Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	C. D. Nesaraja	NDS 115, 1 (2014)	31-Jul-2013

Q(β^-)=910.2 *15*; S(n)=6482.07 *16*; S(p)=10139.5 *18*; Q(α)=−5717.3 *8* 2012Wa38
2012Gr06: Summary and compilation of the discovery of the Zn isotopes.

^{69}Zn Levels

Cross Reference (XREF) Flags

A	^{69}Cu β^- decay	E	^{68}Zn(d,p), (pol d,p)
B	^{69}Zn IT decay (13.756 h)	F	^{70}Zn(p,d)
C	^{67}Zn(t,p)	G	^{70}Zn(d,t)
D	^{68}Zn(n,γ), (pol n,γ) E=thermal	H	^{70}Zn(^{3}He,α)

E(level)[†]	J$^\pi$	T$_{1/2}$	XREF	Comments
0	1/2$^-$[‡]	56.4 min *9*	ABCDEFGH	%β^-=100 T$_{1/2}$: weighted average of 55.6 m *16* (1969Zo01), 55 m 1 (1968Ma12), 57 m 2 (1939Li02), and 58.5 m 12 (1956Ru45). Others: 51 m (1948Ho04), 52.5 m (1967Vi08), 52 m (1949Ha17) and 57 m 4 (1958Gu09).
438.636 *18*	9/2$^+$[‡]	13.756 h *18*	BCDEFGH	%IT=99.967 *3*; %β^-=0.033 *3* μ=1.157 *2* (1992Be51) Q=−0.51 *5* (1983Oe01) %IT,%β^-: From %β^-=0.033 *3* (1970Ra08). μ: from NMR on oriented nuclei. Compiled by 2011StZZ. Q: from static nuclear orientation with gamma detection. Compiled by 2011StZZ. T$_{1/2}$: From 1977He20 in ^{69}Zn IT Decay. Others: 13.59 h *18* (2006Ab30) and 13.76 h *3* (1974Ro18).
531.30 *13*	5/2$^-$[‡]		A CDEFGH	XREF: C(?).
834.46 *12*	3/2$^-$		A DEF H	J$^\pi$: from L(d,p)=1 and circular γ polarization measurements on polarized-neutron capture.
872 *5*	5/2$^+$[‡]		DE H	
967 *10*			E	
1007.66 *14*	3/2$^-$		A CDE	J$^\pi$: 1/2$^-$,3/2$^-$,5/2$^-$ from allowed log *ft*=4.82 8 from 3/2$^-$ in ^{69}Cu β^- decay, strong neutron-capture γ feeding from 1/2$^+$ excludes 5/2$^-$. Circular polarization of primary γ in polarized neutron capture rules out 1/2$^-$.
1136 *10*			E	
1180.73 *14*	5/2$^-$[@]		A C F H	
1224 *10*			E	
1251.68 *19*	1/2,3/2		A D	J$^\pi$: 1/2,3/2,5/2$^+$ from primary γ transition from 1/2$^+$ neutron capture level; γ to 1/2$^-$ g.s. rules out 5/2$^+$.
1338 *10*			E	
1409? *10*			C	
1429.56 *15*	1/2$^-$,3/2$^-$,5/2$^-$		A E	J$^\pi$: log *ft*=4.86 8 from 3/2$^-$ in ^{69}Cu β- decay.
1458.3 *5*	5/2$^-$[&]		A C H	J$^\pi$: γ transition to 1/2$^-$.
1595	(1/2$^-$,3/2$^-$)[a]		D F	E(level): L(p,d)=1 at 1610 *30*.
1610 *20*	(5/2$^-$,7/2$^-$)		H	J$^\pi$: L(^{3}He,α)=(3).
1633.2 *6*	5/2$^+$[‡]		A C E	
1650 *20*	(5/2$^-$,7/2$^-$)		H	J$^\pi$: L(^{3}He,α)=(3).
1696 *10*	1/2$^+$[#]		E	

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Adopted Levels, Gammas (continued)

^{69}Zn Levels (continued)

