^{159}Er ε decay 1977Bo26,1979Ad08

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	C. W. Reich	NDS 113, 157 (2012)	31-Dec-2010

Parent: ^{159}Er: E=0; J^π=3/2$^-$; $T_{1/2}$=36 min *1*; Q(ε)=2768.5 *20*; %ε+%$β^+$ decay=100.0

Additional information 1.

^{159}Er has been produced by ^{165}Ho(p,7n) (1965St08,1966La11,1977Bo26), by ^{153}Eu(^{11}B,5n) (1977HaYT), and by spallation of Ta target with 660-MeV p (1961Ab06,1968Ab16,1979Ad08).

The decay scheme is essentially that of 1977Bo26.

Experimental methods:

1961Ab06: Measured ce′s for 205γ in magnetic spectrograph.

1965St08: Measured ce′s with 205γ and 624γ in double-focusing spectrometer.

1966La11: Measured γ′s with NaI(Tl) detector; report 9 γ′s.

1968Ab16: Measured γ′s with Ge(Li) detector and ce′s in spectrographs; report 11 γ′s and 2 multipolarities.

1977Bo26: Measured γ singles, γγ coincidences (with Ge detectors), and ce′s (with Si(Li) detector); report 110 γ′s, γγ coincidence table, and 39 multipolarities. Uncertainties are only in general statements.

1979Ad08: Measured γ′s with Ge detectors; ce′s measured with magnetic spectrograph, Si(Li) detector, and toroidal spectrometer. $β^+$ spectra measured with a Si(Li) detector and with a toroidal spectrometer. Report about 150 γ′s, γγ coincidence table, and about 27 multipolarities (most with a crude limit on mixing ratio).

1995AdZW: One-page summary of measured γ′s; reported energies and intensities for γ′s above 1830 keV. No placements and no basis for the small quoted uncertainties. Only those γ′s definitely assigned to this decay are included here.

2007VaZX: Search for three-quasiparticle states of the form (ν3/2[521],ν5/2[523],π7/2[523]) in the region centered around 1.5 MeV excited via *au* β decay from ^{159}Er through ce studies of the high-energy γ radiation from mass-separated ^{159}Er sources. No evidence for such *au* transitions and, hence, for such excitations, was found in this study.

2008IbZZ (Conference Abstract): From study of the ^{159}Er decay using a variety of HPGE detectors and a mini-orange electron detector, report 293 γ transitions, 144 of which are identified with the ^{159}Er decay for the first time. Introduce 11 new levels at 341, 382, 1259, 1433, 1438, 1504, 1758, 1811, 1905, 1947, and 2005 keV. In the absence of the details regarding these conclusions, the evaluator has not included this information in this data set.

^{159}Ho Levels

E(level)[†]	J^π[‡]	$T_{1/2}$	Comments
0.0[#]	7/2$^-$		
97.45[#] *5*	9/2$^-$		
165.91[@] *10*	7/2$^+$		
205.91[&] *5*	1/2$^+$	8.30 s *8*	$T_{1/2}$: From ^{159}Ho isomeric decay.
212.82[&] *13*	3/2$^+$		E(level): Level proposed by 1977Bo26 as 3/2$^+$ member of the π1/2[411] band, with the bandhead at 205 keV. Level populated by several γ′s, but no depopulating γ′s are observed. 1977HaYT place the 3/2$^+$ level at 211.4 keV, with a 211.4 γ to the g.s. This requires the 211.4 γ to be E3, but the data of 1977Bo26 and 1979Ad08 imply a γ of this energy is E1 and this γ is placed from the 424 level.
252.63[a] *18*	5/2$^+$		
298.0[@] *4*			J^π: 1977Bo26 suggest this is the 9/2$^+$ member of the π7/2[404] band. This is supported by the data from the heavy-ion study of 2000Ma06.
312.81?[&] *7*	5/2$^+$		
424.30[b] *10*	1/2$^-$		
464.27?[b] *14*	5/2$^-$		E(level): 1977Bo26 report this level, but have no γ′s depopulating it. From the (α,t) and (^{3}He,d) studies, 1977Pa23 report 5/2$^-$ at 464 keV. From data of 1977Bo26, it is not clear whether level is populated in this decay.
520.50[b] *11*	3/2$^-$		
580.97[c] *10*	(3/2)$^-$		
624.51[d] *10*	5/2$^-$		

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^{159}Er ε decay 1977Bo26,1979Ad08 (continued)

^{159}Ho Levels (continued)

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
649.15[c] *17*	5/2⁻	1398.44 *23*	5/2⁻	1558.3 *6*	5/2⁻	1891.2 *4*	3/2⁻,5/2⁺
671.26[e] *14*	5/2⁺	1468.7 *4*	3/2⁻,5/2⁻	1680.0 *3*	5/2⁻	1901.7 *9*	(3/2⁻,5/2⁻)
814.99 *19*	3/2⁺	1493.0 *5*	3/2⁻,5/2⁻	1690.1 *3*	5/2⁺	2001.8 *6*	(5/2⁺)
1355.4 *6*	(5/2)⁺	1495.7 *5*	(5/2⁻)	1779.8 *3*	3/2⁻,5/2⁻	2091.1 *6*	(3/2⁻,5/2⁻)

† From least-squares fit to γ energies.
‡ Jπ's and configurations are from ^{159}Ho Adopted Levels, but often these are the assignments of 1977Bo26.
# Band(A): π7/2[523] band.
@ Band(B): π7/2[404] band.
& Band(C): π1/2[411] band.
a Band(D): π5/2[402] bandhead.
b Band(E): π1/2[541] band.
c Band(F): Kπ=3/2⁻ band. K-2 γ-vibrational band built on the π7/2[523] g.s. For J≥5/2, mixed with the members of the π5/2[532] band.
d Band(G): Kπ=5/2⁻, π5/2[532], bandhead. Contains an admixture of the K-2 γ-vibrational band built on the 7/2⁻ g.s. band.
e Band(H): Kπ=5/2⁺, π5/2[413], bandhead.

