^{166}Ho β^- decay (26.824 h)

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin	NDS 109, 1103 (2008)	1-Mar-2008

Parent: ^{166}Ho: E=0.0; $J^\pi=0^-$; $T_{1/2}$=26.824 h *12*; Q(β^-)=1854.7 *9*; %β^- decay=100.0

^{166}Er Levels

E(level)[†]	J^π[‡]	$T_{1/2}$	Comments
0.0	0^+	stable	
80.5775 *20*	2^+	1.815 ns *23*	$T_{1/2}$: from Adopted Levels. Measured values from $\beta^-\gamma$(t) are: 1.76 ns *5* (1963De21), 1.80 ns *5* (1963Fo02), 1.98 ns *21* (1961Bo05). Others: 1950Mc79, 1956Be54, 1959Bi10, 1960Be28, 1960Ma38.
265.02 *9*	4^+		
785.865 *12*	2^+		
1460.025 *7*	0^+		J^π: (1379.4γ)(80.574γ)(θ) is consistent only with J=0 for 0-2-0 cascade (1960Ma19,1960Ma38,1961Ku03).
1528.12 *7*	2^+		
1662.436 *5*	1^-		J^π: (1581.89γ)(80.574γ)(θ) is consistent with 1(D+Q)2(Q)0 cascade and 3(D+Q)2(Q)0 cascade. J=3 ruled out because of log *ft*=6.94 for the β- branch to 1662.45 level (1968Fo11). 1969He02 measured the linear polarization and demonstrate that it is consistent with E1(+M2) for the 1581.89γ only if J=1 for 1662.45 level.
1830.425 *12*	1^-		

[†] From least-squares fit to Eγ.
[‡] From Adopted Levels.

β^- radiations

For measurements of other low energy β- groups, see 1963Fu17, 1966Da04, 1966Be12, 1958Co76, 1976Ra32. Other measurements: 1949Gr01, 1950An12, 1950Si20, 1954Su12, 1958Co76.

β^- $\gamma(\theta)$: (1773.1β-)(80.574γ) cascade is consistent with 0^-,2^+,0^+ (1955Gr07,1965Ma39,1968Me17). Other measurements: 1961De34, 1963Gr36, 1964Gr33.

Eβ^-(g.s.)	Iβ^-	References
1854 5		1955Gr07
1859 3	49	1963Fu17
1857 3	52	1966Da04
1854.7 15	51 2	1974Gr41
1845 2	52	1976Ra32

Eβ^- (80.5 level)	Iβ^-	References
1771 7	48 4	1955Gr07
1779 5	49	1963Fu17
1776 4	47 3	1966Da04
1776 8		1966Be12
1776 5	48 2	1974Gr41
1771 2	47.5	1976Ra32
1773.1 14		weighted ave.

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^{166}Ho β^- decay (26.824 h) (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^-[†#]	Log *ft*	Comments
(24.3 *9*)	1830.425	0.0342 *6*	5.11 *5*	av Eβ=6.12 *23*
(192.3 *9*)	1662.436	0.302 *5*	6.916 *10*	av Eβ=52.18 *27*
(326.6 *9*)	1528.12	0.00268 *12*	9.493[1u] *21*	av Eβ=105.41 *30*
(394.7 *9*)	1460.025	0.943 *13*	7.424 *7*	av Eβ=115.14 *30*
(1068.8 *9*)	785.865	0.0070 *12*	11.62[1u] *8*	av Eβ=369.33 *35*
1773.1 *14*	80.5775	49.9 *12*	8.981[1u] *11*	av Eβ=651.33 *38*
1854.7[‡] *15*	0.0	48.8 *12*	8.104 *11*	av Eβ=693.96 *39*

† From the intensity balance.
‡ From 1974Gr41.
# Absolute intensity per 100 decays.

^{166}Ho β^- decay (26.824 h) (continued)

$\gamma(^{166}Er)$

Iγ normalization: weighted average of 0.920 *13* based on %I(81γ)=6.55 *7* (1994Co02) and %I(1379γ)=0.93 *3* (1962Cl03). See comment on 81γ for additional absolute intensity data for that transition.

$\gamma\gamma(\theta)$: see 1955Fr06, 1960Ma19, 1961Bo05, 1961Ku03, 1963Ve11, 1969KaZV, 1971SkZX, 1973Di18.

β^- $\gamma(\theta,t)$, $\gamma\gamma(\theta,t)$: see 1963Bo19, 1961Bo05, 1969Fo09, 1969KaZV, 1971HeYP, 1971HeYO.

$\gamma\gamma(\theta,H)$, $\gamma\gamma(\theta,H,t)$: 1960Ma38, 1961Bo05, 1961Ku03, 1971SkZX, 1973Di18.

