

$^{180}\text{Hf}(\text{d,p}\gamma)$  2002Gu13

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	S. -c. Wu	NDS 106,367 (2005)	31-Aug-2005

2002Gu13:  $^{180}\text{Hf}(\text{d,p}\gamma)$ , E=12.4 MeV. 94.3% enriched  $\text{HfO}_2$  target; Measured  $E\gamma$ ,  $I\gamma$ ,  $\gamma\gamma$ ; Compton-suppressed Ge detectors.

 $^{181}\text{Hf}$  Levels

E(level) <sup>†</sup>	$J^\pi$ <sup>‡</sup>	Comments
0.0 <sup>#</sup>	1/2 <sup>-</sup>	
45.68 <sup>@</sup> 8	3/2 <sup>-</sup>	
98.62 <sup>#</sup> 7	5/2 <sup>-</sup>	
204.00 <sup>@</sup> 8	7/2 <sup>-</sup>	
251.89 <sup>&amp;</sup> 7	3/2 <sup>-</sup>	
303.94 <sup>#</sup> 8	9/2 <sup>-</sup>	
329.38 <sup>a</sup> 7	5/2 <sup>-</sup>	
440.66 <sup>&amp;</sup> 7	7/2 <sup>-</sup>	
465.93 <sup>@</sup> 9	11/2 <sup>-</sup>	
573.63 <sup>a</sup> 8	9/2 <sup>-</sup>	
595.23 <sup>d</sup> 9	9/2 <sup>+</sup>	Probable $\nu 9/2[624]$ state.
617.24 <sup>#</sup> 11	13/2 <sup>-</sup>	E(level): Due to a possible 3 keV transition yet unobserved, this level could correspond to the 619.9 state of the Adopted Levels.
663.60 <sup>b</sup> 8	7/2 <sup>-</sup>	
722.27 <sup>d</sup>	(11/2 <sup>+</sup> )	
749.37 <sup>&amp;</sup> 9	11/2 <sup>-</sup>	
800.03 <sup>c</sup> 11	9/2 <sup>-</sup>	
805.5?	(11/2 <sup>+</sup> )	E(level): $E\gamma=203.5$ and $210.3$ are in coincidence, possible cascade from a 1009.0 keV 13/2 <sup>+</sup> level through a level at either 798.7 keV or 805.5 keV to the 595.2 keV state. The evaluator has adopted the latter possibility since the states of 804 keV and 1010 keV have been observed in the (t,p) reaction.
830.94 <sup>@</sup> 13	15/2 <sup>-</sup>	E(level): Due to a possible 3 keV transition yet unobserved, this level could correspond to the 835 state of the Adopted Levels. $J^\pi$ : tentative assignment.
874.87 <sup>d</sup>	(13/2 <sup>+</sup> )	Not in Adopted Levels.
904.10 10	7/2 <sup>-</sup>	Probable $\nu 7/2[514]$ state, assignment proposed by 2002Bo41.
930.03 <sup>a</sup> 10	13/2 <sup>-</sup>	$J^\pi$ : tentative assignment.
965.07 <sup>b</sup> 11	11/2 <sup>-</sup>	
1009.0?	13/2 <sup>+</sup>	See comments on 805.5 level.
1053.67 <sup>d</sup>	(15/2 <sup>+</sup> )	Not in Adopted Levels.

<sup>†</sup> From least-squares fit to  $E\gamma$ 's.

<sup>‡</sup> Assigned by the authors of 2002Gu13 based on  $\gamma\gamma$ -coin. information and band structures.  $J^\pi$  assignments agree with those in the Adopted Levels.

# Band(A):  $\nu 1/2[510]$ .

@ Band(a):  $\nu 1/2[510]$ .

& Band(B):  $\nu 3/2[512]$ .

<sup>a</sup> Band(b):  $\nu 3/2[512]$ .

<sup>b</sup> Band(C):  $\nu 7/2[503]$ .

