^{180}Hf IT decay (5.53 h) 1961Ed01,1970Re08,1971Gu02

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	E. A. Mccutchan	NDS 126, 151 (2015)	1-Feb-2015

Parent: ^{180}Hf: E=1141.729 *21*; $J^\pi=8^-$; $T_{1/2}$=5.53 h *2*; %IT decay=99.7 *1*

Additional information 1.
α: Additional information 2.

^{180}Hf Levels

E(level)[†]	J^π[‡]	$T_{1/2}$	Comments
0.0[#]	0^+	stable	
93.325[#] *12*	2^+	1.524 ns *10*	g=+0.305 *14* (1996Al20) $T_{1/2}$: weighted average of 1.40 ns *10* (1955Su64), 1.48 ns *5* (1960De18), 1.53 ns *6* (1961Bo25), 1.50 ns *4* (1962Fo05), 1.53 ns *5* (1963Li04), and 1.528 ns *10*; all from $\gamma\gamma$(t) or γ-x-ray(t).
308.751[#] *14*	4^+	71 ps *10*	g=+0.36 *4* (1996Al20) J^π: A_2=0.093 *7* and A_4=0.014 *9* from $\gamma\gamma(\theta)$ for the 215γ-93γ cascade are consistent with J=4 if 215γ and 93γ are E2 (1961Bo25,1975Gr18). Other: 1962Ko15. $T_{1/2}$: weighted average of 60 ps *17* (1958Su54) and 75 ps *10* (1963Li04), both from centroid shift measurements.
641.026[#] *18*	6^+		g=+0.34 *7* (1996Al20) J^π: A_2=0.09 *1* and A_4=0.006 *10* from $\gamma\gamma(\theta)$ from the 332γ-215γ cascade are consistent with J=6 if 332γ and 215γ are E2 (1961Bo25,1975Gr18).
1084.183[#] *21*	8^+		J^π: A_2=0.091 *5* and A_4=0.010 *7* from $\gamma\gamma(\theta)$ for the 443γ-332γ cascade are consistent with J=8 if 443γ and 332γ are E2 (1962Ko15,1975Gr18).
1141.729[@] *21*	8^-	5.53 h *2*	%β^-=0.3 *1*; %IT=99.7 *1* (1992Ke04) $T_{1/2}$: weighted average of 5.5 h *1* (1951Bu50), 5.5 h *1* (1963Ra14), 5.519 h *4* (1980Ho17), 5.40 h *5* (2003Al36), and 5.540 h *3* (2006Vo12). A 0.4% uncertainty was added in quadrature to latter three values to incorporate systematic errors. Other: 2001Al23, reported variation in $T_{1/2}$ with temperature which was not confirmed in 2003Al36 by same authors. J^π: A_2=0.154 *15*, A_2=0.162 *15*, A_2=0.165 *15*, A_2=0.14 *4* for the 57γ-443γ, 57γ-332γ, 57γ-215γ, and 57γ-93γ cascades, respectively, are consistent with J=8 if δ(57γ)<0.1 (1960De22,1975Gr18). Parity mixing with 1084-keV ($J^\pi=8^+$) level was reported by 1966Bl12, 1966Bo12, 1972JeZZ, 1973Sc25, 1972Ku23, 1972Li11, 1972Kr06, 1975Ch16, 2007St20. Configuration=π7/2[404]$\otimes\pi$9/2[514].

[†] From a least-squares fit to Eγ, by evaluator.
[‡] From the Adopted Levels.
[#] $K^\pi=0^+$ g.s.-rotational band.
[@] $K^\pi=8^-$ bandhead.

γ(^{180}Hf)

Iγ normalization: From decay scheme using %β^-=0.3 *1* (1992Ke04), and I(γ+ce)(332.3γ)=99.7% *1*.

E_γ[†]	I_γ[‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α	Comments
57.538 *17*	51.0 *10*	1141.729	8^-	1084.183	8^+	E1	0.652 *25*	α(L)=0.230 *4*; α(M)=0.0523 *8*; α(N)=0.01207 *17*; α(O)=0.001638 *23*; α(P)=6.68×10^{-5} *10* E_γ: weighted average of 57.54 *1* (1961Ed01),

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γ(^{180}Hf) (continued)

