^{162}Ho $\varepsilon+\beta^+$ decay (15.0 min)

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 195,1 (2024)	19-Sep-2023

Parent: ^{162}Ho: E=0.0; $J^\pi=1^+$; $T_{1/2}$=15.0 min *10*; Q(ε)=2141 *3*; %ε+%β^+ decay=100

^{162}Ho-J^π: Additional information 1.

^{162}Ho-$T_{1/2}$: Additional information 2.

^{162}Ho-Q(ε): Additional information 3.

^{162}Ho-Q(ε): From 2021Wa16.

Additional information 4.

Data for the 15-min decay itself are from 1975Ed02 and 1973Ba21. Since this ^{162}Ho state is fed from the decay of the 67-min ^{162}Ho isomer, these γ's also occur in the spectrum of that isomer. The results of 1971Wo09 and 1999Za15 from studies of this isomer have also been used.

1999Za15: ^{162}Ho produced using the ^{159}Tb(α,n) reaction. Both activities were present in the sources. γ's detected using a Clover detector and a 70% Ge detector. Measured $\gamma\gamma$. Emphasis was on the 67-min activity, but new information was gained on this 15-min activity. Authors discuss nature of the first excited 0^+ band. Other reports from this same group are given in 2000Za03 and 1998LiZR.

1979Mi17: ft values calculated.

1975Ed02: ^{162}Ho (15 min and 67 min) produced using the ^{162}Dy(p,n) reaction on an enriched (97%) target and the ^{159}Tb(α,n) reaction. γ's measured using Ge and Si(Li) detectors and ce with a lens spectrometer. Measured γce coincidences. Only portions of their data were reported.

1973Ba21: ^{162}Ho (15 min and 67 min) produced using the ^{162}Dy(p,n) reaction on an enriched (95%) target. γ's measured using Ge detectors.

1969Ak01: ^{162}Ho (15 min and 67 min) produced in ^{162}Dy(p,n). γ's measured using a NaI detector, β^+ with scintillator, and $\gamma\beta$+ coincidences. E(β^+) reported.

1961Jo10: ^{162}Ho (67 min) produced in ^{159}Tb(α,n). Some samples were isotope separated. ^{162}Ho (15 min) separated from the 67-min isomer by a recoil method and γ's measured. γ singles and $\gamma\gamma$ coincidences measured using NaI(Tl) detectors. ce, β^+, and ceγ coincidences measured using a magnetic spectrometer. E(β^+) reported.

Other: 1979Mi17.

^{162}Dy Levels

Additional information 5.

E(level)†	J^π‡	Comments
0.0#	0^+	
80.54# *11*	2^+	
265.61# *12*	4^+	
888.18@ *12*	2^+	
1061.00@ *12*	4^+	E(level): Level is populated by γ from 1453 level, deexcitation γ's are not reported by 1975Ed02 or 1973Ba21, but are given in ^{162}Dy Adopted γ radiations.
1275.8& *12*	1^-	
1400.29a *12*	0^+	
1453.48a *12*	2^+	
1742.5b *5*	1^+	
1782.86b *30*	2^+	

† From least-squares fit to γ energies.

‡ J^π and band assignments are from ^{162}Dy Adopted Levels. Arguments are given there for each assignment. See Adopted Levels for configuration assignments.

Continued on next page (footnotes at end of table)

^{162}Ho $\varepsilon+\beta^+$ decay (15.0 min) (continued)

^{162}Dy Levels (continued)

[#] Band(A): $K^\pi=0^+$ ground-state band.
[@] Band(B): $K^\pi=2^+$ γ-vibrational band.
[&] Band(C): Bandhead of the $K^\pi=0^-$ octupole-vibrational band.
[a] Band(D): First excited $K^\pi=0^+$ band.
[b] Band(E): $K^\pi=1^+$ band.

ε,β^+ radiations

E(decay)	E(level)	Iβ^+ [†@]	Iε[@]	Log *ft*	I($\varepsilon+\beta^+$)[‡@]	Comments
(358.1 *32*)	1782.86		0.038 *4*	6.38 *6*	0.038 *4*	εK=0.7994 *5*; εL=0.1538 *4*; εM+=0.04681 *12*
(398.5 *32*)	1742.5		0.013 *5*	6.95 *17*	0.013 *5*	εK=0.8044 *4*; εL=0.15012 *25*; εM+=0.04551 *9*
(740.7 *32*)	1400.29		4.1 *3*	5.04 *5*	4.1 *3*	εK=0.8228; εL=0.13648 *6*; εM+=0.04070 *3*
(865.2 *34*)	1275.8		0.088 *12*	6.86 *7*	0.088 *12*	εK=0.8256; εL=0.13439 *5*; εM+=0.03997 *2*
(2060.5[#] *32*)	80.54	1.9	50	4.9	52	av Eβ=475.8 *14*; εK=0.8049 *3*; εL=0.12298 *6*; εM+=0.03623 *2* E(decay): ≈2090. Additional information 6.
(2141.0[#] *33*)	0.0	1.9	40	5.0	42	av Eβ=511.3 *14*; εK=0.7967 *4*; εL=0.12153 *6*; εM+=0.03579 *2* E(decay): ≈2170. Additional information 7.

