^{186}W(n,n′γ) 1988GoZC,1978Av05

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. C. Batchelder and A. M. Hurst, M. S. Basunia	NDS 183, 1 (2022)	1-Mar-2022

Small changes compared to previous evaluation (2003Ba44).

1988GoZC: fast reactor neutrons; 88.8% ^{186}W target; measured Eγ, Iγ, γ(θ), γ linear polarization.
1978Av05: E(n)=0.06-3 MeV; 97.3% ^{186}W target; measured Eγ, Iγ.
2000Ya22: spallation neutrons from LANSCE/WNR facility, KEGS array of 4 HPGe detectors; measured Eγ, γγ coin (E(n)≈2-8 MeV).
The level scheme is taken from 1988GoZC. This scheme is based on more extensive and higher precision data than were available in 1978Av05, and presumably supersedes the level scheme given in 1978Av05 (these two studies have two authors in common). The level scheme of 1978Av05 differs significantly from that of 1988GoZC above about 1150 keV.

^{186}W Levels

E(level)†	Jπ‡	Comments
0.0#	0^+	
122.631# *15*	2^+	
396.549# *18*	4^+	
737.964@ *19*	2^+	
809.26# *3*	6^+	
862.281@ *20*	3^+	
883.597& *25*	0^+	Jπ: 0^+ favored, based on relatively low population of state in (n,n′γ) (1978Av05).
952.739a *24*	2^-	
1006.734@ *20*	4^+	
1030.234& *16*	2^+	
1045.398a *20*	3^-	
1171.63a *4*	4^-	
1197.30@ *3*	5^+	
1285.420b *21*	2^+	
1298.93& *3*	4^+	
1322.135a *25*	5^-	
1349#	8^+	E(level),Jπ: From Adopted Levels; rounded value given for E(level).
1398.08@ *4*	(6^+)	
1453.449? *23*	(2^+)	
1458.38? *4*	(3^+)	
1463.77 *3*	4^-	
1521.31 *3*	4^+	
1532.32 *3*	3^+	
1563.37 *3*	1	
1607.52 *5*	3	
1628.27 *5*	$(3^-,5^-)$	
1642.46? *5*	4	
1709.74 *3*	3	

† From least-squares adjustment of Eγ.
‡ Values suggested in 1988GoZC; based on measured γ(θ), γ linear polarization and γ deexcitation patterns.
# Band(A): K=0 g.s. band.
@ Band(B): K=2 γ band. Note that identity of J=4 member differs in 1978Av05.

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^{186}W(n,n′γ) 1988GoZC,1978Av05 (continued)

^{186}W Levels (continued)

[&] Band(C): Possible K=0 β band. Note that suggested assignment of J=2 member differs in 1978Av05.
[a] Band(D): Possible $K^{\pi}=2^{-}$ band.
[b] Band(E): K=0 band.

γ(^{186}W)

