^{165}Dy β^- decay (2.334 h) 1972Ma06

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Ashok K. Jain and Anwesha Ghosh, Balraj Singh	NDS 107, 1075 (2006)	15-Apr-2006

Parent: ^{165}Dy: E=0.0; J$^\pi$=7/2$^+$; T$_{1/2}$=2.334 h *1*; Q(β^-)=1286.6 *9*; %β^- decay=100.0
1972Ma06: measured Eγ, Iγ, $\gamma\gamma$, ce; magnetic spectrometer for ce.
2004Mi18: measured Eγ, Iγ; emission probability of 94.7γ; relative intensities of 19 γ rays from 94.7 to 1079.6 keV.
1991Mi26: measured ce data for 94.7γ, 279.8γ, 361.7γ and 633.4γ using high-resolution magnetic spectrometer.
Others:
γ: 1971Lu08, 1965Sc09, 1964Re09, 1963Ma08, 1962Ni11, 1962Ha46, 1956An34.
ce: 1963Pe11, 1962No07, 1962Vo02.
$\gamma(\theta$,T) from oriented ^{165}Dy: 1982HaYO.
β: 1963Pe11, 1959Cr73, 1955Ro57, 1947Sl14.
$\gamma\gamma(\theta)$: 1964Si24, 1959Gr01.
γ(t): 1967Ba27, 1964Ha19, 1959Gr01, 1959Cr80, 1958Ka10, 1951Wr13.
$\beta\gamma$: 1959Bo52.

^{165}Ho Levels

E(level)	J$^\pi$†	T$_{1/2}$	Comments
0.0	7/2$^-$		
94.700 *3*	9/2$^-$	25 ps *10*	T$_{1/2}$: $\gamma\gamma$(t) (1967Ba27).
209.804 *11*	11/2$^-$		
361.675 *11*	3/2$^+$	1.512 μs *4*	T$_{1/2}$: γ(t) (1959Cr80). Other: 1.65 μs *20* (γ(t),1958Ka10).
419.544 *11*	5/2$^+$		
429.388 *11*	1/2$^+$		
449.259 *11*	3/2$^+$		
491.047 *14*	7/2$^+$		
515.476 *11*	3/2$^-$	<0.1 ns	T$_{1/2}$: γ(t) (1964Ha19).
539.011 *13*	5/2$^+$		
565.746 *20*	(5/2)$^-$		
589.802 *18*	7/2$^+$		
715.332 *11*	7/2$^+$	<0.1 μs	T$_{1/2}$: γ(t) (1958Ka10). J$^\pi$: $\gamma(\theta)$ from oriented ^{165}Dy β decay for 620γ and 715γ agree only with J$^\pi$=5/2$^+$, not with 7/2$^+$; however, 620γ to 9/2$^-$ disfavors 5/2$^+$; L=4 and analyzing powers in (pol t,α) strongly favor 7/2$^+$.
820.107 *16*	(9/2$^+$)		
995.095 *11*	5/2$^+$		
1055.761 *25*	5/2$^+$		
1079.616 *17*	7/2$^+$		
1140.36 *5*	7/2$^+$		
1186.59 *6*	9/2$^+$		

† From 'Adopted Levels'.

β^- radiations

E(decay)	E(level)	Iβ^-†‡	Log *ft*	Comments
(100.0 *9*)	1186.59	0.0017 *2*	7.20 *6*	av Eβ= 26.1 *4*
(146.2 *9*)	1140.36	0.0018 *3*	7.69 *8*	av Eβ= 39.0 *4*
(207.0 *9*)	1079.616	0.15 *2*	6.24 *6*	av Eβ= 56.6 *4*
(230.8 *9*)	1055.761	0.043 *6*	6.93 *7*	av Eβ= 63.7 *4*
305 *10*	995.095	1.7 *2*	5.66 *6*	av Eβ= 82.2 *4* E(decay): from 1959Bo52.

