^{158}Er ε decay 1977AnYX,1982Vy06,1996Go06

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 141, 1 (2017)	1-Feb-2017

Parent: ^{158}Er: E=0.0; J$^{\pi}$=0$^+$; T$_{1/2}$=2.29 h *6*; Q(ε)=880 *40*; %ε decay=100.0

^{158}Er-Q(ε): From 2012Wa38; 890 keV *30* (V.G. Kalinnikov, priv. comm., 2010).

The decay scheme is that of 1982Vy06 with changes from 1996Go06 to incorporate the 7.7-keV γ; the coincidence data of 1982Vy06 indicate that several levels proposed by 1972Ha41, and repeated by 1977AnYX, do not exist.

This decay scheme is not well established. The decay energy, now established to 880 keV *40* by the mass evaluators (2012Wa38) and sustained by the more recent figure of 890 keV *30* (V.G. Kalinnikov, priv. comm., 2010), was previously in dispute with the mass evaluation, when some of the important references reported of β+ decay to excited levels giving the decay energy of $\approx$ 1700 keV (1961Bo24, 1977KaYG, 1982Vy06). Also, 1977AnYX assigned several γ's with energies above 1000 keV to this decay. While the lower decay energy has been adopted here, some questions can be raised whether the present data are still subject of some inconsistencies.

Primary references are 1977AnYX, 1982Vy06 (which is a summary of previous work at this laboratory), 1996Go06, and 1998KaZV; other measurements include 1981BuZJ, 1978Sc10, 1977KaYG, 1977AnZG, 1975Ru02 (1974RuZX, 1973RuZO), 1975Gr44, 1975BuZQ, 1975AlYQ, 1972Ha41 (1970HaZG, 1970HaZG), 1971TrZQ, 1968Ab04, 1968Ab18, 1965St08, 1961Gr25, 1961Bo24, and 1960Dn01.

After 1996, there is a series of experimental studies (very short conference papers) continuing 1982Vy06 and 1996Go06 done with YaSNAPP-2 ISOL complex (consisting mostly of Ge detectors) by measuring γ and Kx-rays and $\gamma\gamma$ and Kx-γ coin, and dealing with ^{158}Er ε decay to ^{158}Ho, and ^{158}Ho ε decay to ^{158}Dy: 2006VaZY, 2004KaZT (^{158}Ho levels, Qε), 2005KaZY (^{158}Ho excited levels T$_{1/2}$'s), 2008VaZU (^{158}Dy 0$^+$ state), 2011GoZY (^{158}Ho excited levels, Eγ's and Iγ's, but not placed to levels), 2011StZX (Eγ's previously observed in ^{158}Ho but not confirmed hereby). The evaluator received the notes of the private communication of B. Singh with V.G. Kalinnikov, co-author of most of these publications, who proposed some new details and corrections to the previously reported data. These are referenced in this evaluation as "V.G. Kalinnikov, priv. comm., 2010".

Sources produced by spallation of Ta with 660-MeV p, Ho(p,xn), ^{160}Dy(α,6n), ^{150}Sm(^{12}C,4n), and ^{151}Eu(^{11}B,4n) reactions often followed by chemical and/or mass separation. Measurements include E$_{\gamma}$, I$_{\gamma}$, I$_{ce}$, and γ-ce coincidences.

^{158}Ho Levels

See 1981BuZJ for ce-γ coincidence results. Also some of the results of V.G. Kalinnikov, priv. comm., 2010 are based on coincidence results.

2011GoZY give a list of levels (reproduced here exactly by translation from Russian): "74.9 keV (2$^+$) and its rotational state 125.6 keV, 3$^+$; 91.6 keV (1$^-$) and its rotational state 137.1, 2$^-$; 146.8 keV (1$^+$) with rotational states 190.2 keV, 2$^+$ and 254.3 keV, 3$^+$ (presumably). Observed are also a few excitations with states J$^{\pi}$=1$^+$ for energies 385.7; 433.2; 461.7 and 662.7 keV. Presumably characteristic J$^{\pi}$=1$^+$ have levels 810.8 and 857.7 keV". γ-ray energies and relative intensities are also given in a table, (given as unplaced gammas in the γ(^{158}Ho). Table below) but there is no level scheme drawing or a specification of the placement of the γ transitions to levels. However V.G. Kalinnikov, priv. comm., 2010 place many of these γ's and levels in the levels scheme, that are considered in this evaluation as well.

