Coulomb excitation **1989Ku04,1977Mc11,1971Mi08**

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

Others: 1959Bi10 (E(p)=2.8 MeV), 1961Ha21 ((p,p′) and (d,d′)), 1961Mc01, 1962Bi05 (Eα=3 MeV), 1967As03 (^{16}O,^{16}Oγ), 1967Gi02 (^{16}O,^{16}Oγ), 1967Ku07 (p,p′γ), 1968St13 (Eα=8 MeV), 1969Ch23 (Eα=8 MeV), 1970Me09 (Eα=6 MeV), 1971Ob02 (Eα=6 MeV), 1972Hi14 (E(p)=3 MeV), 1974Ba81 (Eα=11.5-13.5 MeV), 1974Br31 (Eα=10-20 MeV), 1974Le16 (Eα=12.5-19 MeV), 1975Le22 (Eα=13.25-19 MeV), 1979Hu01, 1985St07 (E(^{63}Cu)=220 MeV), 1986Bi13 (E(^{32}S)=100 MeV), 2000WhZZ (E(^{238}U)=1600 MeV).

For determinations of transient-field strength and precession, see, e.g., 1991St04, 1988St16, 1987St14.

1971Mi08: (x,x′γ); x=p, E=5.0, 5.08 MeV; x=α, E=14, 15 MeV; x=^{16}O, E=45.1, 45.5 MeV.

1977Mc11: (x,x′γ); x=α, E=15 MeV; x=^{16}O, E=42 MeV.

1979Hu01: (^{84}Kr,^{84}Kr′γ) E=340 MeV, 98.5% ^{186}W target.

1989Ku04: (^{208}Pb,^{208}Pb′γ), E(^{208}Pb)=4.9 MeV/u;≈95% ^{186}W target; measured Eγ, yield at 12 angles; observed multiple Coulomb excitation of g.s. band (J≤14), γ band (J≤12) and quasi-β band (J=0 and 2); extracted electromagnetic matrix elements for π=+ yrast band.

See also 1996Wu10 for extraction and discussion of intrinsic E2 matrix elements between ΔK=2 bands.

^{186}W Levels

Band assignments shown here are from Adopted Levels. Note that 1989Ku04 assign the 1006 level as the J=4 member of the γ band, whereas 1977Mc11 suggest that it is the J=2 member of the β band. The basis for the latter assignment is unclear; such an assignment is inconsistent with adopted J$^{\pi}$(1006), so it is presumed to be in error. The 1030 level is adopted as the J=2 member of the β band.

E(level)[†]	J$^{\pi}$[#]	T$_{1/2}$[‡]	Comments
0[b]	0$^+$		
122.6[b] *7*	2$^+$	1.08 ns *3*	B(E2)↑=3.40 *6* B(E2)↑: weighted average of 3.50 *6* (1968St13), 2.81 *19* (1974Br31) and 3.35 *7* (1975Le22). Others: 3.6 *4* (1961Mc01), 3.57 *25* (1961Ha21), 3.35 *11* (1974Le16), 3.4 *3* (1989Ku04) from coulomb excitation, and 3.46 12 from muonic atom (1970Hi03). g-factor=0.308 *17* from g-factor/g-factor(^{184}W, 111)=1.07 *5* (1991St04) if g-factor(^{184}W, 111)= 0.289 *7*. Others: 0.350 *35* (1967Gi02), 0.35 *3* (1967Ku07). Q/Q(2$^+$ ^{182}W)=0.908 *24* (1969Ch23), 0.906 *18* (1971Ob02). T$_{1/2}$: from B(E2). Other values: 1.12 ns *7* (p,p′γ) (1959Bi10); 1.01 ns *4* (α,α′γ) (1962Bi05); 1.30 ns *21* (1967As03), 1.116 ns *21* pulsed beam (1967Ku07); 1.38 ns *12* (1970Me09, Mossbauer); 1.39 ns *12* (1971Ob02, Mossbauer);≥1.15 ns *6* (1972Hi14, Mossbauer). Static matrix element <2$^+$ M(E2) 2+> =−2.19 *+28−11* (1989Ku04).
396.7[b] *12*	4$^+$	36.4 ps *25*	B(E2)↑=1.63 *11* (1971Mi08); B(E4)↑=0.14 *+15−10* Static matrix element <4$^+$ M(E2) 4+> =−2.89 *+37−14* (1989Ku04). B(E2)↑: for 2+(123) to 4+(397) excitation. Other: 2.7 *+4−3* (1989Ku04). B(E4)↑: from <0$^+$ M(E4) 4+> =−0.37 *17*, weighted average of −0.27 *10* (1974Le16) and −0.64 *16* (1974Br31). Other <0$^+$ M(E4) 4+>: −0.25 *25* (1975Le22). J$^{\pi}$: E2 γ to 2$^+$; J=0 inconsistent with measured T$_{1/2}$. g-factor/g-factor(122, 2$^+$)=1.04 *7* (1985St07). T$_{1/2}$: Other: 38 ps *3* from nuclear deorientation for ions recoiling in vacuum (1986Bi13).
737.2[c] *7*	2$^+$	4.78 ps *16*	B(E2)↑=0.140 *4* B(E2)↑: Weighted average of 0.146 *8* (1977Mc11; supersedes 0.150 *8* from 1971Mi08) and 0.139 *4* (1974Ba81). g-factor/g-factor(122, 2$^+$)=0.63 *13* (1985St07).
810.1[b] *16*	6$^+$[a]	4.0 ps *3*	B(E2)↑=1.70 *12* Static matrix element <6$^+$ M(E2) 6+> =−3.25 *+17−42* (1989Ku04). B(E2)↑: Weighted average of 1.89 *29* (1971Mi08) and 1.66 *13* (1979Hu01); for 4+(397) to

