^{158}Gd(^{11}B,4nγ) 1973Ta18

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 194,460 (2024)	31-Oct-2022

1973Ta18: E(^{11}B)=47.5-88 MeV, Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma(\theta)$ at the Yale heavy-ion accelerator. Target thickness ≈5-7 mg/cm^2. Comparison with theoretical predictions for rotational spacing parameters and band-head energies.

^{165}Tm Levels

E(level)†	Jπ#	E(level)†	Jπ#	E(level)†	Jπ#	E(level)†	Jπ#
0.0[a]	1/2+	293.7[b] 5	9/2−	690.9[a] 5	13/2+	1207.2[&] 12	19/2+
11.9[a] 4	3/2+	362.9‡[a] 4	9/2+	746.9‡[&] 6	15/2+	1216.8[a] 12	19/2+
80.6[&] 5	7/2+	366.4[&] 6	11/2+	769.0[a] 6	15/2+	1310.2[@] 13	21/2−
130.0[a] 3	5/2+	369.5[@] 12	11/2−	796.3[b] 7	17/2−	1467.6[&] 12	21/2+
159.2[a] 5	7/2+	413.9[a] 5	11/2+	866.8[@] 12	17/2−	1551.6‡[@] 13	23/2−
160.9[@] 12	7/2−	497.8[b] 6	13/2−	967.6‡[&] 7	17/2+	1661.0[b] 13	25/2−
182.2[b] 6	5/2−	511.7‡[@] 12	13/2−	1073.6[@] 13	19/2−	1828.8[@] 14	25/2−
210.6[&] 6	9/2+	545.3[&] 6	13/2+	1103.7[a] 6	17/2+	2029.6[&] 16	25/2+
252.9[@] 12	9/2−	676.1[@] 12	15/2−	1186.0[b] 7	21/2−	2098.9[@] 17	27/2−

† From least-squares fit to Eγ data.
‡ The γ-ray branching ratios from Iγ values at E(^{11}B)=52 MeV and 60 MeV are in disagreement.
# From 1973Ta18, based on $\gamma(\theta)$ at E(^{11}B)=52 MeV, and γ-decay patterns of the members of rotational bands. All assignments are consistent with those in the Adopted Levels, except that some are in parentheses there due to insufficient strong supporting arguments.
@ Band(A): π7/2[523] band.
& Band(B): π7/2[404] band.
a Band(C): π1/2[411] band.
b Band(D): π1/2[541] band.

γ(^{165}Tm)

Eγ†	Iγ‡	Ei(level)	Jiπ	Ef	Jfπ	Mult.	Comments
68.7 3	34 4	80.6	7/2+	11.9	3/2+		Iγ=39 4 at E(^{11}B)=60 MeV.
80.3		160.9	7/2−	80.6	7/2+		Eγ: from level-scheme Fig. 5 of 1973Ta18; not listed in authors′ Table III.
84.5# 10	16 3	497.8	13/2−	413.9	11/2+		Iγ=22 2 at E(^{11}B)=60 MeV.
92.0 3	43 4	252.9	9/2−	160.9	7/2−		Iγ=48 5 at E(^{11}B)=60 MeV.
111.9 10	10 2	293.7	9/2−	182.2	5/2−	(Q)	A$_2$=+0.33 37; A$_4$=+0.06 16 Iγ=14 3 at E(^{11}B)=60 MeV.
116.6 3	64 7	369.5	11/2−	252.9	9/2−	D	A$_2$=−0.33 22; A$_4$=+0.16 23 Iγ=90 9 at E(^{11}B)=60 MeV.
118.1 3	34 4	130.0	5/2+	11.9	3/2+		A$_2$=+0.13 37; A$_4$=−0.38 46 Iγ=36 4 at E(^{11}B)=60 MeV.
120.6 10	17 3	413.9	11/2+	293.7	9/2−	(D)	A$_2$=−0.20 28; A$_4$=+0.05 30 Iγ=21 2 at E(^{11}B)=60 MeV.
130.0[a] 3	≈10[a]	130.0	5/2+	0.0	1/2+	Q	A$_2$=+0.26 10; A$_4$=+0.17 10
130.0[a] 3	44[a] 6	210.6	9/2+	80.6	7/2+		A$_2$=+0.26 10; A$_4$=+0.17 10 Iγ: total intensity=54 6. 1973Ta18 estimate that ≈10 units belong to the other placement, based on ^{165}Yb ε decay. Iγ=53 5 for doublet at E(^{11}B)=60 MeV.