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	Comments
122.64 *2*	100 *7*	122.631	2^+	0.0	0^+	Q		A_2=+0.155 *5*; A_4=−0.065 *8*
126.31 *20*	0.35 *5*	1171.63	4^-	1045.398	3^-			
[x]162.48 *8*	0.41 *4*							
164.77 *7*	0.67 *5*	1171.63	4^-	1006.734	4^+			
183.08 *2*	4.8 *3*	1045.398	3^-	862.281	3^+			
[x]195.36 *5*	1.00 *10*					(Q)		A_2=+0.21 *5*; A_4=−0.02 *7* Possibly the known 195γ from the adopted (7^-) 1517 level.
[x]198.11 *3*	1.20 *10*							P_γ=1.81 *+15−14*.
214.75 *4*	31.7 *22*	952.739	2^-	737.964	2^+			A_2=+0.148 *4*; A_4=−0.011 *6* P_γ=0.7 *2*. Interpreted by 1988GoZC as an E1 transition.
218.93 *6*	1.74 *12*	1171.63	4^-	952.739	2^-	Q		A_2=+0.28 *2*; A_4=−0.11 *3*
268.85 *5*	1.11 *8*	1006.734	4^+	737.964	2^+	Q		A_2=+0.26 *3*; A_4=−0.11 *4*
273.93 *5*	49 *4*	396.549	4^+	122.631	2^+	E2		A_2=+0.232 *7*; A_4=−0.035 *10* P_γ=1.84 *8*.
276.72 *2*	2.70 *15*	1322.135	5^-	1045.398	3^-	Q		A_2=+0.13 *6*; A_4=−0.09 *9*
292.97[@]	0.59[@] *5*	1030.234	2^+	737.964	2^+			E_γ: level energy difference is 292.270 *19*.
292.97[@]	0.59[@] *5*	1298.93	4^+	1006.734	4^+			E_γ: level energy difference is 292.194 *25*.
292.97[@]	0.59[@] *5*	1463.77	4^-	1171.63	4^-			E_γ: level energy difference is 292.14 *4*.
307.51 *6*	10.1 *15*	1045.398	3^-	737.964	2^+	D(+Q)	+0.02 *2*	A_2=−0.19 *2*; A_4=−0.03 *4* P_γ=1.3 *2*.
309.38 *8*	4.22 *15*	1171.63	4^-	862.281	3^+	D(+Q)	+0.02 *2*	A_2=−0.19 *2*; A_4=+0.02 *4* P_γ=1.3 *2*.
315.44 *3*	1.34 *10*	1322.135	5^-	1006.734	4^+	D(+Q)	−0.1 *3*	A_2=−0.20 *2*; A_4=+0.01 *3*
[x]318.17 *12*	0.06 *2*							
[x]321.17 *14*	0.18 *2*							
335.04 *5*	0.68 *5*	1197.30	5^+	862.281	3^+	Q		A_2=+0.33 *3*; A_4=−0.16 *4* Placement omitted from table 1 of 1988GoZC.
[x]344.02 *5*	0.72 *6*							A_2=+0.37 *3*; A_4=−0.01 *5*
388.17 *13*	0.20 *2*	1197.30	5^+	809.26	6^+			
391.46 *5*	0.93 *7*	1398.08	(6^+)	1006.734	4^+	Q		A_2=+0.32 *4*; A_4=−0.10 *5*
401.56 *17*	0.15 *2*	1285.420	2^+	883.597	0^+			
412.69 *2*	4.8 *4*	809.26	6^+	396.549	4^+	E2		A_2=+0.296 *6*; A_4=−0.066 *8* P_γ=2.0 5.
418.37 *2*	1.82 *13*	1463.77	4^-	1045.398	3^-	D+Q	−4.7 *3*	A_2=−0.23 *2*; A_4=+0.20 *2* P_γ=1.4 *4*.
423.16[&] *9*	0.33 *3*	1453.449?	(2^+)	1030.234	2^+			A_2=+0.15 *4*; A_4=−0.10 *6*
[x]440.92 *4*	0.72 *10*							A_2=−0.62 *3*; A_4=+0.22 *4*
[x]443.38 *12*	0.36 *8*							A_2=+0.08 *3*; A_4=−0.15 *5*
456.63 *4*	0.70 *6*	1628.27	$(3^-,5^-)$	1171.63	4^-	D+Q	−8 *1*	A_2=−0.20 *3*; A_4=+0.14 *5*
465.70 *2*	3.15 *25*	862.281	3^+	396.549	4^+	D+Q	−4.0 *5*	A_2=−0.030 *9*; A_4=+0.019 *13* P_γ=1.1 *2*.
486.93 *4*	0.61 *5*	1532.32	3^+	1045.398	3^-	D(+Q)	+0.04 *6*	A_2=+0.31 *3*; A_4=+0.08 *4*
[x]528.29 *13*	0.15 *2*							
[x]539.09 *11*	0.20 *2*							See comment on 540γ.
540		1349	8^+	809.26	6^+			E_γ: From Adopted Gammas (rounded

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^{186}W(n,n′γ) 1988GoZC,1978Av05 (continued)

γ(^{186}W) (continued)

