^{59}Zn ε decay 1981Ho19,1984Ar12

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia	NDS 151, 1 (2018)	1-Apr-2018

Parent: ^{59}Zn: E=0.0; J$^\pi$=3/2$^-$; T$_{1/2}$=178.6 ms *18*; Q(ε)=9142.8 *6*; %ε+%β^+ decay=100.0

Others: 1981Ar13, 2014Ru08, 2017RuZX.

1981Ho19: production: ^{58}Ni(^{3}He,2n), E=25 MeV. Measured E(p) and I(p) for β^-delayed protons, Eγ, Iγ, p(t);Ge(Li) and Si detectors, 98% ^{58}Ni target.

1984Ar12, 1981Ar13: production and identification: ^{58}Ni(^{3}He,2n), E≈20 MeV, mass separation. Measured Eβ, Eγ, Iγ, B(t), I(β^-delayed protons); high purity Ge detectors and Si(Au) ΔE-E telescope; FWHM=15 keV for delayed protons.

^{59}Cu Levels

E(level)†	J$^\pi$‡	T$_{1/2}$	Comments
0.0	3/2$^-$	81.5 s *5*	
491.4 *1*	1/2$^-$		
914.2 *1*	5/2$^-$		
4347 *10*	(1/2)$^-$		E(p)(lab)=913 keV *10* and I(p)=7 × 10^{-5} *3* (1981Ho19).
4500 *5*	(1/2)$^-$		E(p)(lab)=1063 keV *5* and I(p)=14 × 10^{-5} *5* (1981Ho19).
4704 *10*	1/2$^-$,3/2$^-$		E(p)(lab)=1264 keV *10* and I(p)=4 × 10^{-5} *3* (1981Ho19).
4773 *10*	3/2$^-$		E(p)(lab)=1331 keV *10* and I(p)=4 × 10^{-5} *3* (1981Ho19).
4818 *5*	3/2$^-$		E(p)(lab)=1376 keV *5* and I(p)=23 × 10^{-5} *7* (1981Ho19).
5227 *5*	1/2$^-$		E(p)(lab)=1778 keV *5* and I(p)=45 × 10^{-5} *13* (1981Ho19).
5267 *5*	3/2$^-$		E(p)(lab)=1817 keV *5* and I(p)=26 × 10^{-5} *8* (1981Ho19).
5308 *5*	(1/2)$^-$		E(p)(lab)=1857 keV *5* and I(p)=17 × 10^{-5} *6* (1981Ho19).
5479# *5*			E(p)(lab)=2025 keV *5* and I(p)=16 × 10^{-5} *5* (1981Ho19).
5544# *5*	1/2$^-$,3/2$^-$,5/2$^-$		E(p)(lab)=2089 keV *5* and I(p)=28 × 10^{-5} *9* (1981Ho19).
5638 *10*	(3/2,5/2)$^-$		E(p)(lab)=2182 keV *10* and I(p)=11 × 10^{-5} *4* (1981Ho19).
5653 *10*	5/2$^-$		E(p)(lab)=2197 keV *10* and I(p)=10 × 10^{-5} *4* (1981Ho19).
5707 *10*	5/2$^-$		E(p)(lab)=2250 keV *10* and I(p)=8 × 10^{-5} *3* (1981Ho19).
5870 *15*	3/2$^-$,5/2$^-$		E(p)(lab)=2410 keV *15* and I(p)=16 × 10^{-5} *6* (1981Ho19).
5916@ *15*	1/2$^-$,3/2$^-$		E(p)(lab)=2455 keV *15* and I(p)=5 × 10^{-5} *2* (1981Ho19).
6460?& *15*			E(level): Uncertainty estimated by evaluator from data in 1981Ho19. E(p)(lab) not listed in 1984Ar12.

† For bound levels: from Eγ. For unbound levels (E>3418): from E(p)(lab) (1981Ho19) and S(p)=3418.6 *4* (2017Wa10). Data from 1981Ho19 are in excellent agreement with those from ^{58}Ni(p,γ) and ^{58}Ni(^{3}He,dp) studies.

‡ From Adopted Levels.

Level not reported in ^{58}Ni(^{3}He,dp) reaction (1976Ga19).

@ Correspondence of this level to the 5923 level of 1976Ga19 is not certain.

& From 1984Ar12 (fig. 4); Iβ quoted as 0.003%. Source of data unclear, so evaluator has indicated existence of level as tentative.