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^{158}Gd(^{11}B,4nγ) 1973Ta18 (continued)

γ(^{165}Tm) (continued)

E_γ †	I_γ ‡	E_i(level)	J_i^π	E_f	J_f^π	Mult.	Comments
134.4 *3*	98 *10*	293.7	9/2$^-$	159.2	7/2$^+$	D	A_2=−0.18 *11*; A_4=+0.07 *10* Iγ=118 *12* at E(^{11}B)=60 MeV.
142.0 *3*	69 *7*	511.7	13/2$^-$	369.5	11/2$^-$		A_2=+0.18 *14*; A_4=+0.01 *15* Iγ=112 *11* at E(^{11}B)=60 MeV.
147.2 *3*	100 *10*	159.2	7/2$^+$	11.9	3/2$^+$	(Q)	A_2=+0.28 *6*; A_4=+0.01 *1* Iγ=100 *10* at E(^{11}B)=60 MeV.
x152 *1*	@						
155.5 *5*	22 *2*	366.4	11/2$^+$	210.6	9/2$^+$		A_2=+0.54 *23* Iγ=28 *3* at E(^{11}B)=60 MeV.
164.4 *3*	66 *7*	676.1	15/2$^-$	511.7	13/2$^-$	(D)	A_2=+0.02 *8*; A_4=−0.05 *90* Iγ=102 *10* at E(^{11}B)=60 MeV.
170.4 *5*	22 *2*	182.2	5/2$^-$	11.9	3/2$^+$	D	A_2=−0.21 *13*; A_4=−0.05 *15* Iγ=42 *4* at E(^{11}B)=60 MeV.
178.8 *5*	20 *2*	545.3	13/2$^+$	366.4	11/2$^+$		Iγ=40 *4* at E(^{11}B)=60 MeV.
x183 *1*	20 *2*						Iγ=40 *4* at E(^{11}B)=60 MeV.
191.1 *3*	84 *9*	866.8	17/2$^-$	676.1	15/2$^-$		A_2=+0.13 *12*; A_4=+0.02 *12* Iγ=104 *11* at E(^{11}B)=60 MeV.
202.6 *10*	10 *2*	746.9	15/2$^+$	545.3	13/2$^+$		Iγ=43 *4* at E(^{11}B)=60 MeV.
203.4 *3*	80 *16*	362.9	9/2$^+$	159.2	7/2$^+$		I_γ: total intensity for 203.4+204.1=160 *16*. From ^{165}Yb ε decay, 1973Ta18 estimate that the two components are of about equal intensity. Iγ=239 *24* for 203.4+204.1 at E(^{11}B)=60 MeV.
204.1 *3*	80 *16*	497.8	13/2$^-$	293.7	9/2$^-$	(Q)	A_2=+0.24 *8*; A_4=−0.08 *8* I_γ: see comment for 203.4γ. $\gamma(\theta)$ for 204.4γ+203.2γ. Iγ=239 *24* for 204.4+203.2 at E(^{11}B)=60 MeV.