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	Comments
								value). γ reported by 2000Ya22; possibly the same As the unplaced 539.09γ In 1988GoZC.
[x]544.01 *9*	0.32 *3*							
547.41 *3*	1.04 *8*	1285.420	2^+	737.964	2^+	D+Q		A_2=+0.13 *2*; A_4=−0.02 *2* P_γ=1.2 *+8−5*. δ: −0.10 *5* or +2.8 *5* (1988GoZC).
561.96 *13*	0.13 *2*	1607.52	3	1045.398	3^-			
[x]567.10 *2*	1.83 *14*							A_2=+0.33 *3*; A_4=−0.12 *4*
[x]574.69 *18*	0.13 *2*							
579.57 *2*	1.85 *18*	1532.32	3^+	952.739	2^-	D(+Q)	+0.01 *2*	A_2=−0.19 *2*; A_4=−0.03 *3* P_γ=2.5 *+15−8*.
582.84 *6*	0.53 *5*	1628.27	$(3^-,5^-)$	1045.398	3^-	(Q)		A_2=+0.21 *3*; A_4=−0.05 *4*
588.70 *5*	0.50 *8*	1398.08	(6^+)	809.26	6^+			Placed by evaluator, consistent with observation of a 589γ from this level in (^{238}U,^{238}U′γ).
591.18[&] *3*	0.90 *8*	1453.449?	(2^+)	862.281	3^+			A_2=−0.21 *2*; A_4=+0.07 *3*
[x]599.21 *3*	0.84 *7*							A_2=−0.16 *2*; A_4=−0.01 *2*
[x]603.68 *3*	0.87 *8*							A_2=−0.06 *2*; A_4=+0.04 *2*
610.22 *2*	7.7 *2*	1006.734	4^+	396.549	4^+	D+Q	−1.21 *10*	A_2=−0.207 *10*; A_4=−0.07 *2* P_γ=0.95 *10*.
615.31 *2*	43 *4*	737.964	2^+	122.631	2^+	D+Q	−4.1 *5*	A_2=−0.093 *6*; A_4=−0.015 *10* P_γ=0.94 *7*.
621.71 *10*	0.30 *3*	1628.27	$(3^-,5^-)$	1006.734	4^+			
633.70 *2*	3.3 *4*	1030.234	2^+	396.549	4^+	Q		A_2=+0.073 *5*; A_4=+0.010 *6* P_γ=1.9 *+5−4*.
[x]650.25 *11*	0.18 *2*							
659.05 *5*	0.49 *4*	1521.31	4^+	862.281	3^+			
[x]678.64 *5*	0.54 *5*							A_2=−0.17 *4*; A_4=−0.05 *5*
[x]682.56 *2*	1.30 *15*							A_2=−0.010 *11*; A_4=+0.064 *15*
[x]700.28 *5*	0.60 *5*							
[x]704.80 *5*	0.45 *5*							
[x]708.67 *8*	0.25 *8*							Possibly the known 708γ from the adopted (7^-) 1517 level.
715.45[&] *3*	2.86 *25*	1453.449?	(2^+)	737.964	2^+			A_2=+0.089 *6*; A_4=−0.015 *8* P_γ=1.4 *+4−3*.
720.42[&] *9*	0.22 *3*	1458.38?	(3^+)	737.964	2^+			
[x]724.33 *8*	0.40 *4*							
[x]734.57 *10*	0.60 *12*							
737.97 *8*	45.0 *8*	737.964	2^+	0.0	0^+	E2		A_2=+0.147 *12*; A_4=−0.03 *2* P_γ=1.76 *+25−14*.
739.73 *8*	35.0 *8*	862.281	3^+	122.631	2^+	D+Q	−7 *2*	A_2=−0.063 *14*; A_4=0.000 *20* P_γ=2.1 *+4−3*.
760.96 *2*	6.3 *5*	883.597	0^+	122.631	2^+			
[x]765.11 *10*	0.19 *2*							
[x]770.66 *25*	0.10 *3*							
780.08[&] *8*	0.56 *8*	1642.46?	4	862.281	3^+	D+Q	+0.25 *2*	A_2=+0.10 *2*; A_4=−0.04 *3*
783.34 *3*	1.12 *15*	1521.31	4^+	737.964	2^+	Q		A_2=+0.24 *2*; A_4=−0.12 *3*
[x]792.24 *3*	1.00 *12*							
[x]794.24 *4*	0.45 *8*							
800.74 *2*	3.0 *3*	1197.30	5^+	396.549	4^+	D+Q	−8.0 *8*	A_2=−0.212 *12*; A_4=+0.165 *17* P_γ=1.2 *2*.
[x]807.71 *2*	2.23 *19*							A_2=+0.016 *11*; A_4=+0.008 *15* P_γ=1.9 *+6−4*.
[x]816.58	1.32 *12*							Multiplet (1988GoZC).

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^{186}W(n,n′γ) 1988GoZC,1978Av05 (continued)