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Coulomb excitation 1989Ku04,1977Mc11,1971Mi08 (continued)

^{186}W Levels (continued)

E(level)[†]	Jπ[#]	$T_{1/2}$[‡]	Comments
			6+(810) excitation. Other: 1.21 *+14−11* (1989Ku04).
			g-factor/g-factor(122, 2^+)=1.03 *20* (1985St07).
861.8[c] *9*	$(3)^+$		Jπ: E1 γ from 3^-; band structure.
884[@d]	(0^+)		Jπ: from Adopted Levels.
952.1[e] *10*	$(2)^-$		Jπ: anisotropies of γ to 2^+ and γ from 3^-.
1006.7[c] *15*	4^+		B(E2)↑: 1977Mc11 report B(E2)=0.0030 *6* for 0+(g.s.) to 2+(1007) excitation, based on 610γ yield and the assumption that the 1007 level is the 2^+ member of the β band; however level is currently designated as the J=4 member of the γ band. Jπ: 1989Ku04 observe the gammas known to deexcite this level, and designate them as transitions from the 4^+ member of the γ band rather than from the 2^+ member of the β band (as supposed in 1977Mc11). The J=4 assignment is consistent with expected strong excitation of γ band levels in 1989Ku04 and with band systematics in nearby W and Os even-A nuclei.
1030[@d]	2^+		Jπ: from Adopted Levels.
1045.0[e] *7*	3^-		B(E3)↑=0.101 *8* B(E3)↑: From 1977Mc11 (based on yields of 308γ, 183γ and 215γ).
1196[c] *6*	(5^+)[&]		
1285.8 *8*	2^+	4.0 ps *4*	B(E2)↑=0.0089 *7* B(E2)↑: From 1971Mi08.
1350.0[b] *19*	8^+[a]	1.08 ps *7*	B(E2)↑=1.47 *10* Static matrix element $<8^+$ M(E2) 8+> =−3.30 *+18−27* (1989Ku04). B(E2)↑: For 6+(810) to 8+(1350) excitation; weighted average of 1.56 *14* (1979Hu01) and 1.38 *+14−16* (1989Ku04).
1397[c] *3*	(6^+)[&]		
1907[c] *4*	(8^+)[&]		
2003.2[b] *21*	10^+[a]	0.49 ps *+14−5*	B(E2)↑=1.18 *+13−34* (1989Ku04) Static matrix element $<10^+$ M(E2) 10+> =−4.21 *+21−122* (1989Ku04). B(E2)↑: For 8+(1350) to 10+(2003) excitation. Other: 1.4 *4* (1979Hu01).
2515[c] *7*	(10^+)[&]		
2751.7[b] *23*	(12^+)[&]	0.20 ps *+6−2*	B(E2)↑=1.42 *+15−42* (1989Ku04) Static matrix element $<12^+$ M(E2) 12+> =−4.6 *+3−17* (1989Ku04). B(E2)↑: For 10+(2003) to 12+(2752) excitation.
3192[c] *9*	(12^+)[&]		
3563[b] *3*	(14^+)[&]	0.183 ps *20*	B(E2)↑=1.01 *+11−10* (1989Ku04) Static matrix element $<14^+$ M(E2) 14+> =−5.0 *+9−16* (1989Ku04). B(E2)↑: For 12+(2752) to 14+(3563) excitation.