207.1 *3*	81 *8*	1073.6	19/2$^-$	866.8	17/2$^-$	D	A_2=+0.09 *9*; A_4=−0.07 *14* Iγ=87 *9* at E(^{11}B)=60 MeV.
x212.4 *5*	15 *3*						Iγ=40 *4* at E(^{11}B)=60 MeV.
x218.5 *5*	12 *3*						Iγ=40 *4* at E(^{11}B)=60 MeV.
221.6 *10*	12 *3*	967.6	17/2$^+$	746.9	15/2$^+$		Iγ=40 *4* at E(^{11}B)=60 MeV.
232.9 *3*	44 *5*	362.9	9/2$^+$	130.0	5/2$^+$	(Q)	A_2=+0.22 *14*; A_4=−0.26 *50* Iγ=39 *4* at E(^{11}B)=60 MeV.
236.6 *3*	44 *5*	1310.2	21/2$^-$	1073.6	19/2$^-$		A_2=+0.12 *17*; A_4=−0.23 *20* Iγ=59 *6* at E(^{11}B)=60 MeV.
241.2 *5*	25 *3*	1551.6	23/2$^-$	1310.2	21/2$^-$		Iγ=45 *5* at E(^{11}B)=60 MeV.
x245.3 *5*	14 *3*						Iγ=46 *5* at E(^{11}B)=60 MeV.
255.0 *3*	77 *8*	413.9	11/2$^+$	159.2	7/2$^+$	Q	A_2=+0.32 *6*; A_4=−0.13 *8* Iγ=89 *9* at E(^{11}B)=60 MeV.
259.1 *5*	22 *2*	511.7	13/2$^-$	252.9	9/2$^-$		Iγ=18 *4* at E(^{11}B)=60 MeV.
270.1 *10*	10 *2*	2098.9	27/2$^-$	1828.8	25/2$^-$		Iγ=10 *2* at E(^{11}B)=60 MeV.
277.2&b *3*	42& *4*	690.9	13/2$^+$	413.9	11/2$^+$		Iγ=45 *5* at E(^{11}B)=60 MeV.
277.2& *3*	42& *4*	1828.8	25/2$^-$	1551.6	23/2$^-$		
285.9 *3*	33 *3*	366.4	11/2$^+$	80.6	7/2$^+$		Iγ=46 *5* at E(^{11}B)=60 MeV.
298.5 *3*	98 *10*	796.3	17/2$^-$	497.8	13/2$^-$	(Q)	A_2=+0.31 *3*; A_4=+0.01 *9* Iγ=136 *14* at E(^{11}B)=60 MeV.
306.6 *3*	38 *4*	676.1	15/2$^-$	369.5	11/2$^-$	(Q)	A_2=+0.32 *8*; A_4=+0.11 *18* Iγ=46 *5* at E(^{11}B)=60 MeV.
x322 *1*							
327.2 *5*	26 *3*	690.9	13/2$^+$	362.9	9/2$^+$	(Q)	A_2=+0.38 *23*; A_4=+0.25 *25* Iγ=20 *2* at E(^{11}B)=60 MeV.