γ(^{186}W) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	Comments
830.11 *3*	1.05 *9*	952.739	2⁻	122.631	2⁺	D+Q	+0.23 *10*	A_2=+0.279 *11*; A_4=+0.032 *14*
x839.68 *3*	0.95 *8*							A_2=+0.11 *3*; A_4=0.00 *4*
x844.06 *3*	0.80 *7*							
x849.08 *4*	0.60 *4*							
x859.03	0.66 *6*							Multiplet (1988GoZC).
884.08 *2*	5.7 *5*	1006.734	4⁺	122.631	2⁺	E2		A_2=+0.261 *11*; A_4=−0.034 *15* P_γ=4.0 *+40−20*.
902.40 *3*	0.74 *7*	1298.93	4⁺	396.549	4⁺	D+Q	+1.7 *2*	A_2=+0.14 *2*; A_4=−0.06 *3*
907.58 *2*	5.4 *5*	1030.234	2⁺	122.631	2⁺	D+Q	+7.1 *3*	A_2=+0.029 *6*; A_4=−0.010 *8* P_γ=0.6 *2*.
x917.57 *10*	0.18 *2*							
922.77 *2*	1.26 *13*	1045.398	3⁻	122.631	2⁺	D(+Q)	+0.02 *3*	A_2=−0.18 *3*; A_4=+0.03 *4*
x925.12 *17*	0.20 *5*							
x930.64 *16*	0.14 *2*							
x942.72 *7*	0.37 *3*							A_2=+0.13 *4*; A_4=−0.15 *5*
x948.41	0.15 *2*							Multiplet (1988GoZC).
x968.46 *4*	0.81 *7*							A_2=+0.23 *3*; A_4=−0.06 *5*
x973.17 *10*	0.23 *2*							
x985.26 *3*	0.94 *8*							A_2=−0.254 *13*; A_4=−0.03 *2*
x991.54	0.39 *4*							Multiplet (1988GoZC).
x996.99 *15*	0.08 *2*							
1001.55 *6*	0.42 *4*	1398.08	(6⁺)	396.549	4⁺	Q		A_2=+0.25 *2*; A_4=−0.07 *3*
x1007.01 *8*	0.42 *4*							A_2=−0.04 *4*; A_4=+0.02 *6*
x1021.49 *4*	0.67 *6*							A_2=−0.27 *4*; A_4=−0.04 *6*
1030.23 *2*	4.6 *4*	1030.234	2⁺	0.0	0⁺	E2		A_2=+0.20 *2*; A_4=−0.06 *3* P_γ=2.0 *3*.
x1035.96 *12*	0.25 *3*							
x1041.92 *8*	0.42 *4*							A_2=+0.16 *5*; A_4=0.00 *6*
x1058.04 *8*	0.35 *5*							
x1062.00 *6*	0.45 *5*							
x1074.59 *6*	0.39 *4*							A_2=+0.20 *6*; A_4=−0.10 *8*
x1082.83 *4*	0.73 *7*							A_2=+0.18 *3*; A_4=+0.05 *4*
x1098.4 *15*	0.4 *2*							Reported by 1978Av05 but absent in 1988GoZC.
x1113.1 *2*	0.13 *2*							
x1119.79 *3*	0.12 *2*							
1124.53 *16*	0.20 *2*	1521.31	4⁺	396.549	4⁺			
x1136.15 *11*	0.23 *3*							
1162.81 *2*	2.47 *23*	1285.420	2⁺	122.631	2⁺	D+Q		A_2=+0.038 *10*; A_4=−0.016 *14* P_γ=1.2 *4*. δ: −0.25 *5* or +6 *1* (1988GoZC).
1176.27 *3*	1.44 *14*	1298.93	4⁺	122.631	2⁺	E2		A_2=+0.31 *2*; A_4=−0.04 *4* P_γ=5.4 *+15−30*.
x1191.4 *2*	0.14 *3*							
x1194.2 *2*	0.14 *3*							
x1200.64 *5*	0.65 *6*							A_2=+0.15 *3*; A_4=−0.04 *4*
1210.98 *4*	0.97 *9*	1607.52	3	396.549	4⁺	Q(+D)		A_2=−0.17 *4*; A_4=+0.046 P_γ=0.8 *4*. δ=+0.10 *5* or 1/δ=−0.01 *5* (1988GoZC).
x1228.29 *3*	1.29 *12*							A_2=−0.09 *2*; A_4=+0.01 *3*
1245.92[&] *5*	0.54 *5*	1642.46?	4	396.549	4⁺	D+Q	+0.40 *10*	A_2=+0.36 *2*; A_4=−0.28 *3*
x1254.45 *8*	0.36 *4*							A_2=+0.34 *6*; A_4=−0.03 *8*
1285.40 *5*	2.61 *25*	1285.420	2⁺	0.0	0⁺	E2		A_2=+0.224 *9*; A_4=−0.058 *12* P_γ=2.4 *+9−3*.
x1297.81 *6*	0.39 *4*							
1313.16 *3*	1.10 *10*	1709.74	3	396.549	4⁺	D(+Q)	−0.02 *3*	A_2=−0.07 *3*; A_4=+0.02 *4*
x1319.18	0.47 *5*							Multiplet (1988GoZC).

