Yb(α,xnγ) 1973Re16,1978HaZS,1980Wa23

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 75,199 (1995)	31-May-1995

Includes ^{175}Lu(p,xnγ) and ^{176}Yb(^{3}He,xnγ).
(α,xnγ) reactions include ^{170}Yb(α,2nγ); ^{171}Yb(α,3nγ); ^{172}Yb(α,4nγ); ^{174}Yb(α,6nγ); ^{176}Yb(α,8nγ).
1973Re16 (also 1973Sa14): ^{171}Yb(α,3nγ) E=39 MeV. Enriched target. Measured γ, $\gamma\gamma$, $\gamma\gamma(\theta)$, γ(t).
1978HaZS (also 1977HaYH,1977GoZK): ^{172}Yb(α,4nγ) E=45-55 MeV. Measured γ, $\gamma\gamma$, $\gamma(\theta)$, delayed γ, ce, excitation functions. Details of these measurements are not available.
Additional information 1.
1980Wa23: ^{170}Yb(α,2nγ) E=26-30 MeV. Measured $\gamma(\theta$,H,t). g factor measured for 1685 and 2006 levels.
1973Bi10: ^{175}Lu(p,4nγ) E=47.5 MeV. Measured γ, excitation functions. Following γ rays (g.s. band cascade) reported with Eγ(Iγ): 95 (130), 213.5 (100), 318.0 (60), 408.5 (30), 483 (15), 543 (5).
1966Mo01: ^{172}Yb(α,4nγ) E=52 MeV. Measured G. g.s. band established up to 10^+ from five γ transitions in a cascade.
Others: 1980Sa19: ^{174}Yb(α,6nγ) and ^{176}Yb(α,8nγ) E=50-120 MeV; ^{176}Yb(^{3}He,^{7}nγ) E=65-100 MeV; ^{175}Lu(p,4nγ) E=30-57 MeV. Measured γ (prompt and delayed) and yields.
1983KiZY: ^{175}Lu(p,4nγ) E=40 MeV. Measured γ, γ(t), $\gamma\gamma$(t).

^{172}Hf Levels

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]	Comments
0.0[@]	0^+		
95.17[@] *10*	2^+		
309.17[@] *15*	4^+		
628.19[@] *17*	6^+		
1037.1[@] *3*	8^+		
1129.6 *4*	4^+		
1393.9 *4*			
1418.4[&] *3*	(4^-)	≈1 ns	T$_{1/2}$: from centroid-shift analysis (1977HaXK,1978HaZS).
1503.4[a] *2*	(5^-)		
1520.7[@] *3*	10^+		
1597.5[&] *3*	(6^-)		
1676.8 *3*	$(6,7,8^+)$		
1684.5[b] *3*	(6^+)	4.8 ns *4*	T$_{1/2}$: from time differential precession (1980Wa23). Others: 4.5 ns *10* (1976HaXB,1978HaZS). g factor=0.92 *10* (1980Wa23). Configuration=((π g$_{7/2}$)(π d$_{5/2}$)) (1980Wa23). Deduced g$_K$=1.00 *12* (1980Wa23).
1727.6[a] *3*	(7^-)		
1738.5 *4*	$(8,9,10^+)$		
1852.5[&] *3*	(8^-)		
1856.7[d] *3*	(6^-)		
1878.1[b] *4*			
1965.0[d] *4*			
1967.6[a] *3*	(9^-)		
2005.8[c] *5*	(8^-)	163 ns *3*	T$_{1/2}$: from time differential precession (1980Wa23). Other: 155 ns *20* (1976HaXC,1978HaZC). g factor=0.982 *8* (1980Wa23). Configuration=((π g$_{7/2}$)(π h$_{9/2}$)) (1980Wa23). Deduced g$_K$=1.049 *16* (1980Wa23).
2033.9 *4*	$(8,9,10^+)$		
2064.1[@] *4*	12^+		
2095.9[d] *4*			
2155.0 *5*			

