^{169}Hf ε decay 1973Me09,1973FoYE

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin	NDS 109, 2033 (2008)	15-Jun-2008

Parent: ^{169}Hf: E=0.0; J$^{\pi}$=5/2^{-}; T$_{1/2}$=3.24 min *4*; Q(ε)=3360 *28*; %ε+%β^{+} decay=100.0

Others: 1969Ar23, 1970At01, 1970Ch17, 1975Gr44.

1973Me09: sources from ^{170}Yb(^{3}He,4n); Yb oxide targets enriched to 67% in ^{170}Yb; measured Eγ, Iγ (Compton-suppressed Ge(Li) (FWHM=1.9 keV at 1332 keV), surface-barrier Ge(Li) (FWHM=0.8 keV at 122 keV)), Ice (Si(Li)).

1973FoYE: sources from ^{168}Yb(α,3n) and ^{170}Yb(α,5n); measured Eγ, Iγ (Ge(Li), FWHM=1.4 keV at 100 keV, 2.3 keV at 1 MeV); measured Eγ, Iγ $\gamma\gamma$ coin; placed 72.9γ and 68.4γ.

1969Ar23: Hf sources from ^{169}Ta parent decay; measured Eγ, Iγ, γ(t), $\gamma\gamma$ coin using coaxial Ge(Li) and NaI(Tl) detectors, and β^{+} data using a 2 cm x 2 cm anthracene crystal (14% energy resolution for 624-keV ce line from ^{137}Cs).

The decay scheme is tentative and incomplete. the measured I(K x ray) cannot Be corrected for K conversion of possible 71γ and 85γ because their intensities are unknown; if significant, this would lower εK/β^{+} and, hence, the calculated ε+β^{+} feeding to the 493 level. however, a very large change In feeding to the 493 level would Be required to invalidate the conclusion that this is an allowed, unhindered transition. feeding to the (5/2^{-}) 43 level May Be significant, but is unknown. there May also exist feeding to levels with E>493 that are As yet unknown.

^{169}Lu Levels

E(level)†	J$^{\pi}$‡	T$_{1/2}$‡	Comments
0.0	7/2^{+}	34.06 h *5*	
29.0 *5*	1/2^{-}	160 s *10*	
42.9 *6*	(5/2^{-})		
97.4 *5*	(1/2^{+})		log $f^{1u}t$>8.5 implies %ε+%β^{+} feeding<0.4 to this level.
113.8 *6*	(3/2^{+})		log *ft*>5.9 implies %ε+%β^{+}<5 to this level.
123.49 *15*	(9/2)$^{+}$		log $f^{1u}t$>8.5 implies %ε+%β^{+} feeding<0.4 to this level, consistent with intensity balance At this level.
186.7 *6*	(5/2^{+})		
492.89 *10*	7/2^{-}		

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

ε,β^{+} radiations

E(decay)	E(level)	Iβ^{+} †	Iε†	Log *ft*	I($\varepsilon+\beta^{+}$)†	Comments
(2.87×10^{3} *3*)	492.89	>13	>75	<4.5	>88	av Eβ=835 *13*; εK=0.709 *5*; εL=0.1130 *9*; εM+=0.0343 *3* E(decay): 2872 *200* from measured Eβ+=1850 *200* (1969Ar23). I($\varepsilon+\beta^{+}$): estimated from I(K x ray)=86 *5* and I($\gamma^{\pm}$)=33.0 *15*, relative to Iγ=100 for 492.9γ (1973Me09).
(3.17×10^{3} *3*)	186.7	<1	<4	>5.9	<5	av Eβ=972 *13*; εK=0.652 *6*; εL=0.1035 *10*; εM+=0.0314 *3* I($\varepsilon+\beta^{+}$): 6.8 from intensity imbalance; however, uncertainty May Be large (1973FoYE do not state uncertainty In I(73γ)). <5% feeding is expected based on log *ft*>5.9 for first-forbidden transition.
(3.32×10^{3}‡ *3*)	42.9					
(3.36×10^{3}‡ *3*)	0.0	<1	<4	>5.9	<5	av Eβ=1056 *13*; εK=0.614 *6*; εL=0.0973 *10*; εM+=0.0295 *3* I($\varepsilon+\beta^{+}$): from log *ft*>5.9 for first-forbidden transition.

† Absolute intensity per 100 decays.
‡ Existence of this branch is questionable.

^{169}Hf ε decay 1973Me09,1973FoYE (continued)

γ(^{169}Lu)

Iγ normalization: from estimate by 1973Me09 that total I(γ+ce) from 492.9 level>88% based on measured I(K x ray)=86 *5* and I($\gamma^{\pm}$)=33.0 *15* relative to I(493γ)=100; 94% 6 was used to calculate normalization. This normalization should Be considered to Be highly tentative.