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^{186}W(n,n′γ) 1988GoZC,1978Av05 (continued)

γ(^{186}W) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	Comments
[x]1326.60 *8*	0.33 *5*							A_2=−0.16 *4*; A_4=+0.01 *6*
1330.84[&] *3*	1.23 *15*	1453.449?	(2$^+$)	122.631	2$^+$			A_2=+0.19 *2*; A_4=−0.06 *3*
1335.74[&] *3*	1.85 *20*	1458.38?	(3$^+$)	122.631	2$^+$			A_2=+0.225 *8*; A_4=+0.153 *12*
[x]1343.6 *3*	0.13 *2*							
[x]1351.58 *8*	0.21 *2*							
[x]1369.26 *15*	0.18 *2*							
[x]1375.45 *9*	0.28 *3*							
[x]1389.95 *17*	0.16 *2*							
[x]1399.26 *13*	0.23 *2*							
1409.71 *4*	1.26 *12*	1532.32	3$^+$	122.631	2$^+$	D+Q	+8.5 *8*	A_2=+0.21 *2*; A_4=+0.11 *2*
1440.75 *3*	1.79 *17*	1563.37	1	122.631	2$^+$	D+Q		A_2=−0.023 *7*; A_4=0.000 P_γ=1.5 *+36−8*. δ: +0.05 *4* or −4.1 *6* (1988GoZC).
[x]1443.99 *17*	0.16 *3*							
[x]1454.17 *11*	0.21 *2*							
[x]1474.16 *7*	0.37 *4*							
1484.62	0.57 *6*	1607.52	3	122.631	2$^+$			E_γ,I_γ: for multiplet (1988GoZC).
1520.2[&] *2*	0.12 *2*	1642.46?	4	122.631	2$^+$			
[x]1535.0 *2*	0.19 *2*							
[x]1557.77	0.30 *3*							Multiplet (1988GoZC).
1563.34 *4*	1.23 *12*	1563.37	1	0.0	0$^+$	D		A_2=−0.13 *2*; A_4=0.00
[x]1575.92 *11*	0.30 *3*							Member of multiplet (1978Av05).
1587.15 *4*	1.26 *12*	1709.74	3	122.631	2$^+$	D(+Q)	−0.01 *2*	A_2=−0.22 *3*; A_4=+0.04 *4*
[x]1596.88 *9*	0.30 *5*							
[x]1600.55 *6*	0.50 *6*							
[x]1657.17 *7*	0.35 *4*							A_2=+0.22 *5*; A_4=+0.04 *6*
[x]1712.09 *13*	0.39 *7*							
[x]1718.7 *2*	0.20 *2*							
[x]1772.2 *3*	0.10 *2*							
[x]1779.08 *7*	0.55 *5*							A_2=+0.24 *6*; A_4=−0.07 *8*
[x]1795.0 *4*	0.14 *2*							
[x]1827.57 *18*	0.20 *2*							
[x]1839.57 *18*	0.18 *2*							
[x]1854.9 *2*	0.20 *2*							
[x]1869.96 *8*	0.35 *4*							
[x]1927.8 *2*	0.19 *2*							
[x]1936.8 *2*	0.26 *3*							
[x]1943.6 *2*	0.31 *3*							
[x]1959.4 *3*	0.06 *2*							
[x]1981.7 *2*	0.32 *3*							
[x]1993.14 *16*	0.54 *5*							
[x]2046.2 *3*	0.14 *2*							
[x]2052.2 *2*	0.22 *2*							
[x]2121.2 *2*	0.28 *3*							
[x]2150.0 *2*	0.25 *3*							
[x]2166.53 *11*	0.34 *4*							
[x]2174.1 *3*	0.11 *2*							
[x]2182.3 *2*	0.11 *2*							
[x]2191.0 *3*	0.12 *2*							
[x]2215.6 *3*	0.10 *2*							
[x]2395.34 *14*	0.14 *2*							
[x]2424.4 *3*	0.06 *2*							
[x]2434.4	0.25 *3*							Multiplet (1988GoZC).
[x]2445.2 *4*	0.16 *2*							
[x]2450.6 *4*	0.10 *2*							

Continued on next page (footnotes at end of table)

^{186}W(n,n′γ) 1988GoZC,1978Av05 (continued)

γ(^{186}W) (continued)

