Coulomb excitation **1987Mi04,1969Tv01,1978Br20**

History

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

Additional information 1.
1987Mi04 (also 1989Os01): (^{58}Ni,^{58}Ni′γ) E= 250 MeV and (^{35}Cl,^{35}Cl′γ) E=160 MeV; measured Eγ, Iγ, $\gamma\gamma$, $\gamma(\theta)$, $T_{1/2}$ by DSAM. $\gamma(\theta)$ results reanalyzed by 1989Os01 for δ and revised $\Delta(\delta)$.
1969Tv01: (^{16}O,^{16}O′γ) E=36-52 MeV. Measured excitation functions, γ′s at 55°, and ^{16}O at 90°.
1978Br20: (α,α′) E=11.4− 12.8 MeV. Measured $\sigma(\theta)$, deduced B(E2) for first two excited states.
Others:
1985Bu22: (^{58}Ni,^{58}Ni′γ) E=204-280 MeV. Measured (particle)-γ coin.
1978Wo02: (α,α′) E= 12 MeV. Measured $\sigma(\theta)$ for first three excited states. Deduced E2 and E4 matrix elements.
1970Ga19: (^{14}N,^{14}N′γ) E= 59 MeV. Measured γ.
1966Bo16: (^{16}O,^{16}O′γ) E≈ 45 MeV. Measured gyromagnetic ratio.
1966As03: (^{16}O,^{16}O′γ) E≈35 MeV. Measured lifetime by K x ray(t).
1964Al27: (^{14}N,^{14}N′γ). Measured γ.
1963El06, 1957El10: E(d)= 4 MeV. Measured $\sigma(\theta)$.
1960Be16: (p,p′ce) E= 3.2 MeV. Measured ce.
1959De29: (p,p′γ) E= 4 MeV. Measured γ′s, p$\gamma(\theta)$.
1958Ch36: (p,p′γ) E= 3.7 MeV.
1957He26: (α,α′γ) E= 4.0 MeV.

^{163}Dy Levels

B(E2): calculated from εB(E2)↑′s of 1969Tv01 and adopted γ properties.

E(level)	J^{π}[†]	$T_{1/2}$[‡]	Comments
0.0[@]	5/2−		
73.44[&] *10*	7/2−[#]	1.51 ns *5*	B(E2)↑=2.63 *11* (1978Br20) $T_{1/2}$: from nuclear recoil (1966As03). Other: 1.34 ns *7* from B(E2). B(E2)↑: others: 2.44 *14* (from E2 matrix element=3.83 *10* in 1978Wo02), 2.56 *15* (1963El06), 1960Be16, 1959De29, 1957He26.
167.23[@] *13*	9/2−[#]	0.34 ns *6*	B(E2)↑=0.900 *19* (1978Br20) $T_{1/2}$: from B(E2) and adopted γ properties. B(E2)↑: others: 0.89 *2* (from E2 matrix element=2.31 *2* in 1978Wo02), 0.68 *10* (1963El06), 1960Be16, 1959De29, 1957He26.
281.48[&] *13*	11/2−		B(E4)↑=0.06 *+11−6* (1978Wo02) B(E4) from E4 matrix element= 0.60 *+42−60* (1978Wo02).
351.1[a]	(1/2)−	0.26 ns *5*	B(E2)↑=0.0130 *26* $T_{1/2}$: from εB(E2)↑(351γ) and adopted γ properties.
389.7[a]	3/2−	0.12 ns *4*	B(E2)↑=0.014 *3* $T_{1/2}$: from εB(E2)↑(390γ) and adopted γ properties. B(E2)(7/2− to 3/2−)= 0.014 *6*.
415.13[@] *14*	13/2−	46 ps *18*	
421.8[b]	(3/2)−	0.18 ns *6*	B(E2)↑=0.0075 *19* $T_{1/2}$: from εB(E2)↑(422γ) and γ properties.
427.4[a]	(5/2)−	0.15 ns *7*	B(E2)↑=0.0073 *22* $T_{1/2}$: from εB(E2)↑(428γ) and adopted γ properties. Other: 0.29 ns *12* from εB(E2)↑(354γ) and adopted γ properties. B(E2)(7/2− to 5/2−)= 0.0088 *24*.
475.3[b]	(5/2)−	0.10 ns *10*	B(E2)↑=0.012 *8*

