^{161}Dy(α,2nγ) 1970Hj02,1974An04

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	C. W. Reich, Balraj Singh	NDS 111, 1211 (2010)	12-Apr-2010

Additional information 1.

Includes ^{159}Tb(^{7}Li,3nγ) and ^{160}Dy(α,nγ).

1970Hj02: Eα= 28 MeV. Measured γ's, γ(90°,110°,125°,150°), and $\alpha\gamma$(t). ΔE(γ)=0.5; relative Iγ's from several runs agree within 10% (1969Hj01). ^{163}Er γ rays also observed in ^{160}Dy(α,nγ) E=38 MeV (1970Hj02).

1974An04: Eα=27 MeV. Measured $\gamma\gamma$(t) and $\gamma\gamma$-coincidences. NaI, Ge(Li). See also ε decay.

1974Fe01: E(^{7}Li)= 34 MeV. Observed 126.7, 164.9, 170.8, 213.3, 217.6, 313.7, 325.5, and 408.2 γ's from ^{163}Er in a study of high-spin states of ^{160}Dy. Excitation function of 314γ in ^{163}Er is reported.

^{163}Er Levels

The level scheme is from 1970Hj02, with levels added (by evaluators) at 249.4, 360.0, 439.2, 466.5, 496.1, 640.8, 655.2, 821.4, 839.9, 1032.5, 1244.6, 1270.9, 1298, 1481.5, 1508.3, 1688.0, 1722.0, 1843.2, 1959.5, 2102.1, 2269.2 and 2459.3 based on (^{18}O,5nγ) results and unplaced γ rays taken from 1970Hj02.

Bands: Nilsson single-particle assignments based mainly on analogy with ^{161}Er and ^{165}Er (1970Hj02); adopted with some reservations by the evaluators. Four rotational bands were observed to feed the K^{π}=11/2$^-$, 444, isomer; $\gamma(\theta)$ and excitation energies established.

E(level)[†]	J$^{\pi}$[‡]	E(level)[†]	J$^{\pi}$[‡]	T$_{1/2}$[#]	E(level)[†]	J$^{\pi}$[‡]
0.0[b]	5/2$^-$	443.8[d] 4	(11/2$^-$)	0.58[&] μs 10	1187.4[c] 9	(25/2$^+$)
69.1[c] 3	5/2$^+$	465.2[c] 7	(17/2$^+$)		1244.6[b] 8	(21/2$^-$)
84.3[b] 3	7/2$^-$	466.5[b] 4	13/2$^-$		1258.0[d] 7	(19/2$^-$)
91.5[c] 3	7/2$^+$	496.1 6	11/2$^-$		1270.9 9	(19/2$^-$)
104.1[f] 3	3/2$^-$	614.6[d] 6	(13/2$^-$)		1298?[a]	
120.2[c] 4	9/2$^+$	640.8[b] 6	(15/2$^-$)		1481.5[b] 8	(23/2$^-$)
164.5[f] 3	5/2$^-$	655.2 7	(13/2$^-$)		1508.3?[a] 7	(17/2$^-$)
189.8[b] 4	9/2$^-$	737.0[c] 7	(19/2$^+$)		1684.2[c] 11	(29/2$^+$)
198.9[c] 4	11/2$^+$	779.2[c] 8	(21/2$^+$)		1688.0[c] 13	(27/2$^+$)
247.2[c] 6	(13/2$^+$)	808.3[d] 6	(15/2$^-$)		1722.0[b] 10	(25/2$^-$)
249.4 4	7/2$^-$	821.4[b] 6	(17/2$^-$)		1843.2[e] 8	(19/2$^-$)
320.3[b] 4	(11/2$^-$)	839.9 8	(15/2$^-$)		1959.5[e] 11	(21/2$^-$)
360.0 6	(9/2$^-$)	1022.9[d] 6	(17/2$^-$)		2102.1[e] 12	(23/2$^-$)
411.9[c] 6	(15/2$^+$)	1032.5[b] 8	(19/2$^-$)		2269.2[e] 13	(25/2$^-$)
439.3?[@] 4	5/2$^-$	1165.0[c] 7	(23/2$^+$)		2459.3[e] 14	(27/2$^-$)

[†] From least-squares fit to Eγ's. The level energies deviate by as much as 2 keV from those in Adopted Levels due to disparity in Eγ's in this dataset.