Iγ(K x ray)=86 *5*, I($\gamma^{\pm}$)=33.0 *15*, relative to Iγ=100 for 492.9γ (1973Me09).

E_γ[†]	I_γ[†&]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	α[a]	$I_{(\gamma+ce)}$[&]	Comments
(14.1[@] *8*)		42.9	(5/2⁻)	29.0	1/2⁻				
(16.4[@] *8*)		113.8	(3/2⁺)	97.4	(1/2⁺)			≈3.7	$I_{(\gamma+ce)}$: since negligible ε+β^+ feeding of the 97 level is expected (ΔJ$^\pi$=^{2,}No, the level scheme implies Ti(16γ)≈Ti(68γ)=3.7.
(29.0 *5*)		29.0	1/2⁻	0.0	7/2⁺	E3	9.4×10^4 *11*		α(L)=6.8×10^4 *8*; α(M)=2.08×10^4 *24*; α(N+..)=5.4×10^3 *7* α(N)=4.9×10^3 *6*; α(O)=5.4×10^2 *7*; α(P)=0.35 *4* E_γ,Mult.: from ^{169}Lu IT decay (160 s).
68.4[@] *1*	1.9[#]	97.4	(1/2⁺)	29.0	1/2⁻	(E1)[@]	0.931		α(K)=0.754 *11*; α(L)=0.1379 *21*; α(M)=0.0311 *5*; α(N+..)=0.00815 *12* α(N)=0.00716 *11*; α(O)=0.000951 *14*; α(P)=3.88×10^{-5} *6*
(70.9[@] *2*)		113.8	(3/2⁺)	42.9	(5/2⁻)	[E1]	0.851 *14*		α(K)=0.691 *11*; α(L)=0.1248 *20*; α(M)=0.0282 *5*; α(N+..)=0.00738 *12* α(N)=0.00648 *11*; α(O)=0.000864 *14*; α(P)=3.56×10^{-5} *6*
72.9[@] *2*	0.7[#]	186.7	(5/2⁺)	113.8	(3/2⁺)	[M1,E2]	10.6 *15*		α(K)=5 *3*; α(L)=5 *4*; α(M)=1.1 *9*; α(N+..)=0.29 *22* α(N)=0.26 *20*; α(O)=0.032 *23*; α(P)=0.00034 *24*
(84.8[@] *2*)		113.8	(3/2⁺)	29.0	1/2⁻	[E1]	0.538 *9*		α(K)=0.440 *7*; α(L)=0.0760 *12*; α(M)=0.0171 *3*; α(N+..)=0.00451 *7* α(N)=0.00395 *7*; α(O)=0.000534 *9*; α(P)=2.32×10^{-5} *4*
123.6 *2*	4.6 *5*	123.49	(9/2)⁺	0.0	7/2⁺	M1,E2	1.8 *3*		α(K)=1.1 *6*; α(L)=0.47 *22*; α(M)=0.11 *6*; α(N+..)=0.030 *14* α(N)=0.026 *13*; α(O)=0.0034 *14*; α(P)=8.E−5 *5* Mult.: from 1.16<α(exp)<4.9 (1973Me09).
369.5 *2*	11.6 *10*	492.89	7/2⁻	123.49	(9/2)⁺	[E1]	0.01253		α(K)=0.01054 *15*; α(L)=0.001548 *22*;

Continued on next page (footnotes at end of table)

^{169}Hf ε decay 1973Me09,1973FoYE (continued)

γ(^{169}Lu) (continued)

E_γ [†]	I_γ [†&]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [‡]	α [a]	Comments
								α(M)=0.000346 *5*; α(N+..)=9.35×10^{-5} *14* α(N)=8.11×10^{-5} *12*; α(O)=1.173×10^{-5} *17*; α(P)=6.64×10^{-7} *10*
492.86 *10*	100	492.89	7/2$^-$	0.0	7/2$^+$	E1	0.00651	α(K)=0.00550 *8*; α(L)=0.000792 *11*; α(M)=0.0001765 *25*; α(N+..)=4.78×10^{-5} *7* α(N)=4.14×10^{-5} *6*; α(O)=6.04×10^{-6} *9*; α(P)=3.53×10^{-7} *5* α(K)exp=0.004 *1* (1973Me09).

† From 1973Me09, except As noted.

‡ From α(K)exp, as deduced from simultaneous measurement of Ice and Iγ, except where noted (detector calibration assumes α(L)=0.0814 (E2 theory) for 198.8γ in ^{168}Yb) (1973Me09).

From 1973FoYE; uncertainty unstated by authors.

@ From Adopted Gammas.

& For absolute intensity per 100 decays, multiply by 0.84 *6*.

a 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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Decay Scheme