ε,β^+ radiations

E(decay)†	E(level)	Iβ^+ #	Iε#	Log *ft*	I($\varepsilon+\beta^+$)‡#	Comments
(2683@ *15*)	6460?	0.003	0.0004	5.1	0.003	av Eβ=725.8 *69*; εK=0.105 *3*; εL=0.0115 *3*; εM+=0.00201 *5* I($\varepsilon+\beta^+$): From 1984Ar12.
(3227 *15*)	5916	0.0020 *9*	0.00011 *5*	5.78 *19*	0.0021 *9*	av Eβ=976.8 *70*; εK=0.0472 *10*; εL=0.00515 *11*; εM+=0.000899 *18* I($\varepsilon+\beta^+$): Assuming Γ_p/Γ=1 and I(p)=0.0021% 9 (1981Ho19-normalized).

Continued on next page (footnotes at end of table)

^{59}Zn ε decay 1981Ho19,1984Ar12 (continued)

ε,β^+ radiations (continued)

E(decay)†	E(level)	Iβ^+ #	Iε#	Log *ft*	I(ε+β^+)‡#	Comments
(3273 *15*)	5870	0.0066 *25*	0.00035 *13*	5.30 *17*	0.0069 *26*	av Eβ=998.3 *70*; εK=0.0444 *9*; εL=0.00485 *10*; εM+=0.000847 *17* I(ε+β^+): Using Γ_p/Γ=0.98 *2* (1976Ga19) and I(p)=0.0068% 26 (1981Ho19-normalized).
(3436 *10*)	5707	0.0035 *12*	0.00015 *5*	5.71 *16*	0.0036 *13*	av Eβ=1074.5 *47*; εK=0.0363 *5*; εL=0.00396 *5*; εM+=0.000691 *9* I(ε+β^+): Using Γ_p/Γ=0.96 *6* (1976Ga19) and I(p)=0.0034% 13 (1981Ho19-normalized).
(3490 *10*)	5653	0.0042 *17*	0.00017 *7*	5.66 *18*	0.0044 *18*	av Eβ=1099.8 *47*; εK=0.0340 *4*; εL=0.00371 *5*; εM+=0.000648 *8* I(ε+β^+): Using Γ_p/Γ=0.98 *4* (1976Ga19) and I(p)=0.0043% 17 (1981Ho19-normalized).
(3505 *10*)	5638	0.0045 *16*	0.00018 *6*	5.65 *16*	0.0047 *17*	av Eβ=1106.8 *47*; εK=0.0334 *4*; εL=0.00364 *5*; εM+=0.000636 *8* I(ε+β^+): Assuming Γ_p/Γ=1 and I(p)=0.0047% 17 (1981Ho19-normalized).
(3599 *5*)	5544	0.012 *4*	0.00041 *14*	5.31 *15*	0.012 *4*	av Eβ=1151.0 *24*; εK=0.02996 *18*; εL=0.003269 *19*; εM+=0.000571 *4* I(ε+β^+): Assuming Γ_p/Γ=1 and I(p)=0.012% 4 (1981Ho19-normalized).
(3664 *5*)	5479	0.0066 *20*	0.00021 *7*	5.60 *14*	0.0068 *21*	av Eβ=1181.6 *24*; εK=0.02785 *16*; εL=0.003039 *17*; εM+=0.000530 *3* I(ε+β^+): Assuming Γ_p/Γ=1 and I(p)=0.0068% 21 (1981Ho19-normalized).
(3835 *5*)	5308	0.007 *3*	0.00020 *7*	5.68 *16*	0.0075 *27*	av Eβ=1262.4 *24*; εK=0.02317 *13*; εL=0.002527 *14*; εM+=0.0004412 *2* I(ε+β^+): Using Γ_p/Γ=0.97 *3* (1976Ga19) and I(p)=0.0073% 26 (1981Ho19-normalized).
(3876 *5*)	5267	0.011 *3*	0.00028 *8*	5.54 *12*	0.011 *3*	av Eβ=1281.8 *24*; εK=0.02221 *12*; εL=0.002422 *13*; εM+=0.0004228 *2* I(ε+β^+): Assuming Γ_p/Γ=1 and I(p)=0.011% 3 (1981Ho19-normalized).
(3916 *5*)	5227	0.032 *9*	0.00079 *22*	5.09 *12*	0.033 *9*	av Eβ=1300.8 *24*; εK=0.02131 *11*; εL=0.002325 *12*; εM+=0.0004058 *2* I(ε+β^+): Using Γ_p/Γ=0.59 *2* (1976Ga19) and I(p)=0.0019% 6 (1981Ho19-normalized).
(4325 *5*)	4818	0.014 *4*	0.00023 *7*	5.72 *13*	0.014 *4*	av Eβ=1495.4 *24*; εK=0.01444 *7*; εL=0.001575 *8*; εM+=0.0002748 *1* I(ε+β^+): Using Γ_p/Γ=0.69 *3* (1976Ga19) and I(p)=0.0098% 30 (1981Ho19-normalized).
(4370 *10*)	4773	0.0026 *20*	4.×10^{-5} *3*	6.5 *4*	0.0026 *20*	av Eβ=1516.9 *48*; εK=0.01388 *13*; εL=0.001513 *14*; εM+=0.0002641 *2* I(ε+β^+): Using Γ_p/Γ=0.65 *4* (1976Ga19) and I(p)=0.0017% 13 (1981Ho19-normalized).
(4439 *10*)	4704	0.0029 *22*	4.×10^{-5} *3*	6.5 *4*	0.0029 *22*	av Eβ=1549.8 *48*; εK=0.01307 *12*; εL=0.001425 *13*; εM+=0.0002486 *2* I(ε+β^+): Using Γ_p/Γ=0.59 *3* (1976Ga19) and I(p)=0.0017% 13 (1981Ho19-normalized).
(4643 *5*)	4500	0.019 *7*	0.00024 *9*	5.77 *16*	0.019 *7*	av Eβ=1647.6 *25*; εK=0.01101 *5*; εL=0.001200 *5*; εM+=0.0002095 *9* I(ε+β^+): Using Γ_p/Γ=0.31 *3* (1976Ga19) and I(p)=0.0060% 21 (1981Ho19-normalized).
(4796 *10*)	4347	0.011 *5*	0.00012 *5*	6.09 *20*	0.011 *5*	av Eβ=1721.1 *49*; εK=0.00975 *8*; εL=0.001062 *9*; εM+=0.0001854 *1* I(ε+β^+): Using Γ_p/Γ=0.27 *2* (1976Ga19) and I(p)=0.0030% 13 (1981Ho19-normalized).