[‡] From Adopted Levels.

[#] From $\gamma\gamma$(t) (1970Hj02), except when stated otherwise.

[@] Level added (evaluators) based on results from ε decay.

[&] From $\gamma\gamma$(t) (1974An04).

[a] Level from (^{18}O,5nγ). No gammas are reported in (α,nγ).

[b] Band(A): ν5/2[523] band (1970Hj02). Extension of this band beyond 320 is from 1985Ba07.

[c] Band(B): ν5/2[642] band (1970Hj02). Interpreted by 1970Hj02 as a Coriolis-mixed rotational band involving orbitals originating from the i$_{13/2}$ spherical shell-model state.

[d] Band(C): ν11/2[505] band (1970Hj02).

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^{161}Dy(α,2nγ) 1970Hj02,1974An04 (continued)

^{163}Er Levels (continued)

[e] Band(D): K$^{\pi}$=(19/2$^-$) band (1985Ba07).
[f] Band(E): ν3/2[521] band (1970Hj02).

γ(^{163}Er)

All measured $T_{1/2}$'s are < 10 ns, except for gammas deexciting through the 444 isomer, for which $T_{1/2}$> 100 ns.

Intensities in ^{160}Dy(α,nγ) E= 38 MeV (1970Hj02)

Eγ	Iγ	Eγ	Iγ
69.2	16.2	217.0	11.0
79.2	2.0	252.7	0.8
84.4	0.8	271.9	3.6
90.8	2.4	276.8	3.2
107.3	0.8	297.1	4.5
126.6	4.9	314.5	<25
165.4	4.0	317.5	1.2
171.5	2.8	324.5	3.2
184.9?	2.1	354.8	3.2
190.3	2.4	408.8?	13.8
198.6	1.2	425.1	1.6
211.9	5.3		

E$_\gamma$[†]	I$_\gamma$[†]	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Comments
20.3[@]		104.1	3/2$^-$	84.3	7/2$^-$	
22.3[@]		91.5	7/2$^+$	69.1	5/2$^+$	
28.8[@]		120.2	9/2$^+$	91.5	7/2$^+$	
35.0 *1*	0.2	104.1	3/2$^-$	69.1	5/2$^+$	
60.6 *5*	≈4.4	164.5	5/2$^-$	104.1	3/2$^-$	
69.3 *5*	100	69.1	5/2$^+$	0.0	5/2$^-$	A$_2$=+ 0.08 *3*, A$_4$=− 0.01 *4*. A$_2$=− 0.09 *3* in (α,nγ).
72.9[@]		164.5	5/2$^-$	91.5	7/2$^+$	
[x]74.5[‡] *5*	0.9					
79.2 *5*	12.3	198.9	11/2$^+$	120.2	9/2$^+$	A$_2$=− 0.61 *7*, A$_4$=− 0.01 *10*.
80.5[@]		164.5	5/2$^-$	84.3	7/2$^-$	
84.3 *5*	6.5	84.3	7/2$^-$	0.0	5/2$^-$	A$_2$=− 0.26 *8*.
91.4 *5*	17.0	91.5	7/2$^+$	0.0	5/2$^-$	A$_2$=− 0.06 *2*, A$_4$=− 0.02 *2*.
[x]94.4[‡] *5*	≤1.2					Identified as 91.4γ in ^{164}Er by 1970Hj02. However, the transition may also have a small component (Iγ=0.02) corresponding to 93.9γ? from 439.6 level.
103.8 *5*	5.7	104.1	3/2$^-$	0.0	5/2$^-$	A$_2$=+ 0.01 *10*.
105.3 *5*	2.6	189.8	9/2$^-$	84.3	7/2$^-$	A$_2$=− 0.47 *25*.
107.5 *5*	4.5	198.9	11/2$^+$	91.5	7/2$^+$	A$_2$=+ 0.25 *10*, A$_4$=− 0.14 *10*.
110.5[#] *5*	2.5	360.0	(9/2$^-$)	249.4	7/2$^-$	A$_2$=− 0.36 *16*.
116.3[#] *5*	1.3	1959.5	(21/2$^-$)	1843.2	(19/2$^-$)	A$_2$=− 0.03 *50*.
123.8 *5*	2.1	443.8	(11/2$^-$)	320.3	(11/2$^-$)	
126.7 *5*	20.6	247.2	(13/2$^+$)	120.2	9/2$^+$	A$_2$=+ 0.30 *2*, A$_4$= 0.00 *4*.
129.2[c#] *5*	≈0.5[c]	249.4	7/2$^-$	120.2	9/2$^+$	I$_\gamma$: intensity divided based on branching in adopted gammas.
129.2[cd] *5*	≈0.5[c]	320.3	(11/2$^-$)	189.8	9/2$^-$	A$_2$=− 0.02 *55*.