$\gamma\gamma$-coin: 1954Su12, 1955Fr06, 1958Co61, 1958Kl48, 1961Ha14, 1962Cl03.

Ce(80.6γ): L1:L2=0.0859 *8*, L2:L3=0.962 *9*, M1:M3=0.0744 *22*, M2:M3=0.926 *9*, M45:M3=0.024 *4*, M:M3=2.027 *7*; L3:M3=3.99 *12*, N1:M3=0.024 *3*, N2:M3=0.210 *4*, N3:M3=0.224 *10*, N123:M3=0.458 *11*, O123:M3=0.065 *4*, N123:O123=7.0 *5* (1981Bu24); K:L1:L2:L3:M:M1:M2:M3:N:O= 350 *10*:35 *1*:380 *8*:430 *9*:210 *5*:8.0 *4*:94 *2*:100:42.5 *20*:8.5 *6* (1977Ka30); K:L=0.426 *11* (1968Ni06); L1:L2:L3:M3=87.1 *11*:959 *6*:1000:250 *3* (1966Ka13,1968Ni06); M1:M2:M3:M4:M5=79.0 *18*:934 *8*:1000:10.5 *4*:10.5 *5* (1968Ho19); M:(N+O+P)=3.78 *9* (1968Ni06); N1:N2:N3:N45=85 *28*:90 *7*:1000:10 *8* (1972Dr02); N/O=6.7 *4* (1972Dr02); (M+N)/L=0.320 *3* (1966Da04).

x-rays: (Iγ relative to Iγ(1379.3γ)=100 (1989Ch45)).

Intensity	Designation
13.3 3	L_1 x ray
359 13	L_α x ray
381 13	L_β x ray
59 3	L_γ x ray
346 11	Kα_2 x ray
613 22	Kα_1 x ray
194 8	Kβ_1' x ray
47 2	Kβ_2' x ray

Summary of γ intensity data relative to I(1379γ)=100:

Reference	80.6γ	184.4γ #	521.0γ	674.2γ #	705.4γ #	785.9γ
1962Cl03	730 50	-	-	3.0 5	2.0 5	1.0 5
1967Bu14	667 43	-	-	3.23 22	2.04 32	1.61 32
1970Re16	-	0.22 5	-	2.15 22	1.61 22	1.40 22
1976Ra32	704 32	-	-	3.44 22	2.26 11	1.2 5
1977Al27	672 65	0.129 30	0.032 11	1.76 9	1.37 6	1.25 6
1980VyZZ	-	-	-	1.95 10	1.40 8	1.37 12
1989Ch45	722 8	0.23 1	0.05 2	2.3 1	1.7 1	1.4 1
1992Ar06	656 32	0.097 11	0.0376 43	2.011 32	1.441 22	1.280 22
1995Gi10	-	-	-	2.4 3	-	-
Recommended e	712 10	0.17 4	0.037 4	2.07 10	1.49 8	1.286 23

Reference	1263.0γ	1379.4γ	1447.5γ	1528.2γ	1581.8γ	1662.4γ
1962Cl03	-	100	-	-	19 3	13 3 @
1967Bu14	-	100	-	-	20.6 10	12.9 7
1970Re16	-	100 5	-	-	19.5 10	12.5 6
1976Ra32	-	100	-	-	21.5 11@	9.9 4 @

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1977Al27	0.151 22	100.0 11	0.105 11	0.022	19.7 6	13.0 4	
1980VyZZ	-	100	-	-	20.3 11	13.2 8	
1981Se09	-	100	-	-	-	-	
1989Ch45	0.17 1	100 1	0.12 1	-	19.9 4	12.7 3	
1992Ar06	0.161 32	100.0 11	0.14 5	0.0097 11	19.68 22	13.01 11	
1995Gi10	-	100	-	-	-	-	
Recommended e	0.166 9	100.0	0.114 7	0.0097 11	19.79 22	12.92 14	

Reference	1732.0γ	1749.8γ	1812.8γ	1830.5γ
1962Cl03	-	3.0 5	-	1.0 3 @
1967Bu14	-	3.33 11 @	-	1.00 8 @
1970Re16	-	2.69 22	-	0.86 11
1976Ra32	-	3.01 18	-	0.81 54
1977Al27	-	2.80 22	-	0.89 5
1980VyZZ	-	2.75 15	-	0.83 5
1989Ch45	-	2.8 1	-	0.85 2
1992Ar06	0.0054 22	2.85 4	0.0065 22	0.892 22
Recommended e	0.0054 22	2.84 4	0.0065 22	0.871 15

Data For This γ Are Discrepant (χ^2 Exceeds Critical Value).
@ Statistical Outlier Based On Chauvenet Criterion; Datum Excluded From Average.
e Weighted Average Excluding Statistical Outliers And Data From 1980VyZZ (for Which Evaluator Lacks Complete Documentation).

