^{176}Yb(α,3nγ) 1973Hu04,1976ReZH

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	F. G. Kondev	NDS 159, 1 (2019)	30-Aug-2019

1973Hu04: Reaction: ^{176}Yb(α,3nγ). Target: ^{176}Yb, 96.4% enriched. E=33.5 MeV. Measured: singles γ-ray spectra, excitation functions, Eγ, Iγ. Detectors: 25 cm^{3}Ge(Li) with energy resolution of about 2 keV at 100 keV.
1976ReZH: Reaction: ^{176}Yb(α,3nγ). Target: ^{176}Yb. E=34-43 MeV. Measured: singles γ-ray spectra, lifetimes, $\gamma(\theta)$, ce, $\gamma\gamma$ coin, Eγ.
Others: 1982Ko08; 1971Wa16 and 1972Ch48 isomer decay data.

^{177}Hf Levels

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]	Comments
0.0[@]	7/2$^-$	stable	
112.96[@] *21*	9/2$^-$	0.70 ns *15*	T$_{1/2}$: From centroid-shift analysis in 1982Ko08.
249.50[@] *20*	11/2$^-$		
321.34[&] *21*	9/2$^+$		
409.40[@] *24*	13/2$^-$		
426.61[&] *25*	11/2$^+$		
555.20[&] *24*	13/2$^+$		
591.1[@] *3*	15/2$^-$		
708.3[&] *3*	15/2$^+$		
794.3[@] *4*	17/2$^-$		
882.6[&] *3*	17/2$^+$		
1017.7[@] *4*	19/2$^-$		
1086.7[&] *3*	19/2$^+$		
1260.2[@] *5*	21/2$^-$		
1301.3[&] *3*	21/2$^+$		
1315.0[a] *5*	23/2$^+$	1.09 s *5*	
1342.3[b] *5*	19/2$^-$	55.9 μs *12*	J$^\pi$: From 1976ReZH. T$_{1/2}$: From γ(t) in 1976ReZH.
1520.5[@] *5*	23/2$^-$		
1561.0[&] *4*	23/2$^+$		
1592.3[a] *6*	25/2$^+$		
1712.8[c] *6*	25/2$^-$		J$^\pi$: From 1976ReZH.
1798.1[@] *6*	25/2$^-$		
1887.2[a] *6*	27/2$^+$		
1967.6[c] *7*	(27/2$^-$)		J$^\pi$: From 1976ReZH.
2091.4[@] *6*	27/2$^-$		
2198.7[a] *6*	29/2$^+$		
2249.0[c] *3*	(29/2$^-$)		J$^\pi$: From 1976ReZH.
2525.4[a] *6*	31/2$^+$		
2739.4[d] *7*	37/2$^-$	51.4 min *5*	

[†] From a least-squares fit to Eγ.
[‡] From 1973Hu04 and 1976ReZH.
[#] From Adopted Levels, unless otherwise stated.
[@] Band(A): K^π=7/2$^-$, ν7/2[514].
[&] Band(B): K^π=9/2$^+$, ν9/2[624].

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^{176}Yb(α,3nγ) 1973Hu04,1976ReZH (continued)

^{177}Hf Levels (continued)

[a] Band(C): $K^\pi=23/2^+$, $\nu(7/2[514])\otimes\pi^2(7/2[404],9/2[514])$.
[b] $K^\pi=19/2^-$, $\nu(7/2[514])\otimes\pi^2(5/2[402],7/2[404])$.
[c] Band(D): $K^\pi=25/2^-$, $\nu(9/2[624])\otimes\pi^2(7/2[404],9/2[514])$.
[d] $K^\pi=37/2^-$, $\nu^3(5/2[512],7/2[514],9/2[624])\otimes\pi^2(7/2[404],9/2[514])$.