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^{161}Dy(α,2nγ) 1970Hj02,1974An04 (continued)

$\gamma(^{163}Er)$ (continued)

E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Comments
136.0# 5	2.9	496.1	11/2$^-$	360.0	(9/2$^-$)	A_2=− 0.7 *4*.
x139.3 5	1.3					
142.6# 5	2.1	2102.1	(23/2$^-$)	1959.5	(21/2$^-$)	
145.3c# 5	≈0.7c	249.4	7/2$^-$	104.1	3/2$^-$	See comment for 129.2γ.
145.3c# 5	≈1.0c	466.5	13/2$^-$	320.3	(11/2$^-$)	I_γ: intensity divided (evaluators) based on (^{18}O,5nγ) results.
159.0# 5	2.2	655.2	(13/2$^-$)	496.1	11/2$^-$	
x162.2‡ 5	1.2					
164.4@		164.5	5/2$^-$	0.0	5/2$^-$	
164.9 5	13.9	411.9	(15/2$^+$)	247.2	(13/2$^+$)	A_2=− 0.63 *23*, A_4=− 0.02 *3*. A_2=− 0.76 *2* in (α,nγ).
167.1‡# 5	1.2	2269.2	(25/2$^-$)	2102.1	(23/2$^-$)	
170.8 5	11.9	614.6	(13/2$^-$)	443.8	(11/2$^-$)	A_2=− 0.44 *6*.
x177.9 5	1.2					
x188.6 5	1.7					
190.1c 5	≈13c	189.8	9/2$^-$	0.0	5/2$^-$	I_γ: total Iγ=15.3. A_2=+ 0.19 *3*, A_4=+ 0.06 *4*.
190.1c 5	1.2c	439.3?	5/2$^-$	249.4	7/2$^-$	
190.1c# 5	≈1c	2459.3	(27/2$^-$)	2269.2	(25/2$^-$)	I_γ: assuming intensity balance at 2271 level and mult(167γ, 190γ)=M1.
193.7 5	8.3	808.3	(15/2$^-$)	614.6	(13/2$^-$)	A_2=− 0.52 *9*, A_4=+ 0.16 *11*.
195.6d 5	3.5	443.8	(11/2$^-$)	247.2	(13/2$^+$)	A_2=+ 0.10 *7* for a mixed line.
x200.2 5	2.3					A_2=− 0.3 *4*.
x206.3‡ 5	2.0					
211.0‡# 5	2.6	1032.5	(19/2$^-$)	821.4	(17/2$^-$)	
213.3 5	29.0	411.9	(15/2$^+$)	198.9	11/2$^+$	A_2=+0.24 *1*, A_4=+0.09 *2*. Sign of A_4 is opposite to that expected for ΔJ=2, stretched transition.