[†] From least-squares adjustment of Eγ, allowing ΔE=1 keV for transitions for which authors do not quote ΔE.
[‡] Calculated by the evaluators from measured B(E2) and adopted branching.
[#] From direct E2 Coulomb excitation (1977Mc11), except as noted.
[@] Reported to have been observed by 1989Ku04; E(level) is rounded-off value from Adopted Levels.
[&] From band structure deduced by 1989Ku04, based on γγ coin data and energy and intensity systematics.
[a] E2 γ to (J-2) member of same band in multiple Coulomb excitation.
[b] Band(A): g.s. band (1989Ku04).
[c] Band(B): K=2 γ band (1989Ku04). Note that the 1006 level, adopted here as the 4^+ member of this band, was presumed to be the 2^+ member of the β band in 1977Mc11.
[d] Band(C): K=0 β band. Only weakly populated (J=0 and 2 members) in 1989Ku04. Authors do not indicate E(level) or deexciting transitions for either member.

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Coulomb excitation 1989Ku04,1977Mc11,1971Mi08 (continued)

^{186}W Levels (continued)

[e] Band(D): $K^{\pi}=2^{-}$ band. K=2 based on Alaga rules for transitions from the 3^{-} member to the J=2 and 3 members of the γ band (1977Mc11).

$\gamma(^{186}W)$

E_i(level)	J_i^{π}	E_{γ}[†]	I_{γ}[‡]	E_f	J_f^{π}	Mult.[#]	δ	Comments
122.6	2^+	122.5[&]		0	0^+	E2		
396.7	4^+	274.2[@]		122.6	2^+	E2		
737.2	2^+	615	94 *3*	122.6	2^+	M1+E2	−11 *−4+3*	δ: from 1971Mi08; A_2=−0.140 *15* (1971Mi08).
		737	100	0	0^+	E2		
810.1	6^+	413.4[&]		396.7	4^+	E2		
861.8	$(3)^+$	739		122.6	2^+			
952.1	$(2)^-$	215		737.2	2^+	E1[b]		Mult.: $\gamma(\theta)$ corrected for contamination by ^{184}W line (1977Mc11).
1006.7	4^+	269		737.2	2^+			E_{γ}: rounded-off value from adopted gammas; γ not evident in spectrum shown in 1989Ku04 (possibly masked by intense 274γ), but authors imply that it was observed.
		610	100	396.7	4^+			
		884[a] *5*	<12	122.6	2^+			I_{γ}: from γ yields in 1977Mc11 (γ not observed). However, γ is prominent in spectrum in 1989Ku04.
1045.0	3^-	93		952.1	$(2)^-$	M1+E2[b]	1.3 *5*	δ^2=1.8 *+150−11* (1977Mc11), from analysis of 0+(E3)3−(M1+E2 93γ)2−(E1 215γ)2^+ sequence.
		183	33.5	861.8	$(3)^+$	E1[b]		I_{γ}: from γ yield (relative to 308γ) in 1977Mc11. Anisotropy=1.29 *6* (1977Mc11); consistent with 0+(E3)3−(E1)3^+ sequence.
		308	100	737.2	2^+	E1[b]		Anisotropy=0.761 *14* (1977Mc11); consistent with 0+(E3)3−(E1)2^+ sequence.
		(1045)		0	0^+	[E3]		Mult.: 1045 level directly populated by E3 Coulomb excitation (1977Mc11).
1196	(5^+)	799[a] *5*		396.7	4^+			
1285.8	2^+	548[c]	<24	737.2	2^+			I_{γ}: γ not observed; Iγ is from upper limit for γ yield in 1977Mc11 relative to 1286γ yield in 1971Mi08 (both for Eα=15 MeV).
		1163.0 *2*	117 *10*	122.6	2^+	M1+E2	+13 *+70−6*	E_{γ},δ: from 1971Mi08; A_2=−0.02 *5*. I_{γ}: from 1971Mi08; Iγ/Iγ(1286)=0.96 *20* and 1.28 *10* in independent determinations (1971Mi08).
		1285.6 *2*	100	0	0^+	E2		Anisotropy consistent with J=2 to 0 transition (1971Mi08).
1350.0	8^+	540.0[&]		810.1	6^+	E2		Mult.: B(E2)/B(E2)(rotational model)=1.06 *10* (1979Hu01).
1397	(6^+)	391[a] *5*		1006.7	4^+			
		587[a] *5*		810.1	6^+			
		997[a] *5*		396.7	4^+			
1907	(8^+)	509[a] *5*		1397	(6^+)			
		559[a] *5*		1350.0	8^+			
2003.2	10^+	653.2[&]		1350.0	8^+	E2		Mult.: B(E2)/B(E2)(rotational model)=1.02 *26* (1979Hu01).
2515	(10^+)	608[a] *5*		1907	(8^+)			