$\gamma(^{177}Hf)$

E_γ [†]	I_γ [†]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [‡]	Comments
71.7 *3*		321.34	$9/2^+$	249.50	$11/2^-$	E1+M2	E_γ: From 1976ReZH.
[x]75.9	3						
105.3[@] *3*	19	426.61	$11/2^+$	321.34	$9/2^+$	M1+E2	
112.9 *3*	46	112.96	$9/2^-$	0.0	$7/2^-$	M1+E2	
117.6 *3*	1	708.3	$15/2^+$	591.1	$15/2^-$		
120.5[#] *3*	18	1712.8	$25/2^-$	1592.3	$25/2^+$	E1	Mult.: From measured $\gamma(\theta)$ and α(exp) in 1976ReZH, but individual values are not given by the authors. I_γ: From 1973Hu04.
128.4[@] *3*	21	555.20	$13/2^+$	426.61	$11/2^+$	M1+E2	
136.7 *3*	7	249.50	$11/2^-$	112.96	$9/2^-$	M1+E2	
[x]139.9	3						
145.7[@] *3*	2	555.20	$13/2^+$	409.40	$13/2^-$		
153.2[@] *3*	20	708.3	$15/2^+$	555.20	$13/2^+$	M1+E2	
159.7 *3*	4	409.40	$13/2^-$	249.50	$11/2^-$	M1+E2	
174.3[@] *3*	18	882.6	$17/2^+$	708.3	$15/2^+$	M1+E2	
176.8[@] *3*	5	426.61	$11/2^+$	249.50	$11/2^-$		
181.9[#] *3*		591.1	$15/2^-$	409.40	$13/2^-$	[M1+E2]	
[x]193.5	3						
204.1[@] *3*	16	1086.7	$19/2^+$	882.6	$17/2^+$	M1+E2	
208.2[@] *3*	100	321.34	$9/2^+$	112.96	$9/2^-$	E1+M2	
214.0 *3*		2739.4	$37/2^-$	2525.4	$31/2^+$	E3	
214.3 *3*	25	1301.3	$21/2^+$	1086.7	$19/2^+$	M1+E2	
228.3[@] *3*	31	1315.0	$23/2^+$	1086.7	$19/2^+$	E2	
233.5[@] *3*	8	555.20	$13/2^+$	321.34	$9/2^+$	E2	
[x]240.3	3						
249.6 *3*	31	249.50	$11/2^-$	0.0	$7/2^-$	E2	
254.8[#] *3*	12	1967.6	$(27/2^-)$	1712.8	$25/2^-$	M1+E2	I_γ: From 1973Hu04 for 254.7γ.
259.4 *3*	1	1561.0	$23/2^+$	1301.3	$21/2^+$	M1+E2	
277.3 *3*	32	1592.3	$25/2^+$	1315.0	$23/2^+$	M1+E2	
281[#&] *1*		2249.0	$(29/2^-)$	1967.6	$(27/2^-)$	M1+E2	
281.6[@] *3*	24	708.3	$15/2^+$	426.61	$11/2^+$	E2	
283.4[#] *3*		1301.3	$21/2^+$	1017.7	$19/2^-$		
291.4[#] *3*	4	882.6	$17/2^+$	591.1	$15/2^-$	E1+M2	E_γ: 292.0 keV is reported by 1973Hu04; unresolved doublet. I_γ: From 1973Hu04 for 292.0γ; unresolved doublet.
292.5[#] *3*	4	1086.7	$19/2^+$	794.3	$17/2^-$	E1+M2	E_γ: 292.0 keV is reported by 1973Hu04; unresolved doublet. I_γ: From 1973Hu04 for 292.0γ; unresolved doublet.
294.7 *3*	9	1887.2	$27/2^+$	1592.3	$25/2^+$	M1+E2	
296.4 *3*	51	409.40	$13/2^-$	112.96	$9/2^-$	E2	
298.5 *3*	3	708.3	$15/2^+$	409.40	$13/2^-$	E1+M2	E_γ: 299.0 keV is reported by 1976ReZH.
306.6 *3*	<33	555.20	$13/2^+$	249.50	$11/2^-$	E1+M2	E_γ: 305.5 keV is reported by 1976ReZH. I_γ: Includes contribution from 306.6γ in ^{176}Hf.

