Hf(α,xnγ) 1979FaZR,1966Bu08,1981Av04

History

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

1981Av04: ^{177}Hf(α,nγ), E=25-29 MeV. Measured Eγ, Iγ, γ(t) using a Ge(Li) detector.
1979FaZR: ^{180}Hf(α,4nγ), E(α)=48 MeV. Measured Eγ, Iγ, γγ, γ(θ), and γ(t) using Ge(Li) detectors.
1966Bu08: ^{178}Hf(α,2nγ), E(α)=23 MeV. Measured Eγ, Iγ, γγ, γγ(θ) using three NaI(Tl) detectors and E(ce) and I(ce) using an electron spectrometer of single wedge-gap type.
Others: 1980Go18, 1977Go15, 1976Be47, 1972Fe08, 1969Mi03, 1965La02, 1955So54.

^{180}W Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#]	Comments
0.0[@]	0$^+$		
103.6[@]	2$^+$		
337.8[@]	4$^+$		
689.0[@]	6$^+$		
1006.2[&] *6*	2$^-$		
1082.4[&] *11*	3$^-$		
1138.6[@] *9*	8$^+$		
1184.8[&] *11*	4$^-$		
1307.7[&] *11*	5$^-$		
1461.4[&] *13*	6$^-$		
1529.6[a] *10*	8$^-$	5.2 ms *2*	$T_{1/2}$: weighted average of 5.2 ms *2* (1966Bu08) and 5.6 ms *6* (1981Av04). $T_{1/2}$: Other: 5.5 ms *3* isomer was identified in 1955So54, however, no assignment to a particular level was given.
1624.3[&] *15*	7$^-$		
1640.2[b] *12*	(5)	24 ns *7*	J$^\pi$: proposed configuration of ν9/2[624]ν1/2[521] would mean negative parity for the band.
1664.3[@] *14*	10$^+$		
1726.1[a] *12*	9$^-$		
1765.1[b] *14*	(6)		
1830.3[&] *16*	8$^-$		
1911.9[b] *14*	(7)		
1945.6[a] *12*	10$^-$		
2024.4[&] *18*	9$^-$		
2083.2[b] *15*	(8)		
2187.5[a] *14*	11$^-$		
2235.6[@] *17*	12$^+$		
2274.6[b] *16*	(9)		
2283.5[&] *19*	10$^-$		
2451.4[a] *14*	12$^-$		
2501.1[&] *21*	11$^-$		
2736.7[a] *15*	13$^-$		
2812.9[&] *22*	12$^-$		
2823.2[@] *20*	14$^+$		
3042.7[a] *15*	14$^-$		
3047.4[&] *23*	13$^-$		
3264.8 *15*	14$^-$	2.3 μs *2*	Proposed four qp-isomer with configuration (ν9/2[624])(ν7/2[514])(π7/2[404])(π5/2[402]) (1979FaZR).
3389.8 *18*	15$^+$	8.6 ns *6*	Proposed four qp-state with configuration (ν9/2[624])(ν7/2[514])(ν5/2[512])(ν9/2[624])

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Hf(α,xnγ) 1979FaZR,1966Bu08,1981Av04 (continued)

^{180}W Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	Comments
			(1979FaZR).
3410.7[&] 24	14⁻		
3412.8[@] 22	16⁺		
3547.9[c] 21	16⁺	20.3 ns 6	
3888.2[c] 23	17⁺		
4016[@] 3	18⁺		
4249[c] 3	18⁺		
4629[c] 3	19⁺		

[†] From a least-squares fit to Eγ by evaluator.
[‡] Spin and parity assignments from 1979FaZR based on γ-ray multipolarities and assumed band structure.
[#] From beam-γ(t) in ^{180}Hf(α,4nγ) (1979FaZR), except where noted.
[@] Band(A): $K^{\pi}=0^+$ g.s. rotational band.
[&] Band(B): $K^{\pi}=2^-$ octupole vibrational band.
[a] Band(C): $K^{\pi}=8^-$ band. Proposed configuration of (ν9/2[624])(ν7/2[514]) (1979FaZR).
[b] Band(D): K^{π}=(5) band. Proposed configuration of (ν9/2[624])(ν1/2[521]) (1979FaZR).
[c] Band(E): $K^{\pi}=16^+$ band. Proposed 4-qp configuration of (ν9/2[624])(ν7/2[514])(π7/2[404])(π9/2[514]) (1979FaZR).