E(level)[†]	J$^{\pi}$[‡]	T$_{1/2}$	Comments
0.0	5$^+$	11.3 min *4*	T$_{1/2}$: From ^{158}Ho Adopted Levels.
67.200 *10*	2$^-$	28 min *2*	%ε+%β^+<19; %IT>81 μ=+2.44 *3*; Q=+1.66 *17* %ε+%β^+: From I$_{\gamma+ce}$(feeding 67 level)-I$_{\gamma+ce}$(67), assuming I$_{\gamma}$(67) was measured at equilibrium in ^{158}Er ε decay. T$_{1/2}$: From ^{158}Ho Adopted Levels.
74.897 *11*	2$^+$	60 ns *10*	E(level): level proposed by 1996Go06. T$_{1/2}$: From 2005KaZY, with uncertainty adjusted by V.G. Kalinnikov, priv. comm., 2010; same value as in ^{158}Ho Adopted Levels.
91.595 *12*	1$^-$,2$^-$,3$^-$	140 ns *25*	T$_{1/2}$: From 2005KaZY, same value as in ^{158}Ho Adopted Levels.
125.62 *5*	(2$^+$)[#]		

Continued on next page (footnotes at end of table)

^{158}Er ε decay 1977AnYX,1982Vy06,1996Go06 (continued)

^{158}Ho Levels (continued)

E(level)†	J^{π}‡	$T_{1/2}$	Comments
137.099 *25*	(2^-)#		
146.801 *11*	1^+	1.85 ns *10*	$T_{1/2}$: From X_K-ce delayed coincidence (1978Sc10, 1977AnZG), same value as in ^{158}Ho Adopted Levels; other: 1.7 *2* (1973BuZT).
190.243 *15*	$0^+,1^+,2^+$		
240.75 *4*	$0^+,1^+$		
255.034 *18*	(3^+)#		E(level): postulated by V.G. Kalinnikov, priv. comm., 2010 based only on Ritz rules.
385.708 *19*	1^+		
395.186 *18*	0,1		
398.13? *5*	$0^+,1^+,2^+$		
433.168 *21*	1^+		
461.698 *22*	1^+		
662.69 *4*	$0^+,1^+$		
810.88 *8*	(1^+)#		

† From least-squares fit to γ energies with normalized χ^2 = 81.8 greater than critical χ^2 = 1.8. The cause seems to be the very precisely-reported measured γ-ray energies.

‡ From ^{158}Ho Adopted Levels where the configurations are also discussed.

Postulated by V.G. Kalinnikov, priv. comm., 2010. Specific arguments are given in the Adopted Levels table.

ε radiations

The I_{ε} values have been computed from the γ-intensity balances at each level assuming that there is negligible ε decay to the levels at g.s. and 67 keV, as expected from J^{π} considerations.

One of the questions one can raise here is how consistent are the beta-decay intensities, therefore the log *ft* adopted values, because of the existence of the very many unplaced γ transitions. However the total intensity of the unplaced γ's is less than 2% of the total intensity of the placed γ transitions. Also, although many the multipolarities of the γ transitions are still unknown, for most of the strongest transitions they are known. For these reasons the beta-decay intensities and the log *ft* values are included here; however prudence is advised in their usage.