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^{158}Gd(^{11}B,4nγ) 1973Ta18 (continued)

γ(^{165}Tm) (continued)

E_γ †	I_γ ‡	E_i(level)	J_i^π	E_f	J_f^π	Mult.	Comments
334.7& *3*	46& *5*	545.3	13/2$^+$	210.6	9/2$^+$	(Q)	A_2=+0.19 *10*; A_4=+0.06 *10* Iγ=60 *6* at E(^{11}B)=60 MeV.
334.7& *3*	46& *5*	1103.7	17/2$^+$	769.0	15/2$^+$		
x340.3 *3*	23 *2*						Iγ=16 *3* at E(^{11}B)=60 MeV.
x347 *1*	@						Iγ=10 *2* at E(^{11}B)=60 MeV.
355.0& *3*	92& *9*	769.0	15/2$^+$	413.9	11/2$^+$	(Q)	A_2=+0.26 *10*; A_4=+0.16 *27* Iγ=132 *13* at E(^{11}B)=60 MeV.
355.0& *3*	92& *9*	866.8	17/2$^-$	511.7	13/2$^-$		
x363.9 *5*	17 *4*						Iγ=15 *2* at E(^{11}B)=60 MeV.
380.5 *3*	43 *4*	746.9	15/2$^+$	366.4	11/2$^+$	(Q)	A_2=+0.36 *20*; A_4=−0.17 *20* Iγ=48 *5* at E(^{11}B)=60 MeV.
x385 *1*	@						
389.7 *3*	71 *7*	1186.0	21/2$^-$	796.3	17/2$^-$	(Q)	A_2=+0.29 *15*; A_4=−0.10 *15* Iγ=126 *13* at E(^{11}B)=60 MeV.
397.3 *3*	50 *5*	1073.6	19/2$^-$	676.1	15/2$^-$	(Q)	A_2=+0.33 *20*; A_4=−0.17 *20* Iγ=67 *7* at E(^{11}B)=60 MeV.
403.1# *10*	9.3 *19*	769.0	15/2$^+$	366.4	11/2$^+$		Iγ=8.8 *18* at E(^{11}B)=60 MeV.
412.8 *5*	21 *2*	1103.7	17/2$^+$	690.9	13/2$^+$		Iγ=10 *2* at E(^{11}B)=60 MeV.
x418.5 *10*	10 *2*						Iγ=10 *2* at E(^{11}B)=60 MeV.
422.3 *3*	36 *4*	967.6	17/2$^+$	545.3	13/2$^+$		Iγ=60 *6* at E(^{11}B)=60 MeV.
443.0 *5*	30 *3*	1310.2	21/2$^-$	866.8	17/2$^-$	(Q)	A_2=+0.25 *20*; A_4=−0.02 *19* Iγ=41 *4* at E(^{11}B)=60 MeV.
447.8 *10*	11 *2*	1216.8	19/2$^+$	769.0	15/2$^+$		Iγ=21 *2* at E(^{11}B)=60 MeV.
460.3 *10*	10 *2*	1207.2	19/2$^+$	746.9	15/2$^+$		Iγ=15 *3* at E(^{11}B)=60 MeV.
x472 *1*	18 *4*						Iγ: weak at E(^{11}B)=60 MeV.
475 *1*	68 *7*	1661.0	25/2$^-$	1186.0	21/2$^-$		Iγ=104 *11* at E(^{11}B)=60 MeV.
479 *1*	50 *5*	1551.6	23/2$^-$	1073.6	19/2$^-$		Iγ=58 *6* at E(^{11}B)=60 MeV.
x482 *1*	17 *4*						Iγ: weak at E(^{11}B)=60 MeV.
500 *1*	27 *3*	1467.6	21/2$^+$	967.6	17/2$^+$	Q	A_2=+0.36 *16*; A_4=+0.18 *15* Iγ=38 *4* at E(^{11}B)=60 MeV.
562 *1*	20 *2*	2029.6	25/2$^+$	1467.6	21/2$^+$		Iγ=35 *4* at E(^{11}B)=60 MeV.

† 1973Ta18 state that uncertainty is 0.3 keV for strong lines and 0.5-1.0 keV for weaker lines. The evaluators assign 0.3 keV for γ rays with Iγ>30, 0.5 keV for Iγ=20-30 and 1 keV for Iγ<20 and for Eγ quoted to nearest keV.

‡ At E(^{11}B)=52 MeV. Intensities at 60 MeV are listed under comments. Uncertainties are quoted by 1973Ta18 as 10% for strong and well resolved lines and 20% for others. Evaluators assign 10% for Iγ≥20 and 20% for Iγ<20. Note that γ-ray branching ratios for E(^{11}B)=52 MeV and 60 MeV data are in disagreement for some levels, as indicated, which may be due to different contaminants present in γ spectra at the two beam energies.

Unplaced in 1973Ta18, placement is based on results from Adopted Gammas.

@ Weak line.

& Multiply placed with undivided intensity.

a Multiply placed with intensity suitably divided.

b Placement of transition in the level scheme is uncertain.

x γ ray not placed in level scheme.

