^{81}Ge β^- decay (7.6 s) 1981Ho24

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia	NDS 199,271 (2025)	1-Sep-2024

Parent: ^{81}Ge: E=679.14 *4*; $J^\pi=(1/2^+)$; $T_{1/2}$=7.6 s *6*; Q(β^-)=6242 *3*; %β^- decay=100

^{81}Ge-Q(β^-): from 2021Wa16.

Others: 1972De43, 1981Al20, 1981ZeZY, 1990Ru05.

In 1980HoZN (Lab report of 1981Ho24), Eγ, Iγ and $\gamma\gamma$ coin data are tabulated without differentiation between their ^{81}Ge parentages.

Source: from mass-separated fission products.

1981Ho24, 1980HoZN: single γ and $\gamma\gamma$ coincidences measured with Ge(Li); x-ray detector for low energy γ search (E$\gamma\geq$15 keV); Si(Li) detector for simultaneous measurement of ce and γ spectra (for α(K)exp determination).

From analysis of ^{81}Ga decay and $\beta\gamma$-coin measurements, it is evident that there are two β^- decaying isomers of ^{81}Ge; but, in a multispectrum analysis of mass number 81, 1981Ho24 were unable to differentiate between their half-lives. Hence, 1981Ho24 conclude that there exist two isomers of ^{81}Ge which possess similar $T_{1/2}$ values.

1981Ho24 propose tentative decay schemes for the two isomers, consistent with $\gamma\gamma$ and $\beta\gamma$ coin data and supported by arguments based on the large spin differences of the decaying isomers and on analogies with ^{83}Se decay. However, J^π based on the resulting log *ft* value and observed γ deexcitation patterns are in conflict with L(t,α) for the 758 level unless separate levels with almost identical energy are assumed to be excited in β^- decay and in (t,α).

^{81}As Levels

E(level)†	J^π#	$T_{1/2}$	Comments
0	$3/2^-$	33.3 s *10*	
93.08 *5*	$(3/2)^-$		
290.39 *4*	$(3/2)^-$		
335.97 *4*	$(5/2)^-$	<0.7 ns	$T_{1/2}$: from $\gamma\gamma$(t) (1981Ho24).
737.72 *4*	$(5/2)^-$		
758.41 *7*	$(5/2^-,3/2^+)$		
864.20?‡ *13*	$(1/2^-,3/2^-,5/2^-)$		
1041.99 *8*	$(7/2^-)$		
1869.85?‡ *17*	$(5/2^-,7/2^-,9/2^-)$		J^π: in 2022De07, this level populated in β feeding from $(9/2^+)$ and proposed $J^\pi=5/2^-,7/2^-,9/2^-,11/2^-$. No J^π listed here. (1/2,3/2) can be expected if β feeding from $(1/2^+)$.
2862.46?‡ *17*	$(7/2,9/2^-)$		Iβ=4.8 *19* log *ft*=5.9 *2*, less likely for a $(7/2^+,9/2^+)$ state (Adopted Levels) from $(1/2^+)$.
2911.98?‡ *13*	$(7/2^+,9/2^+)$		Iβ=6.0 *24* log *ft*=5.8 *2*, less likely for a $(7/2^+,9/2^+)$ state (Adopted Levels) from $(1/2^+)$.
3136.27 *13*	$(3/2^+)$		
3195.31 *14*	$(3/2^+)$		
3368.28?‡ *24*	$(7/2^+,9/2^+,11/2^+)$		Iβ=1.8 *8* log *ft*=6.0 *2*, less likely for a $(7/2^+,9/2^+)$ state (Adopted Levels) from $(1/2^+)$.
3531.13 *21*	$(1/2^-,3/2)$		
3562.72 *15*	$(1/2^+,3/2^+)$		

† From a least-squares fit to Eγ.

‡ Level assigned in the ^{81}Ge β- decay (6.4 s) (2022De07). Population in the isomeric ^{81}Ge β- decay (7.6 s) should be considered with caution. The evaluator marks the level as questionable.