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Yb(α,xnγ) 1973Re16,1978HaZS,1980Wa23 (continued)

^{172}Hf Levels (continued)

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
2185.9[&] 4	(10⁻)	2488.3[c] 7		2776.8[a] 4	(13⁻)	3448.8[e] 5	
2235.9[c] 6		2598.4[&] 5	(12⁻)	2899.6[e] 4		3642.9[&] 7	(16⁻)
2246.8[d] 4		2607.1 11		3050.3[c] 8		3860.6[a] 12	(17⁻)
2336.5[a] 4	(11⁻)	2612.2[d] 5		3085.5[&] 6	(14⁻)	3918.6[@] 7	(18⁺)
2416.6[d] 5		2653.4[@] 5	14⁺	3276.5[@] 7	(16⁺)	4264.9[&] 12	(18⁻)
2425.8[e] 4		2760.3[c] 8		3287.8[a] 11	(15⁻)	4575.6[@] 12	(20⁺)

† From least-squares fit to Eγ's, assuming 0.3 keV uncertainty on Eγ's if not given.
‡ From Adopted Levels.
# From γ(t).
@ Band(A): g.s. band.
& Band(B): (π=−,α=0) band.
a Band(C): (π=−,α=1) band.
b Band(D): ΔJ=(1), Kπ=(6⁺) band.
c Band(E): ΔJ=(1), Kπ=(8⁻) band.
d Band(F): band 1, ΔJ=(1).
e Band(G): band 2, ΔJ=(2).

γ(^{172}Hf)

Eγ †	Iγ ‡	Ei(level)	Jiπ	Ef	Jfπ	Comments
x73.1#c	4					
x85.0#	2					
94.1[a]	2	1597.5	(6⁻)	1503.4	(5⁻)	Eγ: 93.2 (1973Re16).
95.17[@] 10	22	95.17	2⁺	0.0	0⁺	A2=0.22 8 (1973Re16).
108.2[&]		1965.0		1856.7	(6⁻)	
124.9[&]		1852.5	(8⁻)	1727.6	(7⁻)	
127.7[a]	3	2005.8	(8⁻)	1878.1		Eγ: 127.5 (1973Re16).
128.3[&c]		2095.9		1967.6	(9⁻)	
130.9[a]	2	2095.9		1965.0		Eγ: 129.7 (1973Re16).
150.9[&]		2246.8		2095.9		
x155.7#	1					
169.8[&]		2416.6		2246.8		
172.2[&]		1856.7	(6⁻)	1684.5	(6⁺)	
175.4[&]		1852.5	(8⁻)	1676.8	(6,7,8⁺)	
179.2[&]		1597.5	(6⁻)	1418.4	(4⁻)	
193.6[a]	7	1878.1		1684.5	(6⁺)	Eγ: 193.1 (1973Re16).
195.6[&]		2612.2		2416.6		
214.0[@] 1	100	309.17	4⁺	95.17	2⁺	A2=0.31 5 (1973Re16).
218.5[&]		2185.9	(10⁻)	1967.6	(9⁻)	
230.1[a]	3	2235.9		2005.8	(8⁻)	Eγ: 229.9 (1973Re16). A2=0.35 18 (1973Re16).
x247.8#	1					
252.4[a]	3	2488.3		2235.9		Eγ: 252.3 (1973Re16).

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Yb(α,xnγ) 1973Re16,1978HaZS,1980Wa23 (continued)

$\gamma(^{172}Hf)$ (continued)