γ(^{180}W)

A_2 and A_4 coefficients from γ(θ) in 1979FaZR. The A_2 coefficients measured by 1966Bu08 are consistent with stretched E2 multipolarities for 448γ, 350γ, 234γ, and 103γ, and with E1 multipolarity for 390γ, assuming a $J^{\pi}=8^-,8^+,6^+,4^+,2^+,0^+$ cascade.

Eγ[†]	Iγ[†]	E_i(level)	J_i^{π}	E_f	J_f^{π}	Mult.[@]	α[&]	Comments
76.1	0.77 8	1082.4	3⁻	1006.2	2⁻			
103.6[‡] 4	20[#] 4	103.6	2⁺	0.0	0⁺	E2	3.45	Mult.: from α(K)exp=2.42 (1966Bu08).
122.8	2.05 14	1307.7	5⁻	1184.8	4⁻			A_2=+0.24 6, A_4=+0.17 9.
124.9		1765.1	(6)	1640.2	(5)			
125.0		3389.8	15⁺	3264.8	14⁻	(E1)		Mult.: from α(exp) determined from intensity balance in 1979FaZR; in spectrum gated on 340.3γ, intensity of 125.0γ is significantly larger than the 158.1γ suggesting E1 for the former and M1 for the latter.
146.9	1.58 13	1911.9	(7)	1765.1	(6)	D		A_2=−0.55 7, A_4=+0.12 12.
158.1	4.09 23	3547.9	16⁺	3389.8	15⁺	(M1)		Mult.: from α(exp) determined from intensity balance in 1979FaZR; in spectrum gated on 340.3γ, intensity of 125.0γ is significantly larger than the 158.1γ suggesting E1 for the former and M1 for the latter.
171.3	1.21 9	2083.2	(8)	1911.9	(7)	D		A_2=−0.48 12, A_4=−0.07 20.
178.7	≤6.0	1184.8	4⁻	1006.2	2⁻			
179.1		1640.2	(5)	1461.4	6⁻			
191.4	1.50 19	2274.6	(9)	2083.2	(8)	D		A_2=−0.33 4, A_4=+0.05 9.
196.5	25.9 15	1726.1	9⁻	1529.6	8⁻			
219.5	13.2 8	1945.6	10⁻	1726.1	9⁻	D		A_2=−0.47 3, A_4=+0.10 5.
222.1	5.8 3	3264.8	14⁻	3042.7	14⁻	(M1)		Mult.: from α(exp)=0.55 4 (1979FaZR). α(exp): from intensity balance in delayed γ spectrum (1979FaZR).
225.2	8.4 5	1307.7	5⁻	1082.4	3⁻	Q		A_2=+0.24 4, A_4=−0.05 6.

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Hf(α,xnγ) 1979FaZR,1966Bu08,1981Av04 (continued)

γ(^{180}W) (continued)