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^{176}Yb(α,3nγ) 1973Hu04,1976ReZH (continued)

$\gamma(^{177}Hf)$ (continued)

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	Comments
311.4 *3*	6	2198.7	29/2$^+$	1887.2	27/2$^+$	M1+E2	
x317.7	3						
321.3@ *3*	4	321.34	9/2$^+$	0.0	7/2$^-$	E1+M2	
326.7# *3*		2525.4	31/2$^+$	2198.7	29/2$^+$	M1+E2	
327.6@ *3*	29	882.6	17/2$^+$	555.20	13/2$^+$	E2	
341.6 *3*	25	591.1	15/2$^-$	249.50	11/2$^-$	E2	
x360.1	3						
x370.7	3						
378.5@ *3*	36	1086.7	19/2$^+$	708.3	15/2$^+$	E2	
385.0 *3*	33	794.3	17/2$^-$	409.40	13/2$^-$	E2	E_γ: From 1976ReZH. Note, that 395.3γ is placed in the level scheme of 1973Hu04.
x391.7	3						
x395.3	3						
x397.9	3						
x416.2	3						
418.6@ *3*	24	1301.3	21/2$^+$	882.6	17/2$^+$	E2	
426.5 *3*	<26	1017.7	19/2$^-$	591.1	15/2$^-$	E2	I_γ: Includes contribution from 426.8γ in ^{178}Hf.
x440.3	3						
x442.3	3						
x453.8	3						
x458.2	3						
465.9 *3*	12	1260.2	21/2$^-$	794.3	17/2$^-$	E2	
474.6 *3*	6	1561.0	23/2$^+$	1086.7	19/2$^+$	E2	
x477.5	3						
x487.2	3						
x491.9	3						
x494.2	3						
502.8 *3*	12	1520.5	23/2$^-$	1017.7	19/2$^-$	E2	
x508.9@	3						
536#& *1*		2249.0	(29/2$^-$)	1712.8	25/2$^-$	[E2]	I_γ: From 1973Hu04 for 535.0γ.
537.9 *3*	7	1798.1	25/2$^-$	1260.2	21/2$^-$	E2	
x541.9	3						
548.0@# *3*	15	1342.3	19/2$^-$	794.3	17/2$^-$	M1+E2	I_γ: From 1973Hu04 for 548.1γ. Mult.: From α(exp) in 1976ReZH.
x557.4	3						
x565.0	3						
x567.4	3						
570.9 *3*	5	2091.4	27/2$^-$	1520.5	23/2$^-$	E2	
x573.9	3						
x583.6	3						
x601.2	3						
606.5# *3*		2198.7	29/2$^+$	1592.3	25/2$^+$	E2	
638.2# *3*		2525.4	31/2$^+$	1887.2	27/2$^+$	E2	
x843.1	3						
x846.6	3						
x938.0	3						
x1015.3	3						
x1040.0	3						
x1049.6	3						
x1116.6	3						

[†] From 1973Hu04, unless otherwise stated. $\Delta E\gamma$ were assigned by the evaluator. $I\gamma$ are relative to $I\gamma(208\gamma)$=100.

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^{176}Yb(α,3nγ) 1973Hu04,1976ReZH (continued)

$\gamma(^{177}Hf)$ (continued)

‡ From adopted gammas, unless otherwise stated.
# From 1976ReZH. ΔEγ were assigned by the evaluator.
@ Contains a delayed component with $T_{1/2}$>50 ns.
& Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