E_γ †		I_γ ‡	E_i(level)	J_i^π	E_f	J_f^π	Comments
255.0[a]		6	1852.5	(8$^-$)	1597.5	(6$^-$)	E_γ: 254.1 (1973Re16). A_2=0.18 *8* (1973Re16).
[x]257.5[#]		4					
272.0[a]		1	2760.3		2488.3		E_γ: 271.7 (1973Re16).
[x]277.9[#]		1					
281.8[a]		1	2246.8		1965.0		E_γ: 281.5 (1973Re16).
[x]287.8[#]		1					
290.0[a]		1	3050.3		2760.3		E_γ: 290.1 (1973Re16).
319.0[@]	*1*	94	628.19	6$^+$	309.17	4$^+$	A_2=0.30 *8* (1973Re16).
333.2[a]		11	2185.9	(10$^-$)	1852.5	(8$^-$)	A_2=0.41 *17* (1973Re16).
[x]351.3[#c]		1					
353.3[&]			1856.7	(6$^-$)	1503.4	(5$^-$)	
365.4[a]		1	2612.2		2246.8		E_γ: 365.5 (1973Re16).
369.0[a]		3	2336.5	(11$^-$)	1967.6	(9$^-$)	E_γ: 368.4 (1973Re16).
[x]370.1[#]		1					
[x]379.1[#]		1					
391.9[&]			2425.8		2033.9	(8,9,10$^+$)	
409.0[@]	*2*	66	1037.1	8$^+$	628.19	6$^+$	A_2=0.33 *4* (1973Re16).
412.5[a]		5	2598.4	(12$^-$)	2185.9	(10$^-$)	
440.4[a]		8	2776.8	(13$^-$)	2336.5	(11$^-$)	E_γ: 440.6 (1973Re16).
447.5[#]		3	1967.6	(9$^-$)	1520.7	10$^+$	Placement from (HI,xnγ).
[x]458.8[#]		1					
473.8[a]		2	2899.6		2425.8		E_γ: 474.3 (1973Re16).
483.7[@]	*2*	46	1520.7	10$^+$	1037.1	8$^+$	A_2=0.35 *17* (1973Re16).
487.1[a]		4	3085.5	(14$^-$)	2598.4	(12$^-$)	
511[&]			3287.8	(15$^-$)	2776.8	(13$^-$)	
543[&c]			2607.1		2064.1	12$^+$	
543.4[@]	*3*	26	2064.1	12$^+$	1520.7	10$^+$	A_2=0.39 *7* (1973Re16).
[x]545.7[#]		2					
549.2[a]		1	3448.8		2899.6		
557.4[&]			3642.9	(16$^-$)	3085.5	(14$^-$)	
572.8[&]			3860.6	(17$^-$)	3287.8	(15$^-$)	
589.3[@]	*3*	14	2653.4	14$^+$	2064.1	12$^+$	A_2=0.42 *14* (1973Re16).
622[&c]			4264.9	(18$^-$)	3642.9	(16$^-$)	
623.1[@]	*4*	6	3276.5	(16$^+$)	2653.4	14$^+$	
634.3[&]			2155.0		1520.7	10$^+$	
642.1[@]			3918.6	(18$^+$)	3276.5	(16$^+$)	
657[&]			4575.6	(20$^+$)	3918.6	(18$^+$)	
690[&c]			1727.6	(7$^-$)	1037.1	8$^+$	
701.4[&]			1738.5	(8,9,10$^+$)	1037.1	8$^+$	
712.7[&]			2776.8	(13$^-$)	2064.1	12$^+$	
765.7[&]			1393.9		628.19	6$^+$	
815.7[a]		4	2336.5	(11$^-$)	1520.7	10$^+$	E_γ: 814.9 (1973Re16).
820.4[&]			1129.6	4$^+$	309.17	4$^+$	
835.5[&]			2899.6		2064.1	12$^+$	
875.2[a]		4	1503.4	(5$^-$)	628.19	6$^+$	E_γ: 874.7 (1973Re16).
905.0[&]			2425.8		1520.7	10$^+$	

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Yb(α,xnγ) 1973Re16,1978HaZS,1980Wa23 (continued)

$\gamma(^{172}Hf)$ (continued)