E(level)[†]	J^π	XREF	Comments
1761? *10*		C	
1791 *10*	−[@]	C E	
1828.01 *17*	3/2−	A CDE	J^π: 3/2− or 5/2+ from L transfer and vector analyzing power data in ^{68}Zn(pol d,p); roughly equal feedings to 1/2− and 5/2− levels rule out 5/2+.
1850 *20*		F H	J^π: L(p,d)=1 at 1850 *30* and L(^{3}He,α)=3 at 1850 *20* indicate a possible doublet.
1893.4 *5*	−[@]	A C H	XREF: C(?).
1941 *10*		E	
1968 *10*	1/2−,3/2−[#]	c E H	
1983	1/2−,3/2−[a]	cD F	
2032.8 *3*	5/2−[@]	A C	
2052	1/2,3/2,5/2+[b]	D	
2085 *10*	5/2−[@]	C	
2210? *10*		C	
2256		E	
2262 *10*	1/2+[#]	C E	
2281 *10*	1/2−,3/2−[a]	EF H	J^π: Inconsistent with L(^{3}He,α)=(3).
2344	1/2+,3/2,5/2+[b]	D	J^π: γ circular polarization rules out 1/2−.
2378	1/2,3/2,5/2+[b]	D	
2410	5/2+[‡]	DE	
2420 *20*	5/2−,7/2−[&]	H	
2460 *30*	1/2−,3/2−[a]	F	
2510	1/2−,3/2−[#]	DE	
2562 *10*	3/2+,5/2+[#]	DE	
2580 *10*	1/2−,3/2−[#]	E	
2607 *10*		E	
2625 *10*		E	
2663 *10*	1/2+[#]	E	
2700 *20*	5/2−,7/2−[&]	H	
2740 *10*	(3/2+,5/2+)[#]	E	
2790 *30*	1/2−,3/2−[a]	F H	XREF: H(?). J^π: Inconsistent with L(^{3}He,α)=(3)L(^{3}He,α)=(3).
2828 *10*	1/2+[#]	E	
2905 *10*	3/2+,5/2+[#]	E	
2919 *10*		E	J^π: Possibly unresolved from 2919 in 1981Bi06; however cross section and analyzing power data show L=2 and J^π=5/2+ for a peak associated by the authors with the 2912 level of 1967Vo05.
2950[c] *10*	3/2+,5/2+[#]	E H	XREF: H(?).
3014 *10*	5/2+[‡]	E	
3061[c] *10*	1/2+[#]	E H	
3091 *10*		E	
3120 *10*		E	
3134 *10*		E	
3194[c] *10*	(3/2+,5/2+)[#]	E H	
3338 *10*		E	
3385[c] *10*	1/2+[#]	E	
3438[c] *10*	(1/2+)[#]	E	
3457 *10*	(3/2+,5/2+)[#]	E	
3671 *10*		E	
3913 *10*		E	

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Adopted Levels, Gammas (continued)

^{69}Zn Levels (continued)

E(level)†	Jπ	XREF	E(level)†	XREF	E(level)†	XREF
3978 *10*	1/2+#	E	4262 *10*	E	4661 *10*	E
4089 *10*		E	4518 *10*	E	4722 *10*	E
4193 *10*	(1/2−,3/2−)&	E H	4620 *10*	E H		

† From β- decay data for levels at 2033 or less if the energy uncertainties are less than 1 keV. Energies quoted without uncertainties are from ^{68}Zn(n,γ) and estimated to be uncertain by 2-5 keV. The other level energies are from reactions.
‡ From L transfer and vector-analyzing power in ^{68}Z(pol d,p).
# From L transfer in ^{68}Zn(d,p).
@ From L transfer in ^{67}Zn(t,p).
& From L transfer in ^{70}Zn(^{3}He,α).
a From L transfer in ^{70}Zn(p,d).
b Primary γ transition assumed to be dipole or E2 from 1/2+ neutron capture level.
c Possible multiplet in (d,p).

