^{179}Hf(d,2nγ), (p,nγ) 1974Ma26

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin	NDS 110, 265 (2009)	15-Nov-2008

Target: 95% enriched ^{179}Hf. E(d)=13.5 MeV; E(p)=6.7, 7.0, 9.8 MeV. Measured Eγ, Iγ, prompt and delayed $\gamma\gamma$ coin, d-γ(t). Detectors: Ge(Li), scin.

^{179}Ta Levels

J^π and Nilsson orbital assignments are based primarily on rotational structure, on approximate energies expected from Nilsson's diagrams, and on systematics of the same orbitals in neighboring odd-A Ta isotopes.

E(level)[†]	J^π[‡]	$T_{1/2}$	Comments
0.0[#]	7/2$^+$		
30.7[@] *3*	9/2$^-$		
133.73[#] *23*	9/2$^+$		
180.9[@] *3*	11/2$^-$		
238.6[&] *1*	5/2$^+$	95 ns *5*	$T_{1/2}$: from γ-238.6γ(t) corrected for background coincidences (1974Ma26).
294.77[#] *23*	11/2$^+$		
344.00[&] *14*	7/2$^+$		
356.4[@] *3*	13/2$^-$		
477.3[&] *3*	9/2$^+$		
481.5[#] *3*	13/2$^+$		
520.26[b] *21*	1/2$^+$	350 ns *20*	$T_{1/2}$: from γ-281.7γ(t) corrected for background coincidences (1974Ma26).
527.60[b] *18*	3/2$^+$		
555.8[@] *4*	15/2$^-$		
628.09[a] *18*	5/2$^-$	80 ns *10*	$T_{1/2}$: from time spectra for 100.5γ, 105.4γ, 289γ and 284.1γ corrected for background coincidences (1974Ma26).
628.09+x[a]	9/2$^-$		E(level): 9/2 to 5/2 transition of this band not observed; however, based on energies of observed band members in neighboring Ta isotopes, x=45 keV *10* is expected and from level energy difference In Adopted Levels, x=45.0 *10*.
636.8[&] *3*	11/2$^+$		
672.96[b] *25*	5/2$^+$		
692.3[#] *3*	15/2$^+$		
696.17[b] *25*	7/2$^+$		
778.1[@] *4*	17/2$^-$		
781.4+x[a]	13/2$^-$		
821.1[&] *3*	13/2$^+$		
925.0[#] *3*	17/2$^+$		
938.0[b] *3*	9/2$^+$		
987.8[b] *4*	11/2$^+$		
1020.7[@] *4*	19/2$^-$		
1028.8[&] *3*	15/2$^+$		
1045.0+x[a]	17/2$^-$		
1177.4[#] *4*	19/2$^+$		
1253.3 *4*	21/2$^-$		$T_{1/2}$=8.6 ms *10* from pulsed-beam-γ(t), attributed to this level by 1974Ma26, is presumably the half-life of the 1318 (25/2$^+$) isomer, now known to feed this level via a 65-keV G. See ^{176}Yb(^{7}Li,4nγ) E=38 MeV (1982Ba21).
1256.3[&] *4*	17/2$^+$		

Continued on next page (footnotes at end of table)

^{179}Hf(d,2nγ), (p,nγ) 1974Ma26 (continued)

^{179}Ta Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$	Comments
1282.0[@] *5*	21/2⁻		
1317.2?		8.6 ms *10*	E(level): rounded value from Adopted Levels. $T_{1/2}$: see comment on 1253 level.
1389.2[b] *5*	15/2⁺		
1415+x[a]	21/2⁻		

† Calculated by evaluator from a least-squares fit to Eγ.
‡ Authors′ values, based on deduced band structure.
# Band(A): 7/2[404] g.s. band.
@ Band(B): 9/2[514] band.
& Band(C): 5/2[402] band.
a Band(D): 1/2[541] band, α=+1/2.
b Band(E): 1/2[411] band.

γ(^{179}Ta)