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Comments
930.4[a]	5	1967.6	(9^-)	1037.1	8^+	E_γ: 929.1 (1973Re16).
996.9[&]		2033.9	$(8,9,10^+)$	1037.1	8^+	
1048.4[a]	2	1676.8	$(6,7,8^+)$	628.19	6^+	E_γ: 1048.1 (1973Re16).
1056.2[b]	5	1684.5	(6^+)	628.19	6^+	E_γ: 1056.1 (1973Re16).
1099.4[&]		1727.6	(7^-)	628.19	6^+	
1109.3[&]		1418.4	(4^-)	309.17	4^+	
1194.3[a]	5	1503.4	(5^-)	309.17	4^+	E_γ: 1194.0 (1973Re16).
1375.4[b]	3	1684.5	(6^+)	309.17	4^+	E_γ: 1375.2 (1973Re16).

† Mainly from (α,4nγ) (1978HaZS). For the g.s. band, values are from (α,3nγ) (1973Sa14).
‡ From ^{171}Yb(α,3nγ) E=39 MeV (1973Re16). 1973Re16 state that calibration uncertainties are 10%.
# From (α,3nγ) (1973Re16).
@ From 1973Sa14.
& γ from 1978HaZS only. Intensity is not available.
a Energy and placement from 1978HaZS.
b Placement from 1978HaZS.
c Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