E_γ[†]	I_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[@]	α[&]	Comments
234.2[‡] 2	100[#] 9	337.8	4+	103.6	2+	E2	0.186	Mult.: from ce(K)/ce(L)=2.1 3 (1966Bu08).
241.8	8.5 5	2187.5	11−	1945.6	10−	D		A_2=−0.63 5, A_4=−0.03 7.
264.0	7.9 5	2451.4	12−	2187.5	11−			
271.7	1.54 10	1911.9	(7)	1640.2	(5)			
276.9	7.7 4	1461.4	6−	1184.8	4−	Q		A_2=+0.26 2, A_4=0.04 3.
285.3	2.43 19	2736.7	13−	2451.4	12−	D		A_2=−0.46 1, A_4=−0.19 1.
306.1	1.58 10	3042.7	14−	2736.7	13−	D		A_2=−0.47 6, A_4=+0.11 9.
316.6	11.1 6	1624.3	7−	1307.7	5−	Q		A_2=+0.34 4, A_4=+0.02 6.
318.0	0.83 7	2083.2	(8)	1765.1	(6)	Q		A_2=+0.46 9, A_4=−0.50 17.
332.2	3.03 18	1640.2	(5)	1307.7	5−			
340.3	3.02 20	3888.2	17+	3547.9	16+	D+Q		A_2=+0.48 7, A_4=+0.13 12.
351.2[‡] 6	101[#] 8	689.0	6+	337.8	4+	E2	0.0541	Mult.: from α(K)exp=0.036, ce(K)/ce(L)=3.1 4 (1966Bu08).
361.0	1.01 9	4249	18+	3888.2	17+	D+Q		A_2=+0.38 6, A_4=+0.09 10.
362.8	1.44 11	2274.6	(9)	1911.9	(7)	Q		A_2=+0.24 5, A_4=+0.17 8.
368.9	5.4 3	1830.3	8−	1461.4	6−	Q		A_2=+0.29 2, A_4=+0.04 4.
380.1		4629	19+	4249	18+			
391.0[‡] 2	101[#] 13	1529.6	8−	1138.6	8+	E1	0.0123	Mult.: from α(K)exp=0.0083 (1966Bu08).
400.1	8.7 5	2024.4	9−	1624.3	7−	Q		A_2=+0.30 3, A_4=−0.03 4.
415.9	14.8 8	1945.6	10−	1529.6	8−	Q		A_2=+0.17 3, A_4=0.00 4.
449.6[‡] 6	117[#] 10	1138.6	8+	689.0	6+	E2	0.0277	Mult.: from α(K)exp=0.017, ce(K)/ce(L)=4.8 11 (1966Bu08).
453.2	4.9 3	2283.5	10−	1830.3	8−	Q		A_2=+0.29 6, A_4=−0.23 10.
455.3	3.47 26	1640.2	(5)	1184.8	4−			
461.4	14.1 8	2187.5	11−	1726.1	9−	Q		A_2=+0.16 3, A_4=−0.01 4.
476.7	5.3 3	2501.1	11−	2024.4	9−			
505.9	17.1 9	2451.4	12−	1945.6	10−	Q		A_2=+0.15 3, A_4=−0.04 5.
525.7	27.4 16	1664.3	10+	1138.6	8+	Q		A_2=+0.29 3, A_4=−0.05 5.
528.0	7.1 4	3264.8	14−	2736.7	13−			
529.4	2.9 3	2812.9	12−	2283.5	10−	Q		A_2=+0.24 8, A_4=−0.12 15.
546.3	2.51 16	3047.4	13−	2501.1	11−	Q		A_2=+0.35 9, A_4=−0.07 5.
549.1	11.1 6	2736.7	13−	2187.5	11−	Q		A_2=+0.17 3, A_4=+0.07 5.
571.3	15.5 9	2235.6	12+	1664.3	10+	Q		A_2=+0.31 4, A_4=−0.01 6.
587.6	8.9 5	2823.2	14+	2235.6	12+	Q		A_2=+0.32 4, A_4=+0.02 6.
589.6	4.8 3	3412.8	16+	2823.2	14+	Q		A_2=+0.36 4, A_4=−0.08 6.
591.2	9.2 5	3042.7	14−	2451.4	12−	Q		A_2=+0.13 4, A_4=−0.03 5.
597.8	3.8 3	3410.7	14−	2812.9	12−			
604.5	2.80 18	4016	18+	3412.8	16+			
668.0		1006.2	2−	337.8	4+			
813.4	6.2 3	3264.8	14−	2451.4	12−			
902.8	20.3 12	1006.2	2−	103.6	2+			
1006.4		1006.2	2−	0.0	0+			

† From ^{180}Hf(α,4nγ) (1979FaZR), except where noted.

‡ From ^{177}Hf(α,nγ) (1981Av04).

\# Weighted averages of delayed Iγ from 1966Bu08 and 1981Av04.