Eγ[†]	Iγ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	Iγ(p,nγ)[#]	α[c]
30.7 *3*	17[a]	30.7	9/2⁻	0.0	7/2⁺			
100.5 *1*	14	628.09	5/2⁻	527.60	3/2⁺	(E1)[b]	11	0.362
105.4 *1*	10	344.00	7/2⁺	238.6	5/2⁺		9.5	
x120.3							≈0.5	
133.2 *3*	10	477.3	9/2⁺	344.00	7/2⁺		9	
133.8 *3*	19	133.73	9/2⁺	0.0	7/2⁺		17	
145.4 *3*	3.5	672.96	5/2⁺	527.60	3/2⁺		3.0	
150.2 *1*	46	180.9	11/2⁻	30.7	9/2⁻		28	
152.8 *3*	1.2	672.96	5/2⁺	520.26	1/2⁺		<1[&]	
153.3 *2*	8	781.4+x	13/2⁻	628.09+x	9/2⁻		4	
159.6 *2*	9	636.8	11/2⁺	477.3	9/2⁺		6.5	
161.1 *2*	16	294.77	11/2⁺	133.73	9/2⁺		10	
168.5 *2*	13	696.17	7/2⁺	527.60	3/2⁺		6	
175.5 *1*	38	356.4	13/2⁻	180.9	11/2⁻		19	
x179.2	2.4						≈0.8	
184.2 *2*	8	821.1	13/2⁺	636.8	11/2⁺		5	
186.7 *2*	6	481.5	13/2⁺	294.77	11/2⁺		4.1	
199.5 *2*	27	555.8	15/2⁻	356.4	13/2⁻		11	
207.5 *3*	4.0	1028.8	15/2⁺	821.1	13/2⁺		1.6	
210.8 *3*	3.5	692.3	15/2⁺	481.5	13/2⁺		1.5	
x218.3	1.3						1.4	
222.2 *3*	19	778.1	17/2⁻	555.8	15/2⁻		4.9	
x226.3	1.7						1.5	
227.6 *3*	2.1	1256.3	17/2⁺	1028.8	15/2⁺		1	
232.6[d] *3*	2[d]	925.0	17/2⁺	692.3	15/2⁺		0.9[@]	
232.6[d] *3*	7[d]	1253.3	21/2⁻	1020.7	19/2⁻		0.9[@]	
238.6 *1*	100	238.6	5/2⁺	0.0	7/2⁺		100	
241.7 *3*	3.3	938.0	9/2⁺	696.17	7/2⁺		1.9	
242.5 *3*	11	1020.7	19/2⁻	778.1	17/2⁻		2.2	
252.3 *3*	1.4	1177.4	19/2⁺	925.0	17/2⁺		0.5	
261.3 *3*	2.3	1282.0	21/2⁻	1020.7	19/2⁻		1.1	
263.6 *3*	5	1045.0+x	17/2⁻	781.4+x	13/2⁻		1.6	

Continued on next page (footnotes at end of table)

^{179}Hf(d,2nγ), (p,nγ) 1974Ma26 (continued)

γ(^{179}Ta) (continued)

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Iγ(p,nγ) [#]
265.2 *3*		938.0	$9/2^+$	672.96	$5/2^+$	0.5
281.7 *2*	19	520.26	$1/2^+$	238.6	$5/2^+$	20
284.1 *3*	5.8	628.09	$5/2^-$	344.00	$7/2^+$	6.7
289.0 *2*	22	527.60	$3/2^+$	238.6	$5/2^+$	20
291.6 *3*	6.5	987.8	$11/2^+$	696.17	$7/2^+$	6.2
292.9 *3*	3.0	636.8	$11/2^+$	344.00	$7/2^+$	2.7
294.7 *3*	8	294.77	$11/2^+$	0.0	$7/2^+$	6
[x]319.1	1.6					0.7
325.6 *3*	3	356.4	$13/2^-$	30.7	$9/2^-$	≤1.5[&]
343.8 *3*	2.2	821.1	$13/2^+$	477.3	$9/2^+$	2.0
347.7 *3*	10	481.5	$13/2^+$	133.73	$9/2^+$	6.5
[x]351.7	2.6					1.3
[x]362.6	3.8					1.8
370.0 *3*	1.5[&]	1415+x	$21/2^-$	1045.0+x	$17/2^-$	
374.9 *3*	5.5	555.8	$15/2^-$	180.9	$11/2^-$	2.2
[x]378.3	2.9					0.9
389.4 *3*	14	628.09	$5/2^-$	238.6	$5/2^+$	11
392.1 *3*	2.9	1028.8	$15/2^+$	636.8	$11/2^+$	1.0
397.5 *3*	6.9	692.3	$15/2^+$	294.77	$11/2^+$	3.8
401.4 *3*	3.3	1389.2	$15/2^+$	987.8	$11/2^+$	2.0
[x]404.8						0.6
421.7 *3*	6.1	778.1	$17/2^-$	356.4	$13/2^-$	1.4
[x]425						<1[&]
435.2 *3*	1	1256.3	$17/2^+$	821.1	$13/2^+$	<1[&]
443.5 *3*	7.3	925.0	$17/2^+$	481.5	$13/2^+$	2.1
[x]445.4						1.5
464.9 *3*	4.6	1020.7	$19/2^-$	555.8	$15/2^-$	0.9
475.2 *3*	8.4	1253.3	$21/2^-$	778.1	$17/2^-$	1.2
485.3 *3*	3.5	1177.4	$19/2^+$	692.3	$15/2^+$	1.0
[x]532.0	2.4					1.6

[†] ΔE=0.1-0.3 keV depending on the γ-ray intensity and on the complexity of the spectrum. Values for individual placed γ rays were assigned by the evaluator based on peak strength and isolation in spectrum of fig. 1 of 1974Ma26.