[†] Total β^+ intensity deduced from I(511) is 4.0% (1973Ba21) and 5% (1961Jo10), or as large as 8% from β^+ spectral measurements (1961Jo10). From calculated capture/β^+ ratios, these β^+ transitions will feed only the 0- and 80-keV levels.
[‡] 1961Jo10 deduce that the $\varepsilon+\beta^+$ intensity to 80-keV level is greater than that to the g.s. by a factor of ≈1.3. See, also, 1973Ba21. The Iγ then require that ≈94% of the $\varepsilon+\beta^+$ decays feed these levels, with 42% feeding the ground state. The γ-intensity balances determine the values for the remaining excited states.
[#] For the ≈2170 and ≈2090 values given in comments: from Eβ+=1150 keV, which is the average of Eβ+=1100 (1961Jo10) and 1200 *50* (1969Ak01), and the assumption that this value represents an average of equally intense branches to the g.s. and the 80-keV level. $\gamma\beta$+ and 511−γ coincidences are seen in coincidence with the 80-keV γ only (1961Jo10,1969Ak01).
[@] Absolute intensity per 100 decays.

^{162}Ho $\varepsilon+\beta^+$ decay (15.0 min) (continued)

$\gamma(^{162}Dy)$

Iγ normalization: From total ground-state feeding of 100% and evaluator's assignment of 42% for the $\varepsilon+\beta^+$ feeding of the ground state.

E_γ[†]	I_γ[‡][d]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[@]	Comments
80.7 *2*	210[&] *10*	80.54	2^+	0.0	0^+	E2		6.14	α(K)=1.82 *3*; α(L)=3.32 *5*; α(M)=0.797 *12*; α(N+..)=0.200 *3* α(N)=0.1784 *25*; α(O)=0.0212 *3*; α(P)=7.66×10^{-5} *11* %Iγ=8.0 *6*
185.0 *1*	11	265.61	4^+	80.54	2^+	E2		0.307	α(K)=0.200 *3*; α(L)=0.0826 *12*; α(M)=0.0194 *3*; α(N+..)=0.00494 *7* α(N)=0.00438 *7*; α(O)=0.000550 *8*; α(P)=9.37×10^{-6} *14* %Iγ=0.42
392.485 *10*	0.18 *2*	1453.48	2^+	1061.00	4^+				Iγ: From intensity balance at 265-keV level. %Iγ=0.0069 *9* Eγ: from 2006Ap01, (n,γ). Iγ: from Iγ(392γ)/Iγ(1187γ) in (n,γ) and Iγ(1187γ).
512.0[b] *2*	8[c] *4*	1400.29	0^+	888.18	2^+	[E2]		0.01425	α(K)=0.01150 *17*; α(L)=0.00214 *3*; α(M)=0.000482 *7*; α(N+..)=0.0001262 *18* α(N)=0.0001103 *16*; α(O)=1.525×10^{-5} *22*; α(P)=6.45×10^{-7} *9* %Iγ=0.31 *15*
[x]540 *2*	0.6[&] *2*								%Iγ=0.023 *8*
807.65[b] *7*	1.9[&] *2*	888.18	2^+	80.54	2^+	E2+M1	+57 +∞−*33*	0.00481	α(K)=0.00400 *6*; α(L)=0.000628 *9*; α(M)=0.0001390 *20*; α(N+..)=3.68×10^{-5} *6* α(N)=3.20×10^{-5} *5*; α(O)=4.56×10^{-6} *7*; α(P)=2.30×10^{-7} *4* %Iγ=0.073 *9*
888.00[b] *20*	1.6[&] *3*	888.18	2^+	0.0	0^+	E2		0.00391	α(K)=0.00327 *5*; α(L)=0.000500 *7*; α(M)=0.0001103 *16*; α(N+..)=2.92×10^{-5} *4* α(N)=2.54×10^{-5} *4*; α(O)=3.64×10^{-6} *5*; α(P)=1.88×10^{-7} *3* %Iγ=0.061 *12*
[x]1134 *1*	<1[&]								%Iγ<0.038
1187.85[b] *6*	12.6[c] *4*	1453.48	2^+	265.61	4^+	[E2]		0.00215	α(K)=0.00181 *3*; α(L)=0.000261 *4*; α(M)=5.71×10^{-5} *8*; α(N+..)=1.93×10^{-5} *3* α(N)=1.317×10^{-5} *19*; α(O)=1.91×10^{-6} *3*; α(P)=1.046×10^{-7} *15*; α(IPF)=4.14×10^{-6} *6* %Iγ=0.481 *31*
1195.1 *14*	1.9[a] *2*	1275.8	1^-	80.54	2^+				%Iγ=0.073 *9* Eγ: placement is that of the evaluator, based on presumed similarity with ^{161}Dy(n,γ) E=th.