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Coulomb excitation 1987Mi04,1969Tv01,1978Br20 (continued)

^{163}Dy Levels (continued)

E(level)	J^{π}[†]	$T_{1/2}$[‡]	Comments
			$T_{1/2}$: from εB(E2)↑(402γ) and adopted γ properties. Other: ≤ 0.78 ns from εB(E2)↑(475γ) and adopted γ properties. B(E2)(7/2$^-$ to 5/2$^-$)= 0.006 *4*.
568.61[&] *15*	15/2$^-$	17 ps *4*	
739.89[@] *16*	17/2$^-$	11.1 ps *14*	
930.81[&] *17*	19/2$^-$	6.2 ps *7*	
1137.00[@] *19*	21/2$^-$	4.2 ps *7*	
1363.48[&] *20*	23/2$^-$	3.0 ps *6*	
1601.23[@] *21*	25/2$^-$		
1858.2[&] *4*	27/2$^-$		

[†] From Adopted Levels. For the main 5/2[523] band populated in Coul. ex., J^{π}'s are supported by $\gamma(\theta)$ (1987Mi04) data assuming a staggered 5/2[523] band consisting of crossover E2's and cascade M1+E2's.
[‡] From DSAM (1987Mi04), except as noted.
[#] From excitation functions, branching ratios, and B(E2)'s (1969Tv01).
[@] Band(A): 5/2[523] band. α=+1/2. 1987Mi04 note that the δ's fall into two groups depending on the signature change (≈−2.7 for α=+1/2→α=−1/2 and ≈−1.7 for α=−1/2→α=+1/2). They further note that B(E2; J→J-2) show no significant signature dependence, while the B(M1; J→J-1)/B(E2; J→J-2) do, indicating that the signature dependence is due to the B(M1) and may be due to the perturbation effect of the rotation.
[&] Band(B): 5/2[523] band. α=−1/2. See also comment for the α=+1/2 branch.
[a] Band(C): K^{π}=1/2$^-$ band. Mixed 1/2[521]+(5/2[523]-Q_{22}) band.
[b] Band(D): 3/2[521] band.

$\gamma(^{163}Dy)$

E_{γ}[†]	I_{γ}[‡]	E_i(level)	J_i^{π}	E_f	J_f^{π}	Mult.[#]	δ[@]	α[c]	Comments
73.43 *10*	61.6 *18*	73.44	7/2$^-$	0.0	5/2$^-$	(E2)		9.0	Mult.: from p$\gamma(\theta)$ (1959De29) and RUL. A_2=− 0.002 *15*, A_4=− 0.002 *18* (1987Mi04).
93.72 *10*	17.2 *9*	167.23	9/2$^-$	73.44	7/2$^-$	E2+M1	−2.6 *+8−6*	3.43 *6*	α(K)=1.48 *13*; α(L)=1.50 *14* Mult.: from $\gamma(\theta)$ (1987Mi04,1959De29) and ce (1960Be16). δ: from 1959De29. Other: δ= 1.6 *1* from K/L= 1.3 *4* (1960Be16). A_2=− 0.030 *15*, A_4=+ 0.005 *18* (1987Mi04).
114.27 *10*	2.9 *1*	281.48	11/2$^-$	167.23	9/2$^-$	M1+E2	−1.7[a] *3*	1.68	A_2=− 0.16 *4*, A_4=+ 0.05 *6* (1987Mi04).
133.68 *10*	0.93 *3*	415.13	13/2$^-$	281.48	11/2$^-$	(M1+E2)	−2.9[a] *3*	0.97	A_2=− 0.21 *3*, A_4=+ 0.05 *3* (1987Mi04).
153.52 *10*	0.28 *1*	568.61	15/2$^-$	415.13	13/2$^-$	(M1+E2)	−1.65[a] *25*	0.624 *6*	A_2=− 0.39 *5*, A_4=+ 0.03 *7* (1987Mi04).
167.32 *10*	100 *3*	167.23	9/2$^-$	0.0	5/2$^-$	(E2)		0.436	α(K)=0.272; α(L)=0.127 εB(E2)↑= 0.43 *11* (1959De29). K/L= 2.0 *3* (1960Be16). A_2=− 0.016 *4*, A_4=+ 0.03 *5* (1987Mi04).