Continued on next page (footnotes at end of table)

^{165}Dy β^- decay (2.334 h) 1972Ma06 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^- †‡	Log *ft*	Comments
(466.5 *9*)	820.107	0.012 *2*	8.48 *8*	av Eβ= 139.3 *5*
(571.3 *9*)	715.332	0.06 *4*	8.1 *3*	av Eβ= 175.7 *5*
(720.9 *9*)	565.746	≤0.33	≥7.7	av Eβ= 229.7 *5*
(795.6 *9*)	491.047	0.015 *4*	9.17 *12*	av Eβ= 258.1 *5*
880	419.544			E(decay): from 1955Ro57, 1947Sl14. Other: 1000 *30* (1959Bo52). Iβ^-: observation of this β^- transition is not compatible with very small Iβ^-<0.05% expected from the balance of I(γ+ce).
(1076.8 *9*)	209.804	0.016 *3*	10.20[1u] *9*	av Eβ= 373.6 *5*
1190	94.700	15 *2*	6.81 *6*	av Eβ= 414.8 *6* E(decay),Iβ^-: from 1959Cr73 (Iβ=14%). Other: 1215 *20* 16% (1959Bo52).
1285 *10*	0.0	83 *2*	6.19 *1*	av Eβ= 453.7 *6* E(decay),Iβ^-: from 1963Pe11. Others: 1280 (84%) (1959Cr73), 1305 *20* (80%) (1959Bo52).

† ce(K)(94.7γ)/β^-=0.093 *10* (1963Pe11).

‡ Absolute intensity per 100 decays.

^{165}Dy β^- decay (2.334 h) 1972Ma06 (continued)

γ(^{165}Ho)

Iγ normalization: from Iγ(94.7γ)/100 decays of ^{165}Dy=3.80 *5* (2004Mi18).

E_γ[†]	I_γ[†a]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[@&]	δ	α[b]	Comments
29.715[#] *3*	0.12 *6*	449.259	3/2$^+$	419.544	5/2$^+$	M1		15.17	α(L)=11.74; α(M)=2.58 Mult.: α(L1)exp=12.9 *69*; L1:L2:L3=100 *20*:80.1 *32*:<5.7 (1972Ma06).
57.864[#] *5*	0.39 *6*	419.544	5/2$^+$	361.675	3/2$^+$	M1+E2	0.130 *+46−30*	13.25	α(K)=10.80 *12*; α(L)=1.90 *22*; α(M)=0.42 *6*; α(N+..)=0.121 *15* Mult.: L1:L2:L3=100 *20*:14.8 *59*:12.0 *48*; α(L1)exp=1.32 *33* (1972Ma06).
67.712[#] *4*	0.40 *20*	429.388	1/2$^+$	361.675	3/2$^+$	M1		8.25	α(K)=6.93; α(L)=1.031; α(M)=0.2273; α(N+..)=0.0651 Mult.: α(K)exp=6.3 *37*; K/L=7.4 *32* (1972Ma06).