ε,β⁺ radiations

E(decay)	E(level)	Iβ⁺ ‡#	Iε‡#	Log *ft*	I(ε+β⁺)†#	Comments
(677.4 *21*)	2091.1		1.5 *3*	5.81 *9*	1.5 *3*	εK= 0.8186; εL= 0.1395; εM+= 0.0419
(766.7 *21*)	2001.8		1.1 *2*	6.06 *8*	1.1 *2*	εK= 0.8212; εL= 0.1375; εM+= 0.0412
(866.8 *22*)	1901.7		0.37 *7*	6.65 *9*	0.37 *7*	εK= 0.8235; εL= 0.1359; εM+= 0.0406
(877.3 *21*)	1891.2		1.2 *2*	6.15 *7*	1.2 *2*	εK= 0.8237; εL= 0.1357; εM+= 0.0406
(988.7 *20*)	1779.8		2.5 *4*	5.94 *7*	2.5 *4*	εK= 0.8256; εL= 0.1343; εM+= 0.0401
(1078.4 *20*)	1690.1		0.64 *12*	6.61 *9*	0.64 *12*	εK= 0.8269; εL= 0.1334; εM+= 0.03975
(1088.5 *20*)	1680.0		1.1 *2*	6.38 *8*	1.1 *2*	εK= 0.8270; εL= 0.1333; εM+= 0.0397
(1210.2 *21*)	1558.3		1.04 *15*	6.50 *7*	1.04 *15*	εK= 0.8283; εL= 0.1323; εM+= 0.03937
(1272.8 *21*)	1495.7		0.42 *10*	6.94 *11*	0.42 *10*	εK= 0.8288; εL= 0.1318; εM+= 0.03922
(1275.5 *21*)	1493.0		0.75 *15*	6.69 *9*	0.75 *15*	εK= 0.8288; εL= 0.1318; εM+= 0.03921
(1299.8 *21*)	1468.7		1.2 *2*	6.50 *8*	1.2 *2*	εK= 0.8293; εL= 0.1306 *7*; εM+= 0.03880 *23*
(1370.1 *20*)	1398.44		0.79 *14*	6.73 *8*	0.79 *14*	εK= 0.8293; εL= 0.1312; εM+= 0.0390
(1413.1 *21*)	1355.4		0.21 *7*	7.34 *15*	0.21 *7*	εK= 0.8293; εL= 0.1309; εM+= 0.0389
(1953.5 *20*)	814.99	0.025 *5*	1.1 *2*	6.92 *8*	1.1 *2*	av Eβ= 429.5 *9*; εK= 0.8136; εL= 0.1261; εM+= 0.03735
(2097.2 *20*)	671.26	0.064 *19*	1.6 *5*	6.80 *13*	1.7 *5*	av Eβ= 492.6 *9*; εK= 0.8021; εL= 0.1239; εM+= 0.03667
(2119.4 *20*)	649.15	1.0 *1*	25 *3*	5.6	26 *3*	av Eβ= 502.4 *9*; εK= 0.8000; εL= 0.1235; εM+= 0.03656
(2144.0 *20*)	624.51	1.4 *2*	32 *4*	5.53 *6*	33 *4*	av Eβ= 513.2 *9*; εK= 0.7975; εL= 0.1230; εM+= 0.03642
(2187.5 *20*)	580.97	0.12 *2*	2.4 *5*	6.67 *9*	2.5 *5*	av Eβ= 532.4 *9*; εK= 0.7929; εL= 0.1222; εM+= 0.03618
(2248.0 *20*)	520.50	0.08 *2*	1.3 *3*	7.0	1.4 *3*	av Eβ= 559.1 *9*; εK= 0.7859; εL= 0.1210; εM+= 0.03581
(2455.7 *20*)	312.81?	0.09 *5*	0.9 *5*	7.2	1.0 *5*	av Eβ= 650.8 *9*; εK= 0.7568; εL= 0.1161; εM+= 0.03434
(2555.7 *20*)	212.82	1	8	6.3	9	av Eβ= 695.2 *9*; εK= 0.7401; εL= 0.1133; εM+= 0.03352

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^{159}Er ε decay 1977Bo26,1979Ad08 (continued)

ε,β+ radiations (continued)

E(decay)	E(level)	Iβ+ ‡#	Iε‡#	Log *ft*	I(ε+β+)†#	Comments
						I(ε+β+): The net feeding to the 205 and 212 levels is 18%, and this is divided equally between the two levels by evaluator.
(2562.6 *20*)	205.91	1	8	6.3	9	av Eβ= 698.3 *9*; εK= 0.7388; εL= 0.1131; εM+= 0.03346 I(ε+β+): The net feeding to the 205 and 212 levels is 18%, and this is divided equally between the two levels by evaluator.

† Values are from γ-transition intensity balances at each level and are somewhat uncertain due to the incompleteness of the decay scheme. Values are taken to be 0 for the 0 and 97 levels, since these are 2nd forbidden decays. Values of <1% for levels below 1 MeV are considered very uncertain and have been omitted.

‡ The Iε and Iβ+ values are computed from the I(ε+β+) and the theoretical ratios from the log *ft* code.

Absolute intensity per 100 decays.

γ(^{159}Ho)

Iγ normalization: calculated to give 100% feeding of the ground state.

E_γ [†]	I_γ [‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[d]	$I_{(\gamma+ce)}$ [c]	Comments
(6.5)		212.82	3/2+	205.91	1/2+				3.4×10^2	E_γ: γ is not observed, but evaluator assumes this level decays to the 205 level. γ is thus an intraband transition. $I_{(\gamma+ce)}$: Value calculated to give equal ε+β$^+$ feeding of the 205 and 212 levels.
[x]16.8 *1*										Mult.: M1 assigned by author (1979Ad08), although the L3/L1 ratio implies M3. $I_{(\gamma+ce)}$: From ce data of 1979Ad08, transition intensity is 106 if γ is M1 and 85 if γ is M3.
(40.0[f] *1*)	1.88×10^{-3}[f] *24*	205.91	1/2+	165.91	7/2+	[M3]		2.10×10^4 *5*	41 *5*	ce(L)/(γ+ce)=0.736 *12*; ce(M)/(γ+ce)=0.209 *6*; ce(N+)/(γ+ce)=0.0550 *16* ce(N)/(γ+ce)=0.0489 *14*; ce(O)/(γ+ce)=0.00593 *18*; ce(P)/(γ+ce)=0.000116 *4* E_γ: Placement by evaluator based on ^{159}Ho isomer decay (8.3 s) (1971Ge01). $I_{(\gamma+ce)}$: From Iγ(1+α)(40)/Iγ(205)=0.142 *10* as observed in ^{159}Ho isomer decay (8.3 s). I_γ: Calculated from I(γ+ce) and α.
40.0[f] *1*	[f]	464.27?	5/2−	424.30	1/2−	[E2]		139 *3*	13 *3*	ce(L)/(γ+ce)=0.763 *10*; ce(M)/(γ+ce)=0.184 *5*; ce(N+)/(γ+ce)=0.0460 *12* ce(N)/(γ+ce)=0.0413 *11*; ce(O)/(γ+ce)=0.00478 *13*; ce(P)/(γ+ce)=2.31×10^{-6} *6* E_γ: Placed by evaluator as a possible mode of depopulation. $I_{(\gamma+ce)}$: Calculated by evaluator to give intensity balance at 464 level in the absence of any ε+β$^+$ feeding. The value will be larger if there is any ε+β$^+$ feeding. From intensity balance at 424 level, Iγ(1+α)(40) < 31. In contrast, from the ce data of 1979Ad08 for the sum of both 40 γ's, Iγ(1+α)=36 *12* for E2 and/or M3 multipolarity. With Iγ(1+α)(40)=41 *5* from the 205 level, that from the 464 level is Iγ(1+α)(40)=−5 *13*.
[x]68.6 *1*	3.2[a] *4*					M1(+E2)	≤0.75	8.6 *9*		α(K)=5.7 *8*; α(L)=2.2 *13*; α(M)=0.5 *3*; α(N+..)=0.13 *8* α(N)=0.12 *7*; α(O)=0.015 *8*; α(P)=0.00035 *6* δ: Authors' value; their K/L ratio gives δ=0.31 *+5−10*.
[x]85.2 *2*	1.2[a] *4*									