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Coulomb excitation 1987Mi04,1969Tv01,1978Br20 (continued)

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

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ [@]	α [c]	Comments
171.2 *3*	0.065 *13*	739.89	17/2$^-$	568.61	15/2$^-$				I_γ: from $\gamma\gamma$. δ: - 2.7 *8* (average of 93.7γ and 133.7γ δ's, 1987Mi04).
190.7 *2*	0.024 *7*	930.81	19/2$^-$	739.89	17/2$^-$	(M1+E2)	−1.7[a] *5*	0.309 *3*	A_2=− 0.40 *5*, A_4=+ 0.07 *7* (1987Mi04).
206.4 *3*		1137.00	21/2$^-$	930.81	19/2$^-$				
208.10 *10*	39 *1*	281.48	11/2$^-$	73.44	7/2$^-$	(E2)		0.208	A_2=+ 0.071 *15*, A_4=− 0.009 *18* (1987Mi04).
x237[b]									
x240[b]									
247.82 *10*	23.0 *8*	415.13	13/2$^-$	167.23	9/2$^-$	(E2)		0.118	A_2=+ 0.131 *15*, A_4=− 0.018 *19* (1987Mi04).
259[bd]		427.4	(5/2)$^-$	167.23	9/2$^-$				Placement (evaluators) based on adopted gammas.
287.18 *10*	11.0 *3*	568.61	15/2$^-$	281.48	11/2$^-$	(E2)		0.0743	A_2=+ 0.165 *14*, A_4=− 0.026 *19* (1987Mi04).
x311[b]									
316.2[&]		389.7	3/2$^-$	73.44	7/2$^-$				εB(E2)↑= 0.0035 *15* (1969Tv01).
324.68 *10*	5.6 *2*	739.89	17/2$^-$	415.13	13/2$^-$	E2		0.0510	A_2=+ 0.193 *14*, A_4=− 0.038 *18* (1987Mi04).
351.1[&]		351.1	(1/2)$^-$	0.0	5/2$^-$	E2		0.0405	εB(E2)↑= 0.0125 *25* (1969Tv01).
354.3[&]		427.4	(5/2)$^-$	73.44	7/2$^-$				εB(E2)↑= 0.0040 *10* (1969Tv01).
362.28 *10*	2.60 *8*	930.81	19/2$^-$	568.61	15/2$^-$	(E2)		0.0369	A_2=+ 0.162 *22*, A_4=− 0.03 *3* (1987Mi04).
x386[b]									
389.8[&]		389.7	3/2$^-$	0.0	5/2$^-$				εB(E2)↑= 0.0090 *20* (1969Tv01).
397.09 *10*	1.43 *4*	1137.00	21/2$^-$	739.89	17/2$^-$	(E2)		0.0284	A_2=+ 0.14 *4*, A_4= 0.00 *4* (1987Mi04). E_γ: 395γ assigned to a 1041 level (1985Bu22) may correspond to this γ.
401.5[&]		475.3	(5/2)$^-$	73.44	7/2$^-$				εB(E2)↑= 0.0025 *15* (1969Tv01).
421.8[&]		421.8	(3/2)$^-$	0.0	5/2$^-$				εB(E2)↑= 0.0065 *15* (1969Tv01).
x427[b]									
427.7[&]		427.4	(5/2)$^-$	0.0	5/2$^-$				εB(E2)↑= 0.0025 *10* (1969Tv01).
432.67 *10*	0.47 *2*	1363.48	23/2$^-$	930.81	19/2$^-$	(E2)		0.0224	A_2=+ 0.20 *4*, A_4=− 0.06 *5* (1987Mi04).
464.23 *10*	0.178 *16*	1601.23	25/2$^-$	1137.00	21/2$^-$				A_2=+ 0.02 *26*, A_4=− 0.05 *21* (1987Mi04).
475.7[&]		475.3	(5/2)$^-$	0.0	5/2$^-$				εB(E2)↑= 0.0050 *30* (1969Tv01).
494.7 *3*		1858.2	27/2$^-$	1363.48	23/2$^-$				Mult.: E2 assigned by 1987Mi04 but no $\gamma(\theta)$ data are available.
x496[b]									
x588[b]									

[†] From 1987Mi04, unless otherwise stated.
[‡] From 1987Mi04 (^{35}Cl or ^{58}Ni beam).
[#] From $\gamma(\theta)$ (1987Mi04) assuming that they were dealing with a staggered 5/2[523] band consisting of crossover E2′s and cascade M1+E2′s. Parentheses added by evaluators when A_2, A_4 data do not give a unique assignment of ΔJ or multipolarity.