E_γ [†]	I_γ [‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α	Comments
								57.549 *5* (1970Re08), 57.442 *15* (1971Gu02), and 57.44 *5* (1972GeZG). I_γ: weighted average of 51.3 *12* (1961Ed01), 51.3 *20* (1970Re08), and 47.5 *34* (1971Gu02). α=0.75 *3* from intensity balance at 1084 level. α: experimental value (1986BeZE). Mult.: K-forbidden E1 transition. Multipolarity from ce(L1)/ce(L2) exp=4.02 *18*, ce(L1)/ce(L3) exp=4.49 *9*, ce(L2)/ce(L3) exp=1.16 *3*, ce(M1)/ce(M2) exp=3.79 *15*, ce(M2)/ce(M3) exp=1.28 *6*, ce(N1)/ce(N2) exp=4.1 *5*, ce(N1)/ce(N3) exp=6.7 *13*, ce(N2)/ce(N3) exp=1.6 *4*, weighted averages from 1967Gi11, 1967Sc19, 1970Gv01, 1972Dr02, and 1981Fr05. Penetration parameters are λ(1)=7.0 *7* and λ(2)=0, from ce(L1)/ce(L3) exp: 4.49 *20*, ce(L2)/ce(L3) exp: 1.16 *5*, and α(L3)exp=0.061 *4* (1981Fr05). δ(M2/E1)=−0.009 *+65−85*, δ(E3/E1)=0.013 *20* (1972Kr06), γ(θ,H,t). Other: 1961Ed01.
93.324 *15*	17.5 *5*	93.325	2^+	0.0	0^+	E2	4.63	α(K)=1.081 *16*; α(L)=2.70 *4*; α(M)=0.675 *10*; α(N)=0.1562 *22*; α(O)=0.0197 *3* α(P)=6.96×10^{-5} *10* E_γ: weighted average of 93.33 *2* (1961Ed01), 93.332 *6* (1970Re08), 93.263 *15* (1971Gu02), and 93.328 *15* (1972GeZG). I_γ: weighted average of 17.6 *4* (1961Ed01), 18.0 *5* (1970Re08), 19.5 *17* (1971Gu02), and 15.5 *8* (1972GeZG). α(exp)=4.77 *6* (1986BeZE), 4.91 *23* (1967Ne07), 5.14 *24* (1961Ed01). ce(K)/ce(L1)+ce(L2)/ce(L3)/ce(M)+ce(N)+ce(O) exp: 205 *12*/343 *17*/239 *13*/169 *12* s (1961Ed01). Others: 1967Sc19, 1968Gv01, 1968El02, 1970Gv01, 1972Dr02.
215.426 *13*	86.7 *20*	308.751	4^+	93.325	2^+	E2	0.225	α(K)=0.1361 *19*; α(L)=0.0676 *10*; α(M)=0.01653 *24*; α(N)=0.00385 *6*; α(O)=0.000509 *8* α(P)=9.07×10^{-6} *13* E_γ: weighted average of 215.25 *13* (1961Ed01), 215.251 *13* (1970Re08), 215.241 *15* (1971Gu02), and 215.243 *15* (1972GeZG). I_γ: weighted average of 88.2 *25* (1961Ed01), 86.5 *20* (1970Re08), 85.9 *25* (1971Gu02), and 86.2 *25* (1972GeZG). α(K)exp=0.123 *9* (1961Ed01); ce(L1)/ce(L3) exp: 0.73 *5*, ce(L2)/ce(L3) exp: 1.52 *10* (1968Gv01).
332.274 *15*	100.0 *25*	641.026	6^+	308.751	4^+	E2	0.0586	α(K)=0.0418 *6*; α(L)=0.01286 *18*; α(M)=0.00308 *5*; α(N)=0.000721 *10*; α(O)=9.90×10^{-5} *14* α(P)=3.04×10^{-6} *5* E_γ: weighted average of 332.5 *3* (1961Ed01), 332.307 *36* (1970Re08), 332.272 *15* (1971Gu02), and 332.269 *18* (1972GeZG). I_γ: weighted average of 100 *4* (1961Ed01), 100.0 *25* (1970Re08), 100 *4* (1971Gu02), and 100.0 *25* (1972GeZG). α(K)exp=0.038 *3* (1961Ed01). ce(L1)/ce(L3) exp: 1.8 *1*, ce(L2)/ce(L3) exp: 1.6 *1* (1968Gv01,1975Gr18).