215.5 5	7.2	1022.9	(17/2$^-$)	808.3	(15/2$^-$)	
217.6 5	58.5	465.2	(17/2$^+$)	247.2	(13/2$^+$)	A_2=+ 0.27 *6*, A_4=− 0.16 *11*. Additional information 2.
235.8b 5	14.1b	320.3	(11/2$^-$)	84.3	7/2$^-$	A_2=+ 0.12 *15*. Complex. Contains components with $T_{1/2}$< 10 ns and $T_{1/2}$> 100 ns.
235.8b 5	14.1b	1258.0	(19/2$^-$)	1022.9	(17/2$^-$)	Iγ(235.8γ)/Iγ(449.0γ)=0.6 from 1258 level in (^{18}O,5nγ).
244.6 5	5.5	443.8	(11/2$^-$)	198.9	11/2$^+$	A_2=− 0.1 *7*.
246.7# 5	3.8	496.1	11/2$^-$	249.4	7/2$^-$	A_2=+ 0.4 *5*.
254.0 5	5.7	443.8	(11/2$^-$)	189.8	9/2$^-$	A_2=− 0.15 *7*.
268.0# 5	3.1	466.5	13/2$^-$	198.9	11/2$^+$	A_2=− 0.09 *20*.
271.8 5	7.7	737.0	(19/2$^+$)	465.2	(17/2$^+$)	A_2=− 0.84 *15*.
274.8 5	2.3	439.3?	5/2$^-$	164.5	5/2$^-$	
277.1# 5	15.3	466.5	13/2$^-$	189.8	9/2$^-$	A_2=+ 0.36 *7*, A_4=− 0.19 *13*.
x292.8‡ 5	1.5					
295.4# 5	7.0	655.2	(13/2$^-$)	360.0	(9/2$^-$)	A_2=+ 0.46 *4*, A_4=− 0.05 *8*.
x297.8‡ 5	1.5					
x311.5 5	5.6					A_2=+ 0.40 *6*; A_4=+ 0.18 *11* for 311.5γ+313.7γ+315.1γ+315.0γ(^{164}Er).
313.7 5	54	779.2	(21/2$^+$)	465.2	(17/2$^+$)	A_2=+ 0.40 *6*, A_4=+ 0.18 *11* for a complex line.
320.6# 5	12.3	640.8	(15/2$^-$)	320.3	(11/2$^-$)	A_2=+ 0.38 *10*, A_4=+ 0.17 *18*.
323.5c& 5	≈4ca	443.8	(11/2$^-$)	120.2	9/2$^+$	I_γ: total Iγ=39.0.
323.5c& 5	≈35ca	737.0	(19/2$^+$)	411.9	(15/2$^+$)	A_2=+ 0.19 *14*, A_4=− 0.5 *3*. A_2=+ 0.5 *3* in (α,nγ).
335.2c 5	0.5c	439.3?	5/2$^-$	104.1	3/2$^-$	

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^{161}Dy(α,2nγ) 1970Hj02,1974An04 (continued)

γ(^{163}Er) (continued)