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Coulomb excitation **1987Mi04,1969Tv01,1978Br20 (continued)**

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

[@] From 1987Mi04, attenuation factors derived by comparing experimental A_2's for pure E2 γ's to calculated A_2's for complete alignment.
[&] From 1969Tv01.
[a] Uncertainty is from 1989Os01, revised analysis of data in 1987Mi04.
[b] From 1985Bu22 only.
[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] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

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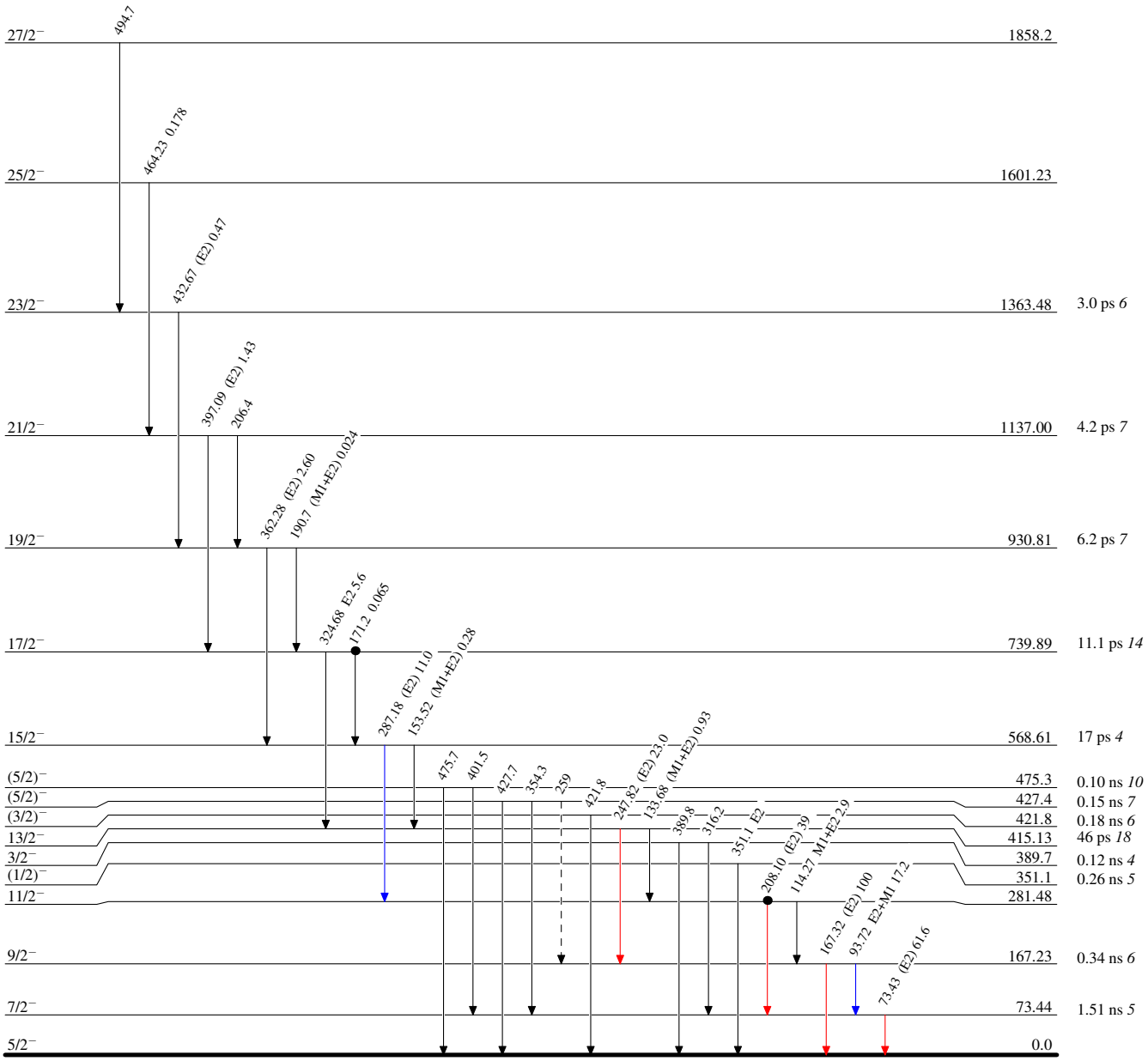
Level Scheme