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$\gamma(^{180}Hf)$ (continued)

E_γ [†]	I_γ [‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α	Comments
443.162 *15*	86.8 *25*	1084.183	8^+	641.026	6^+	E2		0.0264	α(K)=0.0201 *3*; α(L)=0.00486 *7*; α(M)=0.001146 *16*; α(N)=0.000269 *4*; α(O)=3.80×10^{-5} *6* α(P)=1.518×10^{-6} *22* E_γ: weighted average of 443.8 *6* (1961Ed01), 443.181 *55* (1970Re08), 443.168 *15* (1971Gu02), and 443.149 *20* (1972GeZG). I_γ: weighted average of 86.6 *46* (1961Ed01), 90.4 *30* (1970Re08), 84.8 *25* (1971Gu02), and 86.4 *25* (1972GeZG). α(K)exp=0.0189 *17* (1961Ed01). ce(L1)/ce(L3) exp: 3.0, ce(L2)/ce(L3) exp: 1.9 s (1968Gv01,1975Gr18).
500.697 *15*	15.1 *4*	1141.729	8^-	641.026	6^+	M2+E3	−5.3 *2*	0.0610	α(K)=0.0406 *6*; α(L)=0.01555 *22*; α(M)=0.00379 *6*; α(N)=0.000892 *13*; α(O)=0.0001228 *18* α(P)=3.67×10^{-6} *6* E_γ: weighted average of 500.714 *66* (1970Re08), 500.702 *15* (1971Gu02), and 500.680 *25* (1972GeZG). I_γ: weighted average of 13.6 *12* (1970Re08), 15.7 *14* (1971Gu02), 15.1 *8* (1972GeZG), and 15.2 *4* (1971Ja21). Value from 1971Ja21 is deduced by the evaluator using their measured ratio Iγ(443γ)/Iγ(501γ)=5.70 *15* and Iγ(443γ)=86.8 *25*. α(K)exp=0.0383 *12*, α(L)exp=0.0168 *11* (1967Gi11). ce(L1)/ce(L3) exp: 3.0 *3*, ce(L2)/ce(L3) exp: 3.0 *3* (1968Gv01). Others: 1961Ed01, 1967Sc19, 1990Mi25. δ: −5.3 *4* from $\gamma\gamma(\theta)$ in 1961Bo25 and −5.3 *3* from γ anisotropy in 1971Kr18. Also 1962Ko15. Penetration parameter λ=−40 *8* from ce(K)/ce(L1)/ce(L2)/ce(L3) exp: 0.043 *3*/0.0072 *5*/0.0072 *5*/0.0023 *2* consistent with δ=5.4 (1977Se10). Penetration parameter λ=−44 *6* from α(K)exp=0.0463 *12*, ce(K)/ce(L) exp=2.65 *10*, ce(L1)/ce(L2) exp=1.00 *4*, ce(L1)/ce(L3) exp=3.0 *2*, and δ=−5.5 *2* (1990Mi25,1990MiZP).

[†] Weighted average of data from 1961Ed01, 1970Re08, 1971Gu02, and 1972GeZG. Individual values are included in the comments.
[‡] Weighted average of data from 1961Ed01, 1970Re08, 1971Ja21, 1971Gu02, and 1972GeZG. Individual values are included in the comments.
[#] From ce measurements as provided in the comments.
[@] For absolute intensity per 100 decays, multiply by 0.941 *9*.

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Decay Scheme

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

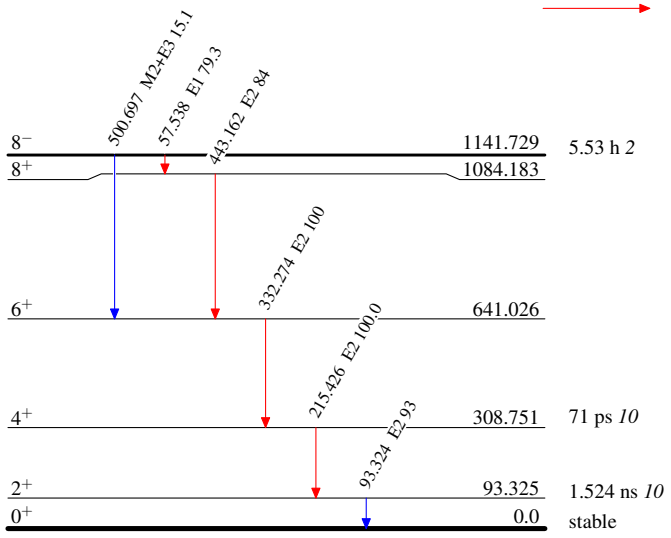
%IT=99.7 *1*

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$



$^{180}_{72}Hf_{108}$