^{174}Au α decay (162.9 ms) 2004GoZZ,1996Pa01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	C. M. Baglin[1], E. A. Mccutchan[2], S. Basunia[1]	NDS 153, 1 (2018)	1-Oct-2018

Parent: ^{174}Au: E=0.0+x; $J^{\pi}=(9^+)$; $T_{1/2}$=162.9 ms *16*; Q(α)=6699 *7*; %α decay<100.0

^{174}Au-J^{π}: is unmeasured. However, for small deformation, the lowest-energy orbitals available to the 79th proton are probably 1/2[400] ($s_{1/2}$), 1/2[411] and 3/2[402] ($d_{3/2}$), and 11/2[505] ($h_{11/2}$); those available to the 95th neutron are 5/2[512] ($h_{9/2}$) and 7/2[514] ($f_{7/2}$). The close proximity of $1/2^+$ and $11/2^-$ orbitals results In $1/2^+$ and $11/2^-$ isomer pairs In the neighboring odd-A Au isotopes, and the isotones ^{173}Pt, ^{171}Os, ^{167}W have $(5/2^-)$ (probably 5/2[523]) ground states. If ^{174}Au is near-spherical, its structure might resemble that of ^{166}Ir (and possibly ^{170}Au) where a $((\pi\ d_{3/2})\otimes(\nu\ f_{7/2}))2^-$ state is believed to account for the low-spin g.s., based on the Nordheim strong rule (1997Da07), and a $(\pi\ h_{11/2})(\nu\ f_{7/2})$ configuration leads via the Nordheim weak rule to a $J^{\pi}=9^+$ isomeric state (1997Da07). However, if the deformation is large enough for the Gallagher-Moszkowski rule to apply, a 3^- and 9^+ isomer doublet could result from coupling a 1/2[411] or 1/2[400] proton or a 11/2[505] proton with a neutron In the 5/2[523] (or 5/2[512]) orbital, consistent with J^{π} values suggested by 2004GoZZ and supported by HF<4 deduced here for low-spin ^{174}Au α decay to a possible (3^-) ^{170}Ir g.s. The evaluator very tentatively adopts (3^-) and (9^+) for the ^{174}Au isomers.

^{174}Au-$T_{1/2}$: weighted average of 163 ms *2* (6618α), 160 ms *5* (6548α), 171 ms *7* (6471α), 162 ms *4* (6433α), all from 2004GoZZ. Others: 119 ms *26* (1984ScZQ for 6626α); 171 ms *29* (1996Pa01, 6544α). $T_{1/2}$=120 ms *20* (1983Sc24, 6530α) and 123 ms *20* (1984ScZQ, 6546α) are tentatively associated by the evaluator with a different ^{174}Au state.

^{174}Au-%α decay: α decay observed by 1983Sc24, 1996Pa01, 2002Ro17 and 2004GoZZ. Gross β decay theory predicts a partial β decay $T_{1/2}$ of≈1 s (1973Ta30) for ^{174}Au, so %ε+β^+≈16 is expected; thus, %α may be somewhat less than 100.

2004GoZZ: ^{174}Au source from ^{92}Mo(^{84}Sr,pn), E=390, 395 MeV; 98.27% ^{92}Mo target; fragment mass analyzer and double-sided Si strip detector (for recoils and decay α particles) surrounded by 4 Ge detectors and a low-energy photon spectrometer; recoil decay tagging technique; measured Eα, Iα, Eγ, Iγ, I(K x ray), recoil-α-γ coin, α(t), parent-daughter α correlations. Supersedes 2001KoZY.

2002Ro17: ^{174}Au produced by α decay of ^{178}Tl; Si strip detector; measured Eα, parent-daughter α correlations, $T_{1/2}$ for daughter.

1996Pa01: ^{174}Au produced in 309 MeV ^{70}Ge bombardment of ^{106}Cd; recoil mass separator with double-sided Si strip detector At focal plane (FWHM≤20 keV); measured Eα, Iα, α(t), parent-daughter α correlations. Other: 1984ScZQ,

The adopted decay scheme is based on the data of 2004GoZZ.

The interpretation of data from this decay is complicated by the similarity of $T_{1/2}$ for the two ^{174}Au isomers, the similarity of $T_{1/2}$ and one Eα to that for ^{175}Au and the possibility of two α+ce sum peaks for one ^{174}Au isomer At almost the same energy As an α group from the other ^{174}Au isomer. α correlation information is of vital importance. The available data for both ^{174}Au isomers are summarized In the table below. it remains unclear why the 6471α and 6433α from 2004GoZZ are not reported by either 2002Ro17 or 1996Pa01 even though the latter studies report a 6544α correlated with the ^{170}Ir 6083α. Additional measurements appear to be necessary.

Summary of ^{174}Au α decay data (for **both** isomers):

Eα	Iα	Half-life		Reference(s)	Correlation(s)
6433 5	29 2	162 ms 4	H	2004GoZZ	^{170}Ir(6088α),191.2γ
6471 5	32 3	171 ms 7	H	2004GoZZ	^{170}Ir(6088α),153.2γ
6544 10	-	171 ms 29	H	1996Pa01	^{170}Ir(6083α)
6544	-		H	2002Ro17	^{170}Ir(6082α)
6548# 10	35 3	160 ms 5	H	2004GoZZ	^{170}Ir(6088α)
6530 20	-	120 ms 20	?	1983Sc24	
6546 10	-	123 ms 20	?	1984ScZQ	
6538	-	139 ms 3	L	2002Ro17	^{178}Tl(6704α)& ^{170}Ir(5817α)
6547 5	-	-	L	2004GoZZ	^{170}Ir(5815α)
6626 10	-	119 ms 26	?	1984ScZQ	-
6637 13	-	-	H	1996Pa01	-
6618 15	<4	163 ms 2	H	2004GoZZ	^{170}Ir(6088α)

Identified by 2004GoZZ as sum peak from 6471α(^{174}Au)-153ce(K)(^{170}Ir) coincidences.
L - Associated With Low-spin ^{174}Au Decay.
H - Associated With High-spin ^{174}Au Decay.