<sup>c</sup> Band(c):  $\nu 7/2[503]$ .

<sup>d</sup> Possible member of the  $\nu 9/2[624]$  band.

$^{180}\text{Hf}(\text{d},\text{p}\gamma)$  2002Gu13 (continued) $\gamma(^{181}\text{Hf})$ 

$E_i(\text{level})$	$J_i^\pi$	$E_\gamma^\dagger$	$I_\gamma^\dagger$	$E_f$	$J_f^\pi$	Comments
98.62	5/2 <sup>-</sup>	98.6 <i>I</i>		0.0	1/2 <sup>-</sup>	
204.00	7/2 <sup>-</sup>	105.4 <i>I</i>	100	98.62	5/2 <sup>-</sup>	
		158.4 <i>I</i>	27 6	45.68	3/2 <sup>-</sup>	
251.89	3/2 <sup>-</sup>	153.4 <i>I</i>	24 5	98.62	5/2 <sup>-</sup>	
		206.1 <i>I</i>	100	45.68	3/2 <sup>-</sup>	
		252.0 <i>I</i>	30 6	0.0	1/2 <sup>-</sup>	
303.94	9/2 <sup>-</sup>	100.0 <i>I</i>	13 3	204.00	7/2 <sup>-</sup>	
		205.2 <i>I</i>	100	98.62	5/2 <sup>-</sup>	
329.38	5/2 <sup>-</sup>	77.4 <i>I</i>	≈6	251.89	3/2 <sup>-</sup>	
		125.3 <i>I</i>	55 11	204.00	7/2 <sup>-</sup>	
		230.7 <i>I</i>	7 1	98.62	5/2 <sup>-</sup>	
		283.7 <i>I</i>	9 2	45.68	3/2 <sup>-</sup>	
		329.3 <i>I</i>	100	0.0	1/2 <sup>-</sup>	
440.66	7/2 <sup>-</sup>	110.9 <i>I</i>	≈5	329.38	5/2 <sup>-</sup>	$E_\gamma$ : Level-energy difference=111.3.
		136.7 <i>I</i>	6 1	303.94	9/2 <sup>-</sup>	
		188.9 <i>I</i>	9 2	251.89	3/2 <sup>-</sup>	
		236.7 <i>I</i>	28 6	204.00	7/2 <sup>-</sup>	
		342.1 <i>I</i>	100	98.62	5/2 <sup>-</sup>	
		395.0 <i>I</i>	14 3	45.68	3/2 <sup>-</sup>	
465.93	11/2 <sup>-</sup>	162.0 <i>I</i>	72 14	303.94	9/2 <sup>-</sup>	
		261.9 <i>I</i>	100	204.00	7/2 <sup>-</sup>	
573.63	9/2 <sup>-</sup>	133.2 <i>I</i>	30 6	440.66	7/2 <sup>-</sup>	
		244.2 <i>I</i>	100	329.38	5/2 <sup>-</sup>	
		369.7 <i>I</i>	86 17	204.00	7/2 <sup>-</sup>	