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^{159}Er ε decay 1977Bo26,1979Ad08 (continued)

γ(^{159}Ho) (continued)

E_γ[†]	I_γ[‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[d]	Comments
[x]89.10 *5*	9.3[a] *9*					M1(+E2)	≤1.7	3.9 *3*	α(K)=2.5 *6*; α(L)=1.1 *7*; α(M)=0.27 *17*; α(N+..)=0.07 *5* α(N)=0.06 *4*; α(O)=0.008 *5*; α(P)=0.00014 *5*
97.45 *5*	23 *2*	97.45	9/2⁻	0.0	7/2⁻	M1(+E2)	≤1.7	2.92 *12*	α(K)=1.9 *5*; α(L)=0.8 *5*; α(M)=0.18 *11*; α(N+..)=0.05 *3* α(N)=0.041 *24*; α(O)=0.005 *3*; α(P)=0.00011 *4* I_γ: Calculated by 1979Ad08 from ce data; other: 31.0 *20* (1979Ad08). δ: Authors′ limit; their α_K(exp) gives δ=+1.0 +*7*−*4* and their K/L gives δ < 0.09, which are not consistent.
[x]104.2 *1*	2.1[a] *6*								
[x]105.8 *1*	1.7[a] *4*								
106.90 *5*	12 *2*	312.81?	5/2⁺	205.91	1/2⁺	M1,E2		2.18 *4*	α(K)=1.4 *5*; α(L)=0.6 *4*; α(M)=0.15 *9*; α(N+..)=0.038 *22* α(N)=0.033 *20*; α(O)=0.0042 *22*; α(P)=8.E−5 *4* Mult.: Measurements are consistent with M1,E2, but J^π′s require E2.
[x]113.0 *1*	3.5[a] *7*					E2(+M1)	≥1.7	1.80	α(K)=0.90 *10*; α(L)=0.69 *7*; α(M)=0.165 *17*; α(N+..)=0.042 *5* α(N)=0.037 *4*; α(O)=0.0045 *5*; α(P)=4.2×10^{-5} *8*
[x]123.5 *1*	2.8[a] *11*								
[x]125.8 *1*	1.8[a] *6*								
[x]129.75 *7*	3.5[a] *7*					E2(+M1)	≥1.6	1.11 *3*	α(K)=0.63 *7*; α(L)=0.37 *4*; α(M)=0.089 *9*; α(N+..)=0.0226 *23* α(N)=0.0201 *20*; α(O)=0.00245 *22*; α(P)=3.0×10^{-5} *6*
132.1 *3*	≈10	298.0		165.91	7/2⁺				E_γ: From 1977Bo26.
165.5[@]	<10	814.99	3/2⁺	649.15	5/2⁻				
165.9 *3*	150 *15*	165.91	7/2⁺	0.0	7/2⁻	E1		0.0823	α(K)=0.0691 *11*; α(L)=0.01028 *16*; α(M)=0.00226 *4*; α(N+..)=0.000594 *9* α(N)=0.000518 *8*; α(O)=7.19×10^{-5} *11*; α(P)=3.38×10^{-6} *5* I_γ: Other: 114 *7* (1979Ad08). δ: δ(M2/E1) < 0.10 (1979Ad08).
[x]167.15 *10*	9[a] *1*								
[x]175.45 *10*	3[a] *1*								
[x]199.35 *10*	8[a] *2*								
205.92 *5*	290 *29*	205.91	1/2⁺	0.0	7/2⁻	E3		1.363	α(K)=0.492 *7*; α(L)=0.665 *10*; α(M)=0.1646 *24*; α(N+..)=0.0419 *6* α(N)=0.0374 *6*; α(O)=0.00449 *7*; α(P)=2.76×10^{-5} *4* K/L1=11.9 *4*; L1/L2=0.10 *4*; L2/L3=1.5 *5* (1968Ab16) I_γ: Other: 244 *14* (1979Ad08).
211.48 *10*	35 *7*	424.30	1/2⁻	212.82	3/2⁺	E1		0.0435	α(K)=0.0366 *6*; α(L)=0.00535 *8*; α(M)=0.001176 *17*; α(N+..)=0.000310 *5* α(N)=0.000270 *4*; α(O)=3.78×10^{-5} *6*; α(P)=1.85×10^{-6} *3*
218.4 *1*	≈28	424.30	1/2⁻	205.91	1/2⁺	[E1]		0.0400	α(K)=0.0337 *5*; α(L)=0.00491 *7*; α(M)=0.001079 *16*; α(N+..)=0.000285 *4* α(N)=0.000248 *4*; α(O)=3.48×10^{-5} *5*; α(P)=1.704×10^{-6} *24*
[x]224.8 *4*	9[a] *3*								
[x]237.8 *3*	9[a] *3*								
[x]250.9 *1*	20[a] *6*								
252.3 *3*	123 *18*	252.63	5/2⁺	0.0	7/2⁻	E1		0.0276	α(K)=0.0233 *4*; α(L)=0.00336 *5*; α(M)=0.000739 *11*; α(N+..)=0.000195

$^{159}_{67}Ho_{92}$-5

^{159}Er ε decay 1977Bo26,1979Ad08 (continued)

γ(^{159}Ho) (continued)