$^{162}_{66}Dy_{96}$-3

^{162}Ho $\varepsilon+\beta^+$ decay (15.0 min) (continued)

$\gamma(^{162}Dy)$ (continued)

E_γ[†]	I_γ[‡][d]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[@]	$I_{(\gamma+ce)}$[d]	Comments
1276.0 *20*	0.4[&] *2*	1275.8	1^-	0.0	0^+	E1		8.60×10^{-4}		α(K)=0.000687 *10*; α(L)=9.03×10^{-5} *13*; α(M)=1.96×10^{-5} *3*; α(N+..)=6.30×10^{-5} *13* α(N)=4.52×10^{-6} *7*; α(O)=6.62×10^{-7} *10*; α(P)=3.85×10^{-8} *6*; α(IPF)=5.78×10^{-5} *13* %Iγ=0.015 *8* E_γ: From 1971Wo09, where γ is unplaced.
1319.75[b] *7*	100[c]	1400.29	0^+	80.54	2^+	[E2]		1.77×10^{-3}		α(K)=0.001477 *21*; α(L)=0.000209 *3*; α(M)=4.57×10^{-5} *7*; α(N+..)=3.54×10^{-5} *5* α(N)=1.054×10^{-5} *15*; α(O)=1.532×10^{-6} *22*; α(P)=8.53×10^{-8} *12*; α(IPF)=2.33×10^{-5} *4* %Iγ=3.82 *21*
1372.93[b] *8*	20.7[c] *6*	1453.48	2^+	80.54	2^+	M1+E2(+E0)	+0.40 *15*	0.00253 *4*		α(K)=0.00202 *8*; α(L)=0.000277 *10*; α(M)=6.04×10^{-5} *22*; α(N+..)=5.65×10^{-5} *14* α(N)=1.40×10^{-5} *5*; α(O)=2.06×10^{-6} *8*; α(P)=1.21×10^{-7} *5*; α(IPF)=4.03×10^{-5} *8* %Iγ=0.79 *5* Mult.,δ: from 2002Go15 (n,n′γ). α: value computed using the listed mult and δ. No contribution from a possible E0 contribution is included.
1400.3 *3*		1400.29	0^+	0.0	0^+	E0			0.052 *4*	$I_{(\gamma+ce)}$: Computed from Ice(1400K)/Ice(1319K)=0.31 *2* (1975Ed02), α(K)(1319)=0.00148, and α(K)(1400)/α(L)(1400)=7.
1453.77[b] *21*	0.7[c] *3*	1453.48	2^+	0.0	0^+	[E2]		1.50×10^{-3}		α(K)=0.001228 *18*; α(L)=0.0001715 *24*; α(M)=3.74×10^{-5} *6*; α(N+..)=6.83×10^{-5} *10* α(N)=8.64×10^{-6} *12*; α(O)=1.259×10^{-6} *18*; α(P)=7.09×10^{-8} *10*; α(IPF)=5.83×10^{-5} *9* %Iγ=0.027 *12* γ not reported in (n,γ) and (n,n′γ).
1517.2 *5*	0.12[a] *3*	1782.86	2^+	265.61	4^+					%Iγ=0.0046 *12*
1669 *1*	0.2[&] *1*	1742.5	1^+	80.54	2^+					%Iγ=0.008 *4* E_γ: Poor energy fit. 1973Ba21 place this γ from this level, but do not show a γ to ground state.

