6.66×10^{3} *3*)	1718.59	4.4 *5*	1.2 *1*	5.81 *5*	5.6 *6*	av Eβ=2576 *13*; εK=0.1777 *19*; εL=0.0287 *3*; εM+=0.00884 *10* Additional information 7.
(6.80×10^{3} *3*)	1578.07	7.9 *8*	2.0 *2*	5.60 *5*	9.9 *10*	av Eβ=2642 *13*; εK=0.1682 *18*; εL=0.0271 *3*; εM+=0.00836 *9* Additional information 8.
(6.86×10^{3} *3*)	1517.04	3.4 *6*	0.84 *16*	5.99 *9*	4.2 *8*	av Eβ=2671 *13*; εK=0.1642 *18*; εL=0.0265 *3*; εM+=0.00816 *9* Additional information 9.
(6.89×10^{3} *3*)	1492.33	3.6 *4*	0.89 *10*	5.97 *5*	4.5 *5*	av Eβ=2683 *13*; εK=0.1627 *18*; εL=0.0262 *3*; εM+=0.00808 *9*

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^{170}Re ε decay 2001Ki10,1992Me10 (continued)

ϵ,β^+ radiations (continued)

E(decay)	E(level)	Iβ^+ ‡	Iε†‡	Log *ft*†	I($\varepsilon+\beta^+$)‡	Comments
						Additional information 10.
(7.01×10^3 *3*)	1363.1	8.1 *12*	1.9 *3*	5.66 *7*	10.0 *15*	av Eβ=2743 *13*; εK=0.1547 *17*; εL=0.0250 *3*; εM+=0.00769 *8* Additional information 11.
(7.05×10^3 *3*)	1327.3	1.9 *4*	0.43 *9*	6.31 *10*	2.3 *5*	av Eβ=2760 *13*; εK=0.1526 *16*; εL=0.0246 *3*; εM+=0.00758 *8* Additional information 12.
(7.06×10^3 *3*)	1314.22	1.9 *4*	0.42 *9*	6.32 *10*	2.3 *5*	av Eβ=2767 *13*; εK=0.1519 *16*; εL=0.0245 *3*; εM+=0.00754 *8* Additional information 13.
(7.16×10^3 *3*)	1219.77	2.5 *4*	0.53 *9*	6.23 *8*	3.0 *5*	av Eβ=2811 *13*; εK=0.1465 *16*; εL=0.02362 *25*; εM+=0.00728 *8* Additional information 14.
(7.18×10^3 *3*)	1201.96	5.4 *8*	1.1 *2*	5.90 *7*	6.5 *10*	av Eβ=2820 *13*; εK=0.1455 *15*; εL=0.02346 *25*; εM+=0.00723 *8* Additional information 15.
(7.23×10^3 *3*)	1152.82	3.5 *7*	0.73 *14*	6.10 *9*	4.2 *8*	av Eβ=2843 *13*; εK=0.1428 *15*; εL=0.02303 *24*; εM+=0.00709 *8* Additional information 16.
(7.30×10^3 *3*)	1073.36	4.7 *6*	0.96 *12*	5.99 *6*	5.7 *7*	av Eβ=2880 *13*; εK=0.1386 *15*; εL=0.02235 *23*; εM+=0.00688 *7* Additional information 17.
(7.43×10^3# *3*)	952.29	1.0 *4*	0.19 *8*	6.70 *19*	1.2 *5*	av Eβ=2938 *13*; εK=0.1325 *14*; εL=0.02135 *22*; εM+=0.00658 *7*
(7.44×10^3 *3*)	936.96	6.1 *5*	1.2 *1*	5.92 *4*	7.3 *6*	av Eβ=2945 *13*; εK=0.1318 *14*; εL=0.02123 *22*; εM+=0.00654 *7* Additional information 18.
(7.50×10^3 *3*)	875.28	8 *3*	1	5.85 *15*	9 *3*	av Eβ=2974 *13*; εK=0.1288 *13*; εL=0.02075 *21*; εM+=0.00639 *7* Additional information 19.