E_γ [†]	I_γ [‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[d]	Comments
									3 α(N)=0.0001699 *25*; α(O)=2.39×10^{-5} *4*; α(P)=1.196×10^{-6} *18* I_γ: from 1979Ad08; other:≈100 (1977Bo26).
307.7 *3*	10 *2*	520.50	3/2$^-$	212.82	3/2$^+$	[E1]		0.01677	α(K)=0.01419 *21*; α(L)=0.00202 *3*; α(M)=0.000444 *7*; α(N+..)=0.0001175 *17* α(N)=0.0001023 *15*; α(O)=1.449×10^{-5} *21*; α(P)=7.42×10^{-7} *11*
314.6 *1*	35 *7*	520.50	3/2$^-$	205.91	1/2$^+$	E1		0.01588	α(K)=0.01343 *19*; α(L)=0.00191 *3*; α(M)=0.000420 *6*; α(N+..)=0.0001111 *16* α(N)=9.67×10^{-5} *14*; α(O)=1.371×10^{-5} *20*; α(P)=7.04×10^{-7} *10*
x321.6 *2*	15[a] *3*					E1		0.01504	α(K)=0.01273 *18*; α(L)=0.00181 *3*; α(M)=0.000397 *6*; α(N+..)=0.0001052 *15* α(N)=9.15×10^{-5} *13*; α(O)=1.298×10^{-5} *19*; α(P)=6.68×10^{-7} *10*
x325.9 *2*	7[a] *2*					M1(+E2)	≤4.9	0.076 *23*	α(K)=0.062 *21*; α(L)=0.0110 *11*; α(M)=0.00248 *18*; α(N+..)=0.00066 *6* α(N)=0.00057 *5*; α(O)=8.0×10^{-5} *11*; α(P)=3.6×10^{-6} *15*
x344.2 *2*	5[a] *2*					E2,E1		0.029 *16*	
x366.2 *2*	6.6 *20*								
x370.0	4.4 *13*								I_γ: Other:≤2 (1979Ad08).
373.6[g] *3*		671.26	5/2$^+$	298.0					
x375.0 *2*	4[a] *1*								
390.6 *2*	13 *3*	814.99	3/2$^+$	424.30	1/2$^-$	E1		0.00943	α(K)=0.00799 *12*; α(L)=0.001124 *16*; α(M)=0.000246 *4*; α(N+..)=6.54×10^{-5} *10* α(N)=5.68×10^{-5} *8*; α(O)=8.11×10^{-6} *12*; α(P)=4.26×10^{-7} *6*
418.2 *3*	5.4 *16*	671.26	5/2$^+$	252.63	5/2$^+$	M1(+E2)	≤2.0	0.041 *11*	α(K)=0.034 *10*; α(L)=0.0054 *8*; α(M)=0.00121 *16*; α(N+..)=0.00032 *5* α(N)=0.00028 *4*; α(O)=4.0×10^{-5} *7*; α(P)=2.0×10^{-6} *7*
x434.8 *3*	6[a] *2*								
436.4	7.4 *22*	649.15	5/2$^-$	212.82	3/2$^+$	E1		0.00729	α(K)=0.00618 *9*; α(L)=0.000864 *12*; α(M)=0.000189 *3*; α(N+..)=5.03×10^{-5} *7* α(N)=4.37×10^{-5} *7*; α(O)=6.25×10^{-6} *9*; α(P)=3.32×10^{-7} *5* E_γ: From 1977Bo26. Other: 434.8 *3* (1979Ad08).
x437.3 *3*	7.4 *22*								E_γ: Other: 436.4 (1977Bo26).
x441.3 *3*	4[a] *1*								
x461.9 *3*	6[a] *2*								
x483.3 *3*	4.6 *14*					M1		0.0351	α(K)=0.0297 *5*; α(L)=0.00425 *6*; α(M)=0.000935 *14*; α(N+..)=0.000251 *4* α(N)=0.000217 *3*; α(O)=3.17×10^{-5} *5*; α(P)=1.81×10^{-6} *3*
x499.9 *2*	9[a] *2*					E1,E2		0.011 *6*	
505.4 *1*	55 *11*	671.26	5/2$^+$	165.91	7/2$^+$	M1(+E2)	≤0.61	0.0292 *22*	α(K)=0.0246 *20*; α(L)=0.00359 *20*; α(M)=0.00079 *5*; α(N+..)=0.000212 *12* α(N)=0.000184 *10*; α(O)=2.67×10^{-5} *16*; α(P)=1.48×10^{-6} *13*
551.7 *2*	70 *14*	649.15	5/2$^-$	97.45	9/2$^-$	E2		0.01229	α(K)=0.00994 *14*; α(L)=0.00183 *3*; α(M)=0.000414 *6*; α(N+..)=0.0001088 *16* α(N)=9.51×10^{-5} *14*; α(O)=1.310×10^{-5} *19*; α(P)=5.57×10^{-7} *8*
562.6 *3*	10 *3*	814.99	3/2$^+$	252.63	5/2$^+$	M1(+E2)	≤1.9	0.019 *5*	α(K)=0.016 *5*; α(L)=0.0024 *5*; α(M)=0.00054 *10*; α(N+..)=0.00014 *3* α(N)=0.000124 *23*; α(O)=1.8×10^{-5} *4*; α(P)=1.0×10^{-6} *3*

$^{159}_{67}Ho_{92}$-6

^{159}Er ε decay 1977Bo26,1979Ad08 (continued)

γ(^{159}Ho) (continued)

E_γ[†]	I_γ[‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[d]	Comments
[x]565.3 *4*	6[a] *2*					E2(+M1)	≥1.0	0.015 *3*	α(K)=0.012 *3*; α(L)=0.0020 *3*; α(M)=0.00044 *6*; α(N+..)=0.000118 *17* α(N)=0.000103 *15*; α(O)=1.45×10^{-5} *23*; α(P)=7.0×10^{-7} *17*
581.0 *1*	121 *12*	580.97	(3/2)$^-$	0.0	7/2$^-$	E2		0.01081	α(K)=0.00878 *13*; α(L)=0.001582 *23*; α(M)=0.000356 *5*; α(N+..)=9.38×10^{-5} *14* α(N)=8.20×10^{-5} *12*; α(O)=1.134×10^{-5} *16*; α(P)=4.94×10^{-7} *7*
[x]585.5 *3*	14[a] *2*					E2(+M1)	≥1.1	0.0131 *25*	α(K)=0.0108 *22*; α(L)=0.00178 *24*; α(M)=0.00040 *5*; α(N+..)=0.000106 *14* α(N)=9.2×10^{-5} *12*; α(O)=1.30×10^{-5} *19*; α(P)=6.3×10^{-7} *14*
[x]592.0 *3*	7[a] *2*					E2		0.01033	α(K)=0.00840 *12*; α(L)=0.001501 *22*; α(M)=0.000338 *5*; α(N+..)=8.90×10^{-5} *13* α(N)=7.78×10^{-5} *11*; α(O)=1.077×10^{-5} *16*; α(P)=4.73×10^{-7} *7*
[x]599.5 *3*	8.2 *25*					M1(+E2)	≤3.2	0.016 *5*	α(K)=0.013 *5*; α(L)=0.0020 *5*; α(M)=0.00044 *10*; α(N+..)=0.00012 *3* α(N)=0.000102 *23*; α(O)=1.5×10^{-5} *4*; α(P)=8.E−7 *3*
[x]610.2[&] *3*	6.0 *18*								I_γ: Other: 2 *1* (1979Ad08).
[x]613.8 *3*	4.8 *14*								I_γ: Other: 9 *2* (1979Ad08).
624.5 *1*	1000 *99*	624.51	5/2$^-$	0.0	7/2$^-$	M1		0.0183	α(K)=0.01549 *22*; α(L)=0.00220 *3*; α(M)=0.000483 *7*; α(N+..)=0.0001296 *19* α(N)=0.0001123 *16*; α(O)=1.640×10^{-5} *23*; α(P)=9.37×10^{-7} *14* E_γ: Other: 624.423 *19* from 1995AdZW.
[x]635.3 *4*	10[a] *3*					E2(+M1)	≥0.56	0.012 *4*	α(K)=0.010 *3*; α(L)=0.0016 *4*; α(M)=0.00035 *7*; α(N+..)=9.3×10^{-5} *20* α(N)=8.1×10^{-5} *17*; α(O)=1.1×10^{-5} *3*; α(P)=5.9×10^{-7} *19*
649.1 *3*	700 *70*	649.15	5/2$^-$	0.0	7/2$^-$	M1(+E2)	≤0.67	0.0153 *13*	α(K)=0.0129 *12*; α(L)=0.00187 *13*; α(M)=0.00041 *3*; α(N+..)=0.000110 *8* α(N)=9.5×10^{-5} *7*; α(O)=1.39×10^{-5} *11*; α(P)=7.8×10^{-7} *8* E_γ: From 1977Bo26. I_γ: Other:≤3 (1979Ad08).
[x]668.0	7.2 *22*								
[x]674.5 *4*	3[a] *1*								
[x]679.2 *4*	5[a] *2*								
[x]697.7 *5*	3[a] *1*								
[x]758.8 *3*	6[a] *2*								
774.2[g] *3*	5.5 *17*	1355.4	(5/2)$^+$	580.97	(3/2)$^-$	[E1]		0.00214	α(K)=0.00182 *3*; α(L)=0.000247 *4*; α(M)=5.39×10^{-5} *8*; α(N+..)=1.437×10^{-5} *21* α(N)=1.246×10^{-5} *18*; α(O)=1.80×10^{-6} *3*; α(P)=1.001×10^{-7} *14*
[x]779.8 *3*	9[a] *2*								
[x]783.5 *5*	4[a] *2*								
[x]796.4 *3*	9[a] *2*								
[x]800.4 *5*	3[a] *1*								
[x]809.3 *5*	9[a] *3*								