From Adopted Levels.

^{81}Ge β^- decay (7.6 s) 1981Ho24 (continued)

β^- radiations

From γ-gated β endpoint measurements, 1981Al20 determine Q(β) values of 6220 *130* and 6930 *280* for g.s. and isomeric state β^- decay, respectively. These imply E(isomeric state, ^{81}Ge)=710 *310*, consistent with its identification as the 679 level of ^{81}Ge.
Measured average Eβ=1580 *150* (1990Ru05).
β^- av Eβ: Additional information 1.

E(decay)	E(level)	Iβ^-[†]	Log *ft*	Comments
(3358.4 *30*)	3562.72	6.1 *24*	5.40 *17*	av Eβ=1445.0 *14*
(3390.0 *30*)	3531.13	1.1 *5*	6.16 *20*	av Eβ=1460.1 *14*
(3552.9[‡] *30*)	3368.28?	1.8 *8*	6.04 *20*	av Eβ=1538.0 *14*
(3725.8 *30*)	3195.31	10 *4*	5.39 *18*	av Eβ=1620.8 *14*
(3784.9 *30*)	3136.27	10 *4*	5.42 *18*	av Eβ=1649.2 *14*
(4009.2[‡] *30*)	2911.98?	6.0 *24*	5.75 *18*	av Eβ=1756.9 *14*
(4058.7[‡] *30*)	2862.46?	4.8 *19*	5.87 *18*	av Eβ=1780.6 *14*
(5051.3[‡] *30*)	1869.85?	3.4 *14*	6.44 *18*	av Eβ=2259.1 *14*
(6162.7 *30*)	758.41	4.9 *23*	6.68 *21*	av Eβ=2796.6 *15*
(6183.4[‡] *30*)	737.72	8 *4*	8.45[1u] *22*	av Eβ=2800.5 *14*
(6630.8 *30*)	290.39	12 *5*	6.43 *18*	av Eβ=3023.2 *15*
(6828.1 *30*)	93.08	7 *5*	6.73 *31*	av Eβ=3118.8 *15*
(6921.1 *32*)	0	<54	>5.9	av Eβ=3163.9 *15*

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

^{81}Ge β^- decay (7.6 s) 1981Ho24 (continued)

$\gamma(^{81}As)$

Iγ normalization: approximate value from ΣI(γ+ce) to g.s.=73% *27*, deduced assuming log *ft*>5.9 to g.s., which implies Iβ(g.s.)<54%.
Measured average Eγ=2000 *222* (1990Ru05).