† Iε values deduced from intensity imbalance at each level are given for completeness only; they do not lead to meaningful log *ft* values, possibly due to an incomplete decay scheme (see general comment on decay scheme), so log *ft* values are not considered to provide useful arguments for J$^\pi$ assignments. The completeness of the scheme can significantly affect conclusions concerning which levels are fed in this decay. For example, based on all transitions reported in 2001Ki10, significant feeding occurs from the (5$^+$) parent to levels with J$^\pi$ from 2$^+$ to 8$^+$, but the 157 (2$^+$) and 462 (4$^+$) levels do not appear to be fed at all. However, if one were to consider only the 8 transitions reported in 1992Me10, the Iγ data from 1992Me10 and 2001Ki10 would imply non-zero ε branches to both levels, viz., 15% *4* and 9% *4*, respectively, to the 2$^+$ 157 level, and 23% *5* and 14.7% *24*, respectively, to the (4)$^+$ 462 level.

‡ Absolute intensity per 100 decays.

Existence of this branch is questionable.

$\gamma(^{170}W)$

Iγ normalization: from Σ (I(γ+ce) to g.s.)=100; no $\varepsilon+\beta^+$ branch to g.s. is expected because ΔJ=(5).

E_γ[†]	I_γ[‡a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ[&]	α[#]	Comments
156.67 *19*	100 *3*	156.52	2$^+$	0.0	0$^+$	E2		0.718	α(K)=0.322 *5*; α(L)=0.301 *5*; α(M)=0.0754 *12*; α(N+..)=0.0203 *3* α(N)=0.0178 *3*; α(O)=0.00248 *4*; α(P)=2.44×10^{-5} *4* E_γ: weighted average of 156.0 *4* (1975St02), 156.9 *2* (1992Me10), 156.6 *2* (2001Ki10). Iγ=54.1% 7 assuming adopted decay scheme normalization.
249.9 *2*	1.4 *5*	1201.96	4$^+$	952.29	(2$^+$)	[E2]		0.1491	α(K)=0.0926 *14*; α(L)=0.0430 *7*; α(M)=0.01059 *16*; α(N+..)=0.00288 *5* α(N)=0.00251 *4*; α(O)=0.000360 *6*; α(P)=7.67×10^{-6} *11*
305.7 *2*	144.3 *26*	462.11	4$^+$	156.52	2$^+$	E2		0.0804	α(K)=0.0543 *8*; α(L)=0.0199 *3*; α(M)=0.00486 *7*; α(N+..)=0.001326 *19* α(N)=0.001153 *17*; α(O)=0.0001680 *24*; α(P)=4.66×10^{-6} *7* I_γ: other: 135 *5* (1992Me10). A_2=+0.09 *3*, A_4=+0.03 *3* (2001Ki10).
344.6 *2*	0.9 *3*	1219.77	(4$^+$)	875.28	6$^+$	[E2]		0.0567	α(K)=0.0398 *6*; α(L)=0.01292 *19*; α(M)=0.00313 *5*; α(N+..)=0.000857 *13* α(N)=0.000744 *11*; α(O)=0.0001095 *16*; α(P)=3.49×10^{-6} *5*
376.3 *2*	3.1 *5*	1578.07	6$^+$	1201.96	4$^+$	[E2]		0.0443	α(K)=0.0318 *5*; α(L)=0.00951 *14*; α(M)=0.00229 *4*; α(N+..)=0.000629 *9* α(N)=0.000545 *8*; α(O)=8.09×10^{-5} *12*; α(P)=2.83×10^{-6} *4*
413.1 *2*	113.5 *25*	875.28	6$^+$	462.11	4$^+$	E2		0.0344	α(K)=0.0253 *4*; α(L)=0.00695 *10*; α(M)=0.001667 *24*; α(N+..)=0.000458 *7* α(N)=0.000397 *6*; α(O)=5.94×10^{-5} *9*; α(P)=2.27×10^{-6} *4* I_γ: other: 88 *5* (1992Me10). A_2=+0.13 *4*, A_4=+0.02 *4* (2001Ki10). E_γ: other: 412.5 *4* (1975St02).
418.9 *2*	1.7 *3*	1492.33	(4$^-$)	1073.36	(3$^+$)				
428.4 *2*	9.9 *21*	1791.4	7$^-$	1363.1	8$^+$	(E1)		0.00998 *14*	α=0.00998 *14*; α(K)=0.00836 *12*; α(L)=0.001253 *18*; α(M)=0.000283 *4*; α(N+..)=7.93×10^{-5} *12* α(N)=6.77×10^{-5} *10*; α(O)=1.084×10^{-5} *16*; α(P)=7.08×10^{-7} *10*
487.9 *2*	27.8 *17*	1363.1	8$^+$	875.28	6$^+$	E2		0.0223	α(K)=0.01698 *24*; α(L)=0.00409 *6*; α(M)=0.000972 *14*; α(N+..)=0.000269 *4* α(N)=0.000232 *4*; α(O)=3.52×10^{-5} *5*; α(P)=1.548×10^{-6} *22* I_γ: other: 17.6 *13* (1992Me10). A_2=+0.11 *10*, A_4=+0.07 *10* (2001Ki10).
611.3 *2*	2.3 *6*	1073.36	(3$^+$)	462.11	4$^+$				
641.7 *2*	6.7 *13*	1517.04	5$^-$	875.28	6$^+$				