E(decay)	E(level)	Iε†	Log *ft*	Comments
(7×10^1 *4*)	810.88	0.29 *5*	4.4 *10*	εK=0.2 *4*; εL=0.6 *3*; εM+=0.22 *14*
(2.2×10^2 *4*)	662.69	1.84 *14*	5.17 *24*	εK=0.76 *3*; εL=0.185 *21*; εM+=0.058 *8*
(4.2×10^2 *4*)	461.698	8.9 *7*	5.16 *11*	εK=0.803 *5*; εL=0.151 *4*; εM+=0.0459 *12*
(4.5×10^2 *4*)	433.168	4.0 *4*	5.57 *11*	εK=0.806 *4*; εL=0.149 *3*; εM+=0.0452 *11*
(4.8×10^2 *4*)	398.13?	0.113 *22*	7.19 *12*	εK=0.809 *4*; εL=0.1467 *24*; εM+=0.0445 *9*
(4.8×10^2 *4*)	395.186	3.24 *22*	5.74 *9*	εK=0.809 *4*; εL=0.1466 *24*; εM+=0.0444 *9*
(4.9×10^2 *4*)	385.708	4.4 *3*	5.63 *9*	εK=0.810 *3*; εL=0.1461 *23*; εM+=0.0442 *8*
(6.4×10^2 *4*)	240.75	2.0 *3*	6.21 *9*	εK=0.8172 *17*; εL=0.1405 *13*; εM+=0.0423 *5*
(7.3×10^2 *4*)	146.801	76 *11*	4.76 *9*	εK=0.8203 *13*; εL=0.1382 *9*; εM+=0.0415 *4* E(decay): other: $E_{\beta+}$=780 (1961Bo24). I($\varepsilon+\beta^+$): Other, 77.5% (2006VaZY).

† Absolute intensity per 100 decays.

γ(^{158}Ho)

Iγ normalization: calculated to give 100% ε decay with zero ε branching to the ground state and the 67-keV level.
Additional information 2.

E_γ [†‡#]	I_γ [@k]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [&]	δ [ai]	α [j]	$I_{(\gamma+ce)}$ [k]	Comments
7.697 4		74.897	2^+	67.200	2^-	E1		14.14	12891	ce(M)/(γ+ce)=0.763 7 ce(N)/(γ+ce)=0.158 3; ce(O)/(γ+ce)=0.01278 25; ce(P)/(γ+ce)=0.000216 5 α(M)=11.56 17 α(N)=2.38 4; α(O)=0.193 3; α(P)=0.00327 5 E_γ: from 1996Go06. Mult.: from M-shell and N-shell ce ratios (1996Go06). $I_{(\gamma+ce)}$: from intensity balance at the 74 level assuming the 2nd forbidden ε transition to this level is negligible.
24.395 6	27 3	91.595	$1^-,2^-,3^-$	67.200	2^-	M1+E2	0.071 10	34.2 25		α(L)=26.6 19; α(M)=6.0 5 α(N)=1.38 10; α(O)=0.190 12; α(P)=0.00847 12 %Iγ=0.195 24. E_γ: from 1996Go06.
^{x}25.5[d] 2	17[d] 3									%Iγ=0.123 23.
^{x}28.66[f] 6	1.4[f] 4									%Iγ=0.010 3.
28.7[d] 2	2.0[d] 6	461.698	1^+	433.168	1^+	M1		16.2 4	35 11	ce(L)/(γ+ce)=0.736 12; ce(M)/(γ+ce)=0.163 6 ce(N)/(γ+ce)=0.0377 13; ce(O)/(γ+ce)=0.00547 19; ce(P)/(γ+ce)=0.000305 11 α(L)=12.7 4; α(M)=2.80 7 α(N)=0.649 17; α(O)=0.0941 24; α(P)=0.00525 14 %Iγ=0.014 5. $I_{(\gamma+ce)}$: From I_{ce}(L1) and α(M1). I_γ: From $I_{\gamma+ce}$ and α(M1); measured I_γ < 3.
^{x}30.6[f] 1	≈0.5[f]									%Iγ=0.0036 19.
^{x}30.8[d] 2	<3[d]									%Iγ=0.011 11. Mult.,δ: Assigned E1 (1972Ha41) and M1+E2 with δ ≈ 0.18 (1982Vy06).
^{x}43.43[f] 2	21[f] 3									%Iγ=0.216 25.
43.43 2	59 6	190.243	$0^+,1^+,2^+$	146.801	1^+	M1+E2	0.050 23	5.0 3		α(L)=3.89 20; α(M)=0.86 5 α(N)=0.200 11; α(O)=0.0287 13; α(P)=0.001542 22 %Iγ=0.43 5.
45.4[g] 1	≈30[g]	137.099	(2^-)	91.595	$1^-,2^-,3^-$	[M1,E2]		39 36		α(L)=30 27; α(M)=7.3 66 α(N)=1.6 15; α(O)=0.19 17; α(P)=8.0×10^{-4} 56 %Iγ=0.22 11.

γ(^{158}Ho) (continued)

E_γ [†‡#]	I_γ [@k]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [&]	δ [ai]	α [j]	Comments
[x]45.5 *2*									E_γ: from 1982Vy06.
50.68[h] *4*	30 *4*	240.75	0$^+$,1$^+$	190.243	0$^+$,1$^+$,2$^+$	M1+E2	0.21 *+5−3*	4.7 *9*	α(L)=3.7 *7*; α(M)=0.84 *16* α(N)=0.19 *4*; α(O)=0.026 *4*; α(P)=0.000948 *22* %Iγ=0.22 *4*. Mult.,δ: Assigned E1 by 1972Ha41 and 1977AnYX and M1+E2 by 1982Vy06 with $\delta \approx$ 0.65, but all consistent with δ given here.
50.7[g] *1*	8[g] *2*	125.62	(2$^+$)	74.897	2$^+$	[M1,E2]		23 *21*	α(L)=18 *16*; α(M)=4.3 *38* α(N)=0.97 *85*; α(O)=0.114 *97*; α(P)=5.9$\times$10^{-4} *40* %Iγ=0.058 *15*.
[x]62.2[f] *2*	$\approx$2.5[f]								%Iγ=0.018 *9*.
64.89[gh] *1*	1.3[g] *4*	255.034	(3$^+$)	190.243	0$^+$,1$^+$,2$^+$	[M1,E2]		12.3 *32*	α(K)=5.0 *27*; α(L)=5.6 *45*; α(M)=1.4 *11* α(N)=0.30 *25*; α(O)=0.036 *28*; α(P)=3.0$\times$10^{-4} *18* %Iγ=0.0094 *28*.
67.200 *10*	29.0 *15*	67.200	2$^-$	0.0	5$^+$	E3		477	α(K)=3.85 *6*; α(L)=356 *5*; α(M)=93.1 *13* α(N)=21.1 *3*; α(O)=2.41 *4*; α(P)=0.001608 *23* %Iγ=0.209 *3*. I_γ: Relative intensity at equilibrium: 36.4 *19*. E_γ: from 2000KoZT and 1998KaZV.
69.91 *3*	7.3 *15*	137.099	(2$^-$)	67.200	2$^-$	[M1,E2]		9.4 *21*	α(K)=4.2 *20*; α(L)=4.0 *31*; α(M)=0.96 *76* α(N)=0.22 *17*; α(O)=0.026 *20*; α(P)=2.4$\times$10^{-4} *15* %Iγ=0.053 *12*.
71.903 *2*	15.0$\times$10^2 *17*	146.801	1$^+$	74.897	2$^+$	M1+E2	0.068 *15*	6.77	α(K)=5.65 *8*; α(L)=0.873 *18*; α(M)=0.193 *4* α(N)=0.0448 *9*; α(O)=0.00647 *12*; α(P)=0.000352 *5* %Iγ=10.8 *14*. E_γ: from 2000KoZT; others: 71.904 *4* (1996Go06) and 71.904 *6* (1998KaZV). I_γ: From 1230 *16* (1977AnYX), 1600 *100* (1982Vy06), and 1658 *33* (1998KaZV).
79.603 *10*	13.4 *15*	146.801	1$^+$	67.200	2$^-$	[E1]		0.580	α(K)=0.479 *7*; α(L)=0.0785 *11*; α(M)=0.01734 *25* α(N)=0.00394 *6*; α(O)=0.000523 *8*; α(P)=2.12$\times$10^{-5} *3* %Iγ=0.097 *12*. E_γ: from 1996Go06.
[x]86.3[g] *1*	6.5[g] *10*								%Iγ=0.048 *7*.
93.68 *5*	23.5 *20*	240.75	0$^+$,1$^+$	146.801	1$^+$	[M1,E2]		3.38 *24*	α(K)=1.96 *69*; α(L)=1.09 *70*; α(M)=0.26 *18* α(N)=0.059 *39*; α(O)=0.0072 *43*; α(P)=1.09$\times$10^{-4} *56* %Iγ=0.170 *17*. E_γ: From 1998KaZV; others: 93.05 (1968Ab14) and 93.1 (1972Ha41).
[x]101.34[c] *4*	28[c] *5*								%Iγ=0.20 *4*.
107.48[eh] *3*	5.1[e] *8*	255.034	(3$^+$)	146.801	1$^+$	[E2]		2.16	α(K)=0.920 *13*; α(L)=0.950 *14*; α(M)=0.229 *4*

$^{158}_{67}$Ho$_{91}$-4

γ(^{158}Ho) (continued)

E_γ [†‡#]	I_γ [@k]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [&]	α [j]	Comments
								α(N)=0.0516 *8*; α(O)=0.00616 *9*; α(P)=3.83×10^{-5} *6* %Iγ=0.037 *6*.
[x]114.17[e] *5*	2.3[e] *6*							%Iγ=0.017 *5*.
115.40 *2*	22.5 *20*	190.243	0$^+$,1$^+$,2$^+$	74.897	2$^+$	(E2)	1.661	α(K)=0.765 *11*; α(L)=0.688 *10*; α(M)=0.1656 *24* α(N)=0.0374 *6*; α(O)=0.00447 *7*; α(P)=3.21×10^{-5} *5* %Iγ=0.162 *17*. E_γ: from 1998KaZV; other: 115.33 *2* (1977AnYX) 115.36 *5* (1982Vy06). I_γ: From 20.9 *19* (1977AnYX), 30 *6* (1982Vy06), and 24.2 *13* (1998KaZV).
[x]118.63[b] *6*	18 *2*							%Iγ=0.130 *16*. Mult.: Assigned E1 or E2 (1977AnYX).
131.65[gh] *8*	19.0[g] *12*	385.708	1$^+$	255.034	(3$^+$)	[E2]	1.033	α(K)=0.536 *8*; α(L)=0.382 *6*; α(M)=0.0916 *13* α(N)=0.0207 *3*; α(O)=0.00250 *4*; α(P)=2.30×10^{-5} *4* %Iγ=0.141 *15*.
[x]162.37[f] *7*	2.9[f] *4*							%Iγ=0.021 *3*.
[x]162.5[d] *5*	7[d] *3*							%Iγ=0.050 *22*.
[x]166.89[e] *5*	3.8[e] *12*							%Iγ=0.027 *9*.
[x]189.1[f] *1*	2.5[f] *4*							%Iγ=0.018 *3*.
[x]190.2[d] *5*	6[d] *3*							%Iγ=0.043 *22*.
195.42 *2*	200 *10*	385.708	1$^+$	190.243	0$^+$,1$^+$,2$^+$	M1	0.394	α(K)=0.332 *5*; α(L)=0.0487 *7*; α(M)=0.01076 *15* α(N)=0.00250 *4*; α(O)=0.000364 *5*; α(P)=2.05×10^{-5} *3* %Iγ=1.44 *11*. E_γ: from 1998KaZV; other: 195.43 *1* (1977AnYX).
200.2[dl] *3*	≤6[d]	662.69	0$^+$,1$^+$	461.698	1$^+$			%Iγ=0.022 *22*.
[x]201.5[f] *1*	1.6[f] *5*							%Iγ=0.012 *4*.
204.16[h] *3*	24 *2*	395.186	0,1	190.243	0$^+$,1$^+$,2$^+$	M1,E2	0.29 *6*	α(K)=0.222 *72*; α(L)=0.051 *8*; α(M)=0.0117 *23* α(N)=0.0027 *5*; α(O)=0.00036 *4*; α(P)=1.27×10^{-5} *55* %Iγ=0.173 *18*. E_γ: from 1998KaZV; other: 204.13 *7* (1977AnYX).
207.89 *4*	12.4 *22*	398.13?	0$^+$,1$^+$,2$^+$	190.243	0$^+$,1$^+$,2$^+$	M1,E2	0.27 *6*	α(K)=0.211 *69*; α(L)=0.048 *7*; α(M)=0.0110 *20* α(N)=0.0025 *5*; α(O)=0.00034 *4*; α(P)=1.20×10^{-5} *52* %Iγ=0.089 *17*.
[x]212.52[f] *7*	5.9[f] *6*							%Iγ=0.043 *5*.
[x]233.50[e] *6*	6.3[e] *16*							%Iγ=0.045 *12*.
238.86 *3*	34 *3*	385.708	1$^+$	146.801	1$^+$	M1	0.227	α(K)=0.191 *3*; α(L)=0.0280 *4*; α(M)=0.00617 *9* α(N)=0.001434 *20*; α(O)=0.000209 *3*; α(P)=1.177×10^{-5} *17* %Iγ=0.25 *3*.
248.580[h] *15*	407 *15*	395.186	0,1	146.801	1$^+$	E1	0.0287	α(K)=0.0242 *4*; α(L)=0.00350 *5*; α(M)=0.000768 *11*

γ(^{158}Ho) (continued)

E_γ[†‡#]	I_γ[@k]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[&]	α[j]	Comments
								α(N)=0.0001766 *25*; α(O)=2.49×10^{-5} *4*; α(P)=1.240×10^{-6} *18* %Iγ=2.94 *19*. E_γ: from 1998KaZV; other: 248.58 *1* (1977AnYX) and 248.58 *5* (1982Vy06).
271.45 *5*	29 *3*	461.698	1$^+$	190.243	0$^+$,1$^+$,2$^+$	M1	0.1605	α(K)=0.1353 *19*; α(L)=0.0197 *3*; α(M)=0.00435 *6* α(N)=0.001010 *15*; α(O)=0.0001472 *21*; α(P)=8.31×10^{-6} *12* %Iγ=0.209 *25*. E_γ: from 1998KaZV; other: 271.58 *8* (1977AnYX).
276.98 *10*	5.6 *11*	662.69	0$^+$,1$^+$	385.708	1$^+$	(M1,E2)	0.119 *34*	α(K)=0.095 *33*; α(L)=0.0183 *5*; α(M)=0.00415 *7* α(N)=0.000955 *14*; α(O)=0.000131 *9*; α(P)=5.5×10^{-6} *24* %Iγ=0.040 *9*. E_γ: from 1998KaZV; other: 276.9 *1* (1977AnYX). I_γ: From 5.9 *15* (1977AnYX) and 5.3 *17* (1998KaZV); other: 12 *4* (1982Vy06).
286.40 *5*	22.7 *12*	433.168	1$^+$	146.801	1$^+$	M1+(E2)	0.108 *31*	α(K)=0.087 *31*; α(L)=0.0165 *7*; α(M)=0.00373 *7* α(N)=0.000857 *20*; α(O)=0.000118 *10*; α(P)=5.0×10^{-6} *22* %Iγ=0.164 *13*.
^{x}294.19 *5*	16 *3*							%Iγ=0.115 *23*. E_γ: from 1998KaZV; other: 294.1 *1* (1977AnYX).
296.07 *3*	112 *6*	433.168	1$^+$	137.099	(2$^-$)	E1	0.0185	α(K)=0.01560 *22*; α(L)=0.00223 *4*; α(M)=0.000489 *7* α(N)=0.0001127 *16*; α(O)=1.595×10^{-5} *23*; α(P)=8.13×10^{-7} *12* %Iγ=0.81 *7*. E_γ: from 1998KaZV; other: 295.96 *3* (1977AnYX).
307.7[g] *1*	3.2[g] *12*	433.168	1$^+$	125.62	(2$^+$)			%Iγ=0.024 *9*.
310.82 *3*	250 *6*	385.708	1$^+$	74.897	2$^+$	M1	0.1116	α(K)=0.0941 *14*; α(L)=0.01368 *20*; α(M)=0.00301 *5* α(N)=0.000700 *10*; α(O)=0.0001020 *15*; α(P)=5.77×10^{-6} *8* %Iγ=1.80 *11*. E_γ: from 1998KaZV; other: 310.74 *3* (1977AnYX).
314.89 *3*	37 *3*	461.698	1$^+$	146.801	1$^+$	M1	0.1078	α(K)=0.0909 *13*; α(L)=0.01321 *19*; α(M)=0.00291 *4* α(N)=0.000676 *10*; α(O)=9.85×10^{-5} *14*; α(P)=5.57×10^{-6} *8* %Iγ=0.27 *3*. E_γ: from 1998KaZV; other: 314.95 *7* (1977AnYX).
^{x}326.0[f] *1*	12[f] *3*							%Iγ=0.087 *23*.
^{x}326.7[d] *3*	37[d] *6*					(E1)	0.01448	α(K)=0.01225 *18*; α(L)=0.001741 *25*; α(M)=0.000382 *6* α(N)=8.80×10^{-5} *13*; α(O)=1.249×10^{-5} *18*; α(P)=6.44×10^{-7} *10* %Iγ=0.27 *5*.
^{x}328.9[d] *3*	<6[d]							%Iγ=0.022 *22*.
336.02 *6*	16 *2*	461.698	1$^+$	125.62	(2$^+$)	(M1,E2)	0.069 *22*	α(K)=0.056 *21*; α(L)=0.0100 *11*; α(M)=0.00225 *20* α(N)=0.00052 *5*; α(O)=7.2×10^{-5} *11*; α(P)=3.3×10^{-6} *14* %Iγ=0.115 *16*. coin with 50.7γ.
341.58 *3*	145 *20*	433.168	1$^+$	91.595	1$^-$,2$^-$,3$^-$	E1	0.01299	α(K)=0.01100 *16*; α(L)=0.001559 *22*; α(M)=0.000342 *5* α(N)=7.88×10^{-5} *11*; α(O)=1.120×10^{-5} *16*; α(P)=5.80×10^{-7} *9*

$^{158}_{67}$Ho$_{91}$-6

γ(^{158}Ho) (continued)

E_γ [†‡#]	I_γ [@k]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[&]	α [j]	Comments
								%Iγ=1.05 *16*. E_γ: from 1998KaZV; other: 341.58 *6* (1977AnYX). Mult.: Assigned E1 by 1968Ab14 and 1971TrZQ and E2 by 1982Vy06.
358.24 *3*	275 *25*	433.168	1$^+$	74.897	2$^+$	M1	0.0766	α(K)=0.0646 *9*; α(L)=0.00935 *13*; α(M)=0.00206 *3* α(N)=0.000478 *7*; α(O)=6.97×10^{-5} *10*; α(P)=3.95×10^{-6} *6* %Iγ=1.98 *21*. E_γ: from 1998KaZV; other: 358.21 *3* (1977AnYX).
386.82 *3*	1050 *50*	461.698	1$^+$	74.897	2$^+$	M1	0.0626	α(K)=0.0528 *8*; α(L)=0.00763 *11*; α(M)=0.001679 *24* α(N)=0.000390 *6*; α(O)=5.69×10^{-5} *8*; α(P)=3.23×10^{-6} *5* %Iγ=7.6 *6*. E_γ: from 1998KaZV; other: 386.84 *4* (1977AnYX).
^{x}394.5[e] *1*	≤25[e]							%Iγ=0.09 *9*.
425.2[g] *1*	25[g] *5*	810.88	(1$^+$)	385.708	1$^+$			%Iγ=0.19 *4*.
^{x}425.3[c] *2*	≈4[c]							%Iγ=0.029 *15*.
472.42 *6*	111 *5*	662.69	0$^+$,1$^+$	190.243	0$^+$,1$^+$,2$^+$	M1	0.0372	α(K)=0.0315 *5*; α(L)=0.00451 *7*; α(M)=0.000993 *14* α(N)=0.000231 *4*; α(O)=3.37×10^{-5} *5*; α(P)=1.91×10^{-6} *3* %Iγ=0.80 *6*. E_γ: from 1998KaZV; other: 472.45 *10* (1977AnYX).
515.86 *6*	115 *10*	662.69	0$^+$,1$^+$	146.801	1$^+$	M1	0.0297	α(K)=0.0251 *4*; α(L)=0.00359 *5*; α(M)=0.000790 *11* α(N)=0.000183 *3*; α(O)=2.68×10^{-5} *4*; α(P)=1.526×10^{-6} *22* %Iγ=0.83 *9*. E_γ: from 1998KaZV; other: 515.9 *1* (1977AnYX).
^{x}536.8[c] *2*	19[c] *52*							%Iγ=0.1 *4*.
^{x}571.0[f] *1*	12.9[f] *20*							%Iγ=0.093 *16*.
587.90 *8*	16 *3*	662.69	0$^+$,1$^+$	74.897	2$^+$			%Iγ=0.115 *23*.
^{x}620.5[c] *2*	≈32[c]							%Iγ=0.23 *12*.
620.6[g] *1*	15[g] *3*	810.88	(1$^+$)	190.243	0$^+$,1$^+$,2$^+$			%Iγ=0.11 *2*.
^{x}629.2[c] *2*	43[c] *5*							%Iγ=0.31 *4*.
^{x}664.0[f] *2*	3.5[f] *5*							%Iγ=0.025 *4*.
^{x}735.6[f] *2*	8.0[f] *12*							%Iγ=0.058 *10*.
^{x}766.2[f] *2*	31[f] *6*							%Iγ=0.22 *5*.
^{x}790.5[f] *2*	6.8[f] *17*							%Iγ=0.049 *13*.
^{x}826.7[c] *1*	43[c] *5*							%Iγ=0.31 *4*.

† From 1998KaZV, unless otherwise noted.

‡ Some γ-ray energies are very inconsistent or their uncertainties are grossly under estimated. Those that differ by 4σ or more from calculated value are noted separately.

For the decay energy of 900 keV adopted here, the following γ's from 1977AnYX can not occur in this decay: 1025.2, 1071.4, 1082.5, 1143.2, 1222.9, 1645.0,

γ(^{158}Ho) (continued)

1715.5, and 1720.0 keV.

[@] The values are determined from the consideration of the values reported by 1977AnYX, 1982Vy06, and 1998KaZV; below 60 keV the values of 1977AnYX are considerably lower than those of the other two papers and are not used. Other set of data are given by 1965St08, 1968Ab14, 1971TrZQ, and 1972Ha41.

[&] From I_{ce} and I_γ data of 1977AnYX and 1982Vy06 and ce data of 1972Ha41, unless otherwise noted.

[a] From 1972Ha41 and 1982Vy06.

[b] From 1977AnYX and 1982Vy06.

[c] From 1977AnYX only.

[d] From 1982Vy06 only.

[e] From 1998KaZV only.

[f] From 2011GoZY.

[g] From V.G. Kalinnikov, priv. comm., 2010 (that together with new transitions restate some of the transitions given by 2011GoZY).

[h] Differs by 4σ or more from calculated value.

[i] Additional information 3.

[j] Additional information 4.

[k] For absolute intensity per 100 decays, multiply by 0.0072 *4*.

[l] Placement of transition in the level scheme is uncertain.

[x] γ ray not placed in level scheme.

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^{158}Er ε decay 1977AnYX,1982Vy06,1996Go06

Decay Scheme

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