^{158}Gd(^{11}B,4nγ) 1973Ta18

Level Scheme

Intensities: Relative I_γ

& Multiply placed: undivided intensity given

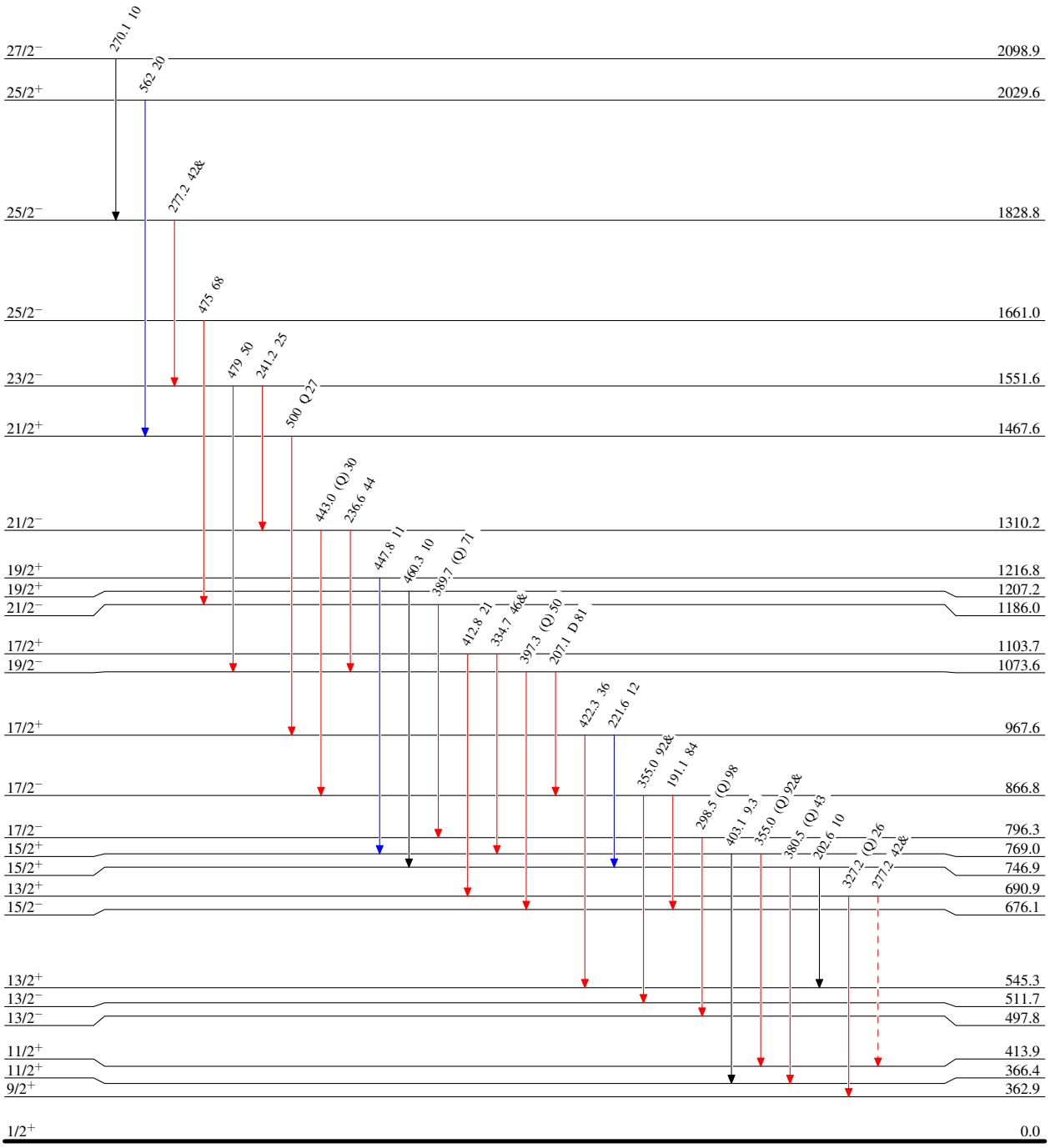
Legend

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

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

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

γ Decay (Uncertain)