$\gamma(^{170}W)$ (continued)

E_γ[†]	I_γ[‡a]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[@]	δ[&]	α[#]	Comments
690.7 *2*	2.3 *6*	1152.82	$(2^+,3,4^+)$	462.11	4^+				
702.6 *2*	13.9 *14*	1578.07	6^+	875.28	6^+	E0+E2+M1	−1.7 *+8−25*	≈0.089	E_γ: weighted average of 702.4 *2* (1992Me10), 702.8 *2* (2001Ki10). I_γ: other: 14.2 *10* (1992Me10). Mult.,δ: from α(K)exp=0.067 *15*, A_2=+0.04 *6*, A_4=+0.12 *7*, q^2(E0/E2)=10 *3*, X(E0/E2)=0.23 *7* (2001Ki10). α: based on α(K)exp.
739.8 *2*	12.9 *14*	1201.96	4^+	462.11	4^+	E0+E2(+M1)	≤−1.7	≈0.061	E_γ: other: 15.6 *12* (1992Me10). Mult.,δ: from α(K)exp=0.046 *11*, A_2=−0.01 *13*, A_4=+0.23 *24*, δ(D,Q)=−3.3 *+1.6−∞*, q^2(E0/E2)=6.1 *18*, X(E0/E2)=0.16 *5* (2001Ki10). α: based on α(K)exp.
757.6 *2*	2.9 *7*	1219.77	(4^+)	462.11	4^+				
780.6 *2*	1.0 *3*	936.96	(2^+)	156.52	2^+				
796.0 *2*	3.9 *7*	952.29	(2^+)	156.52	2^+				
843.4 *2*	3.0 *7*	1718.59	$(4^+,5,6^+)$	875.28	6^+				
852.3 *2*	1.9 *6*	1314.22	(3^-)	462.11	4^+				
916.0 *2*	3.9 *10*	1791.4	7^-	875.28	6^+	E1		0.00210 *3*	α=0.00210 *3*; α(K)=0.001776 *25*; α(L)=0.000253 *4*; α(M)=5.68×10^{-5} *8*; α(N+..)=1.600×10^{-5} *23* α(N)=1.363×10^{-5} *19*; α(O)=2.21×10^{-6} *4*; α(P)=1.556×10^{-7} *22*
916.7 *2*	10.0 *9*	1073.36	(3^+)	156.52	2^+	(M1+E2)	≤+15	0.009 *4*	α=0.009 *4*; α(K)=0.007 *3*; α(L)=0.0011 *4*; α(M)=0.00026 *9*; α(N+..)=7.3×10^{-5} *24* α(N)=6.2×10^{-5} *21*; α(O)=1.0×10^{-5} *4*; α(P)=7.E−7 *3* Mult.,δ: from A_2=−0.13 *23*, A_4=−0.04 *24*, δ(D,Q)=+10 *+5−∞* (2001Ki10); $\Delta\pi$=(no) from level scheme. Pure D or pure Q not ruled out.
935.6 *2*	3.4 *7*	1810.9	(6^-)	875.28	6^+				
936.8 *2*	12.5 *9*	936.96	(2^+)	0.0	0^+				
996.3 *2*	5.4 *12*	1152.82	$(2^+,3,4^+)$	156.52	2^+				
1030.3 *2*	6.7 *8*	1492.33	(4^-)	462.11	4^+	(E1+M2)	−1.7 *+11−39*	0.017 *10*	α(K)=0.014 *8*; α(L)=0.0023 *14*; α(M)=0.0005 *3*; α(N+..)=0.00015 *9* α(N)=0.00013 *8*; α(O)=2.1×10^{-5} *13*; α(P)=1.5×10^{-6} *9* Mult.,δ: D+Q from A_2=+0.09 *21*, A_4=+0.12 *22* (2001Ki10), $\Delta\pi$=yes from level scheme.
1055.0 *2*	1.1 *4*	1517.04	5^-	462.11	4^+				
1063.2 *2*	1.7 *5*	1219.77	(4^+)	156.52	2^+				
1099.2 *2*	3.0 *8*	1974.5		875.28	6^+				
1157.5 *2*	2.3 *6*	1314.22	(3^-)	156.52	2^+				
1170.8 *2*	4.2 *8*	1327.3	(2^-)	156.52	2^+				
1204.5 *2*	3.2 *5*	2079.8		875.28	6^+				
1256.4 *2*	7.4 *7*	1718.59	$(4^+,5,6^+)$	462.11	4^+				
1413.3 *2*	2.0 *7*	1875.4		462.11	4^+				