$^{159}_{67}Ho_{92}$-7

^{159}Er ε decay 1977Bo26,1979Ad08 (continued)

γ(^{159}Ho) (continued)

E_γ[†]	I_γ[‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[d]	Comments
[x]811.8 *5*	2[a] *1*								
817.6 *3*	7.7 *23*	1398.44	5/2⁻	580.97	(3/2)⁻	M1,E2		0.0071 *23*	α(K)=0.0060 *20*; α(L)=0.00088 *24*; α(M)=0.00019 *5*; α(N+..)=5.2×10⁻⁵ *14* α(N)=4.5×10⁻⁵ *12*; α(O)=6.5×10⁻⁶ *18*; α(P)=3.6×10⁻⁷ *13* E_γ: From 1977Bo26.
[x]819.7 *4*	6[a] *2*								
844.0 *4*	21 *4*	1468.7	3/2⁻,5/2⁻	624.51	5/2⁻	M1(+E2)	≤0.83	0.0078 *9*	α(K)=0.0066 *8*; α(L)=0.00094 *9*; α(M)=0.000207 *20*; α(N+..)=5.6×10⁻⁵ *6* α(N)=4.8×10⁻⁵ *5*; α(O)=7.0×10⁻⁶ *7*; α(P)=4.0×10⁻⁷ *5*
[x]851.5 *7*	23 *5*								I_γ: Other 7 *3* (1979Ad08).
[x]857.3 *5*	7[a] *2*								
[x]880.0 *10*	9[a] *4*								
888.1 *5*	15 *3*	1468.7	3/2⁻,5/2⁻	580.97	(3/2)⁻				
[x]910.3 *5*	7[a] *2*								
[x]919.2 *5*	3.4 *10*								I_γ: Other 6 *2* (1979Ad08).
[x]932.6 *5*	11[a] *3*								
[x]942.5 *4*	32 *6*					E1,E2		0.0026 *11*	
947.3[g]	4.5	1468.7	3/2⁻,5/2⁻	520.50	3/2⁻	M1,E2		0.0051 *15*	E_γ: From 1977Bo26. Other: 949.0 (1979Ad08). I_γ: Other:≤3 (1979Ad08).
[x]964.9 *5*	9 *3*					M1		0.00624	α(K)=0.00530 *8*; α(L)=0.000741 *11*; α(M)=0.0001624 *23*; α(N+..)=4.36×10⁻⁵ *7* α(N)=3.77×10⁻⁵ *6*; α(O)=5.52×10⁻⁶ *8*; α(P)=3.18×10⁻⁷ *5*
973.0 *6*	4.5 *13*	1493.0	3/2⁻,5/2⁻	520.50	3/2⁻	M1		0.00612	α(K)=0.00519 *8*; α(L)=0.000725 *11*; α(M)=0.0001591 *23*; α(N+..)=4.27×10⁻⁵ *6* α(N)=3.70×10⁻⁵ *6*; α(O)=5.41×10⁻⁶ *8*; α(P)=3.11×10⁻⁷ *5*
[x]988.5 *6*	5.9 *18*					M1		0.00589	α(K)=0.00499 *7*; α(L)=0.000698 *10*; α(M)=0.0001530 *22*; α(N+..)=4.11×10⁻⁵ *6* α(N)=3.56×10⁻⁵ *5*; α(O)=5.20×10⁻⁶ *8*; α(P)=3.00×10⁻⁷ *5*
[x]1046.0 *6*	5.7 *17*								
[x]1052.0	3.4								I_γ: Other:≤2 (1979Ad08).
[x]1078.8 *8*	2.9 *9*								
[x]1086.4 *6*	2.8 *8*								I_γ: Other: 9 *3* (1979Ad08).
[x]1103.4 *6*	7[a] *2*								
[x]1110.1	4.7								I_γ: other: 10 *4* (1979Ad08).
[x]1120.2 *5*	4.2 *13*								
[x]1125.2 *6*	3.3 *10*								
[x]1139.2 *6*	6.0 *18*								E_γ: Other: 1137.6 (1977Bo26).
[x]1152.4[@]	5.9								
[x]1186.2 *6*	8.3 *25*								
1189.5 *6*	6.4 *19*	1355.4	(5/2)⁺	165.91	7/2⁺	M1		0.00377	α(K)=0.00320 *5*; α(L)=0.000444 *7*; α(M)=9.74×10⁻⁵ *14*; α(N+..)=3.11×10⁻⁵ *5*

^{159}Er ε decay 1977Bo26,1979Ad08 (continued)

γ(^{159}Ho) (continued)