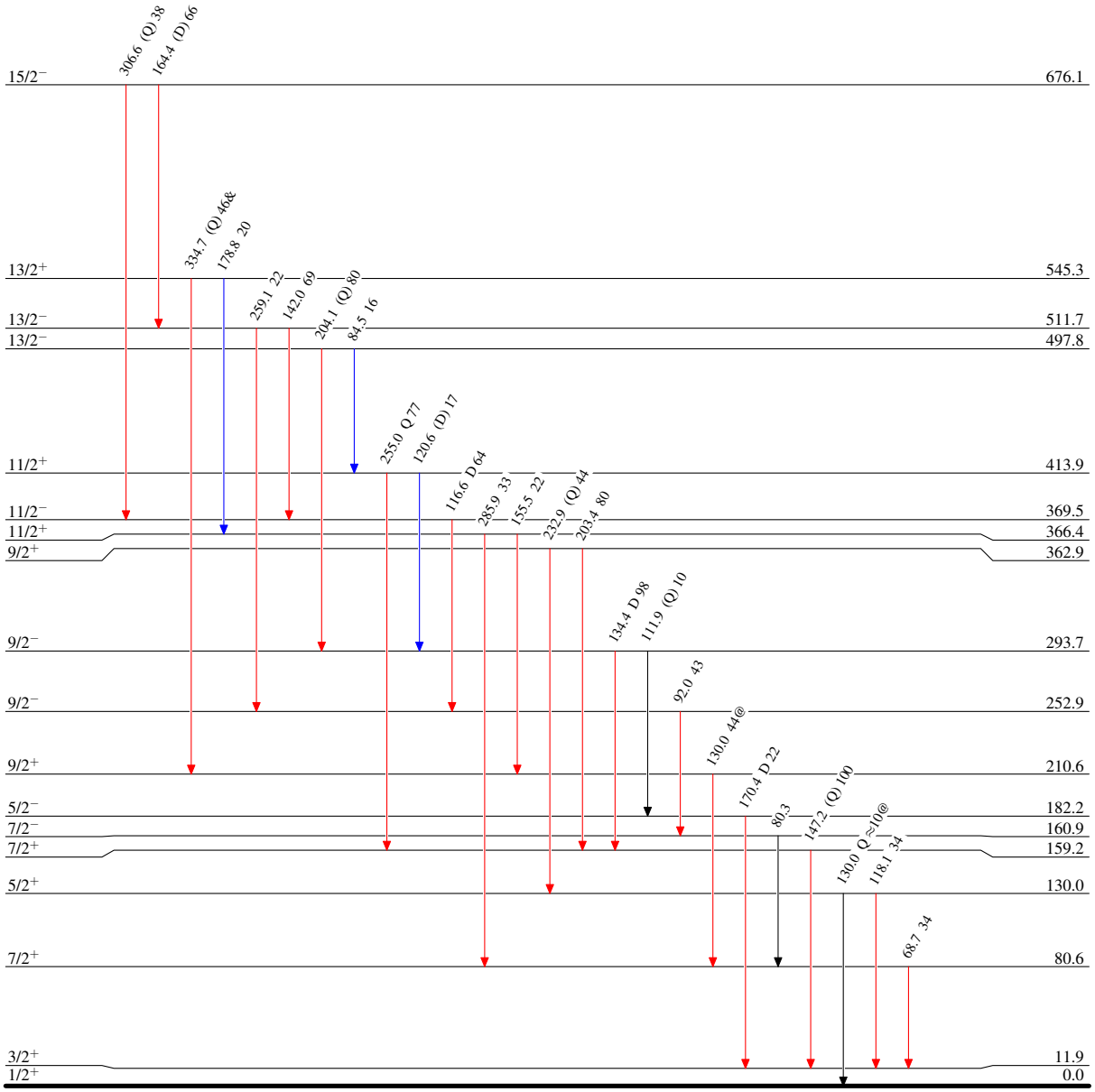
$^{165}_{69}Tm_{96}$

^{158}Gd(^{11}B,4nγ) 1973Ta18

Level Scheme (continued)