[‡] Prompt relative intensities from (d,2nγ) at E(d)=13.5 MeV, θ=125°. ΔIγ=5%−30% depending on Iγ and on the complexity of the spectrum. See 1974Ma26 for delayed Iγ for seven of these transitions.

[#] Prompt intensities from (p,nγ) measured at θ=125°, E(p)=9.8 MeV. ΔIγ=5%−30% depending on Iγ and on the complexity of the spectrum.

[@] Multiply placed; undivided intensity given.

[&] From γγ coin.

[a] from intensity balance about 30.7 level, assuming α(150.2γ)=1.1 (average value for M1 and E2) and adopted α(31γ)=4.6. Iγ>10 is reported in 1974Ma26.

[b] from intensity balance.

[c] 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.

[d] Multiply placed with intensity suitably divided.

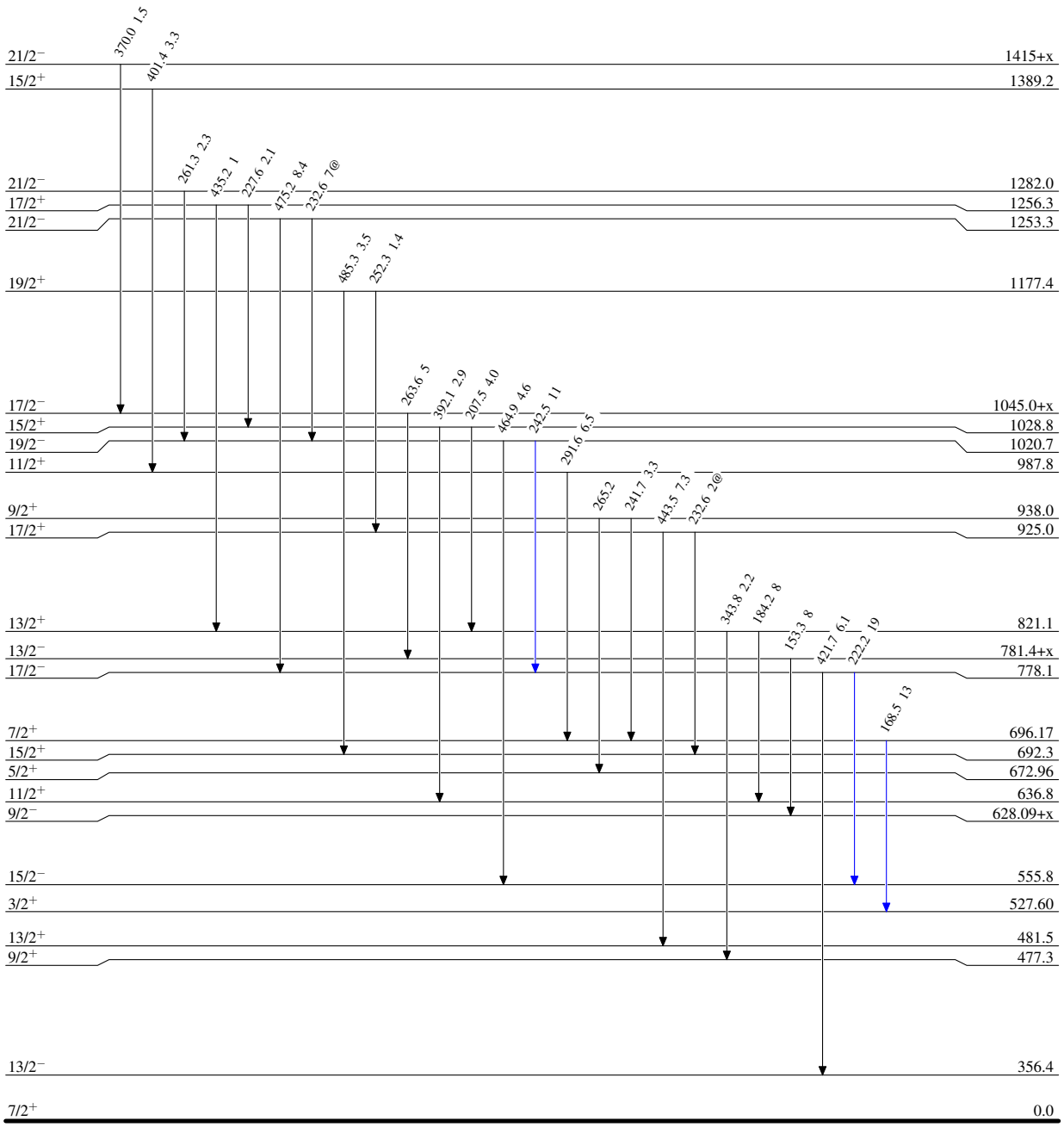
[x] γ ray not placed in level scheme.