E_γ [†]	I_γ [†b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ	α[a]	Comments
93.10 *10*	34 *4*	93.08	(3/2)$^-$	0	3/2$^-$	M1+E2	0.24 *6*	0.160 *26*	α(K)exp=0.141 *21* α(K)=0.140 *22*; α(L)=0.0166 *31*; α(M)=0.0025 *5* α(N)=0.000182 *31* δ: from α(K)exp.
197.30 *5*	16.4 *10*	290.39	(3/2)$^-$	93.08	(3/2)$^-$	(M1)		0.01490 *21*	α(K)exp=0.010 *5* α(K)=0.01326 *19*; α(L)=0.001411 *20*; α(M)=0.0002153 *30* α(N)=1.633×10^{-5} *23*
242.84 *9*	0.7 *4*	335.97	(5/2)$^-$	93.08	(3/2)$^-$				
290.35 *5*	8.6 *7*	290.39	(3/2)$^-$	0	3/2$^-$				
335.98 *5*	17 *3*	335.97	(5/2)$^-$	0	3/2$^-$	M1,E2		0.0067 *27*	α(K)exp=0.0064 *32* α(K)=0.0059 *24*; α(L)=6.4×10^{-4} *27*; α(M)=1.0×10^{-4} *4* α(N)=7.2×10^{-6} *29* δ: both α(K)(M1) and α(K)(E2) lie within limits of experimental uncertainty.
401.75 *5*	5.7 *5*	737.72	(5/2)$^-$	335.97	(5/2)$^-$				
456.3 *2*	2.4 *4*	3368.28?	(7/2$^+$,9/2$^+$,11/2$^+$)	2911.98?	(7/2$^+$,9/2$^+$)				
[x]463.1 *3*	1.9 *4*								
467.98 *6*	3.4 *10*	758.41	(5/2$^-$,3/2$^+$)	290.39	(3/2)$^-$				
[x]609.1 *3*	1.9 *4*								
665.9[#] *3*	3	758.41	(5/2$^-$,3/2$^+$)	93.08	(3/2)$^-$				
706.07 *10*	1.0 *7*	1041.99	(7/2$^-$)	335.97	(5/2)$^-$				
737.74 *5*	14 *1*	737.72	(5/2)$^-$	0	3/2$^-$				
751.51 *10*	1.0 *7*	1041.99	(7/2$^-$)	290.39	(3/2)$^-$				
758.5 *6*	7.4 *7*	758.41	(5/2$^-$,3/2$^+$)	0	3/2$^-$				
771.26 *15*	6.1 *5*	864.20?	(1/2$^-$,3/2$^-$,5/2$^-$)	93.08	(3/2)$^-$				
1005.7[d] *3*	1.6 *4*	1869.85?	(5/2$^-$,7/2$^-$,9/2$^-$)	864.20?	(1/2$^-$,3/2$^-$,5/2$^-$)				
[x]1038.5 *4*	1.7 *5*								
[x]1056.5 *2*	4.2 *4*								
[x]1095.5 *3*	3.0 *3*								
[x]1225.8 *2*	4.1 *5*								
[x]1238.9 *3*	2.4 *4*								
[x]1256.1 *2*	1.1 *3*								

$^{81}_{33}As_{48}$-3

^{81}Ge β^- decay (7.6 s) 1981Ho24 (continued)

$\gamma(^{81}As)$ (continued)

E_γ [†]	I_γ [†b]	E_i(level)	J_i^π	E_f	J_f^π	Comments
[x]1297.4 *3*	2.8 *4*					
[x]1435.7 *2*	4.5 *5*					
[x]1686.5 *3*	1.1 *2*					
1869.8[c@d] *2*	3[c]	1869.85?	(5/2$^-$,7/2$^-$,9/2$^-$)	0	3/2$^-$	E_γ: evaluator marks the placement as questionable and not adopted. See comments with the level. The γ is not listed to populate a comparable level in 2022De07.
1869.8[c@] *2*	2[c]	2911.98?	(7/2$^+$,9/2$^+$)	1041.99	(7/2$^-$)	
2103.9 *3*	2.7 *4*	2862.46?	(7/2,9/2$^-$)	758.41	(5/2$^-$,3/2$^+$)	
2174.32 *15*	8.6 *6*	2911.98?	(7/2$^+$,9/2$^+$)	737.72	(5/2)$^-$	
2331.3 *2*	4.5 *5*	3195.31	(3/2$^+$)	864.20?	(1/2$^-$,3/2$^-$,5/2$^-$)	
2377.4 *4*	3.4 *10*	3136.27	(3/2$^+$)	758.41	(5/2$^-$,3/2$^+$)	
2436.6	≈1	3195.31	(3/2$^+$)	758.41	(5/2$^-$,3/2$^+$)	E_γ: from fig. 11 of 1981Ho24.
2526.5 *2*	3.9 *4*	2862.46?	(7/2,9/2$^-$)	335.97	(5/2)$^-$	
[x]2754.8 *3*	4.5 *5*					
2800.2 *2*	5.7 *6*	3136.27	(3/2$^+$)	335.97	(5/2)$^-$	
2845.8 *2*	2.8 *4*	3136.27	(3/2$^+$)	290.39	(3/2)$^-$	
2859.1	≈1	3195.31	(3/2$^+$)	335.97	(5/2)$^-$	E_γ: from fig. 11 of 1981Ho24.
2904.7 *3*	1.8 *3*	3195.31	(3/2$^+$)	290.39	(3/2)$^-$	
3136.6 *3*	1.7 *3*	3136.27	(3/2$^+$)	0	3/2$^-$	
3195.1[c&] *2*	5.3[c]	3195.31	(3/2$^+$)	0	3/2$^-$	
3195.1[c&] *2*	1.5[c]	3531.13	(1/2$^-$,3/2)	335.97	(5/2)$^-$	
3469.5 *2*	2.9 *3*	3562.72	(1/2$^+$,3/2$^+$)	93.08	(3/2)$^-$	
3562.7 *2*	5.4 *4*	3562.72	(1/2$^+$,3/2$^+$)	0	3/2$^-$	