595.23	9/2 <sup>+</sup>	129.3 <i>I</i>	28 6	465.93	11/2 <sup>-</sup>	
		154.5 <i>I</i>	30 6	440.66	7/2 <sup>-</sup>	
		291.3 <i>I</i>	100	303.94	9/2 <sup>-</sup>	
		391.3 <i>I</i>	42 8	204.00	7/2 <sup>-</sup>	
617.24	13/2 <sup>-</sup>	313.1 <i>I</i>		303.94	9/2 <sup>-</sup>	
663.60	7/2 <sup>-</sup>	222.8 <i>I</i>	29 6	440.66	7/2 <sup>-</sup>	
		334.3 <i>I</i>	100	329.38	5/2 <sup>-</sup>	
		359.7 <i>I</i>	21 4	303.94	9/2 <sup>-</sup>	
		411.8 <i>I</i>	36 7	251.89	3/2 <sup>-</sup>	
		459.6 <i>I</i>	40 8	204.00	7/2 <sup>-</sup>	
		564.9 <i>I</i>	36 7	98.62	5/2 <sup>-</sup>	
722.2?	(11/2 <sup>+</sup> )	127.5 <sup>@</sup> <i>I</i>		595.23	9/2 <sup>+</sup>	
749.37	11/2 <sup>-</sup>	175.7 <i>I</i>	24 5	573.63	9/2 <sup>-</sup>	
		283.5 <i>I</i>	33 7	465.93	11/2 <sup>-</sup>	
		308.6 <i>I</i>	37 7	440.66	7/2 <sup>-</sup>	
		445.5 <i>I</i>	100	303.94	9/2 <sup>-</sup>	
800.03	9/2 <sup>-</sup>	136.4 <i>I</i>		663.60	7/2 <sup>-</sup>	
805.5?	(11/2 <sup>+</sup> )	210.3 <sup>‡</sup> <i>I</i>		595.23	9/2 <sup>+</sup>	
830.94	15/2 <sup>-</sup>	365.0 <i>I</i>		465.93	11/2 <sup>-</sup>	
874.8?	(13/2 <sup>+</sup> )	152.1 <sup>@</sup> <i>I</i>		722.2?	(11/2 <sup>+</sup> )	
904.10	7/2 <sup>-</sup>	240.5 <i>I</i>	40 8	663.60	7/2 <sup>-</sup>	
		652.2 <i>I</i>	100	251.89	3/2 <sup>-</sup>	
930.03	13/2 <sup>-</sup>	312.6 <i>I</i>		617.24	13/2 <sup>-</sup>	
		356.7 <i>I</i>		573.63	9/2 <sup>-</sup>	
		464.0 <i>I</i>		465.93	11/2 <sup>-</sup>	
965.07	11/2 <sup>-</sup>	165.0 <i>I</i>	100	800.03	9/2 <sup>-</sup>	
		301.5 <i>I</i>	45 9	663.60	7/2 <sup>-</sup>	
1009.0?	13/2 <sup>+</sup>	203.5 <sup>‡</sup> <i>I</i>		805.5?	(11/2 <sup>+</sup> )	