E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Comments
335.2[c#] 5	11.1[c]	1843.2	(19/2$^-$)	1508.3?	(17/2$^-$)	Total Iγ=11.6. Intensity divided (by evaluators) based on adopted gammas.
343.8[#] 5	5.1	839.9	(15/2$^-$)	496.1	11/2$^-$	Complex. Contains components with $T_{1/2}$< 10 ns and $T_{1/2}$> 100 ns. A_2=+ 0.38 *10*.
[x]352.8[‡] 5	1.8					
354.9[c] 5	0.4[c]	439.3?	5/2$^-$	84.3	7/2$^-$	
354.9[c#] 5	11.6[c]	821.4	(17/2$^-$)	466.5	13/2$^-$	I_γ: total Iγ=12.0. Intensity divided (by evaluators) based on adopted gammas. A_2=+ 0.25 *15*.
364.8 5	2.8	808.3	(15/2$^-$)	443.8	(11/2$^-$)	
[x]374.9 5	2.3					A_2= 0.0 *8*.
[x]382.9 5	2.3					
385.4 5	9.6	1165.0	(23/2$^+$)	779.2	(21/2$^+$)	I_γ: too large by a factor of ≈ 3 as compared to that in (^{18}O,5nγ).
391.7[#] 5	9.3	1032.5	(19/2$^-$)	640.8	(15/2$^-$)	
408.2[b] 5	34.2[b]	1022.9	(17/2$^-$)	614.6	(13/2$^-$)	I_γ: ≈7 expected from a comparison of branching ratio in (^{18}O,5nγ). A_2=+ 0.31 *5*, A_4=− 0.12 *8* for a complex line. A_2=+ 0.36 *13*, A_4=− 0.09 *18* in (α,nγ).
408.2[b] 5	34.2[b]	1187.4	(25/2$^+$)	779.2	(21/2$^+$)	A_2=+ 0.36 *13*, A_4=− 0.09 *18* in (α,nγ).
423.2[#] 5	8.6	1244.6	(21/2$^-$)	821.4	(17/2$^-$)	A_2=+ 0.40 *9*, A_4=+ 0.08 *17*.
428.3 5	18.0	1165.0	(23/2$^+$)	737.0	(19/2$^+$)	A_2=+ 0.34 *4*, A_4=− 0.15 *7* for a complex line.
431.0[‡#] 5	8.6	1270.9	(19/2$^-$)	839.9	(15/2$^-$)	
449.0[b#] 5	7.4[b]	1258.0	(19/2$^-$)	808.3	(15/2$^-$)	
449.0[b#] 5	7.4[b]	1481.5	(23/2$^-$)	1032.5	(19/2$^-$)	
[x]456.3[‡] 5	0.9					
[x]462.8 5	5.5					
477.4[#] 5	7.2	1722.0	(25/2$^-$)	1244.6	(21/2$^-$)	
496.8 5	10.7	1684.2	(29/2$^+$)	1187.4	(25/2$^+$)	
523[#] *1*	7.5	1688.0	(27/2$^+$)	1165.0	(23/2$^+$)	
546[#]	5.0	1843.2	(19/2$^-$)	1298?		
[x]554	3.1					
[x]561	6.9					
[x]565	3.3					

