Adopted Levels, Gammas

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

Q(β^-)=2681.4 *17*; S(n)=8240.5 *21*; S(p)=9561 *3*; Q(α)=−8975.9 *25* 2012Wa38
2012Ga06: Summary and compilation of the discovery of the Cu isotopes.

^{69}Cu Levels

Cross Reference (XREF) Flags

A	^{69}Ni β^- decay (3.5 s)	E	Coulomb excitation
B	^{69}Ni β^- decay (11.4 s)	F	(HI,xnγ)
C	^{70}Zn(d,^{3}He)	G	U(p,X)
D	^{70}Zn(pol t,α)		

E(level)†	J$^\pi$#@	T$_{1/2}$	XREF	Comments
0.0	3/2$^-$	2.85 min *15*	ABCDEFG	%β^-=100 μ=+2.8383 *10* (2010Vi07) Q=−0.147 *16* (2010Vi07) J$^\pi$: measured from hyperfine spectra (2010Vi07), π confirmed from (pol t,α) and (d,^{3}He). μ,Q: from resonance cell laser spectroscopy. Compiled by 2011StZZ. Other: +2.84 *1* NMR on oriented nuclei with β detection (2000Ri14). T$_{1/2}$: weighted average of 2.7 m *1* (1985Ru05) and 3.0 m *1* (1966Va12).
1096.0 *10*	1/2$^-$	2.0 ps *2*	CDE	J$^\pi$: from ^{70}Zn(pol t,α) differential cross section and analyzing powers. T$_{1/2}$: Deduced by evaluators from experimental B(E2)(W.u.)(2008St04) in Coulomb Excitation and adopted branching ratio.
1110	1/2$^-$		A	
1213.53‡ *10*	(5/2,7/2)$^-$	4.3 ps *4*	BCDEF	T$_{1/2}$: Deduced by evaluators from experimental B(E2)(W.u.)(2008St04) in Coulomb Excitation and adopted branching ratio. J$^\pi$: L(d,^{3}He)=3 for 0$^+$ target.
1297.91 *10*	(1/2$^-$,3/2$^-$)		A C	XREF: C(1310?). J$^\pi$: log *ft*=4.59 from (1/2$^-$).
1430?			C	
1560?			C	
1711.4& *3*	7/2$^-$		BCD F	XREF: C(1740). J$^\pi$: band member; (E2) 1710 γ to 3/2$^-$.
1871.3[a] *3*	7/2$^-$	0.30 ps *5*	BCDEF	T$_{1/2}$: Deduced by evaluators from experimental B(E2)(W.u.)(2008St04) Coulomb Excitation and adopted branching ratio. J$^\pi$: band member; (E2) 1870 γ to 3/2$^-$.
2182.1& *3*	9/2$^-$		B F	J$^\pi$: band member; (M1) 470 γ to 7/2$^-$.
2551.8 *3*	(9/2$^+$)		B D F	J$^\pi$: E2 190 γ from 13/2$^+$.
2602.9 *3*	(9/2$^-$)		B	J$^\pi$: from level scheme in ^{69}Ni β-decay measurements (2001Fr21).
2668.1& *6*	11/2$^-$		F	J$^\pi$: band member; (M1)485.9 γ to 9/2$^-$.
2696.9 *3*	(7/2$^+$,9/2$^+$,11/2$^+$)		B	J$^\pi$: log *ft* >4.6 from (9/2$^+$).
2742.0 *7*	(13/2$^+$)	357 ns *2*	F	μ=1.46 *16* μ: from g factor =0.225 *25* measured using the Time Dependant

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{69}Cu Levels (continued)