^{170}Ir Levels

E(level)[†]	Jπ[‡]	Comments
0.0+x	(8+)	
87+x? *14*		E(level): from difference In Eα to g.s. and possible Eα to this level. Level not adopted because 2004GoZZ identify their 6548α As a sum peak.
153.2+x *5*	(9+)	
191.2+x *5*	(7−,8−,9−)	

[†] Based on measured Eγ, except as noted. Eα energy differences from 2004GoZZ lead to E(level) values that are consistent with these.
[‡] From Adopted Levels.

α radiations

Eα	E(level)	Iα[†@]	HF[‡]	Comments
6433[#] *5*	191.2+x	29.6 *20*	>4.9	Eα: from 2004GoZZ. Correlated with 6088α from ^{170}Ir (2004GoZZ). coincident with 191.2γ.
6471[#] *5*	153.2+x	68.5 *23*	>3.0	Eα: from 2004GoZZ. Iα: sum of I(6471α)=32 *3* and I(6548 sum peak)=35 *3* (2004GoZZ) equals 67 *4*. HF: if %α(^{174}Au) is >83 then HF < 4 and this transition will be unhindered. Correlated with 6088α from ^{170}Ir (2004GoZZ); coincident with 153.2γ.
6548[&] *10*	87+x?			Eα: from 2004GoZZ. other: 6544 *10* (1996Pa01). Note, however, that the peak At this energy is identified by 2004GoZZ As a sum peak arising from 6471α(^{174}Au)−153ce(K)(^{170}Ir) coin. The 6044α from 1996Pa01 (correlated with 6083α(^{170}Ir)) may also include a sum contribution and/or the line from ^{174}Au (139 ms); however, 1996Pa01 do not report the 6471α with which the 153-keV transition′s K conversion electrons could sum. Correlated with 6083α from ^{170}Ir (1996Pa01,2002Ro17, 2004GoZZ). Coincident with Ir K x ray (2004GoZZ, fig. 6.5c); the E=65.0 *5* line from 2001KoZY is presumably the Ir K x ray.
6629 *10*	0.0+x	<4		Eα: weighted average of 6637 *13* (1996Pa01) and 6618 *15* (2004GoZZ; ΔE from text on p. 119). Other Eα: 6626 *10* (1984ScZQ). HF: if Iα=2 *2*, HF≥400 *400*. Correlated with 6088α from ^{170}Ir (2004GoZZ).

[†] Relative intensities from 2004GoZZ have been renormalized so Σ Iα=100%; the relative Iα(6618)<4 from 2004GoZZ has been interpreted As Iα=2 *2*. 1996Pa01 note that their 6544α is stronger than their 6637α; however, it is unclear whether those two lines arise entirely from the same parent.
[‡] r_0=1.5530 *24* (unweighted average of r_0(^{170}Os)=1.556 *6* and r_0(^{170}Pt)=1.548 *12* from 2002Ba93, r_0(^{168}Os)=1.558 *8* and r_0(^{172}Pt)=1.55 *3* from 1998Ak04). HF can be given only as a lower limit because %α(^{174}Au) is unknown.
[#] This α line has been attributed to ^{174}Au only by 2004GoZZ and 2001KoZY. However, 1984ScZQ attribute to ^{175}Au both an Eα=6435 *10* ($T_{1/2}$=220 ms *20*) and an Eα=6470, and these are In coincidence with 190.0γ and 152.7γ, respectively; it seems possible that these May arise, instead, from ^{174}Au decay.
[@] For absolute intensity per 100 decays, multiply by <1.0.
[&] Existence of this branch is questionable.

^{174}Au α decay (162.9 ms) 2004GoZZ,1996Pa01 (continued)

$\gamma(^{170}Ir)$

E_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α‡	Comments
153.2 *5*	153.2+x	(9^+)	0.0+x	(8^+)	(M1)	1.81	α(K)=1.50 *3*; α(L)=0.245 *5*; α(M)=0.0564 *10*; α(N+..)=0.0165 *3* α(N)=0.01386 *24*; α(O)=0.00245 *5*; α(P)=0.000185 *4* Mult.: based on strength of Ir K x ray relative to I(153γ) In 6471α-γ coin spectrum (2004GoZZ).
191.2 *5*	191.2+x	$(7^-,8^-,9^-)$	0.0+x	(8^+)	(E1)	0.0764 *12*	α(K)=0.0629 *10*; α(L)=0.01046 *17*; α(M)=0.00241 *4*; α(N+..)=0.000689 *11* α(N)=0.000584 *10*; α(O)=9.92×10^{-5} *16*; α(P)=5.90×10^{-6} *9* Mult.: based on absence of Ir K x ray In the 6433α-γ coin spectrum containing the 191γ (2004GoZZ).

† From 2004GoZZ.
‡ 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