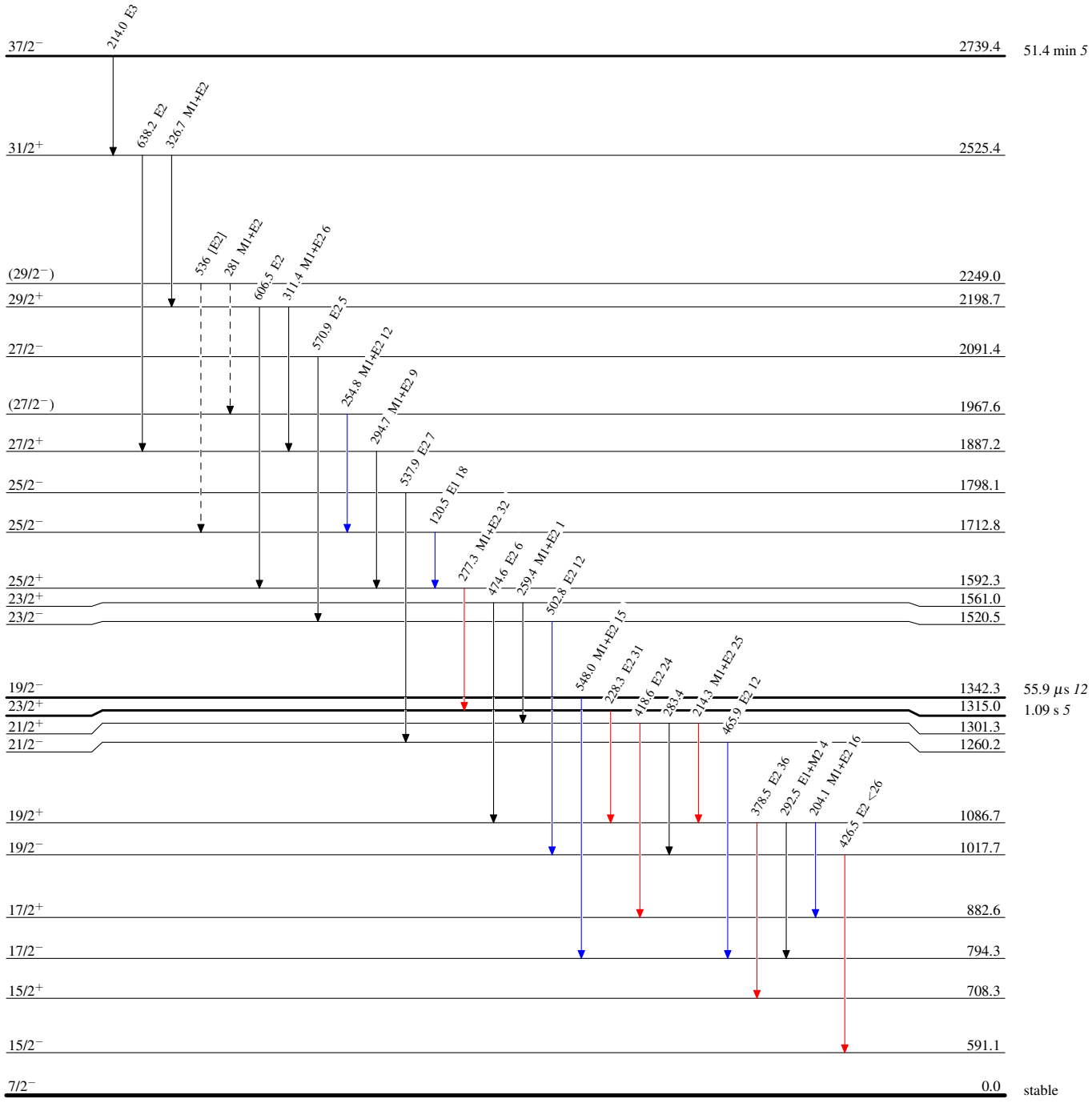
^{176}Yb(α,3nγ) 1973Hu04,1976ReZH

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)