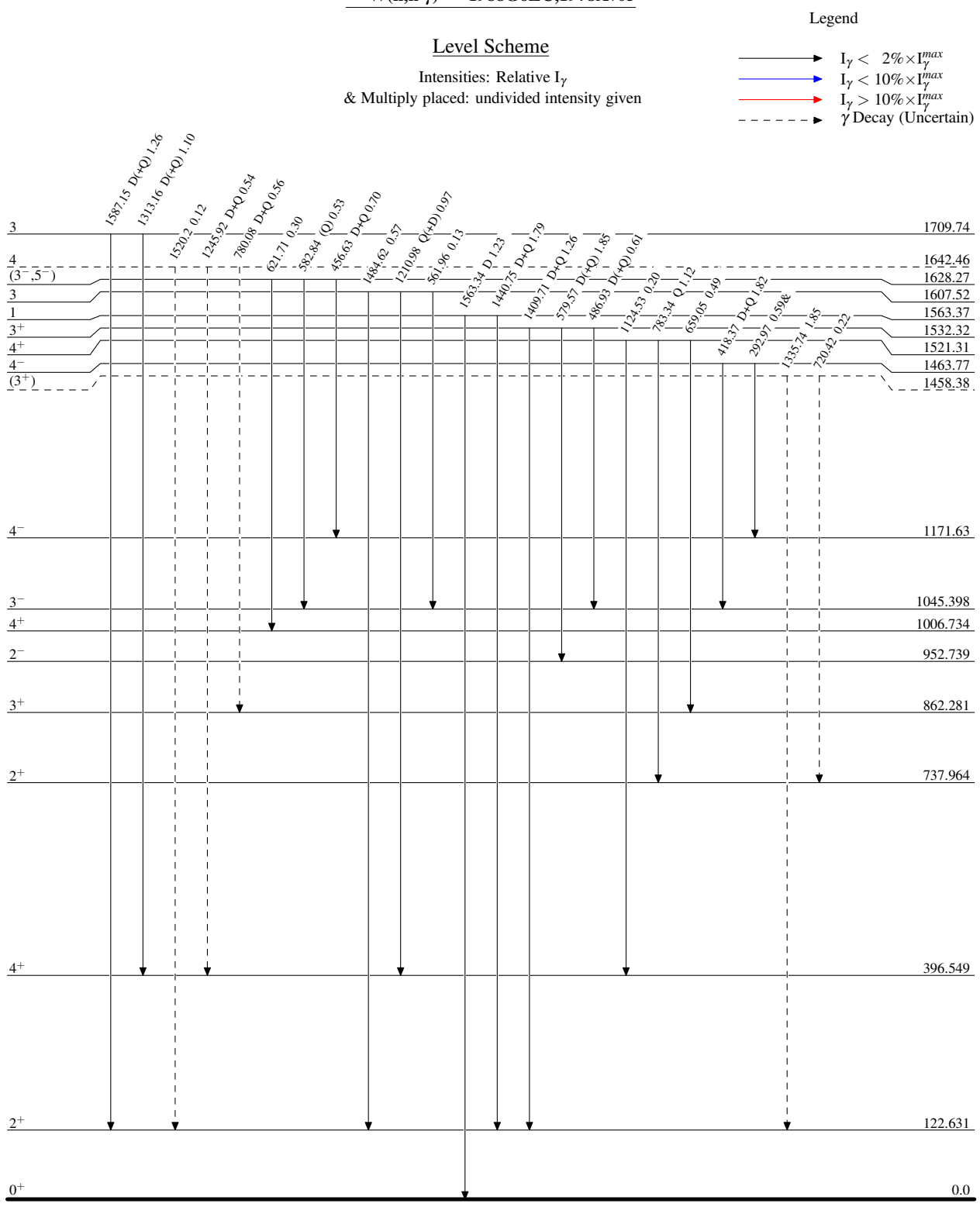
E_γ †	I_γ ‡	E_i(level)
[x]2454.5 *2*	0.10 *2*	
[x]2465.02 *11*	0.22 *2*	

† From 1988GoZC. Data from 1978Av05 are less extensive and of lower precision, but are in excellent agreement with those of 1988GoZC.
‡ Photon intensity relative to I(123γ)=100 *7*; from 1988GoZC.
# Based on γ(θ) and/or γ linear polarization (1988GoZC). A_2, A_4 and P_γ (γ linear polarization) data from 1988GoZC are given in comments on the relevant γ whenever data are available.
@ Multiply placed with undivided intensity.
& Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