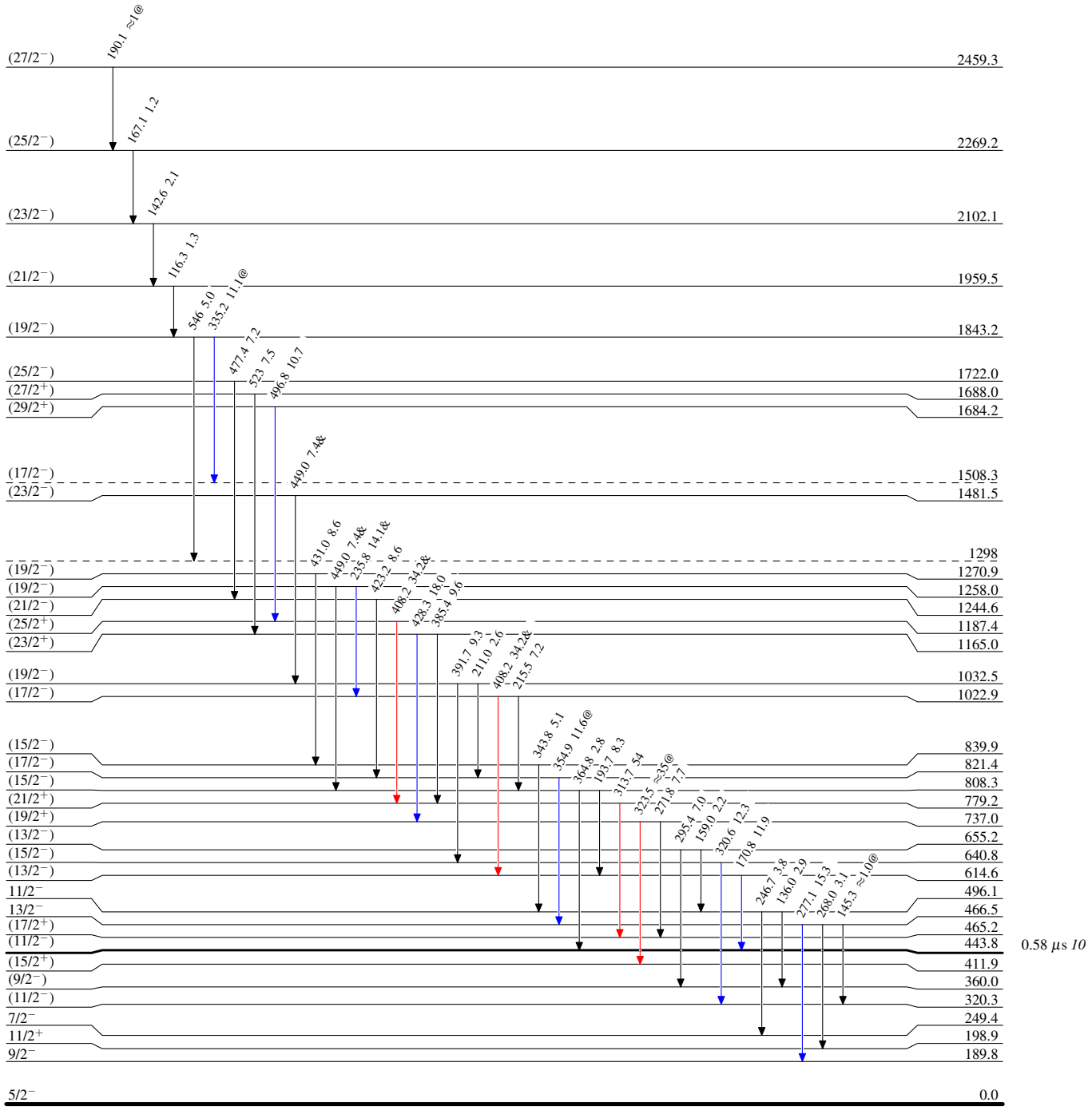
† From 1970Hj02. Δ(Eγ)=0.5 from similar data on other nuclides (1969Hj01).
‡ Existence of transition uncertain (1970Hj02).
# Placement based on (^{18}O,5nγ) results. This γ ray was unplaced by 1970Hj02.
@ From adopted gammas, rounded-off to nearest 0.1 keV.
& From level-scheme figure in 1970Hj02. Eγ=325.5 in a table of 1970Hj02 is less likely in view of more recent high-spin data.
a Line-width larger than expected for a single line. Iγ=39.0 divided on the basis of branching ratio from (^{18}O,5nγ).
Iγ(323.6γ)/Iγ(271.6γ)= 4.6 *8* for 736 level in (^{18}O,5nγ).
b Multiply placed with undivided intensity.
c Multiply placed with intensity suitably divided.
d Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