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Coulomb excitation **1989Ku04,1977Mc11,1971Mi08 (continued)**

$\gamma(^{186}W)$ (continued)

E_i(level)	J_i^π	E_γ †	E_f	J_f^π
2751.7	(12^+)	748.5&	2003.2	10^+
3192	(12^+)	677[a] 5	2515	(10^+)
3563	(14^+)	811.5&	2751.7	(12^+)

† From 1977Mc11, unless noted otherwise.
‡ Relative photon branching from 1971Mi08, except as noted.
# From 1971Mi08, based on γ anisotropy, except as noted.
@ 1989Ku04 give Eγ=264.2 in table 1; evaluators presume this is typographical error for Eγ=274.2 (based on spectrum of fig. 1 and systematics of Eγ for analogous transitions in ^{182}W, ^{184}W, ^{186}W). Eγ=274 in both 1979Hu01 and 1977Mc11.
& From 1989Ku04; uncertainty not stated by authors.
[a] Approximate value read by evaluators from spectrum in fig.1 of 1989Ku04 (ΔE≈5 keV); authors do not quote Eγ or E(level).
[b] From 1977Mc11.
[c] Placement of transition in the level scheme is uncertain.

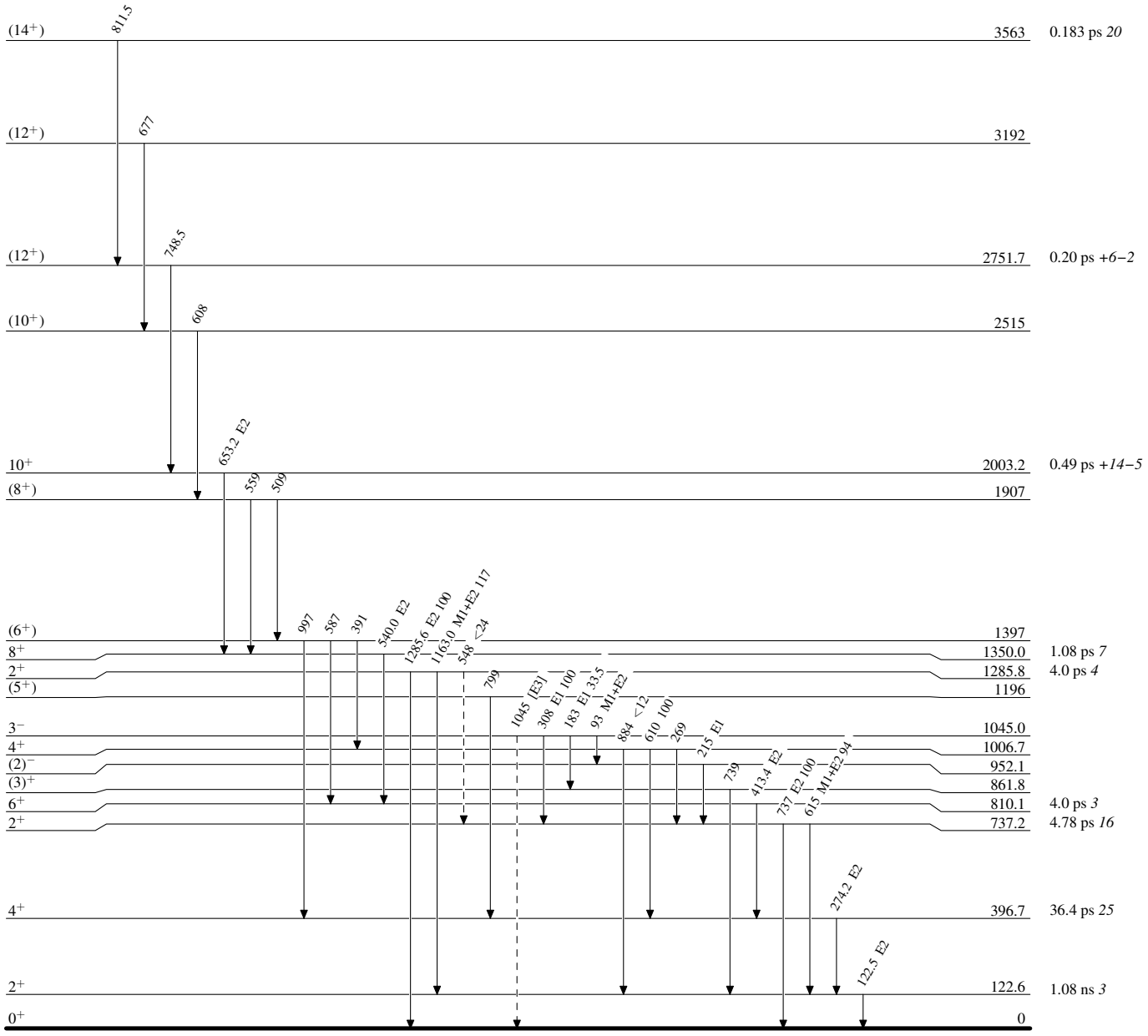
Coulomb excitation 1989Ku04,1977Mc11,1971Mi08