^{186}W(n,n′γ) 1988GoZC,1978Av05

Level Scheme

Intensities: Relative I_γ
& Multiply placed: undivided intensity given



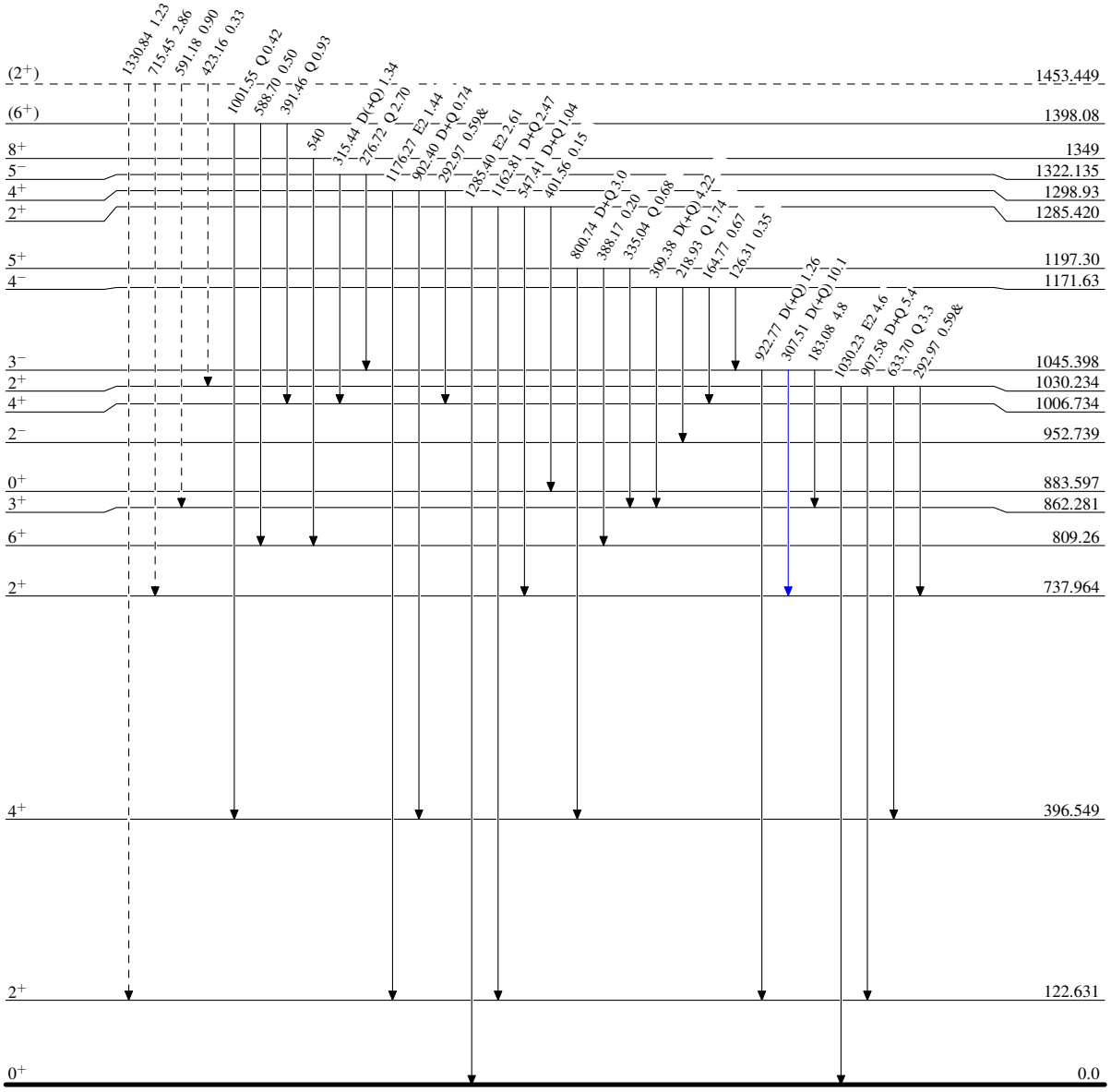
$^{186}_{74}W_{112}$

^{186}W(n,n′γ) 1988GoZC,1978Av05

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)



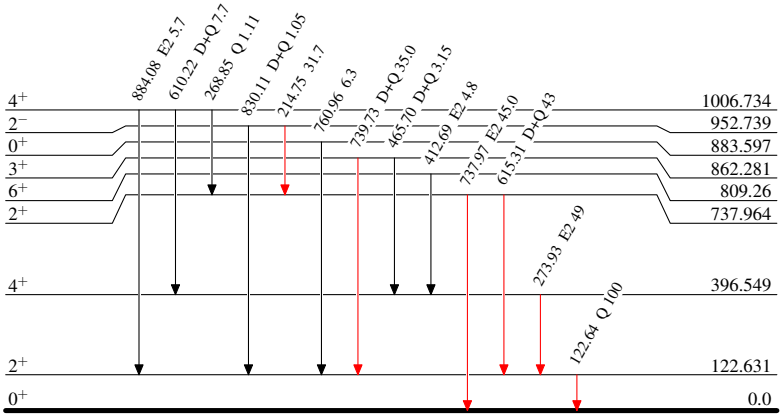
$^{186}_{74}W_{112}$

^{186}W(n,n′γ) 1988GoZC,1978Av05

Level Scheme (continued)