^{161}Dy(α,2nγ) 1970Hj02,1974An04

Level Scheme

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

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



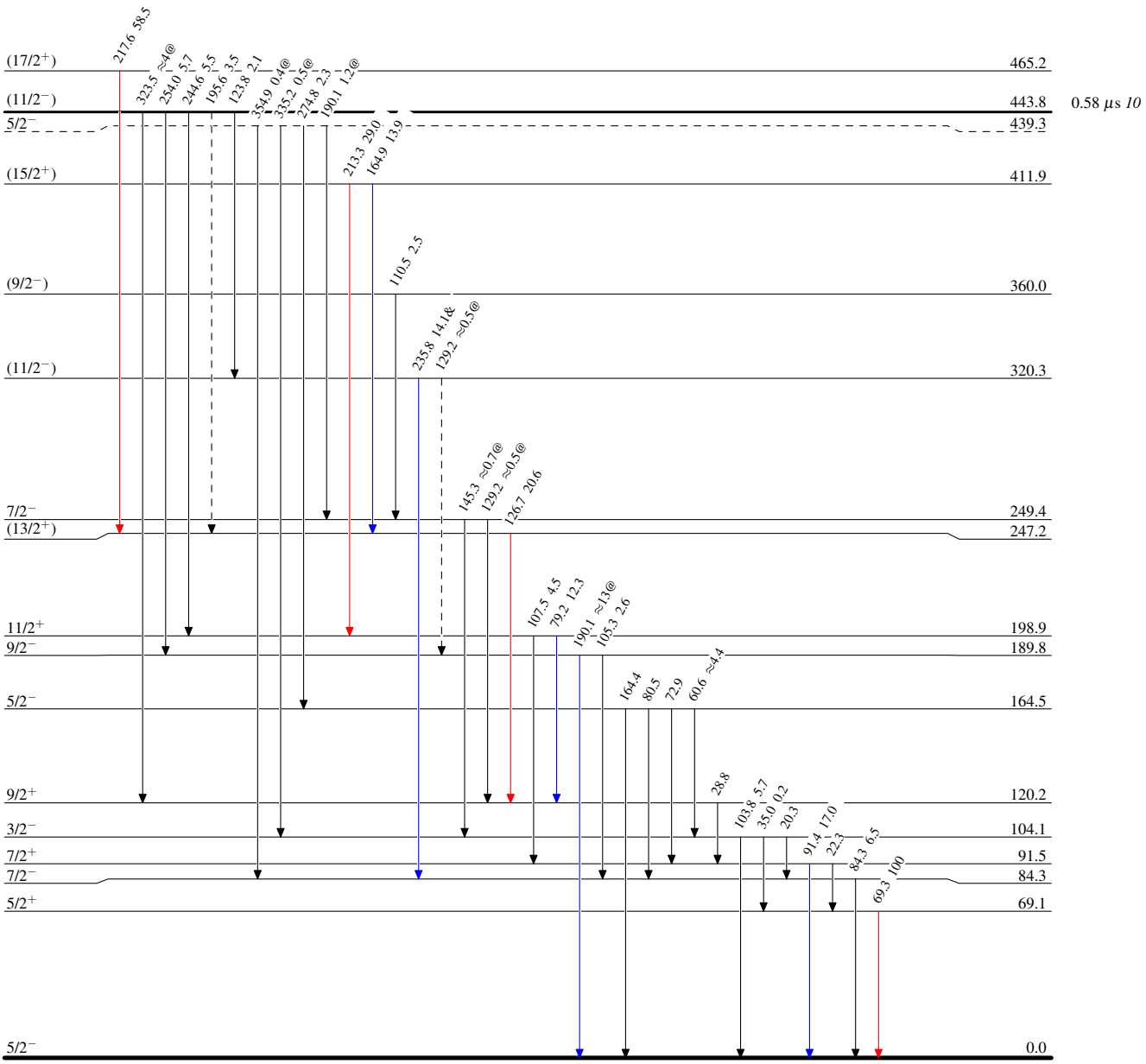
$^{163}_{68}Er_{95}$

^{161}Dy(α,2nγ) 1970Hj02,1974An04

Level Scheme (continued)