71.502[#] *10*	0.066 *10*	491.047	7/2$^+$	419.544	5/2$^+$	M1(+E2)	<0.41	7.3 *9*	α(K)=5.6 *3*; α(L)=1.3 *5*; α(M)=0.29 *12*; α(N+..)=0.08 *3* Mult.: α(K)exp=4.4 *15*, K/L=5.0 *21* (1972Ma06).
87.585[#] *4*	0.40 *4*	449.259	3/2$^+$	361.675	3/2$^+$	M1(+E2)	<0.32	3.95 *24*	α(K)=3.20 *9*; α(L)=0.58 *12*; α(M)=0.13 *3*; α(N+..)=0.037 *7* Mult.: α(K)exp=3.3 *7*, K/L=7.2 *26* (1972Ma06).
89.753[#] *8*	0.080 *16*	539.011	5/2$^+$	449.259	3/2$^+$	M1(+E2)	<0.5	3.7 *5*	α(K)=2.90 *17*; α(L)=0.63 *24*; α(M)=0.14 *6*; α(N+..)=0.041 *12* Mult.: α(K)exp=2.7 *10*, K/L>3 (1972Ma06).
94.700[#] *3*	100.0[‡] *6*	94.700	9/2$^-$	0.0	7/2$^-$	M1+E2	0.160 *5*	3.13	α(K)=2.59; α(L)=0.423 *2*; α(M)=0.094 *1*; α(N+..)=0.0271 *1* E_γ: from 1965Sc09. Others: 94.692 *3* (1971Lu08), 94.705 *3* (1964Re09), 94.697 *5* (1963Ma08), 94.697 *4* (1962Ni11), 94.702 *10* (1962Ha46). δ: weighted average of 0.168 *9* from subshell ratios (1991Mi26) and +0.157 *5* from E2 and M1 matrix elements in Coulomb excitation (2003Iw01). α(K)exp=2.62 *20*, K:L1:L2:L3=1000 *150*:120 *6*:22 *4*:8.6 *20* (1963Pe11). Others: α(K)exp=2.5 *2*, K:L1:L2:L3=1000 *30*:128:19.7 *6*:9.6 *3* (1962No07); α(K)exp=2.60, K:L1:L2:L3=1000:133 *7*:17.8 *18*:8.2 *8* (1972Ma06); for L:M:N+O and L:M1:N1 see 1970Mi15, 1963Pe11, 1962Vo02. δ=0.168 *9* (1991Mi26) from L1/L2/L3=100.0 *5*/14.2 *3*/8.0 *2*.
95.931[#] *4*	0.026 *4*	515.476	3/2$^-$	419.544	5/2$^+$	[E1]		0.357	α(K)=0.297; α(L)=0.0469; α(M)=0.01028; α(N+..)=0.00287
98.80 *15*	0.023 *5*	589.802	7/2$^+$	491.047	7/2$^+$				
109.59[#] *3*	0.016 *5*	539.011	5/2$^+$	429.388	1/2$^+$				
115.104[#] *10*	0.199 *14*	209.804	11/2$^-$	94.700	9/2$^-$	M1+E2	+0.17 *+1−3*	1.78	α(K)=1.479 *8*; α(L)=0.236 *6*; α(M)=0.0523 *14*;