Continued on next page (footnotes at end of table)

$^{180}\text{Hf}(\text{d,p}\gamma)$  2002Gu13 (continued) $\gamma(^{181}\text{Hf})$  (continued)

<u><math>E_i(\text{level})</math></u>	<u><math>J_i^\pi</math></u>	<u><math>E_\gamma^\dagger</math></u>	<u><math>E_f</math></u>	<u><math>J_f^\pi</math></u>
1053.6?	(15/2 <sup>+</sup> )	178.7 <sup>@</sup> I	874.8?	(13/2 <sup>+</sup> )
		331.0 <sup>@</sup> I	722.2?	(11/2 <sup>+</sup> )

<sup>†</sup> From 2002Gu13.

<sup>‡</sup> Order of these two transitions is not established. See the discussion for the 805.5 level.

# 205.4 and 315.4 are very weak in coincidence.

@ Placement of transition in the level scheme is uncertain.

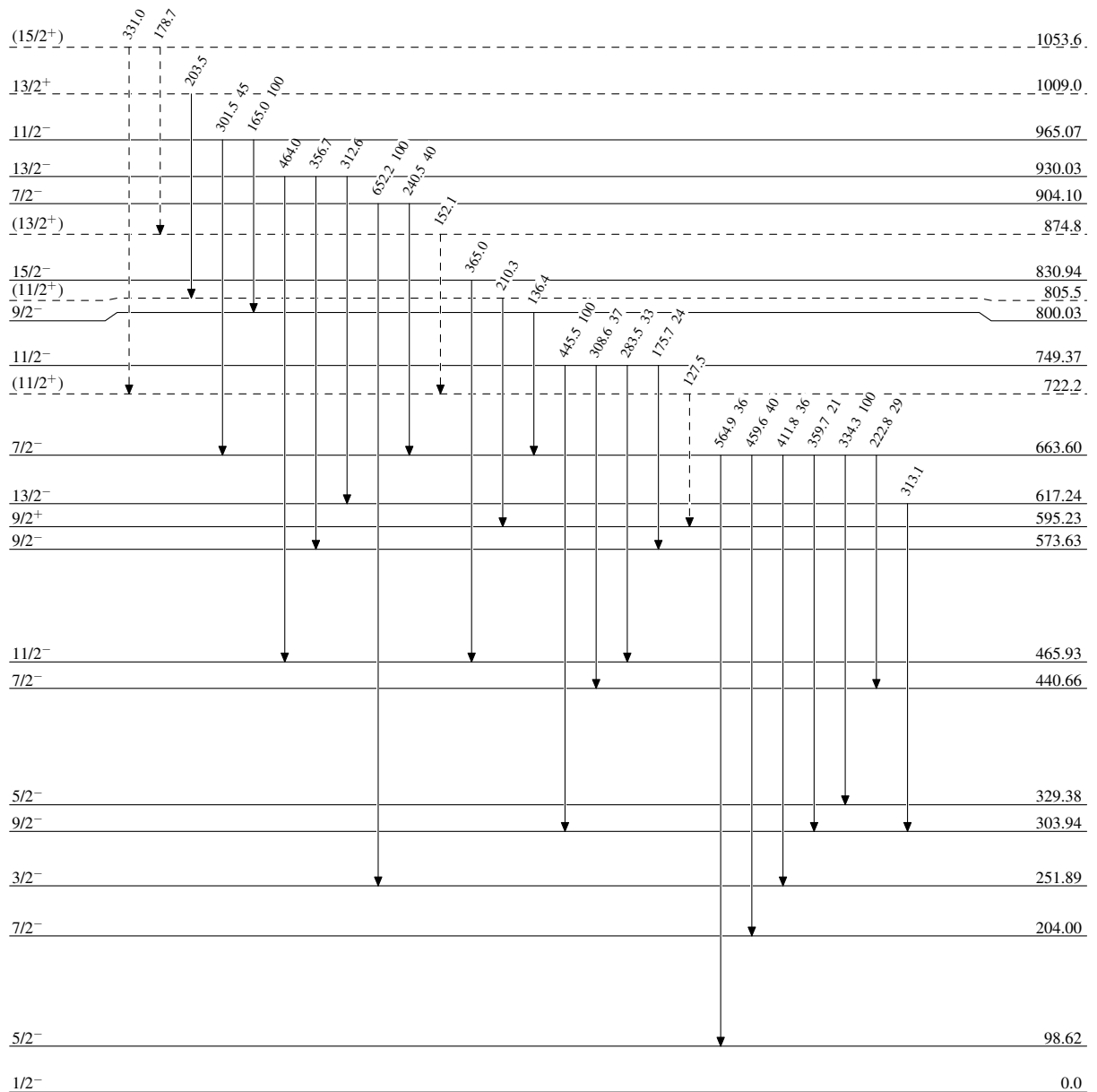
<sup>x</sup>  $\gamma$  ray not placed in level scheme.