^{179}Hf(d,2nγ), (p,nγ) 1974Ma26

Level Scheme

Intensities: Relative Iγ from (d,2nγ), E= 13.5 MeV, θ=125°
@ Multiply placed: intensity suitably divided

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



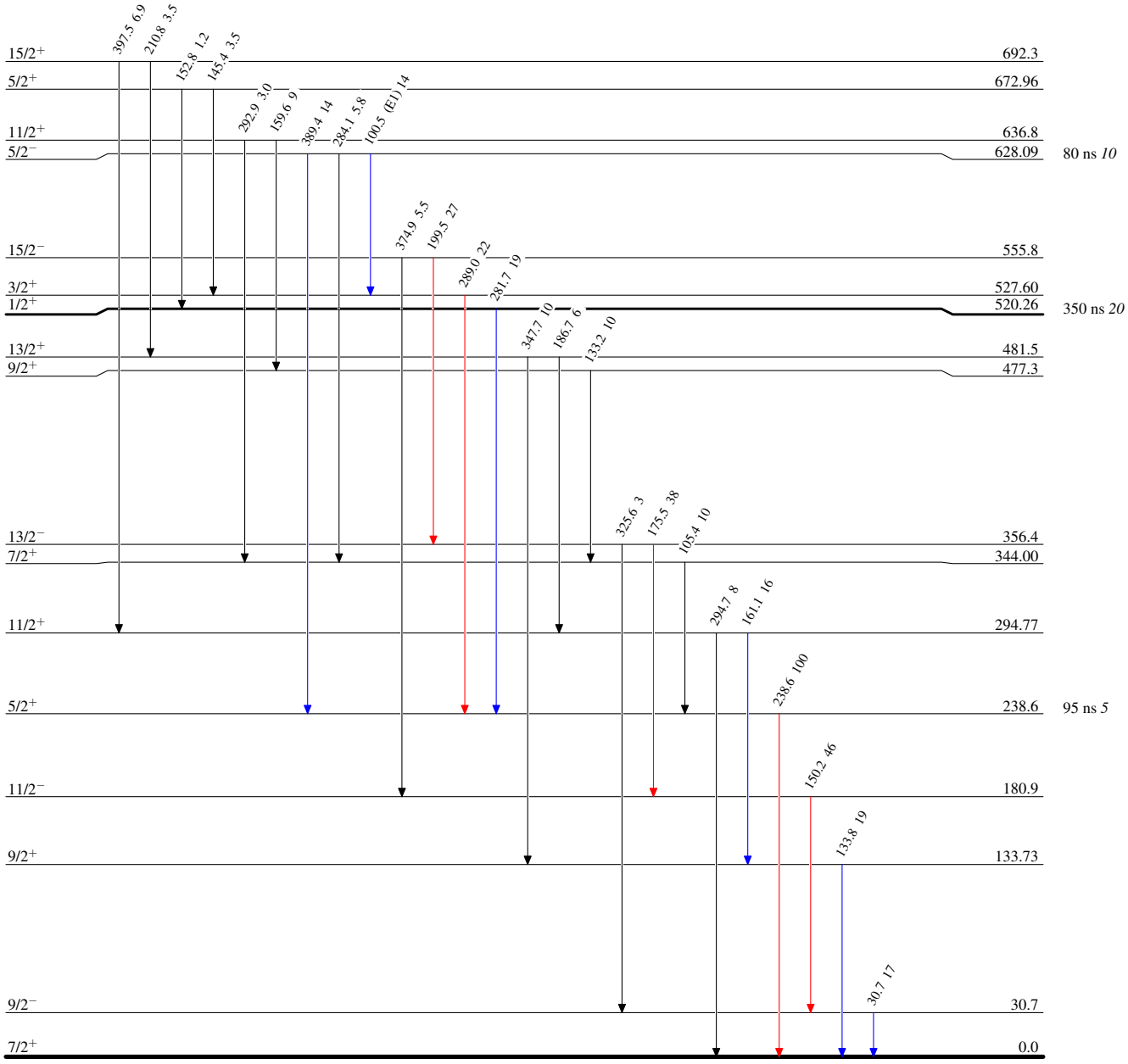
$^{179}_{73}Ta_{106}$

^{179}Hf(d,2nγ), (p,nγ) 1974Ma26

Level Scheme (continued)