$^{165}_{67}Ho_{98}$-3

γ(^{165}Ho) (continued)

E_γ[†]	I_γ[†a]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[@&]	δ	α[b]	Comments
									α(N+..)=0.0152 *4* δ: from 'Adopted Gammas'.
119.47 *3*	0.200 *14*	539.011	5/2+	419.544	5/2+	M1(+E2)	<0.6	1.59 *20*	α(K)=1.26 *9*; α(L)=0.25 *9*; α(M)=0.057 *20*; α(N+..)=0.016 *4* Mult.: α(K)exp=1.44 *31*, K/L>3.3 (1972Ma06).
129.39[#] *3*	0.014 *5*	491.047	7/2+	361.675	3/2+				
140.544[#] *20*	0.059 *6*	589.802	7/2+	449.259	3/2+				
153.803[#] *6*	0.160 *13*	515.476	3/2−	361.675	3/2+	[E1]		0.101	α(K)=0.0849; α(L)=0.01269; α(M)=0.00278; α(N+..)=0.00078
170.22[#] *3*	0.085 *9*	589.802	7/2+	419.544	5/2+				
174.96[#] *3*	0.031 *6*	995.095	5/2+	820.107	(9/2+)				
209.70 *25*	0.028 *14*	209.804	11/2−	0.0	7/2−	E2		0.210	α(K)=0.1403; α(L)=0.0536; α(M)=0.01255; α(N+..)=0.00345
228.3 *3*	0.012 *6*	589.802	7/2+	361.675	3/2+				
259.53 *5*	0.41[‡] *1*	1079.616	7/2+	820.107	(9/2+)				
266.80 *15*	0.031 *8*	361.675	3/2+	94.700	9/2−	[E3]		0.451	α(K)=0.2171; α(L)=0.1789; α(M)=0.0436; α(N+..)=0.01197
279.763[#] *12*	14.06[‡] *8*	995.095	5/2+	715.332	7/2+	M1+E2	−0.38 *+3−1*	0.142	α(K)=0.1188 *12*; α(L)=0.01837; α(M)=0.00407; α(N+..)=0.00114 Mult.: α(K)exp=0.126 *36*; K/L=5.4 *7* (1991Mi26). Others:>5.5 (1963Pe11), K/L=4.3 *6* (1962Vo02). L1/L2/L3=100 *6*/15 *4*/<7 (1991Mi26). E_γ: from 1965Sc09. Others: 279.759 *20* (1971Lu08), 279.784 *41* (1964Re09), 279.755 *30* (1962Ni11). δ: γ(θ,T) (1982HaYO) gives −0.38 *+3−1* or +5.3 *4*. The ce data of 1991Mi26 gives 0.55 *16* from K/L and L1/L2, which supports lower δ of 1982HaYO.
[x]356.90 *25*	0.023 *12*								
361.68[#] *2*	23.79[‡] *12*	361.675	3/2+	0.0	7/2−	M2+E3	0.16 *7*	0.284	α(K)=0.2310; α(L)=0.0413; α(M)=0.00930; α(N+..)=0.00260 E_γ: from 1965Sc09. Others: 361.676 *30* (1971Lu08), 361.699 *25* (1964Re09). Mult.,δ: from K/L,,L1/L2 and L1/L3 (1991Mi26). Other: α(K)exp=0.22 *4* (1963Pe11); K/L=5.2 *3* (1991Mi26), 4.8 *12* (1963Pe11), 6.3 *18* (1965Bo40). L/M=8.1 *14*; L1/L2/L3=100.0 *9*/12.2 *7*/5.5 *8* (1991Mi26).
405.25 *3*	0.298 *15*	995.095	5/2+	589.802	7/2+				
456.093 *25*	1.19[‡] *2*	995.095	5/2+	539.011	5/2+	M1+E2	−0.52 *+14−26*	0.037 *4*	α(K)=0.031 *4*; α(L)=0.0047 *3*; α(M)=0.00103 *6*; α(N+..)=0.00028 δ: from γ(θ), may also be δ≥+29.4 (1982HaYO).
472.11 *15*	0.040 *8*	565.746	(5/2)−	94.700	9/2−				E_γ: poor fit; level-energy difference=471.05.

From ENSDF

$^{165}_{67}$Ho$_{98}$-4

γ(^{165}Ho) (continued)