γ(^{69}Zn)

E_i(level)	J_i^π	E_γ‡	I_γ#	E_f	J_f^π	Mult.	α†	Comments
438.636	9/2+	438.634 *18*	100.0	0	1/2−	M4	0.0540 *8*	α(K)=0.0476 *7*; α(L)=0.00560 *8*; α(M)=0.000807 *12*; α(N+..)=2.95×10^{-5} *5* α(N)=2.95×10^{-5} *5* B(M4)(W.u.)=1.4165 *24* E_γ,I_γ: from ^{69}Zn IT decay (13.76 h). Mult.: from α(exp) in ^{69}Zn IT decay (13.76 h) (1968Sc08).
531.30	5/2−	531.2 *2*	100	0	1/2−			
834.46	3/2−	834.4 *2*	100	0	1/2−			
872	5/2+	436&	100	438.636	9/2+			
1007.66	3/2−	173.4 *2*	1.1 *1*	834.46	3/2−			
		476.3 *3*	0.8 *1*	531.30	5/2−			
		1007.5 *2*	100 *3*	0	1/2−			
1180.73	5/2−	173.4& *2*	<2.0	1007.66	3/2−			
		346.3 *3*	4.1 *10*	834.46	3/2−			
		649.4 *2*	91 *5*	531.30	5/2−			
		1180.7 *2*	100 *3*	0	1/2−			
1251.68	1/2,3/2	417.4 *3*	39 *6*	834.46	3/2−			
		1251.8 *3*	100 *6*	0	1/2−			
1429.56	1/2−,3/2−,5/2−	178.2 *3*	1.0 *2*	1251.68	1/2,3/2			
		421.8 *3*	4.1 *7*	1007.66	3/2−			
		594.9 *2*	77 *4*	834.46	3/2−			
		898.2 *3*	19.2 *14*	531.30	5/2−			
		1429.8 *3*	100 *4*	0	1/2−			
1458.3	5/2−	1458.3 *5*	100	0	1/2−			
1595	(1/2−,3/2−)	760	71	834.46	3/2−			
		1594	100	0	1/2−			
1633.2	5/2+	1633.2 *6*	100	0	1/2−			
1828.01	3/2−	647.4 *4*	10 *2*	1180.73	5/2−			
		820.7 *5*	8 *4*	1007.66	3/2−			

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Adopted Levels, Gammas (continued)

$\gamma(^{69}Zn)$ (continued)

E_i(level)	J_i^π	E_γ [‡]	I_γ [#]	E_f	J_f^π
1828.01	$3/2^-$	993.4 *2*	100 *6*	834.46	$3/2^-$
		1296.6 *3*	20 *2*	531.30	$5/2^-$
		1828.6 *5*	22 *2*	0	$1/2^-$
1893.4	$^-$	1361.9 *5*	100 *15*	531.30	$5/2^-$
		1894 *1*	40 *15*	0	$1/2^-$
1983	$1/2^-,3/2^-$	1452	100	531.30	$5/2^-$
2032.8	$5/2^-$	851.8 *4*	50 *9*	1180.73	$5/2^-$
		1501.6 *3*	100 *9*	531.30	$5/2^-$
		2033 *1*	14 *4*	0	$1/2^-$
2052	$1/2,3/2,5/2^+$	1180 [@&]	100	872	$5/2^+$
		1218	32	834.46	$3/2^-$
2344	$1/2^+,3/2,5/2^+$	1812	44	531.30	$5/2^-$
		2344	100	0	$1/2^-$
2378	$1/2,3/2,5/2^+$	2378	100	0	$1/2^-$

[†] Additional information 1.
[‡] Unless otherwise noted, values with uncertainties are from ^{69}Cu β- decay and those without are from ^{68}Zn(n,γ) in which case the uncertainties are estimated to be 2-5 keV.
[#] Relative branching from each level is given; from β- decay for γ's with a listed ΔE and from ^{68}Zn(n,γ) for those without ΔE.
[@] As placed in ^{68}Zn(n,γ), but poor fit to adopted energy differences. Possible multiple placement since Eγ=1180.7 is observed from 1180.7 level.
[&] Placement of transition in the level scheme is uncertain.