Legend

Level Scheme

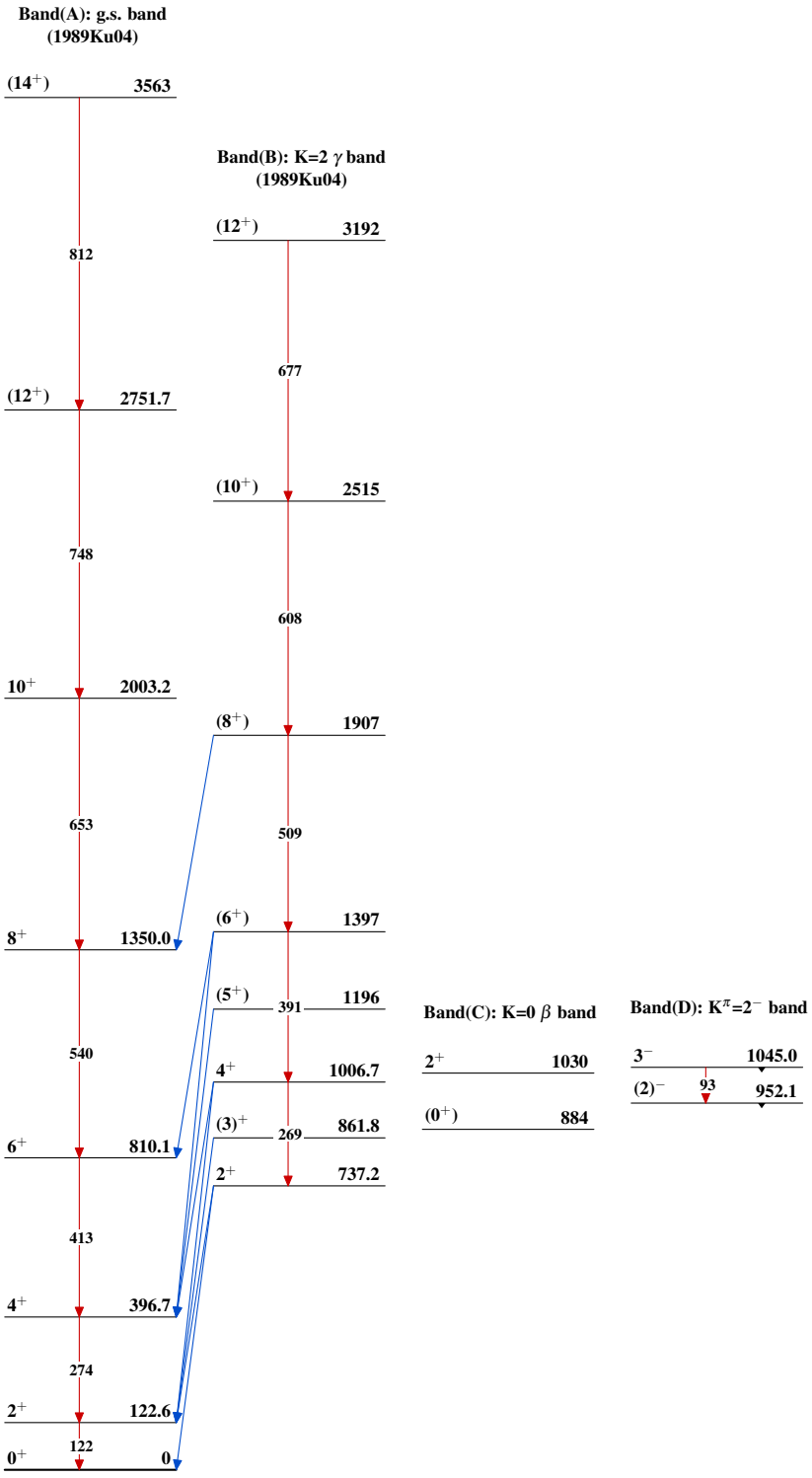
Intensities: Relative photon branching from each level

- - - - - - ► γ Decay (Uncertain)



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

Coulomb excitation 1989Ku04,1977Mc11,1971Mi08



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