E_γ[†]	I_γ[‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[&]	Comments
80.576 *2*	712 *10*	80.5775	2^+	0.0	0^+	E2	6.78	α(K)=1.671 *24*; α(L)=3.91 *6*; α(M)=0.954 *14*; α(N+..)=0.241 *4* α(N)=0.216 *3*; α(O)=0.0251 *4*; α(P)=7.29×10^{-5} *11* E_γ: from 1992Ar06. Other precise Eγ: 80.557 *4* (1963Ma08 cryst), 80.574 *8* (1962Ha46 CRYST.), 80.574 *4* (1965Sc09 CRYST.), 80.53 *5* (1960Ma19). I_γ: %Iγ(81)=6.55 *7* (1994Co02). Other %I(81γ): 6.7 *5* (1962Cl03); 6.6 *4* (1981Se09); 6.3 *4* (1966Ne06); 6.1 *4* and 7.2 *6*, respectively, from I(ce(L))/Iβ=0.240 *15* (1966Da04) and I(ce)/Iβ=0.49 *4* (1974Gr41) and E2 theory. Mult.: from α(K)exp=1.72 *6* (1969Ne02), 1.69 *6* (1971Ca08), 1.76 *15* (1960Ma19). M+N/L=0.320 *3* (1966Da04) cf. 0.306 from E2 theory.
184.4 *1*	0.17 *4*	265.02	4^+	80.5775	2^+	E2	0.331	α(K)=0.205 *3*; α(L)=0.0965 *14*; α(M)=0.0231 *4*; α(N+..)=0.00590 *9* α(N)=0.00525 *8*; α(O)=0.000642 *10*; α(P)=9.48×10^{-6} *14* E_γ: from 1970Re16. other Eγ: 184.5 *2* (1992Ar06), 184.5 *10* (1977Al27). I_γ: weighted average of 1970Re16, 1977Al27, 1989Ch45.
520.8 *4*	0.037 *4*	785.865	2^+	265.02	4^+	E2	0.01482	α(K)=0.01185 *17*; α(L)=0.00231 *4*; α(M)=0.000525 *8*; α(N+..)=0.0001383 *20* α(N)=0.0001211 *18*; α(O)=1.645×10^{-5} *24*; α(P)=6.58×10^{-7} *10* E_γ: from 1977Al27. Other Eγ: 520.8 *5* (1992Ar06).
674.188 *15*	2.07 *10*	1460.025	0^+	785.865	2^+			E_γ: weighted average of 674.222 *16* (1992Ar06), 674.08 *10* (1977Al27), 673.99 *4* (1970Re16).

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^{166}Ho β^- decay (26.824 h) (continued)

$\gamma(^{166}Er)$ (continued)

E_γ [†]	I_γ [‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[&]	$I_{(\gamma+ce)}$ [@]	Comments
705.334 *22*	1.49 *8*	785.865	2^+	80.5775	2^+	E2+M1	−5 *+3−14*	0.00716 *13*		α(K)=0.00588 *11*; α(L)=0.000999 *16*; α(M)=0.000225 *4*; α(N+..)=5.96×10^{-5} *10* α(N)=5.20×10^{-5} *9*; α(O)=7.24×10^{-6} *12*; α(P)=3.32×10^{-7} *7* δ: from Adopted Gammas. E_γ: weighted average of 705.352 *26* (1992Ar06), 705.22 *10* (1977Al27), 705.31 *4* (1970Re16).
785.89 *3*	1.286 *23*	785.865	2^+	0.0	0^+	E2		0.00561		α(K)=0.00464 *7*; α(L)=0.000759 *11*; α(M)=0.0001701 *24*; α(N+..)=4.52×10^{-5} *7* α(N)=3.94×10^{-5} *6*; α(O)=5.52×10^{-6} *8*; α(P)=2.63×10^{-7} *4* E_γ: weighted average of 785.88 *4* (1992Ar06), 785.9 *1* (1977Al27), 785.89 *4* (1970Re16).
1263.01 *14*	0.166 *9*	1528.12	2^+	265.02	4^+	E2		0.00212		α(K)=0.001774 *25*; α(L)=0.000259 *4*; α(M)=5.73×10^{-5} *8*; α(N+..)=2.84×10^{-5} *4* α(N)=1.332×10^{-5} *19*; α(O)=1.91×10^{-6} *3*; α(P)=1.011×10^{-7} *15*; α(IPF)=1.309×10^{-5} *19* E_γ: weighted average of 1262.94 *19* (1992Ar06), 1263.08 *20* (1977Al27).
1379.437 *6*	100	1460.025	0^+	80.5775	2^+	E2		0.00181		α(K)=0.001498 *21*; α(L)=0.000216 *3*; α(M)=4.76×10^{-5} *7*; α(N+..)=4.91×10^{-5} *7* α(N)=1.108×10^{-5} *16*; α(O)=1.591×10^{-6} *23*; α(P)=8.54×10^{-8} *12*; α(IPF)=3.64×10^{-5} *5* Mult.: from α(K)exp=1.4×10^{-3} *4* (1974Gr41). E_γ: weighted average of 1379.437 *6* (1992Ar06), 1379.36 *10* (1977Al27), 1379.43 *6* (1970Re16).
1447.52 *9*	0.114 *7*	1528.12	2^+	80.5775	2^+	M1+E2+E0	+0.5 *3*	0.0021 *5*		α(K)=0.0018 *4*; α(L)=0.00025 *6*; α(M)=5.5×10^{-5} *12*; α(N+..)=7.6×10^{-5} *9* α(N)=1.3×10^{-5} *3*; α(O)=1.8×10^{-6} *4*; α(P)=1.03×10^{-7} *25*; α(IPF)=6.1×10^{-5} *6* E_γ: weighted average of 1447.5 *1* (1992Ar06), 1447.59 *20* (1977Al27).
1460.0		1460.025	0^+	0.0	0^+	E0			≈0.030	Mult.: no photon was observed; α(K)exp≥0.3 (1974Gr41). E_γ,$I_{(\gamma+ce)}$: from ce data (1974Gr41). I(ce(K)