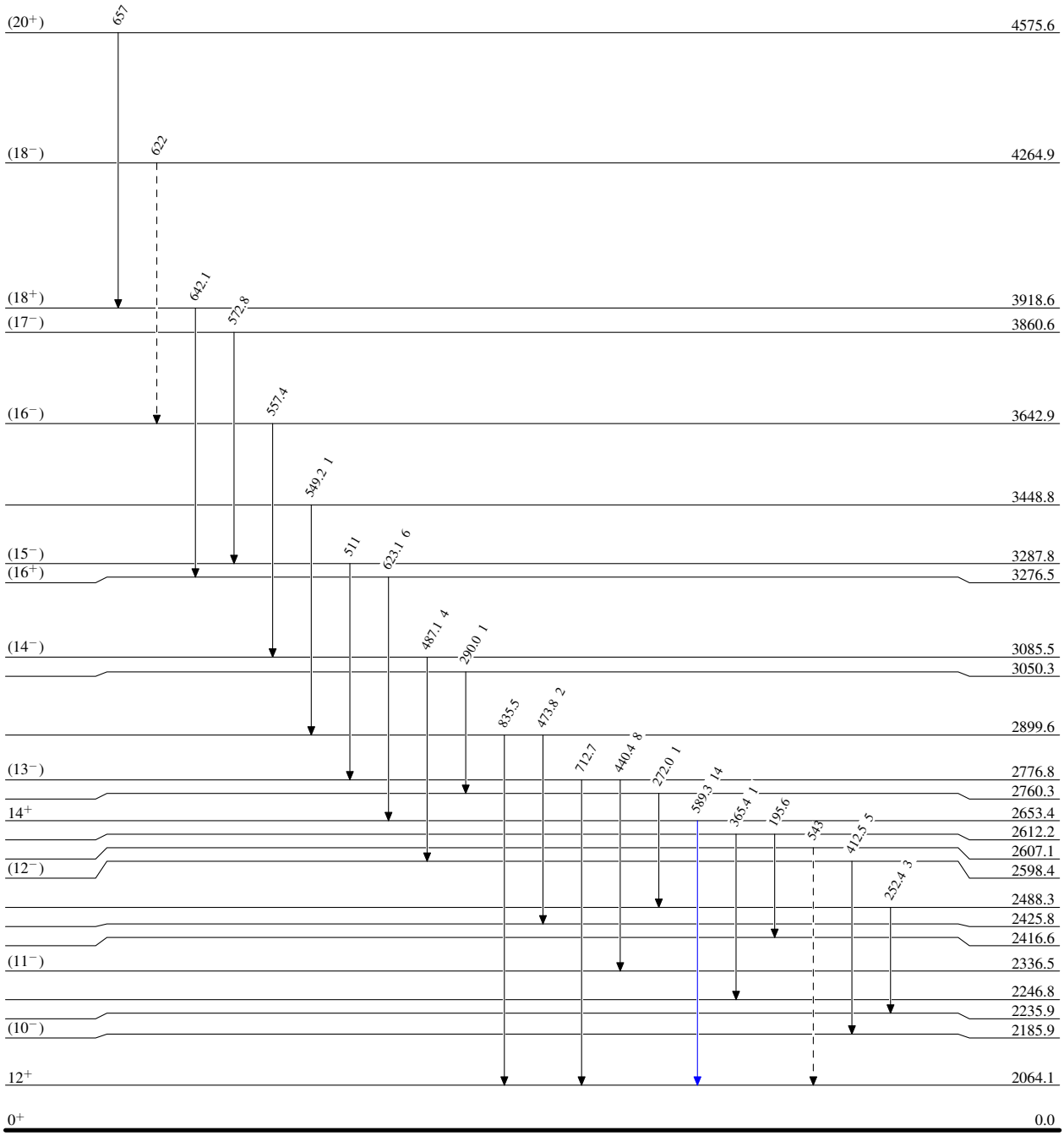
Yb(α,xnγ) 1973Re16,1978HaZS,1980Wa23

Level Scheme

Intensities: Relative I_γ

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)