$^{162}_{66}Dy_{96}$-4

^{162}Ho $\varepsilon+\beta^+$ decay (15.0 min) (continued)

$\gamma(^{162}Dy)$ (continued)

E_γ [†]	I_γ [‡ d]	E_i(level)	J_i^π	E_f	J_f^π	Comments
1702.2 *5*	0.47[a] *6*	1782.86	2^+	80.54	2^+	%Iγ=0.0180 *25*
1740.0 *6*	0.15[a] *4*	1742.5	1^+	0.0	0^+	%Iγ=0.0057 *16* E_γ: Poor energy fit. 1975Ed02 place this γ from this level, but do not show a γ to first 2^+ level.
1783.0 *5*	0.41[a] *6*	1782.86	2^+	0.0	0^+	%Iγ=0.0157 *25*
[x] 1806 *2*	0.40[&] *16*					%Iγ=0.015 *6*

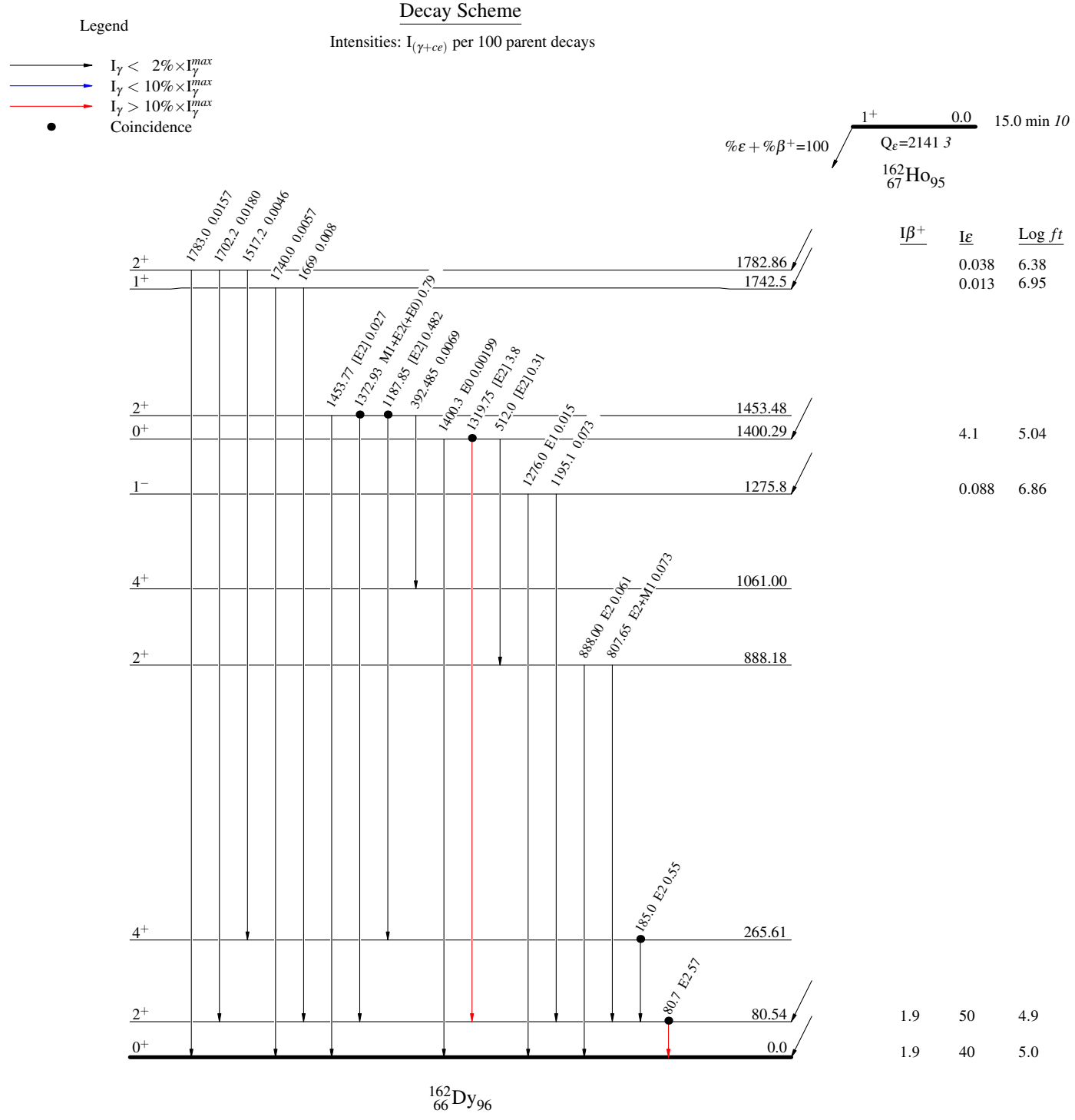
[†] From 1999Za15, 1971Wo09, 1975Ed02, or 1973Ba21 in that order of preference. Unplaced γ′s are from 1973Ba21 only.
[‡] I(511)=230 *20* (1973Ba21).
[#] Assignments and values are from the ^{162}Dy Adopted Gammas Data Set.
[@] Values are computed for the more precise Eγ values in ^{162}Dy Adopted γ radiations.
[&] From 1973Ba21.
[a] From 1975Ed02.
[b] From 1999Za15.
[c] From 1999Za15. The Iγ values are normalized to Iγ=100 for the 1319.7 γ.
[d] For absolute intensity per 100 decays, multiply by 0.0382 *21*.
[x] γ ray not placed in level scheme.