Intensities: Relative I_γ

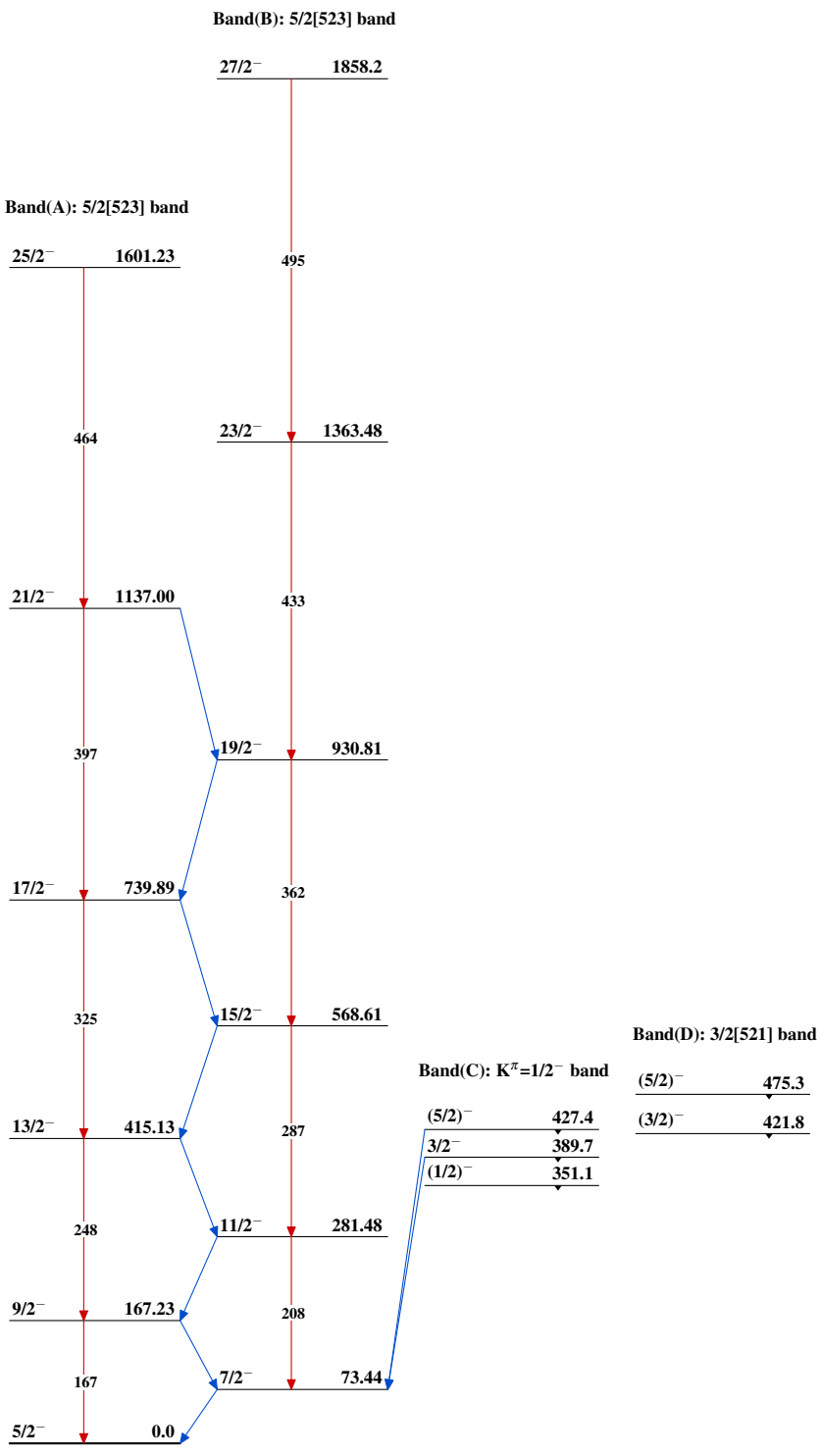
Legend

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



$^{163}_{66}Dy_{97}$

Coulomb excitation 1987Mi04,1969Tv01,1978Br20



$^{163}_{66}Dy_{97}$