Level Scheme

Intensities: Relative I_γ

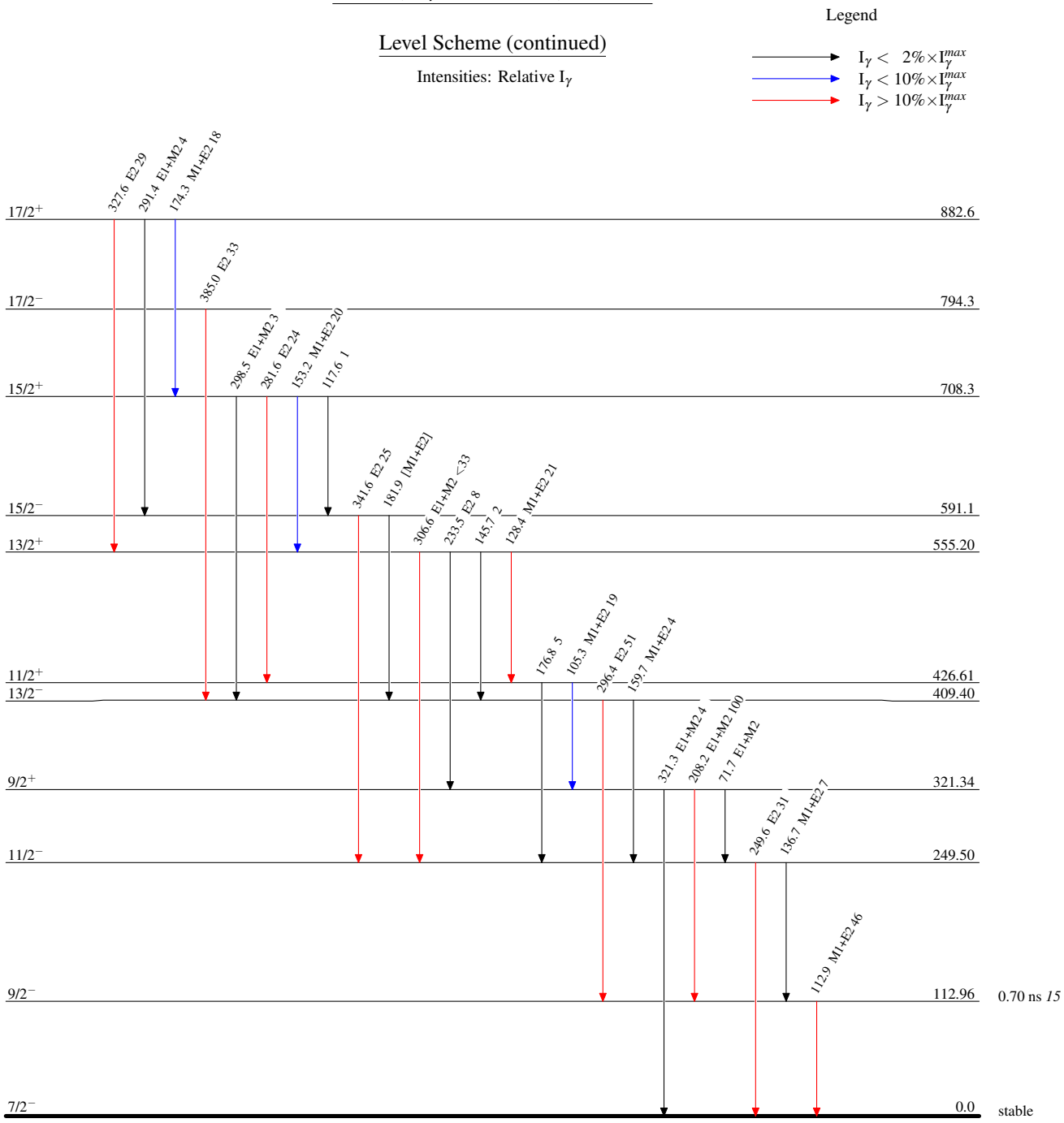


$^{177}_{72}Hf_{105}$

^{176}Yb(α,3nγ) 1973Hu04,1976ReZH