[†] All data for unplaced γ rays and all uncertainties are from 1980HoZN; other data are from 1981Ho24, except as noted.
[‡] From α(K)exp (1981Ho24).
[#] Iγ from drawing in 1981Ho24; Eγ from table 11 of 1980HoZN. Iγ=11.0 *20* for multiplet (1980HoZN, both isomers combined).
[@] Iγ from drawing in 1981Ho24; Eγ from table 11 in 1980HoZN. Iγ=5.0 *5* for doublet (1980HoZN).
[&] Iγ from drawing in 1981Ho24; Eγ from table 11 in 1980HoZN. Iγ=6.8 *6* for doublet (1980HoZN).
[a] Additional information 2.
[b] For absolute intensity per 100 decays, multiply by 0.73 *28*.
[c] Multiply placed with intensity suitably divided.
[d] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

$^{81}_{33}As_{48}$-4

^{81}Ge β^- decay (7.6 s) 1981Ho24

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
@ Multiply placed: intensity suitably divided

Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)
- Coincidence

$(1/2^+)$ 679.14 7.6 s *6*
Q_{β^-}=6242 *3* $\%\beta^-$=100
$^{81}_{32}Ge_{49}$

Iβ⁻	Log *ft*		
6.1	5.40	$(1/2^+,3/2^+)$	3562.72
1.1	6.16	$(1/2^-,3/2)$	3531.13
1.8	6.04	$(7/2^+,9/2^+,11/2^+)$	3368.28
10	5.39	$(3/2^+)$	3195.31
10	5.42	$(3/2^+)$	3136.27
6.0	5.75	$(7/2^+,9/2^+)$	2911.98
4.8	5.87	$(7/2,9/2^-)$	2862.46
3.4	6.44	$(5/2^-,7/2^-,9/2^-)$	1869.85
		$(7/2^-)$	1041.99
		$(1/2^-,3/2^-,5/2^-)$	864.20
4.9	6.68	$(5/2^-,3/2^+)$	758.41
8	8.45[1u]	$(5/2)^-$	737.72
		$(5/2)^-$	335.97 <0.7 ns
12	6.43	$(3/2)^-$	290.39
7	6.73	$(3/2)^-$	93.08
<54	>5.9	$3/2^-$	0 33.3 s *10*

3562.7 3.9, 3469.5 2.1, 3195.1 1.1@, 1.8, 456.3, 3195.1 3.9@, 2904.7 1.3, 2859.1 ≤0.73, 2436.6 ≤0.73, 2331.3 3.3, 3136.6 1.2, 2885.8 2.0, 2800.2 4.2, 2377.4 2.5, 2174.32 6.3, 1869.8 1.5@, 2526.5 2.9, 2103.9 2.0, 1869.8 2.2@, 1005.7 1.2, 751.51 0.7, 706.07 0.7, 771.26 4.5, 758.5 5.4, 665.9 2.2, 467.98 2.5, 737.74 10, 401.75 4.2, 335.98 M1+E2 13, 242.84 0.5, 290.25 6.3, 197.30 (M1) 12, 93.10 M1+E2 29

$^{81}_{33}As_{48}$