E_γ [†]	I_γ [‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	α [d]	Comments
								α(N)=2.26×10^{-5} *4*; α(O)=3.31×10^{-6} *5*; α(P)=1.91×10^{-7} *3*; α(IPF)=4.98×10^{-6} *10*
1198.8 *5*	25 *5*	1779.8	3/2$^-$,5/2$^-$	580.97	(3/2)$^-$	M1	0.00370	
x1210.4 *6*	13 *3*							
x1219.8	6.2 *19*							E_γ: From 1977Bo26. I_γ: Other:≤4 (1979Ad08).
x1224.5	4.4							E_γ: From 1977Bo26; other: 1225.8 *6* (1979Ad08), but this may be doublet including 1224.5 and 1226.1 (from 1689 level). I_γ: Other: 14 *5* (1979Ad08), but this is probably doublet including 1224.5 and 1226.1 (from 1689 level).
1226.1[@] *3*	8.8 *26*	1690.1	5/2$^+$	464.27?	5/2$^-$	[E1]		
1230.4 *8*	11 *2*	1901.7	(3/2$^-$,5/2$^-$)	671.26	5/2$^+$	(E1)	0.00090	
1232.4 *3*	16 *3*	1398.44	5/2$^-$	165.91	7/2$^+$	(E1)		E_γ: From 1977Bo26.
1239.9 *6*	18 *4*	1493.0	3/2$^-$,5/2$^-$	252.63	5/2$^+$	(E1)		
1255.7[eg] *7*		1468.7	3/2$^-$,5/2$^-$	212.82	3/2$^+$			
1255.7[e] *7*	5.5 *16*	1680.0	5/2$^-$	424.30	1/2$^-$			
x1261.4 *8*	5[a] *2*							
x1281.2 *7*	5[a] *2*							
x1285.2 *7*	5.7 *17*							
x1292.5 *7*	6.3 *19*							
x1295.4	3.5 *10*							E_γ: From 1977Bo26. I_γ: Other:≤2 (1979Ad08).
1316.2	4.6 *14*	1779.8	3/2$^-$,5/2$^-$	464.27?	5/2$^-$	[M1,E2]		
1329.5 *7*	8.6 *26*	1495.7	(5/2$^-$)	165.91	7/2$^+$	(E1)		
x1334.3 *7*	7.8 *23*							
x1338.5 *8*	5[a] *2*							
1355.3 *6*	29 *6*	1779.8	3/2$^-$,5/2$^-$	424.30	1/2$^-$	E2	0.00177	
x1366.0 *8*	4[a] *2*							
1392.7 *7*	17 *3*	1558.3	5/2$^-$	165.91	7/2$^+$	(E1)		
x1402.7 *7*	8.7 *26*					M1,E2	0.0021 *5*	
x1408.6 *7*	11[a] *2*							
x1419.2 *7*	4.7 *14*							E_γ: Other: 1418.1 (1977Bo26).
1427.2 *6*	23 *5*	1680.0	5/2$^-$	252.63	5/2$^+$	[E1]		
x1442.6 *8*	5.0 *15*							E_γ: Other: 1443.3 (1977Bo26).
x1445.8 *8*	6.2 *19*							
x1459.0 *8*	10 *3*							
1467.6 *8*	7.8 *23*	1779.8	3/2$^-$,5/2$^-$	312.81?	5/2$^+$	[E1]		
1477.5 *8*	5.8 *17*	1690.1	5/2$^+$	212.82	3/2$^+$	[M1,E2]	0.0019 *4*	
1496.0 *7*	4.0 *12*	1495.7	(5/2$^-$)	0.0	7/2$^-$			
1522.8 *7*	4.4 *13*	1690.1	5/2$^+$	165.91	7/2$^+$	M1		
x1552.4 *7*	28 *6*					(E1)		
1557.9 *8*	14 *3*	1558.3	5/2$^-$	0.0	7/2$^-$	M1,E2		
1566.3 *8*	8.1 *24*	1779.8	3/2$^-$,5/2$^-$	212.82	3/2$^+$	[E1]		

$^{159}_{67}Ho_{92}$-9

^{159}Er ε decay 1977Bo26,1979Ad08 (continued)

γ(^{159}Ho) (continued)

E_γ[†]	I_γ[‡c]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	Comments
[x]1593.7 *8*	4.2 *13*						E_γ: Other: 1594.8 (1977Bo26).
[x]1598.3 *8*	7.9 *24*					E2	
[x]1617.2 *8*	3.8 *11*						
[x]1630.2 *7*	10 *2*						E_γ: Other: 1631.8 (1977Bo26).
[x]1653.6 *8*	3.7 *11*						
[x]1658.9 *8*	5.1 *15*						
1678.8 *7*	2.2 *7*	1891.2	$3/2^-,5/2^+$	212.82	$3/2^+$		
1680.0[@] *3*	4.4 *13*	1680.0	$5/2^-$	0.0	$7/2^-$		
1685.0 *7*	3.8 *11*	1891.2	$3/2^-,5/2^+$	205.91	$1/2^+$		
[x]1708.8 *8*	3.9 *12*						
1749.5 *8*	3.6 *11*	2001.8	$(5/2^+)$	252.63	$5/2^+$		
[x]1775.8 *8*	7.3 *22*						
[x]1786.4 *8*	5.1 *15*						
[x]1791.1 *8*	3.6 *11*						
[x]1833.52[b] *27*	1.45[b] *25*						
1838.3 *7*	37 *7*	2091.1	$(3/2^-,5/2^-)$	252.63	$5/2^+$	(E1)	E_γ,I_γ: Other: 1838.527 *28* and 37.1 *5* from 1995AdZW.
[x]1849.4[b] *4*	1.63[b] *23*						
[x]1852.56[b] *17*	3.4[b] *3*						
[x]1887.37[b] *13*	4.49[b] *25*						
1891.0 *7*	31 *6*	1891.2	$3/2^-,5/2^+$	0.0	$7/2^-$		E_γ,I_γ: Other: 1890.97 *3* and 31.0 *6* from 1995AdZW.
[x]1906.0 *8*	3.9 *12*						E_γ,I_γ: Other: 1906.37 *7* and 6.2 *3* from 1995AdZW.
[x]1928.0 *8*	5[a] *2*						
[x]1948.44[b] *12*	5.27[b] *26*						
[x]1965.77[b] *13*	4.17[b] *22*						
[x]1997.5[b] *3*	1.39[b] *24*						
2001.6 *7*	29 *6*	2001.8	$(5/2^+)$	0.0	$7/2^-$	(E1)	E_γ,I_γ: Other: 2001.65 *3* and 28.1 *4* from 1995AdZW.
[x]2006.0 *8*	15 *3*					E2	E_γ,I_γ: Others: 2006.52 *4* and 14.3 *3* from 1995AdZW and Iγ = 8 *2* (1979Ad08).
[x]2020.49[b] *18*	4.09[b] *28*						
[x]2063.0[b] *4*	2.8[b] *5*						
2091.2 *8*	8.6 *26*	2091.1	$(3/2^-,5/2^-)$	0.0	$7/2^-$		E_γ,I_γ: Other: 2091.28 *4* and 8.7 *3* from 1995AdZW.
[x]2122.60[b] *25*	2.6[b] *4*						
[x]2146.7[b] *4*	0.76[b] *17*						
[x]2203.9 *8*	5[a] *2*						
[x]2217.64[b] *24*	3.1[b] *3*						
[x]2390.7[b] *3*	0.74[b] *13*						
[x]2429.0 *10*	9[a] *3*						
[x]2430.74[b] *27*	1.49[b] *16*						
[x]2445.73[b] *16*	1.19[b] *12*						
[x]2459.0[b] *4*	0.82[b] *15*						

$^{159}_{67}Ho_{92}$-10

^{159}Er ε decay 1977Bo26,1979Ad08 (continued)

γ(^{159}Ho) (continued)

E_γ †	I_γ ‡ c	E_i(level)	E_γ †	I_γ ‡ c	E_i(level)	E_γ †	I_γ ‡ c	E_i(level)
x2462.9 b 4	0.92 b 15		x2688.93 b 29	1.34 b 16		x2843.96 b 27	0.97 b 12	
x2525.8 b 4	0.83 b 13		x2700.40 b 28	1.45 b 17		x2859.9 b 5	0.62 b 12	
x2635.42 b 13	2.48 b 16		x2757.5 b 4	0.82 b 13				
x2675.03 b 28	1.39 b 18		x2765.5 b 4	0.77 b 12				

† From 1979Ad08, unless noted as from 1977Bo26 or 1995AdZW; significant differences between 1979Ad08 and 1977Bo26 values are noted. Uncertainties in 1977Bo26 are≈0.3 keV from a general statement; these uncertainties have not been included here.