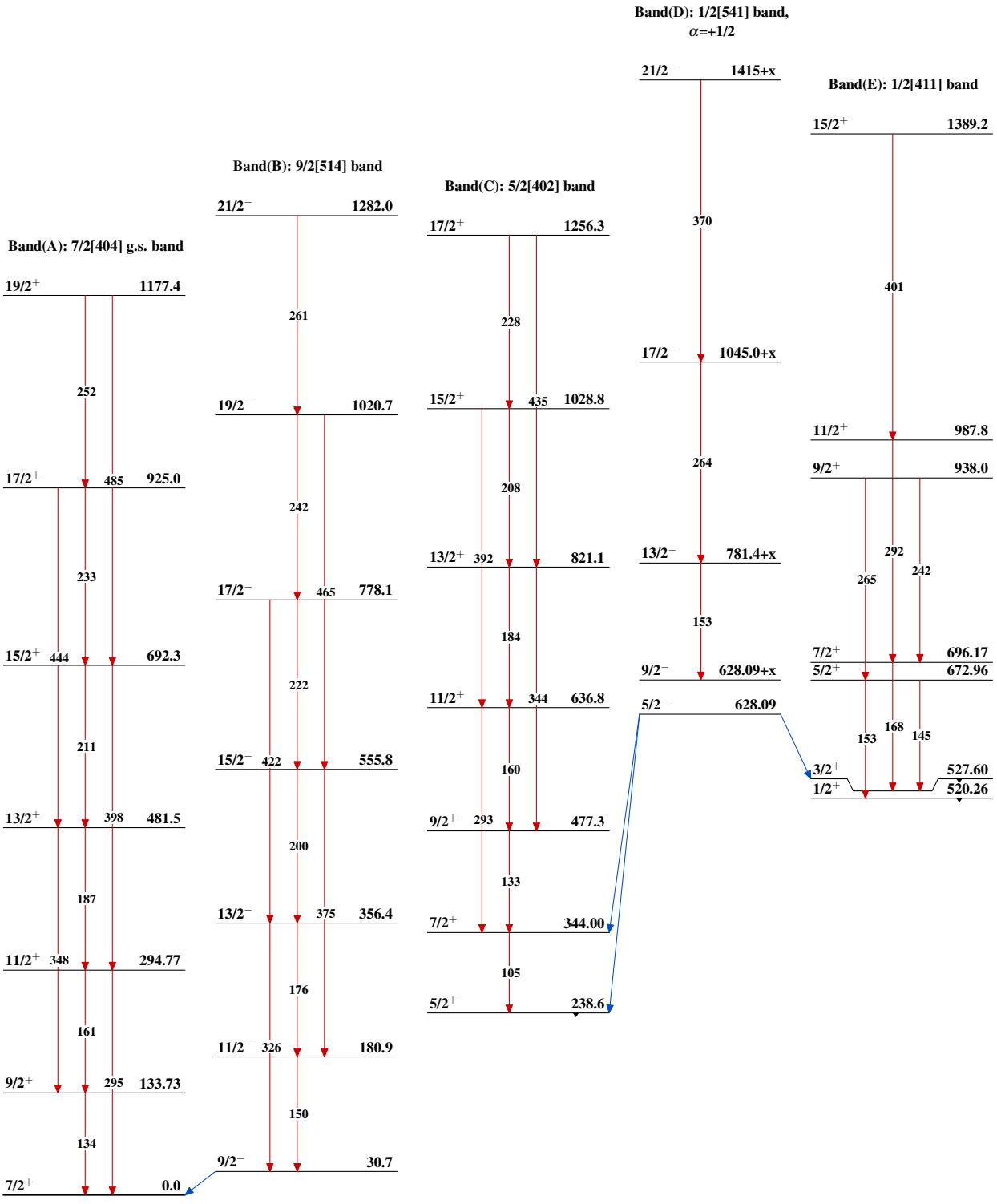
Intensities: Relative Iγ from (d,2nγ), E= 13.5 MeV, θ=125°
@ Multiply placed: intensity suitably divided

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



$^{179}_{73}Ta_{106}$

^{179}Hf(d,2nγ), (p,nγ) 1974Ma26



$^{179}_{73}Ta_{106}$