Continued on next page (footnotes at end of table)

^{59}Zn ε decay 1981Ho19,1984Ar12 (continued)

ε,β^+ radiations (continued)

E(decay)†	E(level)	Iβ^+ #	Iε#	Log *ft*	I(ε+β^+)‡#	Comments
(8228.6 *6*)	914.2	1.1 *2*	0.0018 *3*	5.39 *8*	1.1 *2*	av Eβ=3395.26; εK=0.0014431 *4*; εL=0.0001571; εM+=2.7409×10^{-5} *7*
(8651.4 *6*)	491.4	4.8 *6*	0.0066 *8*	4.86 *6*	4.8 *6*	av Eβ=3603.58; εK=0.0012194 *3*; εL=0.0001327; εM+=2.3157×10^{-5} *6*
(9142.8 *6*)	0.0	94 *3*	0.108 *4*	3.698 *15*	94.1 *30*	av Eβ=3846.04; εK=0.0010139 *3*; εL=0.0001103; εM+=1.9254×10^{-5} *5*

† Measured E(β^+)(max)=8100 *100* (1981Ar13,1984Ar12).
‡ For bound levels: from Iγ imbalance. For unbound levels: from measured proton intensities of 1981Ho19 renormalized so total I(p)=0.10% 3 (adopted value) combined with Γ_p/Γ, assuming Γ_p/Γ=1, except when data are available from ^{58}Ni(^{3}He,dp) (1976Ga19).
# Absolute intensity per 100 decays.
@ Existence of this branch is questionable.

γ(^{59}Cu)

Iγ normalization: from I(491γ)/Iβ(total)=4.8% 6 (measured in planar HPGe detector which detected both β and γ) and I(β^+-p)=0.10% 3 (1984Ar12) and intensity imbalance at 491 and 914 levels. Other I(491γ): 5% 2 (1981Ho19) from measured intensity relative to $\gamma^{\pm}$ radiation (allowing 10% correction for annihilation in flight).

E_γ†	I_γ†@	E_i(level)	J^π_i	E_f	J^π_f	Mult.‡	δ‡	α#	Comments
423&	<0.2	914.2	5/2$^-$	491.4	1/2$^-$				I_γ: after correction for I(423γ) from daughter (^{59}Cu) ε decay. Existence of transition uncertain.
491.4 *1*	4.8 *6*	491.4	1/2$^-$	0.0	3/2$^-$	M1(+E2)	<0.37	0.00108 *6*	α(K)=0.00097 *5*; α(L)=9.6×10^{-5} *6*; α(M)=1.36×10^{-5} *8* α(N)=4.12×10^{-7} *21*
914.2 *1*	1.1 *2*	914.2	5/2$^-$	0.0	3/2$^-$	M1+E2	−0.21 *2*	2.71×10^{-4}	α(K)=0.000243 *4*; α(L)=2.40×10^{-5} *4*; α(M)=3.38×10^{-6} *5* α(N)=1.037×10^{-7} *15*

† From 1984Ar12.
‡ From adopted gammas.
# Additional information 1.
@ Absolute intensity per 100 decays.
& Placement of transition in the level scheme is uncertain.

^{59}Zn ε decay 1981Ho19,1984Ar12