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Legend

## Level Scheme

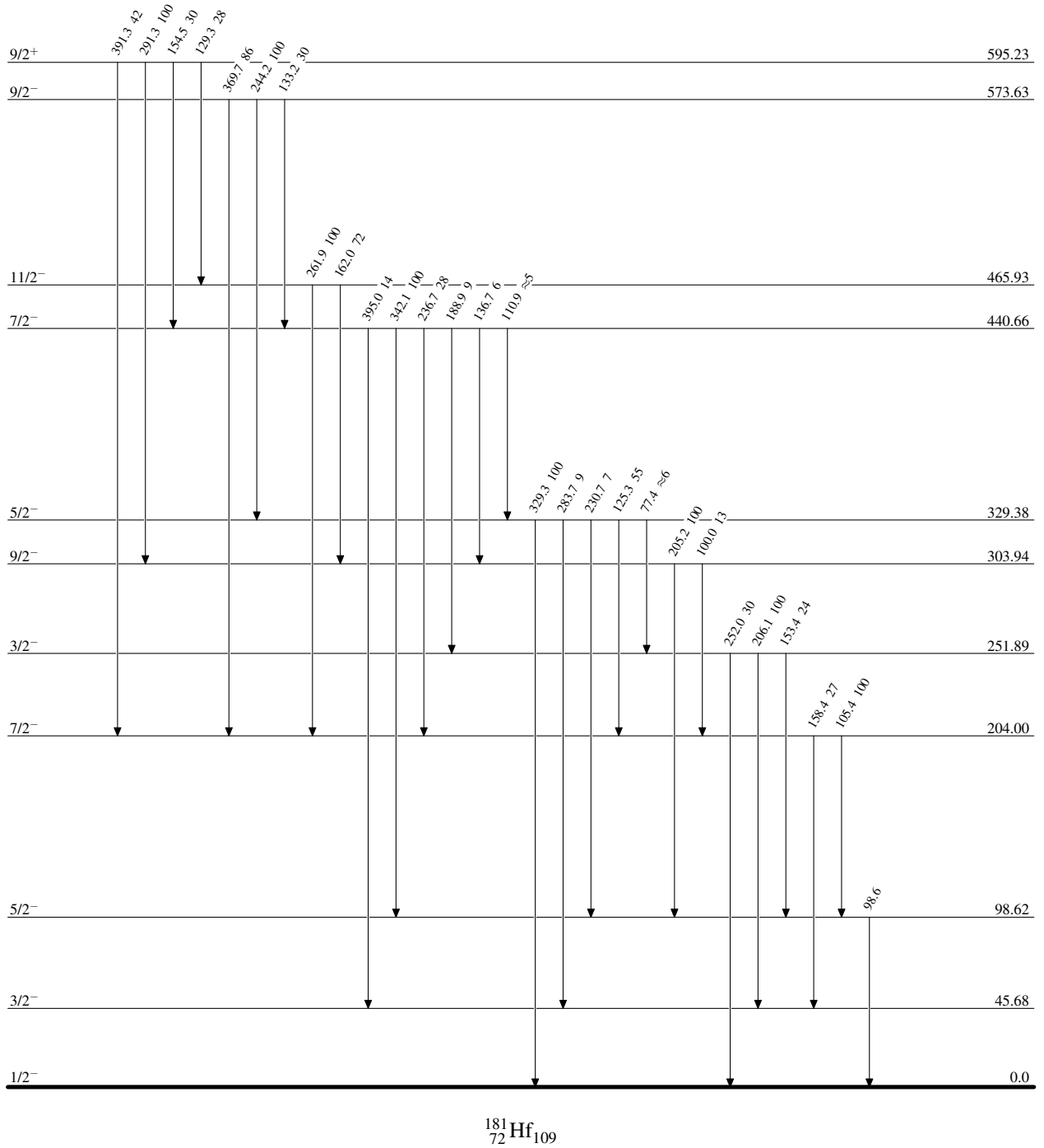
Intensities: Relative photon branching from each level