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^{166}Ho β^- decay (26.824 h) (continued)

$\gamma(^{166}Er)$ (continued)

E_γ [†]	I_γ [‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[&]	Comments
									1460)/I(ce(K) 1379)=0.2 *1*, so I(ce(K) 1460)=0.030 *15* if α(K)(1379)=0.00150.
1528.23 *15*	0.0097 *11*	1528.12	2^+	0.0	0^+	E2		1.54×10^{-3}	E_γ: from 1992Ar06. Other Eγ: 1528.2 (1977Al27).
1581.834 *7*	19.79 *22*	1662.436	1^-	80.5775	2^+	E1(+M2)	−0.027 *27*	8.69×10^{-4} *15*	α(K)=0.000523 *11*; α(L)=6.94×10^{-5} *15*; α(M)=1.52×10^{-5} *4*; α(N+..)=0.000261 *4* α(N)=3.53×10^{-6} *8*; α(O)=5.11×10^{-7} *11*; α(P)=2.89×10^{-8} *7*; α(IPF)=0.000257 *4* Mult.: from linear polarization (1969He02). δ: from 1968Fo11. E_γ: weighted average of 1581.833 *7* (1992Ar06), 1581.88 *10* (1977Al27), 1581.89 *8* (1970Re16).
1662.439 *6*	12.92 *14*	1662.436	1^-	0.0	0^+	E1		8.77×10^{-4}	E_γ: 1662.439 *6* (1992Ar06), 1662.53 *10* (1977Al27), 1662.48 *8* (1970Re16).
1749.836 *14*	2.84 *4*	1830.425	1^-	80.5775	2^+	(E1(+M2))		0.0023 *15*	E_γ: 1749.833 *14* (1962Cl03), 1749.88 *10* (1977Al27), 1749.94 *10* (1970Re16).
1830.419 *23*	0.871 *15*	1830.425	1^-	0.0	0^+	(E1)		9.20×10^{-4}	E_γ: 1830 *413* 24 (1992Ar06), 1830.46 *10* (1977Al27), 1830.57 *15* (1970Re16).

[†] Weighted average of data from 1977Al27 and 1970Re16, except As noted.

[‡] Weighted average of photon data In table above after elimination of data (denoted there by '@′) which are statistical outliers based on the Chauvenet criterion, and excluding data from 1980VyZZ. uncertainties In I(1379γ) have been added In quadrature to the uncertainties In Iγ of other lines from the same data set before averages were calculated. Other measurements: 1950Si20, 1952Mc05, 1952Mi18, 1954Su12, 1955Fr06, 1955Gr07, 1957Mc34, 1958Co76, 1958Kl48, 1960He09, 1960Ma19, 1961Ha14, 1962El12, 1963Fu17, 1968Da24, 1971Be74.

[#] From Adopted Gammas, unless otherwise noted.

[@] For absolute intensity per 100 decays, multiply by 0.00922 *12*.

[&] 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.

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^{166}Ho β^- decay (26.824 h)

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays