^{160}Er ε decay 1990Go02

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 176, 1 (2021)	1-May-2021

Parent: ^{160}Er: E=0.0; $J^\pi=0^+$; $T_{1/2}$=28.58 h *9*; Q(ε)=318 *29*; %ε decay=100.0

^{160}Er-Q(ε): From 2021Wa16.

Additional information 1.

^{160}Er: from proton-induced spallation of tantalum at E(p)=640 MeV. Chemical separation. Electrostatic electron spectrometers, one set to ΔE/E=0.011 and one operated at ΔE=9 eV; HPGe detector of dimensions 0.30 cm^2 by 0.6 cm and resolution=200 eV at 6.4 keV. Measured E(ce), Ice, Eγ, Iγ, I(L x ray).

Others: 2010VaZZ, 2006KaZX, 1982Vy06, 1973Al15, 1965Av03.

^{160}Ho Levels

E(level)	J^π[†]	$T_{1/2}$[‡]	Comments
0.0	5^+	25.6 min *3*	
59.98 *3*	2^-	5.02 h *5*	%ε+%$β^+$=23.8 *20*; %IT=76.2 *20* %ε+%$β^+$,%IT: weighted average of %IT values (measured by almost the same group of authors by varied methods): 73.6 *52* (2002Ad34), 73.3 *30* (2003KaZR), 77.9 *20* (2006KaZX) (the smallest measured unc was adopted); other: 65 *3* (1974Al28). Since this level has %ε+%$β^+$=23.8 *20*, there is an imbalance in the listed intensities into and out of it. Further, this level has $T_{1/2}$=5.02 h, with the result that the intensity of the radiations deexciting it will exhibit a time dependence relative to that of the feeding transition.
67.11 *4*	1^+	28 ns *2*	$T_{1/2}$: from 2006KaZX by measuring the retarded KX(Ho)-γ coincidences with respect to the time decrease in the 7.1γ intensity. Other: 30 ns *8* (2005KaZY, obtained by the same group).
175.6? *10*	(1^-)		E(level),J^π: level introduced by 2010VaZZ based on γ assumed to decay to 67, 1^+ level with J^π value postulated by authors; because of the lack of evidence this level is questionable.

[†] From Adopted Levels.

[‡] From Adopted Levels unless noted otherwise.

ε radiations

E(decay)	E(level)	Iε[†]	Log *ft*	Comments
(1.4×10^2[‡] *3*)	175.6?	≈10	≈5.0	εK=0.68 *8*; εL=0.24 *6*; εM+=0.078 *21* Because of the lack of evidence on the level and its decaying γ the ε population is also questionable. Iε: difference of 100% and the estimated feeding of 67, 1^- level.
(2.5×10^2 *3*)	67.11	≈90	≈4.7	εK=0.771 *13*; εL=0.174 *9*; εM+=0.054 *4* Iε: from α(E1) and measured L x ray/γ intensity ratio, 1990Go02 estimate I(γ+ce)(7.133 γ), relative to number of ^{160}Er decays, to be 0.9 *2*, which can be consistent with the expectation that all of the ε transitions feed the 67 level but also is compatible with ≈ 10% of the feeding to 176 level.

[†] Absolute intensity per 100 decays.

[‡] Existence of this branch is questionable.

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γ(^{160}Ho)

I(γ+ce) normalization: Based on deduced absolute intensity of 7.133γ (from measured I_γ and theoretical ICC value) equal to the measured number of ^{160}Er decays reported by 1990Go02 (the experimental ratio of intensities quoted therein is 0.9 *2*).

E_γ	I_γ[#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ[‡]	α[†]	$I_{(\gamma+ce)}$[#]	Comments
7.133 *10*	5.43 *9*	67.11	1^+	59.98	2^-	E1(+M2)	<0.0006	17.4 *3*	100	ce(M)/(γ+ce)=0.774 *7* ce(N)/(γ+ce)=0.159 *3*; ce(O)/(γ+ce)=0.0125 *3*; ce(P)/(γ+ce)=0.000205 *5* α(M)=14.27 *22* α(N)=2.93 *5*; α(O)=0.230 *4*; α(P)=0.00379 *8* I_γ: calculated from I(γ+ce)=100 using α(E1)=17.3 *3*. δ: from 1990Go02 (at the 99% confidence level). α: 1990Go02 report the following measured values of ratios of conversion coefficients for the 7.133 γ: α(M1)exp/α(M2)exp=0.81 *8*; α(M1)exp/α(M3)exp=0.39 *4*; α(M4)exp/α(M3)exp=0.06 *6*; α(M2)exp/α(M5)exp=0.71 *7*; α(N1)exp/α(N3)exp=0.48 *12*; α(N1)exp/α(N4,5)exp=0.57 *14*; α(N6,7)/α(N1)exp=0.20 *5*; α(N6,7)exp/α(O2,3)exp=0.29 *7*.
59.98 *3*	0.082 *11*	59.98	2^-	0.0	5^+	E3(+M4)	<0.017	930 *16*	76.2 *20*	ce(K)/(γ+ce)=0.00211 *8*; ce(L)/(γ+ce)=0.749 *9*; ce(M)/(γ+ce)=0.198 *5* ce(N)/(γ+ce)=0.0450 *11*; ce(O)/(γ+ce)=0.00510 *12*; ce(P)/(γ+ce)=3.8×10^{-6} *7* α(K)=1.97 *7*; α(L)=698 *12*; α(M)=184 *4* α(N)=41.9 *8*; α(O)=4.75 *9*; α(P)=0.0035 *7* E_γ: from 1966Av03. I_γ: calculated from I(γ+ce)=76.2 *20* using α(E3)=930 *16*. (If δ=0, one gets 0.082 *10* withα(E3)=923 *14*) Note that this value of I(γ+ce) is smaller than that of the feeding γ, because of the ε+β^+ branch from this level. Mult.: from measured subshell ratios (1966Av03). δ: %M4<0.03 (2010VaZZ, from α(K)exp). α(K)exp: 1.83 *17* *7*.

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^{160}Er ε decay 1990Go02 (continued)

γ(^{160}Ho) (continued)

E_γ	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α[†]	$I_{(\gamma+ce)}$[#]	Comments
								α(K)exp: from 2010VaZZ, from comparison of Ho K x rays and 59.98γ intensities in the γ spectrum of ^{160}Ho IT decay (5.02 h) (uncertainties are stat and syst in this order).
108.5[@] *10*	175.6?	(1⁻)	67.11	1⁺	[E1,M2]	0.43 *18*	≈10	ce(K)/(γ+ce)=0.241 *74*; ce(L)/(γ+ce)=0.048 *25*; ce(M)/(γ+ce)=0.0109 *60* ce(N)/(γ+ce)=0.0025 *14*; ce(O)/(γ+ce)=3.5×10^{-4} *20*; ce(P)/(γ+ce)=1.62×10^{-5} *96* α(K)=0.35 *14*; α(L)=0.069 *36*; α(M)=0.0157 *84* α(N)=0.0036 *20*; α(O)=5.0×10^{-4} *28*; α(P)=2.3×10^{-5} *14* E_γ,I_γ: γ ray postulated by 2010VaZZ as observed in a "fresh" spectrum of ^{160}Er source with no evidence, reason for which its existence is questionable (ΔEγ is adopted by evaluator and Iγ follows from the ε feeding of the parent level).

† Additional information 2.
‡ Additional information 3.
# Absolute intensity per 100 decays.
@ Placement of transition in the level scheme is uncertain.

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Decay Scheme

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