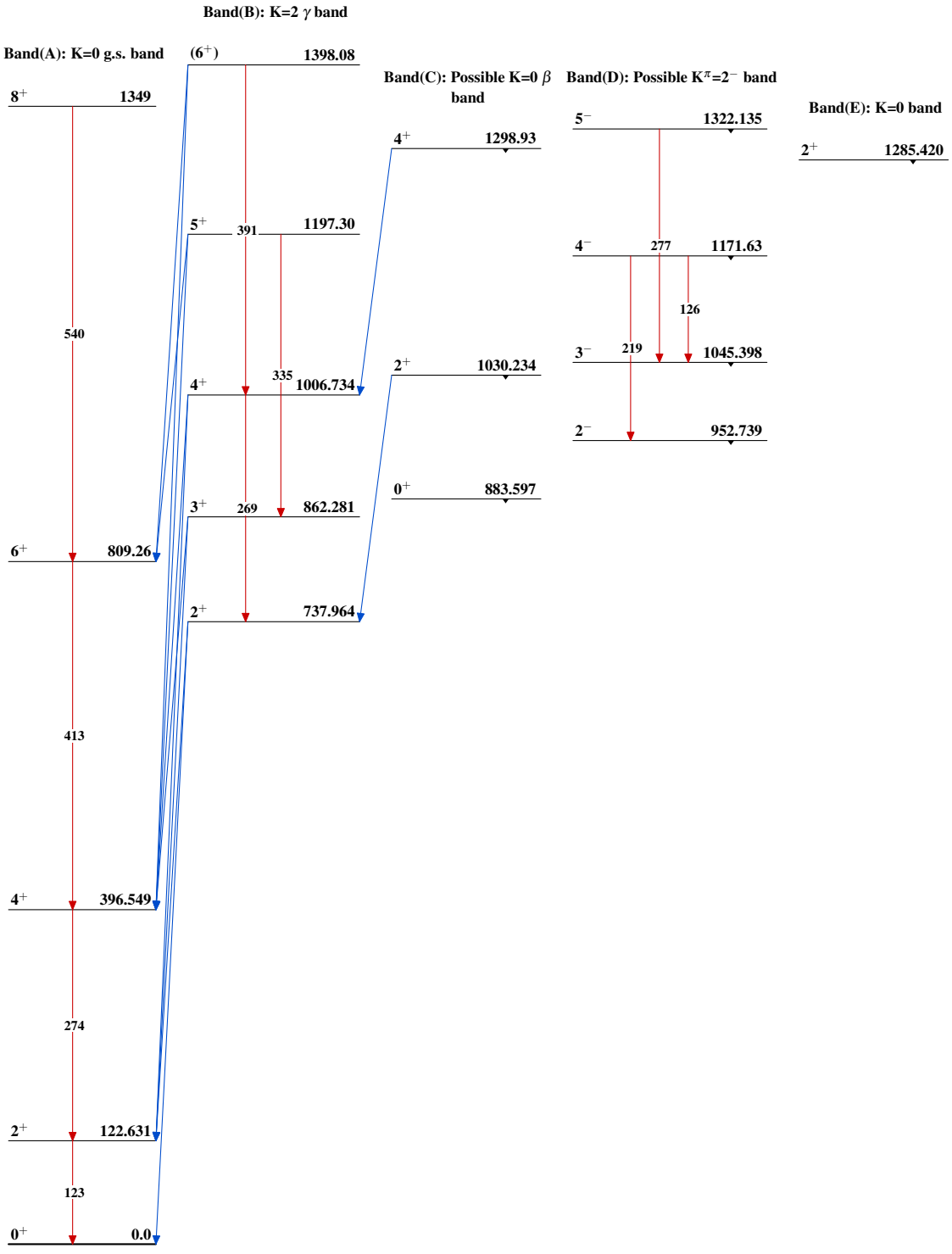
Intensities: Relative I_γ
& Multiply placed: undivided intensity given

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$



$^{186}_{74}W_{112}$

^{186}W(n,n′γ) 1988GoZC,1978Av05



$^{186}_{74}W_{112}$