‡ From 1977Bo26, unless noted as from 1979Ad08 or 1995AdZW. Significant differences between 1979Ad08 and 1977Bo26 are noted. Uncertainties in 1977Bo26 are 10% to 30% from a general comment and are assigned by the evaluator as 30% for Iγ < 10, 20% for 10 ≤Iγ < 100, and 10% for Iγ≥100.

From ^{159}Ho Adopted γ radiations, but based on α_K(exp) and α_L(exp) data of 1977Bo26 and 1979Ad08. Values were normalized for an E3 assignment for the 205.9 G.

@ Reported only in 1977Bo26.

& From 1977Bo26.

a From 1979Ad08.

b From 1995AdZW.

c For absolute intensity per 100 decays, multiply by 0.0334 *16*.

d 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.

e Multiply placed.

f Multiply placed with intensity suitably divided.

g Placement of transition in the level scheme is uncertain.

x γ ray not placed in level scheme.

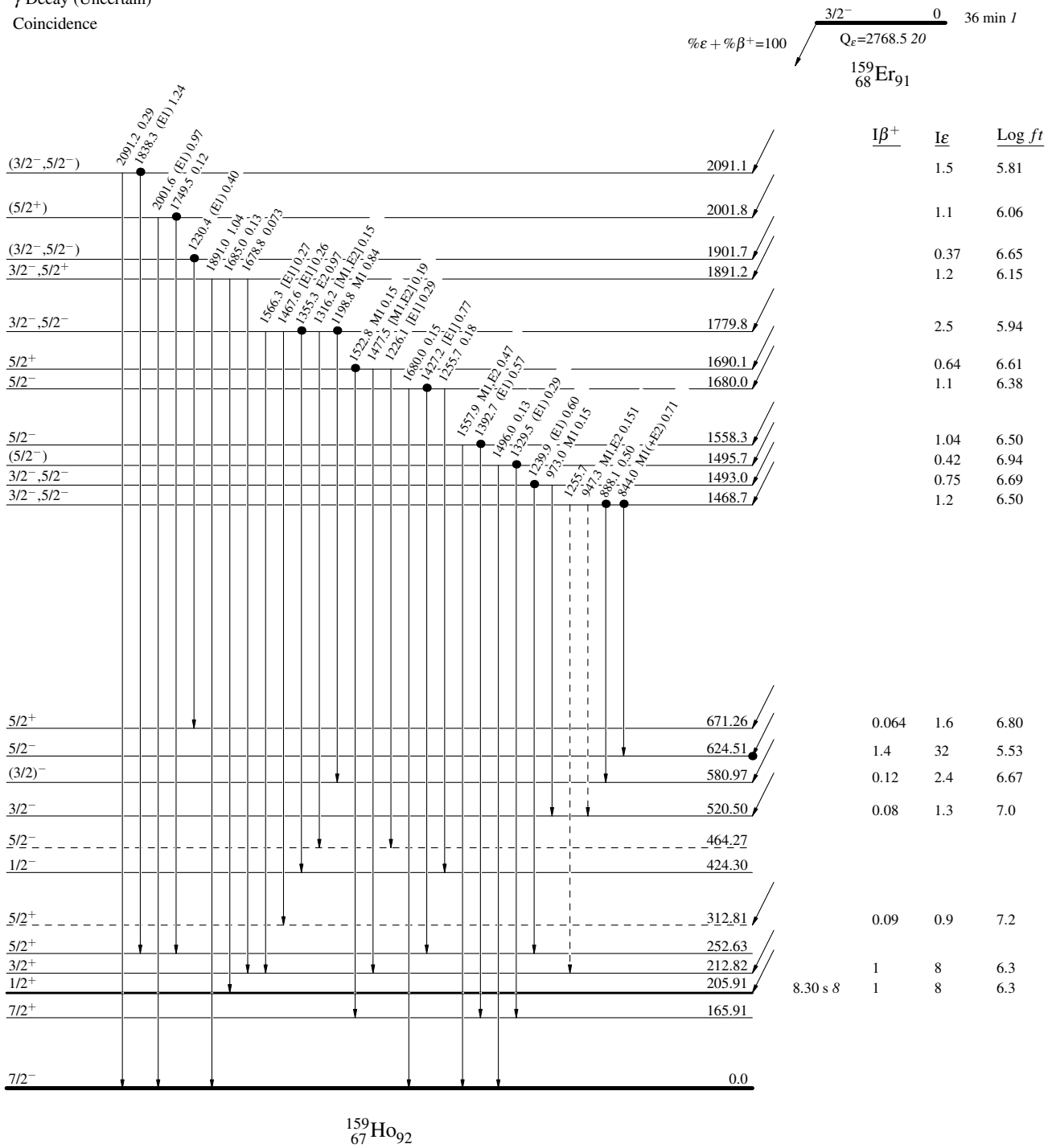
$^{159}_{67}Ho_{92}$-11

^{159}Er ε decay 1977Bo26,1979Ad08

Decay Scheme

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

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

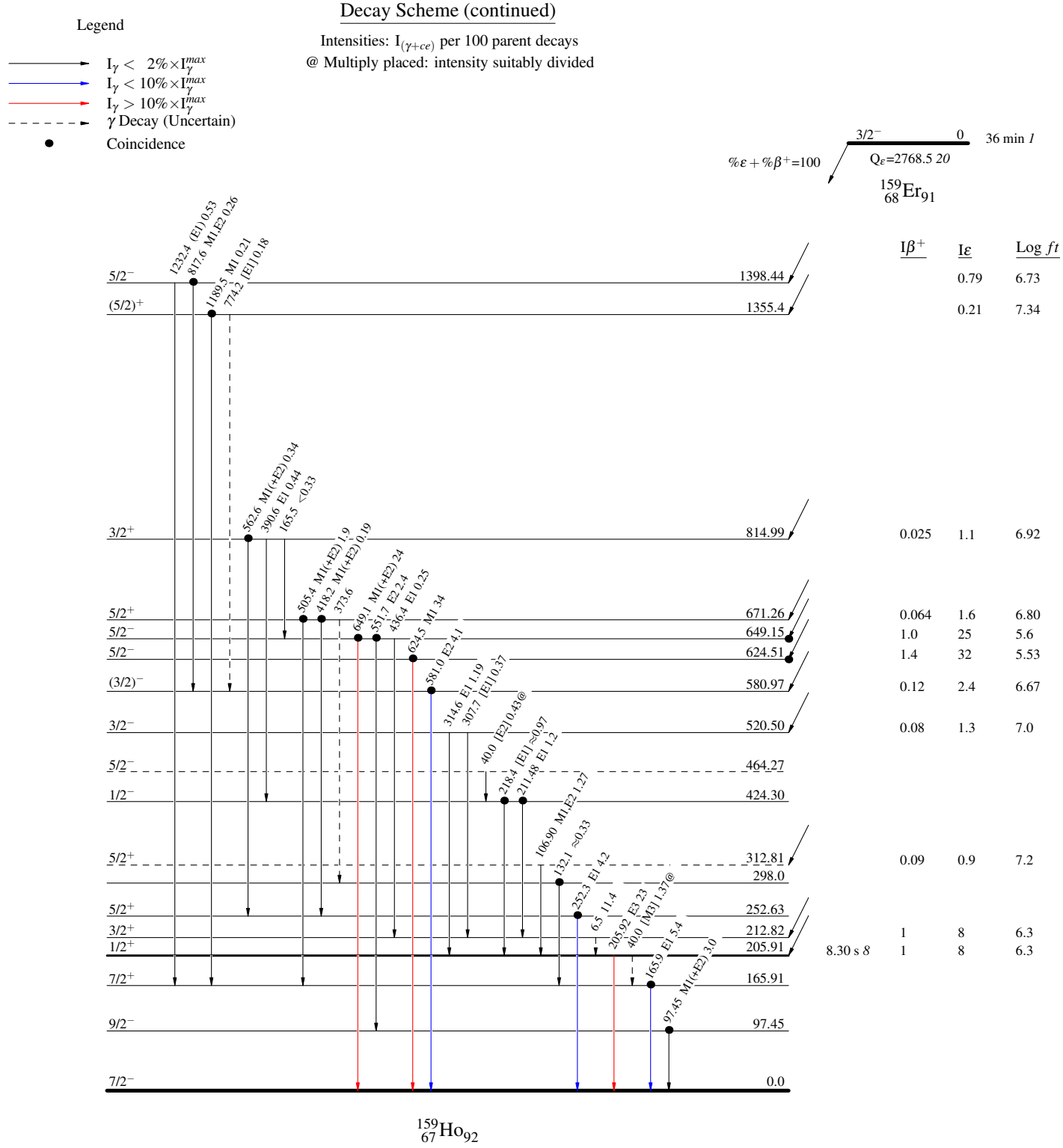


$^{159}_{67}Ho_{92}$

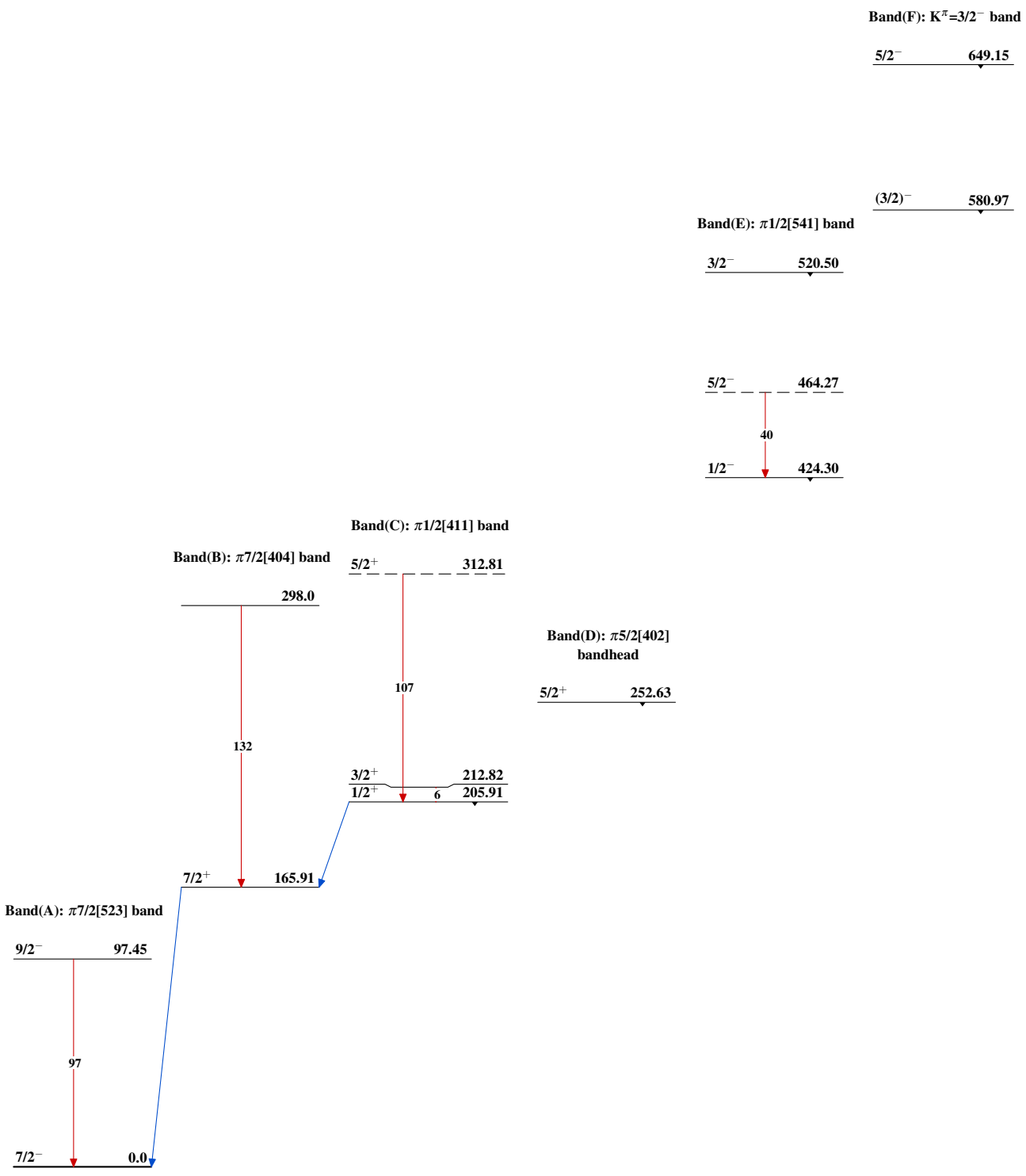
^{159}Er ε decay 1977Bo26,1979Ad08

Decay Scheme (continued)

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



^{159}Er ε decay 1977Bo26,1979Ad08



$^{159}_{67}Ho_{92}$

^{159}Er ε decay 1977Bo26,1979Ad08 (continued)

Band(G): $K^{\pi}=5/2^{-}$, $\pi 5/2[532]$, bandhead		Band(H): $K^{\pi}=5/2^{+}$, $\pi 5/2[413]$, bandhead	
$5/2^{-}$	624.51	$5/2^{+}$	671.26

$^{159}_{67}Ho_{92}$