E_γ [†]	I_γ [†a]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [@&]	δ	α [b]	Comments
479.622 *25*	1.22[‡] *2*	995.095	5/2$^+$	515.476	3/2$^-$				
489.90 *10*	0.096 *10*	1079.616	7/2$^+$	589.802	7/2$^+$				
504.10 *15*	0.031 *8*	995.095	5/2$^+$	491.047	7/2$^+$				
512.57[d] *25*	0.089 *18*	1079.616	7/2$^+$	565.746	(5/2)$^-$				E_γ: poor fit; level-energy difference=513.87.
515.467 *25*	1.06 *5*	515.476	3/2$^-$	0.0	7/2$^-$	(E2)		0.0148	α(K)=0.01178; α(L)=0.00225
540.52 *5*	0.157 *16*	1079.616	7/2$^+$	539.011	5/2$^+$				
545.834 *20*	4.53 *14*	995.095	5/2$^+$	449.259	3/2$^+$	M1+E2	+0.14 *6*	0.0262	α(K)=0.02197 *23*; α(L)=0.00315 I_γ: 4.72 *4* for 540.5+545.8 (2004Mi18). δ: from $\gamma(\theta)$, may also be δ=+10.5 *+36−53* (1982HaYO).
565.718[c] *20*	≈0.08[c]	565.746	(5/2)$^-$	0.0	7/2$^-$				I_γ: deduced from branching ratios In Coul. ex. and (n,n′γ).
565.718[c] *20*	3.59[c‡] *3*	995.095	5/2$^+$	429.388	1/2$^+$				
575.558 *20*	2.13[‡] *2*	995.095	5/2$^+$	419.544	5/2$^+$	M1+E2	−0.35 *+6−4*	0.0218	α(K)=0.0183 *4*; α(L)=0.00264 *4* δ: from $\gamma(\theta)$, may also be δ=+4.9 *+8−10* (1982HaYO).
588.57 *5*	0.092 *9*	1079.616	7/2$^+$	491.047	7/2$^+$				
610.29 *5*	0.148 *15*	820.107	(9/2$^+$)	209.804	11/2$^-$				
620.635 *20*	2.64[‡] *2*	715.332	7/2$^+$	94.700	9/2$^-$				
633.415 *20*	16.12[‡] *10*	995.095	5/2$^+$	361.675	3/2$^+$	M1+E2	+0.18 *1*	0.0178	α(K)=0.01500 *3*; α(L)=0.00214 Mult.,δ: $\gamma(\theta$,T) (1982HaYO) gives +0.18 *1* or +9.9 *+11−9*. α(K)exp=0.018 *7* (1963Pe11); 0.014 *3* (1991Mi26) support lower δ.
660.08 *3*	0.74[‡] *1*	1079.616	7/2$^+$	419.544	5/2$^+$	M1(+E2)	+0.37 *+11−99*	0.0154 *13*	α(K)=0.0129 *12*; α(L)=0.00185 *13* δ: from $\gamma(\theta)$, may also be≤−6.1 (1982HaYO).
694.08 *4*	0.324 *16*	1055.761	5/2$^+$	361.675	3/2$^+$				
715.328 *20*	15.21[‡] *10*	715.332	7/2$^+$	0.0	7/2$^-$				Mult.: α(K)exp<0.008.
725.39 *3*	0.39 *4*	820.107	(9/2$^+$)	94.700	9/2$^-$				
820.106 *25*	0.225 *15*	820.107	(9/2$^+$)	0.0	7/2$^-$				
900.41 *5*	0.070 *7*	995.095	5/2$^+$	94.700	9/2$^-$				
976.74 *20*	0.0063 *13*	1186.59	9/2$^+$	209.804	11/2$^-$				
984.92 *4*	0.178 *13*	1079.616	7/2$^+$	94.700	9/2$^-$				
995.089 *25*	1.66[‡] *2*	995.095	5/2$^+$	0.0	7/2$^-$				
1045.60 *15*	0.0141 *21*	1140.36	7/2$^+$	94.700	9/2$^-$				
1055.76 *3*	0.91[‡] *1*	1055.761	5/2$^+$	0.0	7/2$^-$	D+Q	+0.32 *+32−18*		Mult.: M1+E2 for 1055.76γ inconsistent with adopted ΔJ^π which requires E1+M2. δ: from $\gamma(\theta)$, may also be δ≥+2.1 (1982HaYO).
1079.63 *3*	2.63[‡] *3*	1079.616	7/2$^+$	0.0	7/2$^-$				
1091.91 *8*	0.028 *3*	1186.59	9/2$^+$	94.700	9/2$^-$				
1140.36 *5*	0.038 *3*	1140.36	7/2$^+$	0.0	7/2$^-$				
1186.56 *10*	0.0129 *13*	1186.59	9/2$^+$	0.0	7/2$^-$				

$\gamma(^{165}$Ho) (continued)

[†] From 1972Ma06, except where noted otherwise. The intensities quoted by 1972Ma06 have been divided by a factor of 42.6 so that the two sets of intensities (from 1972Ma06 and 2004Mi18) are on the same scale.
[‡] From 2004Mi18, corresponding value In 1972Ma06 is In agreement but much less precise.
[#] From 1965Sc09 (curved-crystal spectrometer).
[@] γ's with significant δ>0.1 are interpreted as M1+E2, based on Weisskopf estimates for transition probabilities.
[&] α(K)exp were deduced from Iγ (1972Ma06), ce (1972Ma06,1963Pe11) and normalized to α(K)(94.7γ)=2.59 (for M1+E2, δ=0.168 *9*).
[a] For absolute intensity per 100 decays, multiply by 0.0380 *5*.
[b] 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.
[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.

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Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
@ Multiply placed: intensity suitably divided