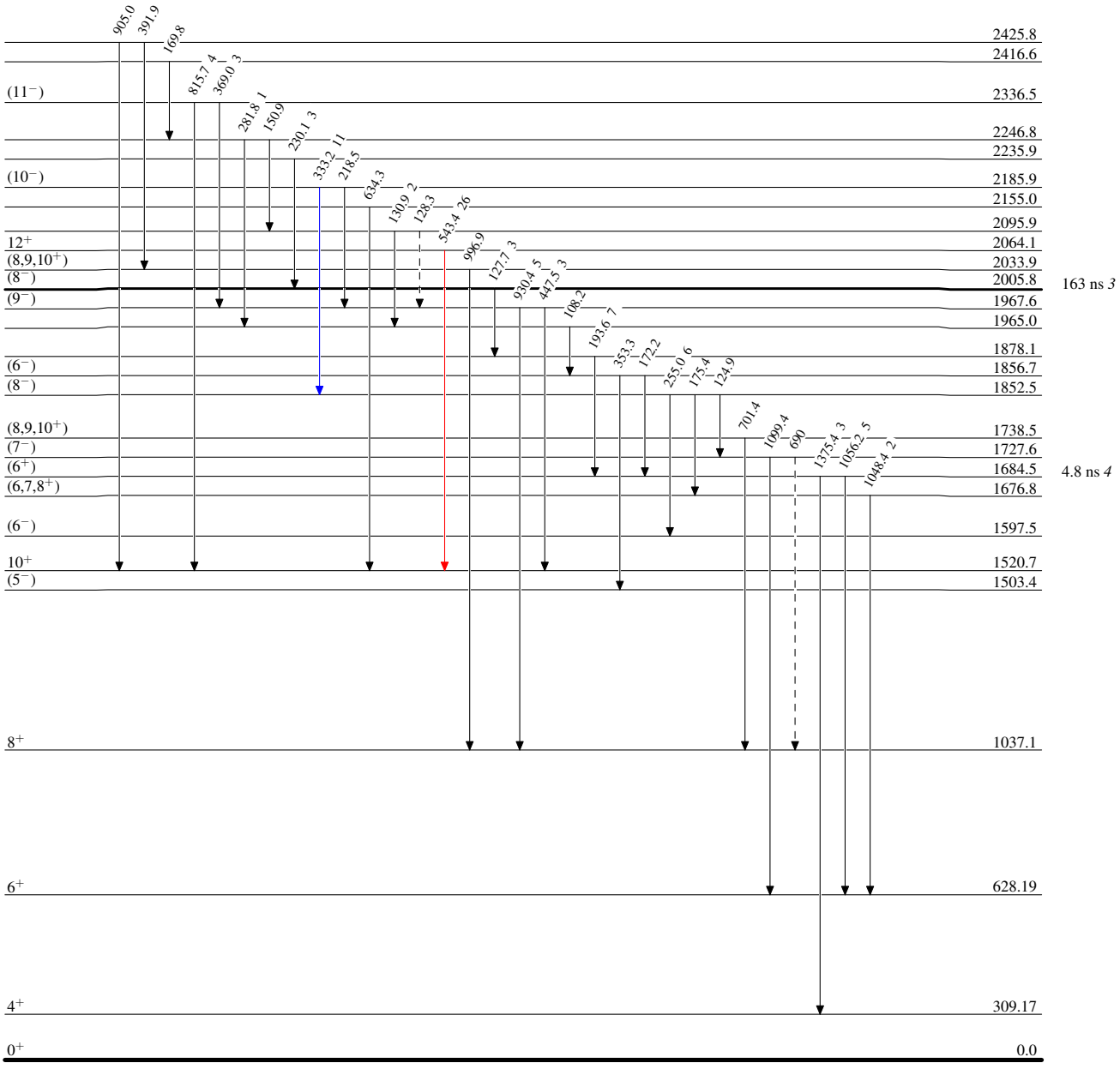
$^{172}_{72}Hf_{100}$

Yb(α,xnγ) 1973Re16,1978HaZS,1980Wa23

Level Scheme (continued)

Intensities: Relative I_γ

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)



$^{172}_{72}Hf_{100}$

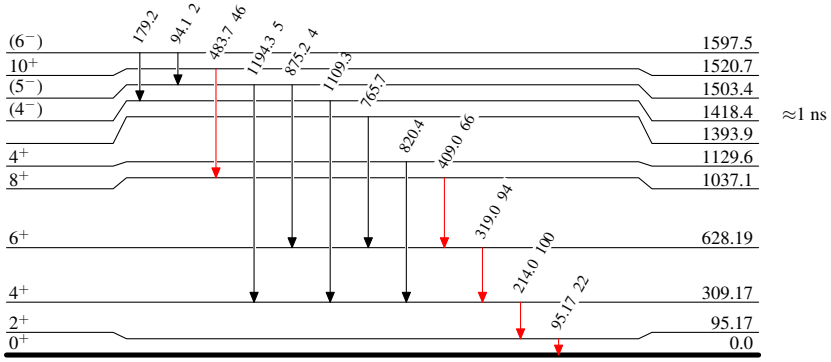
Yb(α,xnγ) 1973Re16,1978HaZS,1980Wa23

Level Scheme (continued)