$^{162}_{66}Dy_{96}$-5

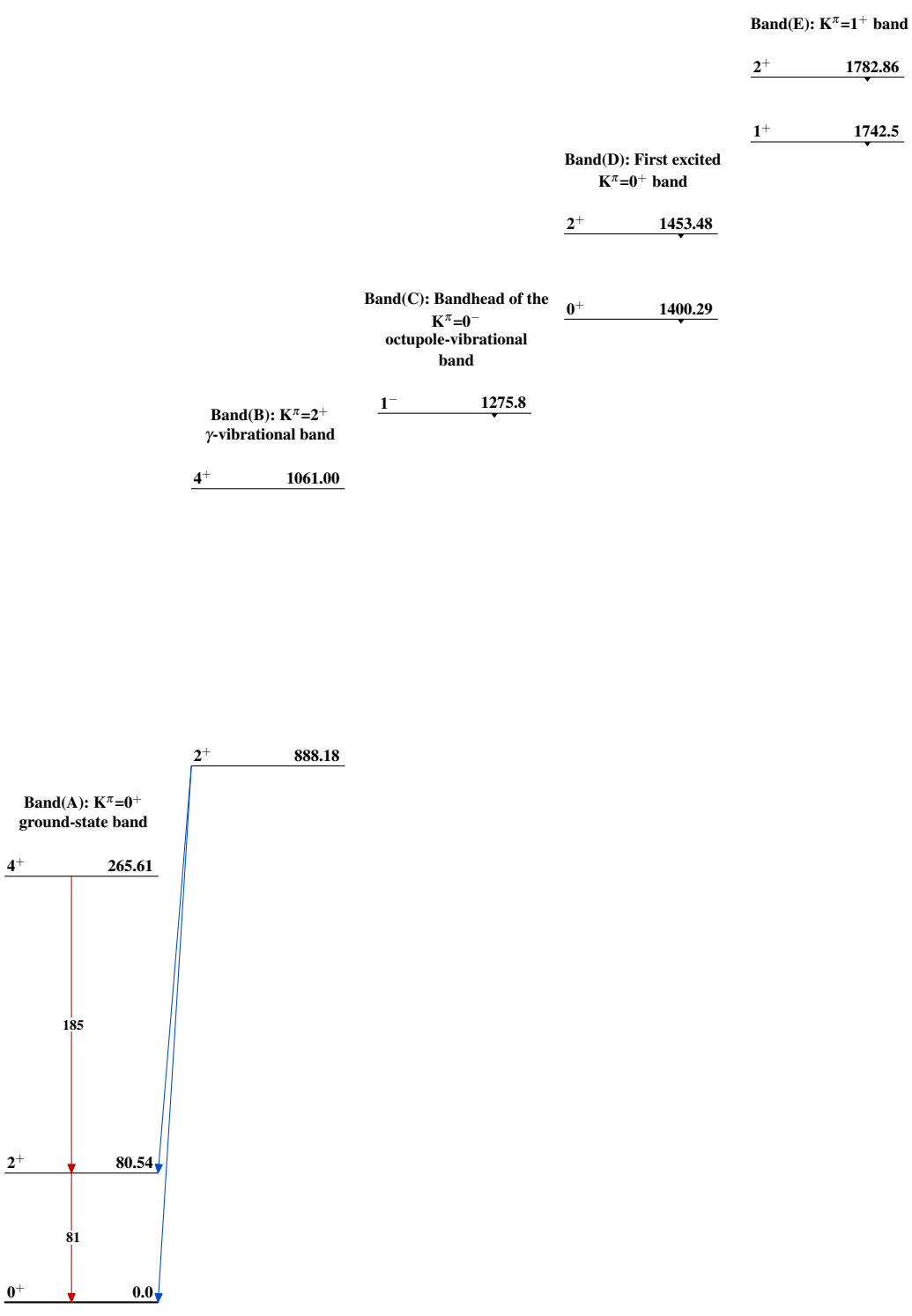
^{162}Ho ε decay (15.0 min)

Decay Scheme

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



^{162}Ho ε decay (15.0 min)



$^{162}_{66}Dy_{96}$