$^{170}_{74}W_{96}$-5

γ(^{170}W) (continued)

E_γ[†]	I_γ[‡a]	E_i(level)	J^π_i	E_f	J^π_f	Comments
1469.3 *2*	12.7 *18*	2344.6		875.28	6^+	I_γ: other: 8.9 *9* (1992Me10). E_γ: other: 1469.9 *4* (1992Me10).
1567.3 *2*	7.7 *17*	2442.6		875.28	6^+	I_γ: other: 11.3 *13* (1992Me10). E_γ: other: 1568.2 *4* (1992Me10).
1605.6 *2*	4.2 *13*	2480.9		875.28	6^+	
1677.3 *2*	3.2 *14*	2552.6		875.28	6^+	
1774.8 *2*	4.6 *11*	2650.1		875.28	6^+	

[†] From 2001Ki10, except as noted. Uncertainties are reported to be≤0.2 keV for most lines; the evaluator has assigned ΔE_γ=0.2 to all Eγ. Data from 1992Me10 are in excellent agreement except for the two highest energy lines reported in 1992Me10. Note that the experiment of 2001Ki10 was unable to observe Eγ>2000.

[‡] Photon intensities from 2001Ki10 relative to I(157γ)=100 *3*; from $\gamma\gamma$ coin total projection spectrum measured between beam bursts, Eγ>2000 excluded (singles spectrum Iγ not reported). Note that singles spectrum data from 1992Me10 are in some cases significantly different from those in 2001Ki10; consequently, Iγ data from 1992Me10 are also indicated (in comments on the relevant transitions).

[#] For transitions with E0 admixture, α=1.25(α(K)exp) has been assumed.

[@] From Adopted Gammas, except as noted.

[&] From $\gamma(\theta)$ and/or α(K)exp (2001Ki10).

[a] For absolute intensity per 100 decays, multiply by 0.541 *17*.

$^{170}_{74}$W$_{96}$-6

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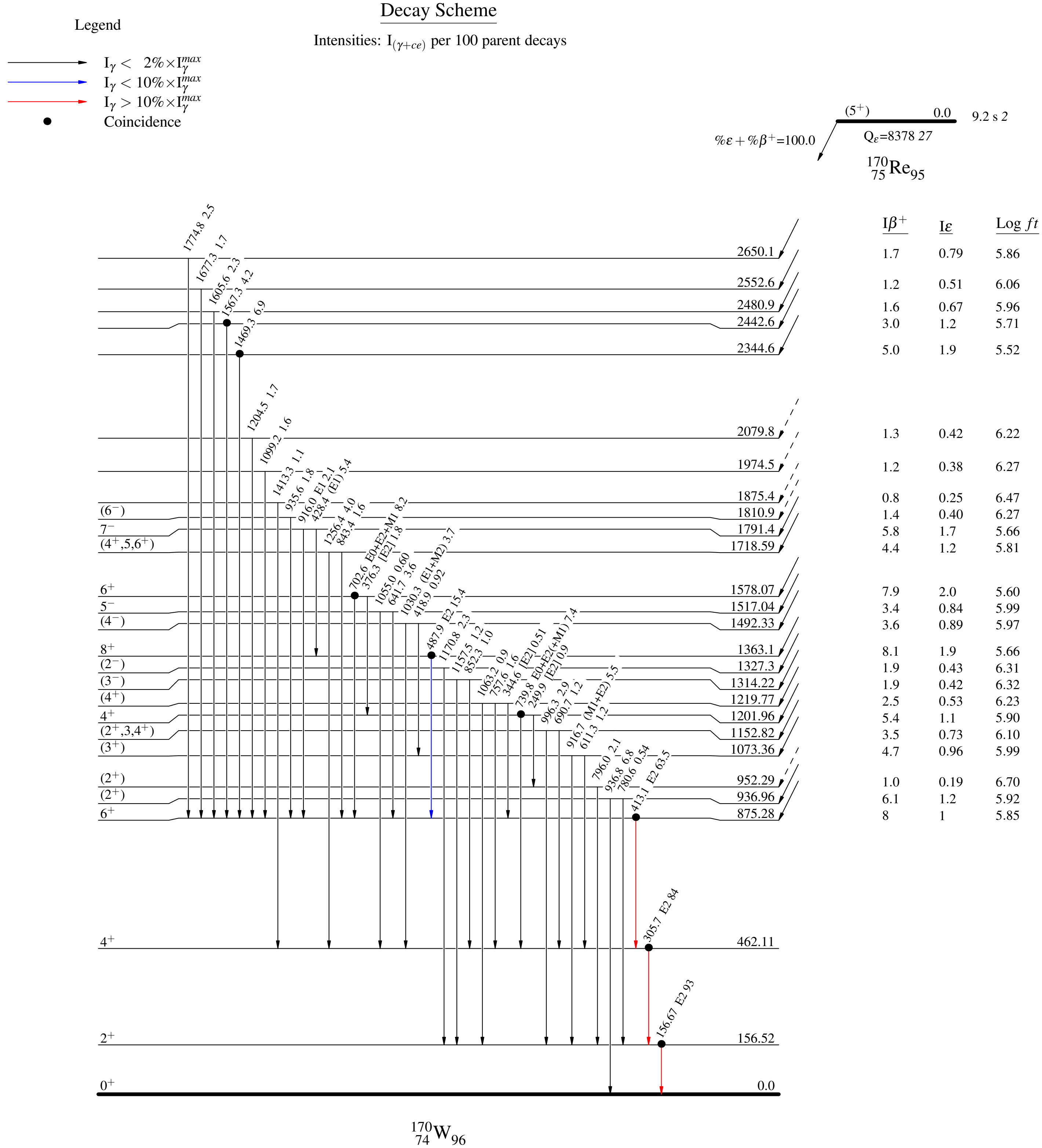
Decay Scheme

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



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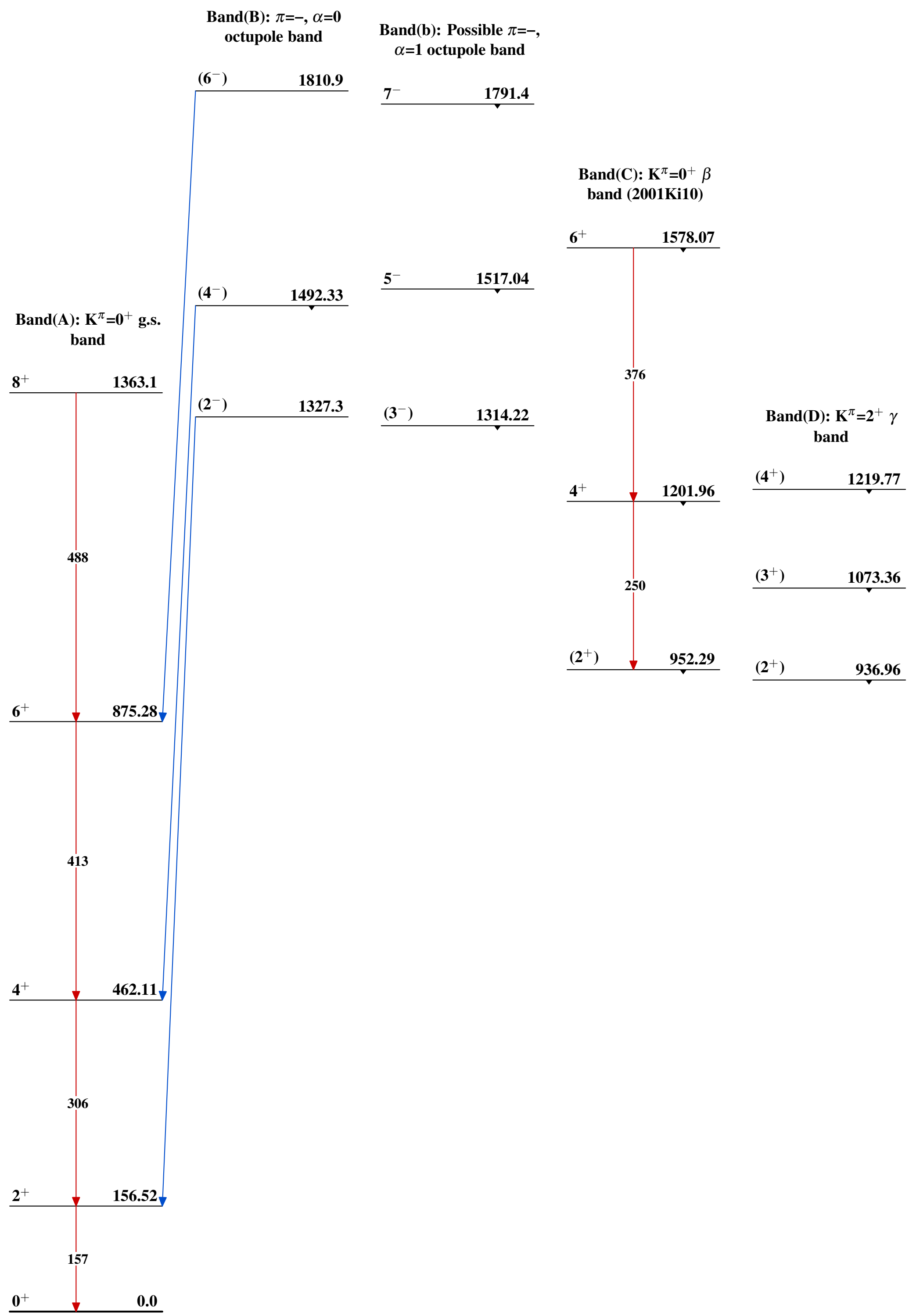

$^{170}_{74}W_{96}$