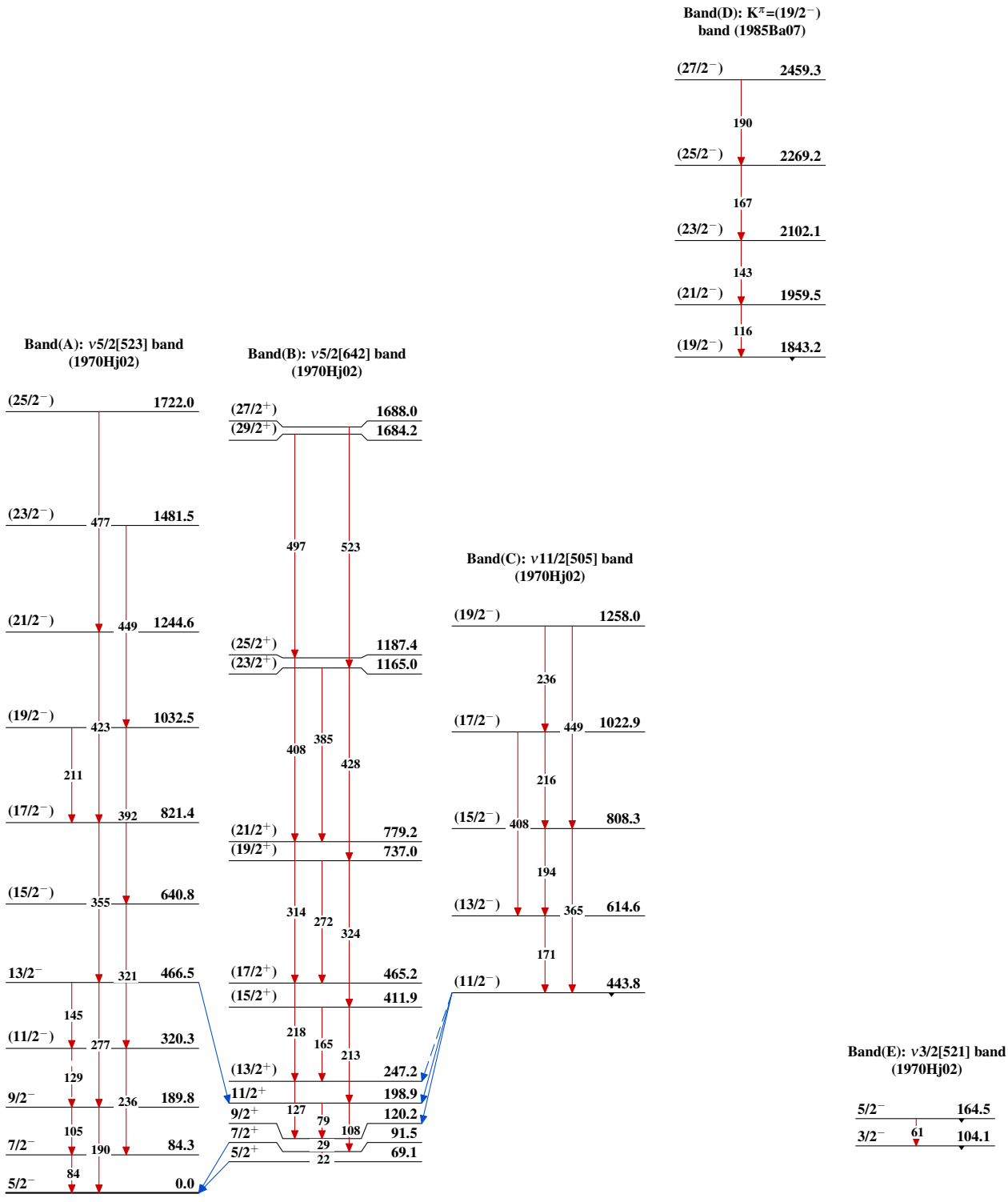
Intensities: Relative I_γ
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$
γ Decay (Uncertain)



$^{163}_{68}Er_{95}$

^{161}Dy(α,2nγ) 1970Hj02,1974An04



$^{163}_{68}Er_{95}$