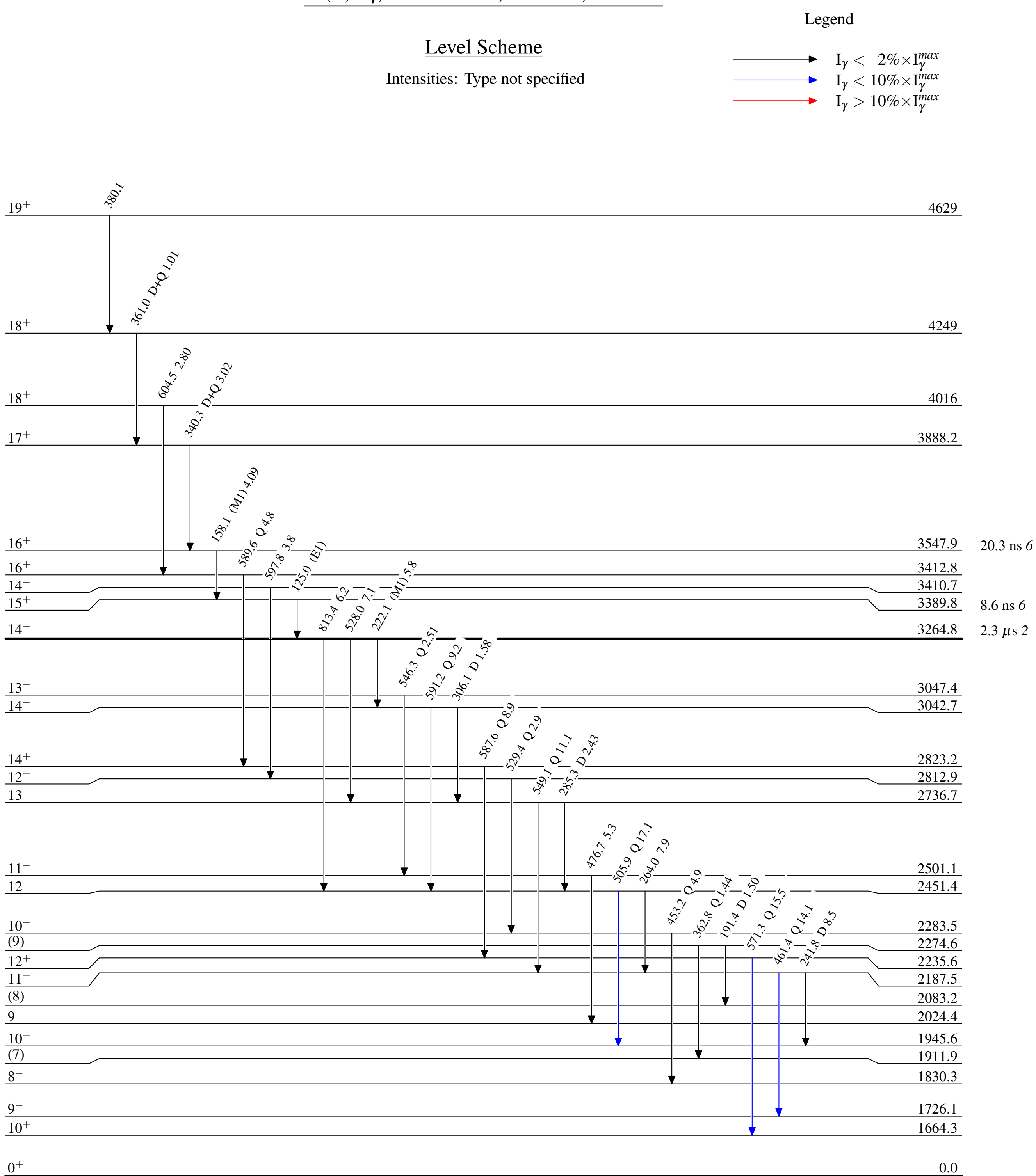
@ From γ(θ) in 1979FaZR, except where noted.

& 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.