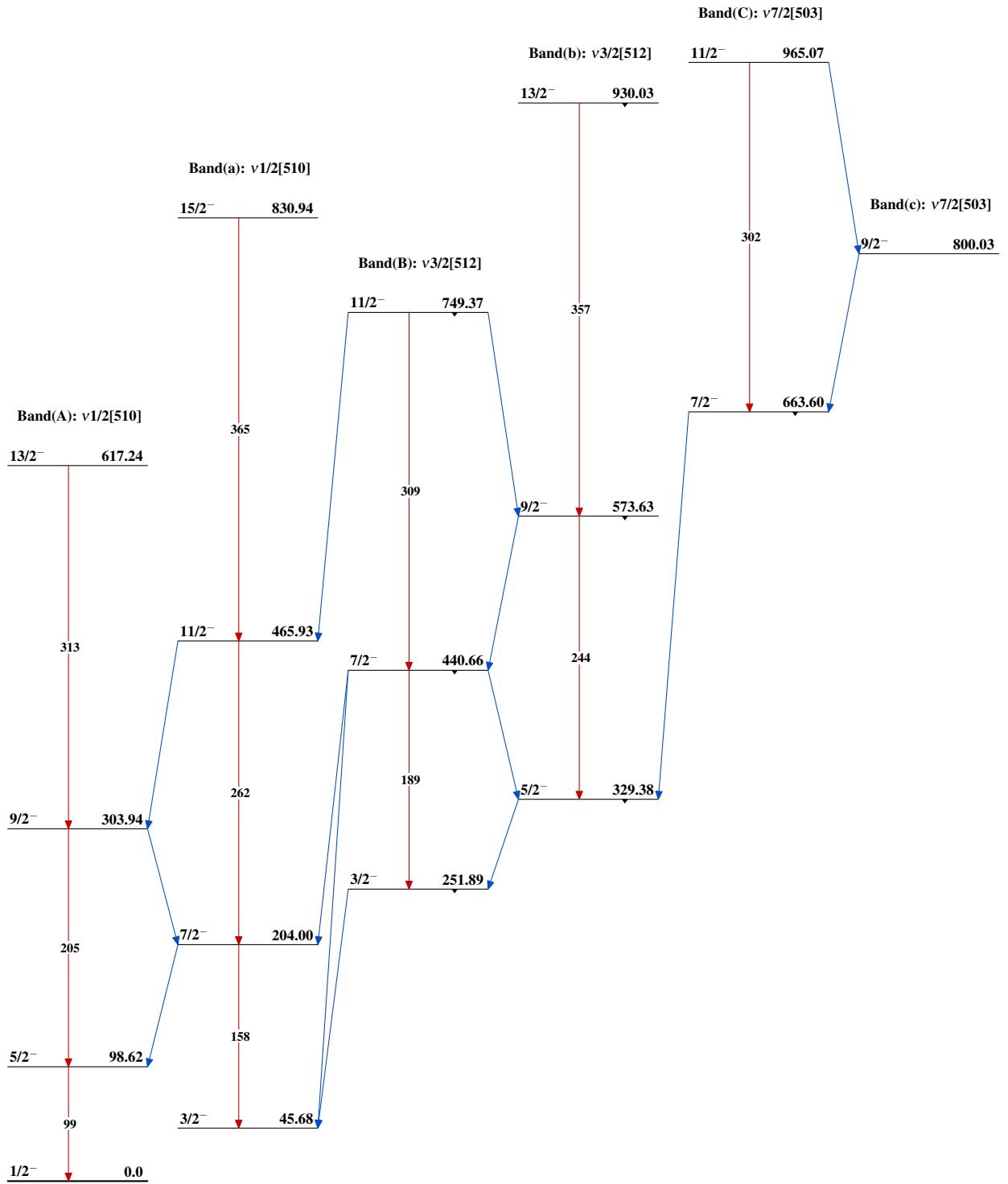
-----▶  $\gamma$  Decay (Uncertain) $^{181}_{72}\text{Hf}_{109}$

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## Level Scheme (continued)

Intensities: Relative photon branching from each level

 $^{181}_{72}\text{Hf}_{109}$

$^{180}\text{Hf}(d,p\gamma)$  2002Gu13 $^{181}_{72}\text{Hf}_{109}$