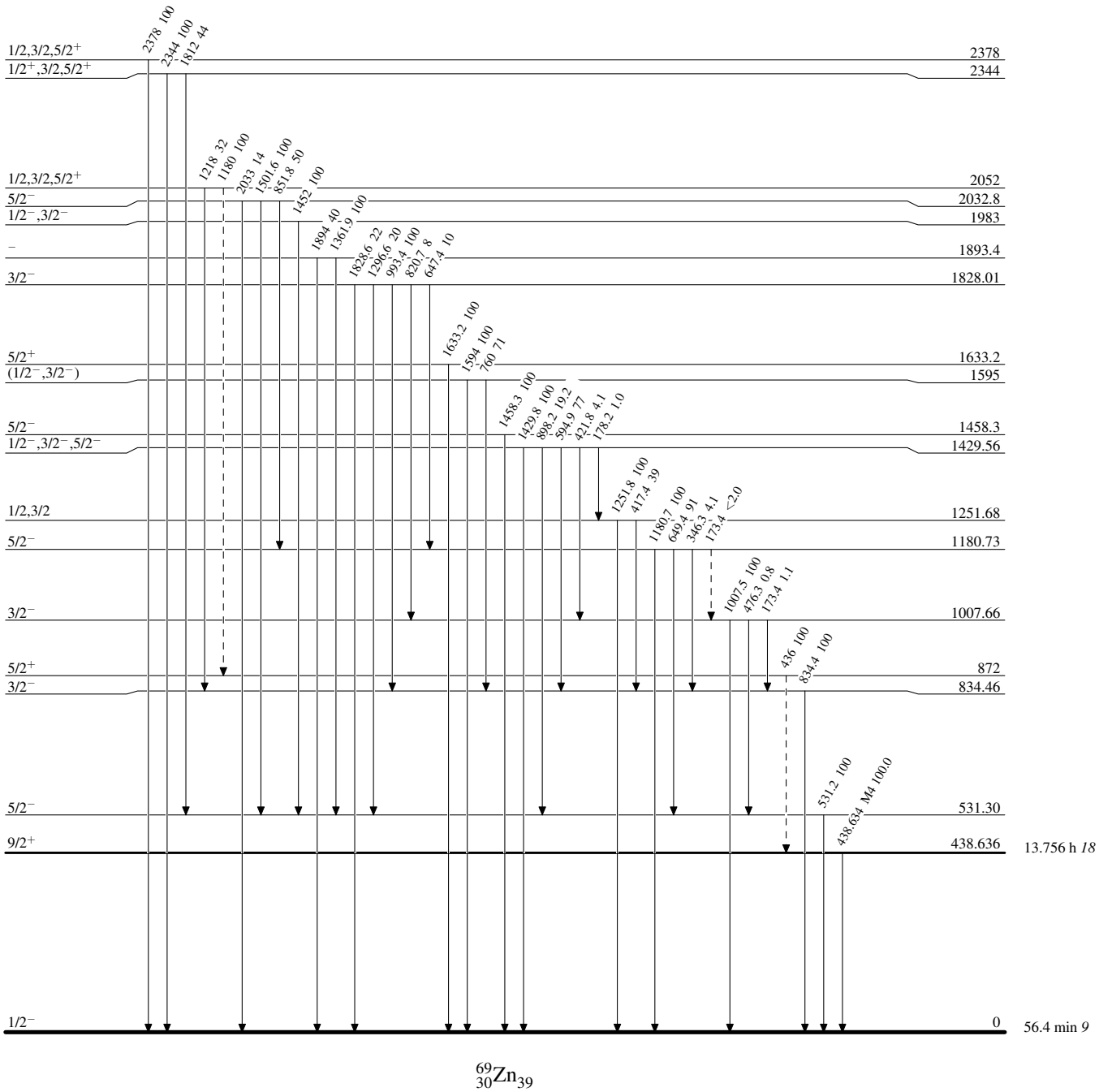
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

– – – – – – ► γ Decay (Uncertain)



$^{69}_{30}Zn_{39}$