Intensities: Relative I_γ

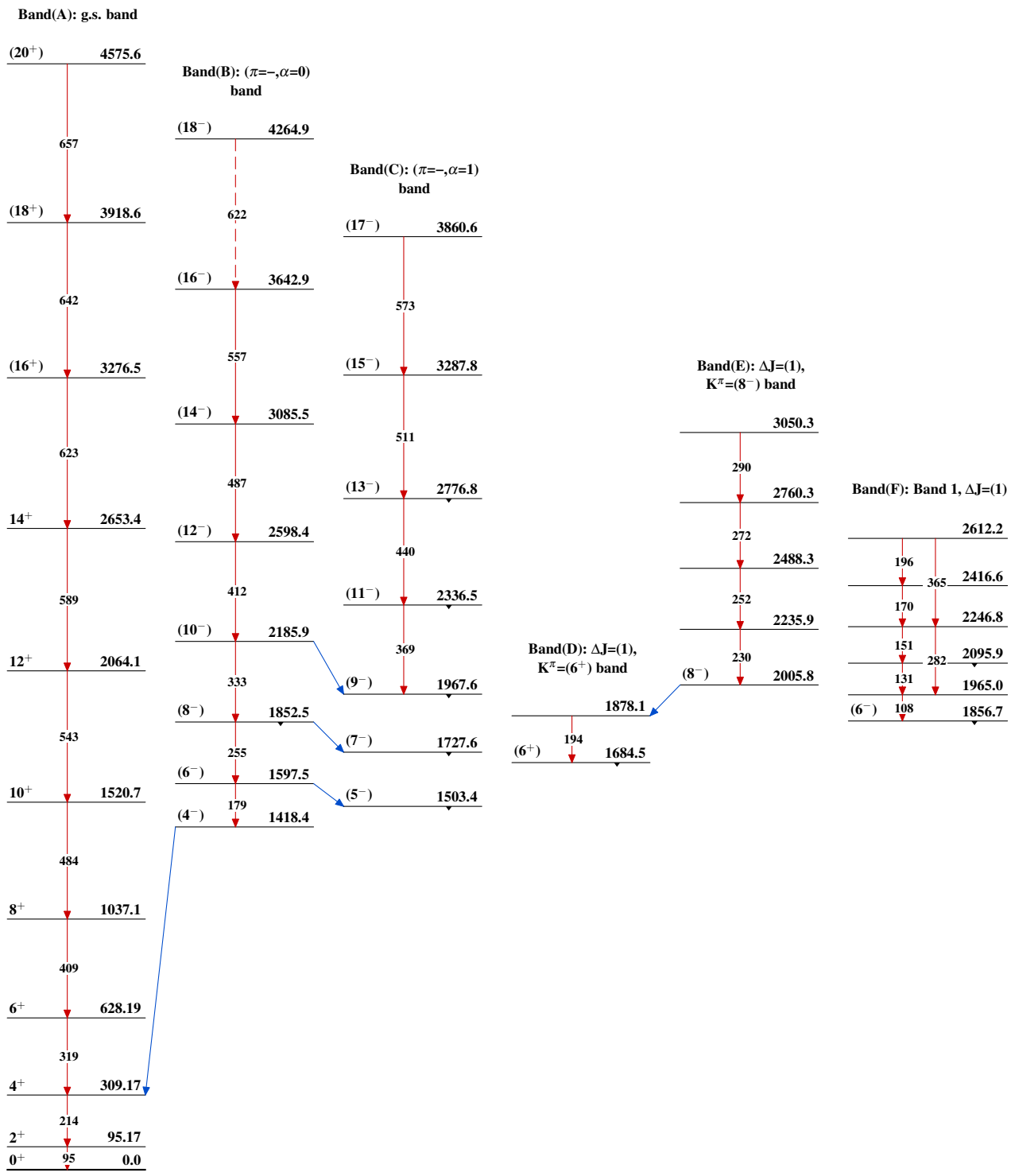
Legend

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



$^{172}_{72}Hf_{100}$

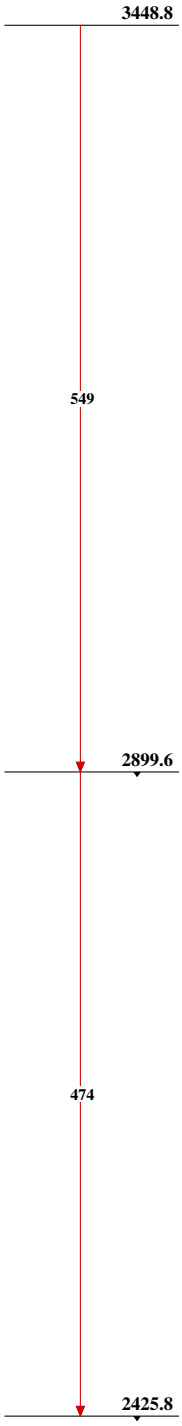
Yb(α,xnγ) 1973Re16,1978HaZS,1980Wa23



$^{172}_{72}Hf_{100}$

Yb(α,xnγ) 1973Re16,1978HaZS,1980Wa23 (continued)

Band(G): Band 2, ΔJ=(2)



$^{172}_{72}Hf_{100}$