Hf(α,xnγ) 1979FaZR,1966Bu08,1981Av04

Level Scheme

Intensities: Type not specified

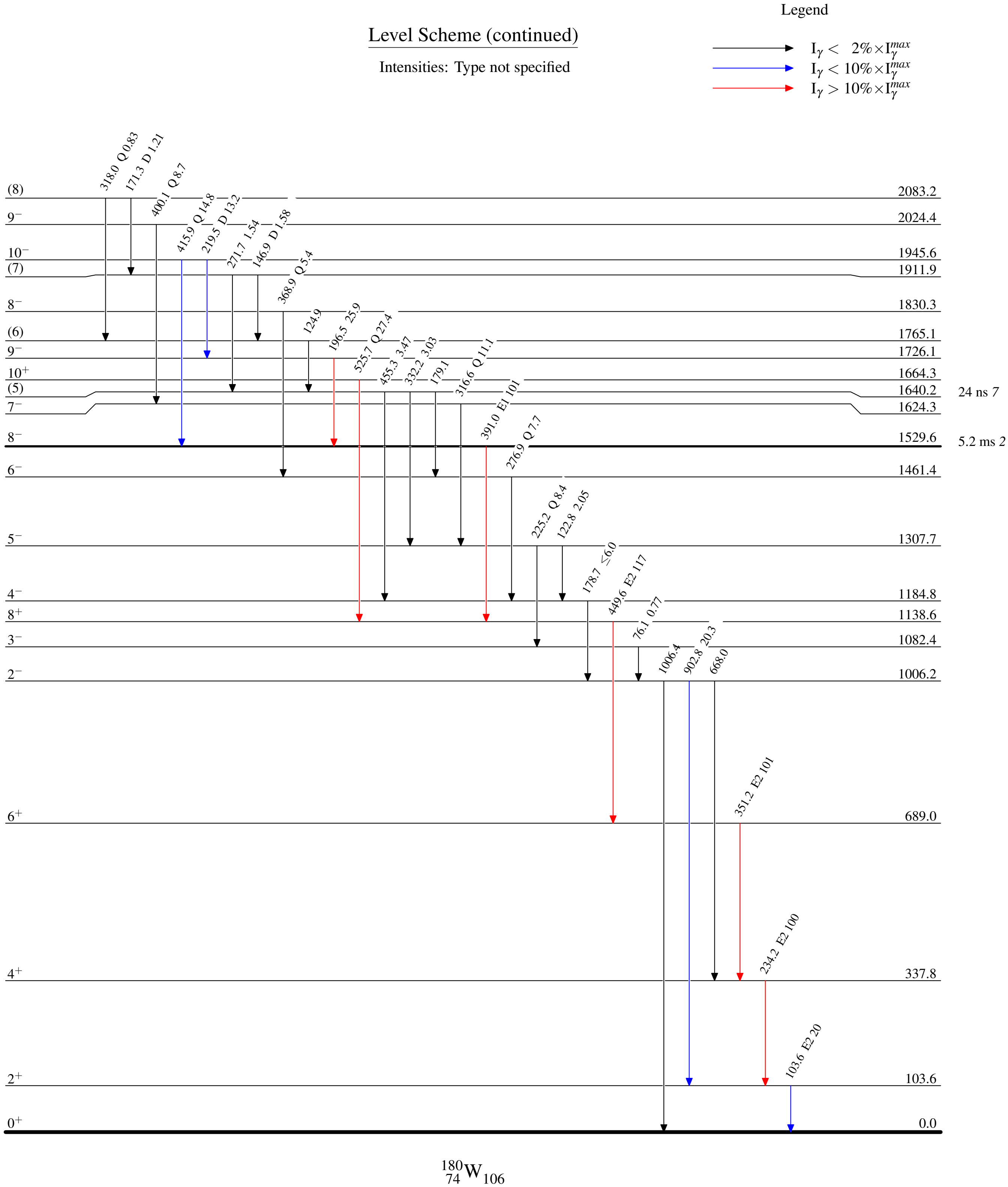


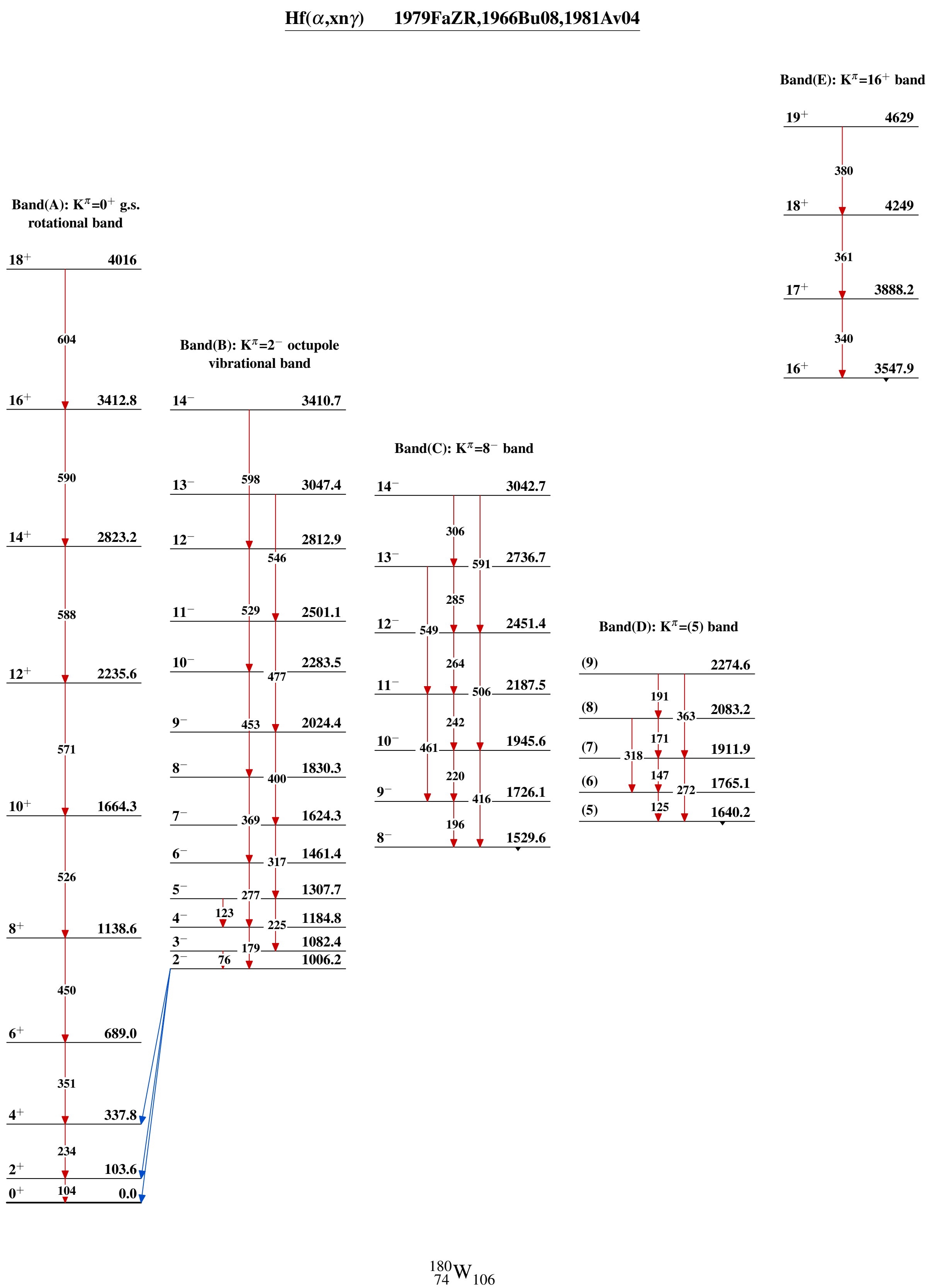
$^{180}_{74}W_{106}$

Hf(α,xnγ) 1979FaZR,1966Bu08,1981Av04

Level Scheme (continued)

Intensities: Type not specified




Hf(α,xnγ) 1979FaZR,1966Bu08,1981Av04
Band(A): Kπ=0+ g.s. rotational band
18+ 4016
16+ 3412.8
14+ 2823.2
12+ 2235.6
10+ 1664.3
8+ 1138.6
6+ 689.0
4+ 337.8
2+ 103.6
0+ 0.0
604
590
588
571
526
450
351
234
104
Band(B): Kπ=2− octupole vibrational band
14− 3410.7
13− 3047.4
12− 2812.9
11− 2501.1
10− 2283.5
9− 2024.4
8− 1830.3
7− 1624.3
6− 1461.4
5− 1307.7
4− 1184.8
3− 1082.4
2− 1006.2
598
546
529
477
453
400
369
317
277
123
225
179
76
Band(C): Kπ=8− band
14− 3042.7
13− 2736.7
12− 2451.4
11− 2187.5
10− 1945.6
9− 1726.1
8− 1529.6
306
591
285
549
264
506
242
461
220
416
196
Band(D): Kπ=(5) band
(9) 2274.6
(8) 2083.2
(7) 1911.9
(6) 1765.1
(5) 1640.2
191
363
171
318
147
272
125
Band(E): Kπ=16+ band
19+ 4629
18+ 4249
17+ 3888.2
16+ 3547.9
380
361
340
$^{180}_{74}W_{106}$