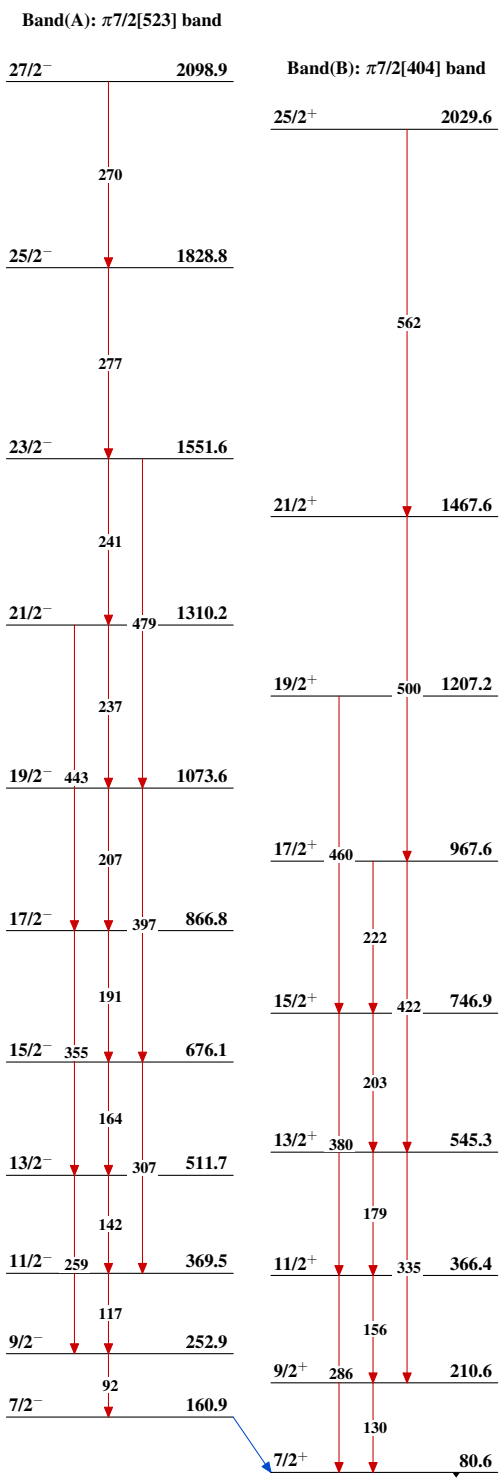
Intensities: Relative I_γ
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

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



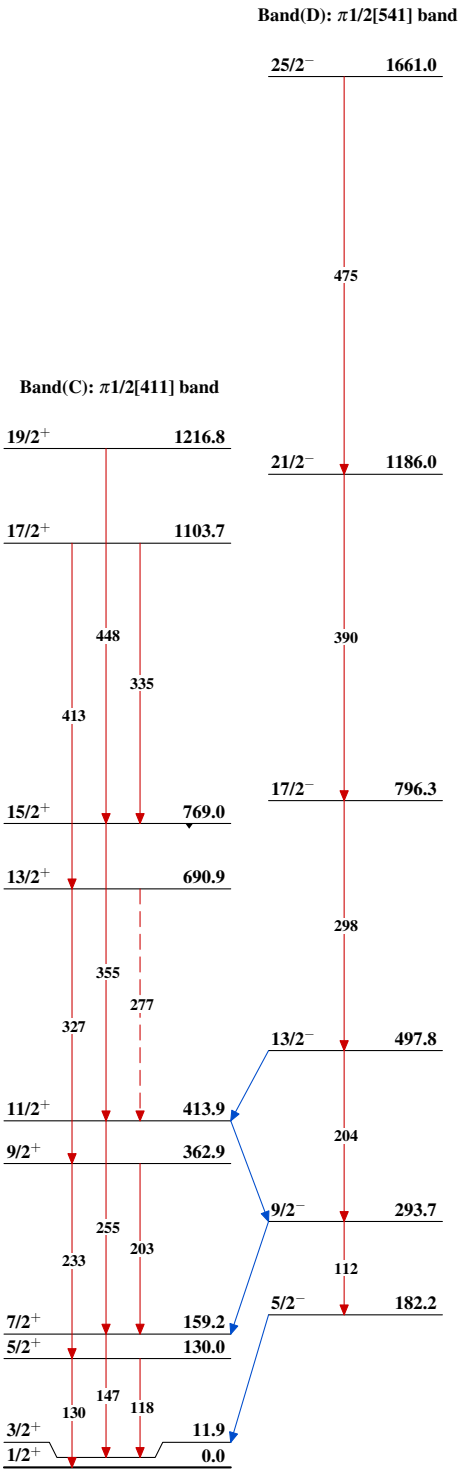
$^{165}_{69}Tm_{96}$

^{158}Gd(^{11}B,4nγ) 1973Ta18



$^{165}_{69}Tm_{96}$

^{158}Gd(^{11}B,4nγ) 1973Ta18 (continued)



$^{165}_{69}Tm_{96}$