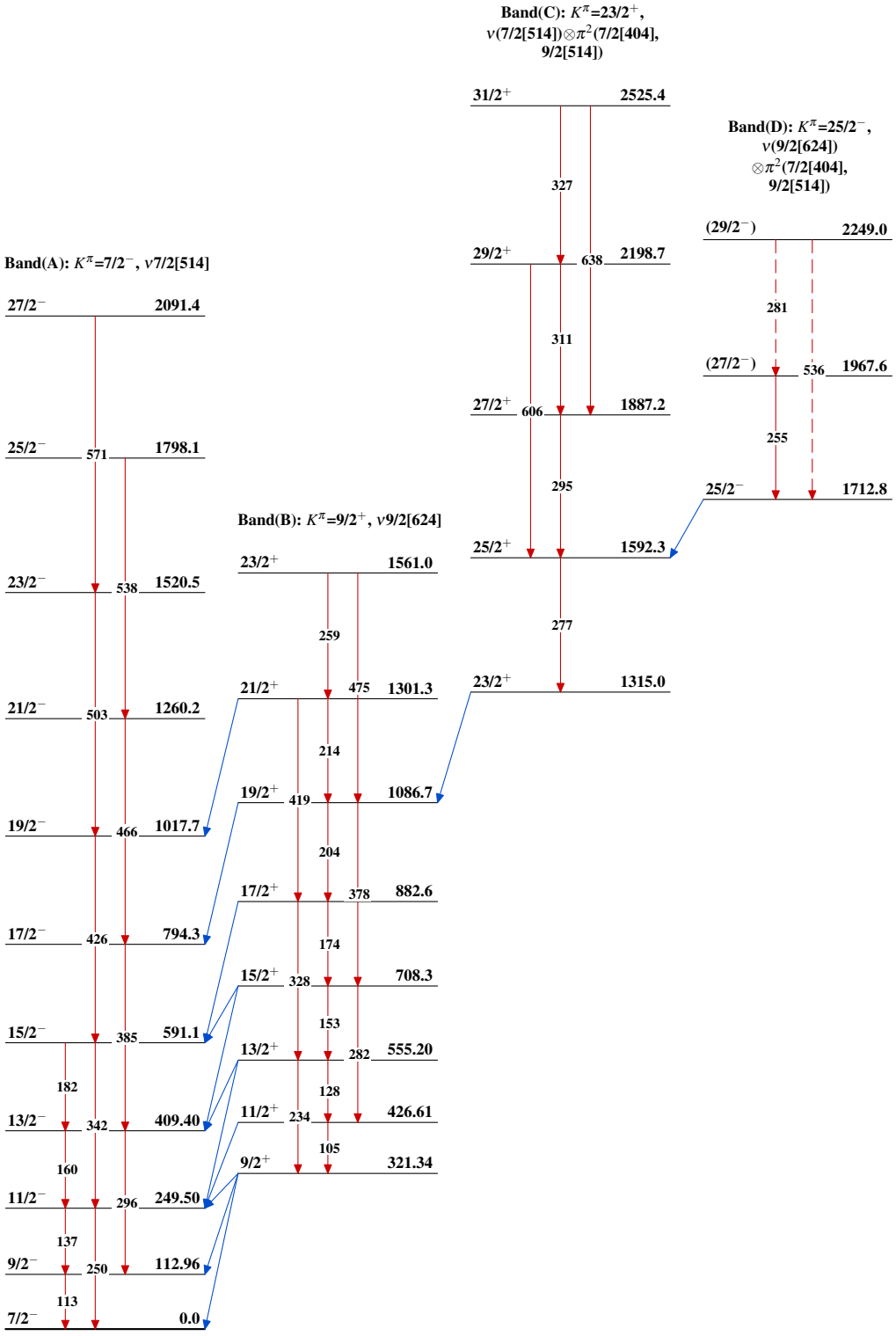
Level Scheme (continued)

Intensities: Relative I_γ



$^{177}_{72}Hf_{105}$

^{176}Yb(α,3nγ) 1973Hu04,1976ReZH



$^{177}_{72}Hf_{105}$