E(level)[†]	Jπ[#@]	$T_{1/2}$	XREF	Comments
				Perturbed Distribution in combination with heavy ion gamma correlation technique (2002Ge16). Compiled by 2011StZZ. Jπ: 74 γ to 11/2⁻ and 189.9 γ to (9/2⁺). $T_{1/2}$: From (HI,xnγ) in 2002Ge16. Others: 360 ns *20* (2012Di03), 330 ns *80* (1999BrZS), 0.36 μs *5* (1998Gr14), and 360 ns *30* (1997Is13).
2756.9 *3*	(7/2⁺,9/2⁺,11/2⁺)		B	Jπ: log *ft* >4.5 from 9/2⁺.
2800.9 *3*	(7/2⁺,9/2⁺,11/2⁺)		B	Jπ: log *ft* >4.5 from (9/2⁺).
2867.8[a] *9*	11/2⁻		F	Jπ: band member; E2 996 γ to 7/2⁻.
3063.7 *4*			B	
3214.5[&] *7*	13/2(⁻)		F	Jπ: band member.
3483.2[a] *8*	15/2⁻		F	Jπ: band member; E2 615 γ to 11/2⁻; E1 741 γ to 13/2⁺ E2 815 γ to 11/2⁻.
3692.0 *13*	(19/2⁻)	22 ns *1*	F	$T_{1/2}$: From (HI,xnγ). Jπ: 208.8 γ to 15/2⁻.
3828.0 *10*	(17/2⁺)	39 ns *6*	F	$T_{1/2}$: From (HI,xnγ). Jπ: Configuration=$\pi p_{3/2}\pi g_{9/2}\pi(f_{7/2}^{-1})$ suggested by 2000Is01.

[†] From least-squares fit to the Eγ's data. In addition to the levels listed here, (d,^{3}He) gives tentative peaks at 3000, 3300, 3700, and 3950.

[‡] Doublet with a spacing of less than 15 keV suggested in ^{70}Z(pol t,α). Systematics suggest that these may have J^π=5/2⁻ and 7/2⁻. $\sigma(\theta)$ cannot differentiate between these two J^π and analyzing-power data do not agree with either assignments although J^π=5/2⁻ level appears to be more strongly populated.

[#] Band member ...$\pi^2\pi^{-1}$ is with $\pi(p_{3/2}^2,p_{3/2}f_{5/2},f_{5/2}^2)\pi(f_{7/2}^{-1})$ configuration.

[@] Band member ...$\pi\nu^2\nu^{-2}$ is with $\pi p_{3/2}\nu g_{9/2}^2\nu p_{1/2}^{-2}$ configuration.

[&] Band(A): Member of band ...$\pi^2\pi^{-1}$.

[a] Band(B): Member of band ...$\pi\nu^2\nu^{-2}$.

Adopted Levels, Gammas (continued)

γ(^{69}Cu)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	α[†]	Comments
1096.0	1/2⁻	1096	100	0.0	3/2⁻			
1213.53	(5/2,7/2)⁻	1213.5 *1*	100	0.0	3/2⁻			E_γ: Poor fit to level energy difference.
1297.91	(1/2⁻,3/2⁻)	1297.9 *1*	100	0.0	3/2⁻			
1711.4	7/2⁻	1711.9 *6*	100	0.0	3/2⁻	(E2)[‡]	0.000261 *4*	α=0.000261 *4*; α(K)=7.57×10⁻⁵ *11*; α(L)=7.44×10⁻⁶ *11*; α(M)=1.046×10⁻⁶ *15*; α(N+..)=0.0001763 α(N)=3.21×10⁻⁸ *5*; α(IPF)=0.0001763 *25*
1871.3	7/2⁻	657.8	4.3	1213.53	(5/2,7/2)⁻			E_γ,I_γ: Not seen in β-decay.
		1872.3 *8*	100	0.0	3/2⁻	(E2)[‡]	0.000321 *5*	α=0.000321 *5*; α(K)=6.39×10⁻⁵ *9*; α(L)=6.27×10⁻⁶ *9*; α(M)=8.82×10⁻⁷ *13*; α(N+..)=0.000250 *4* α(N)=2.71×10⁻⁸ *4*; α(IPF)=0.000250 *4* B(E2)(W.u.)=4.7 *8*
2182.1	9/2⁻	470.7 *1*	100	1711.4	7/2⁻	(M1)[#]	0.001128 *16*	α=0.001128 *16*; α(K)=0.001013 *15*; α(L)=0.0001009 *15*; α(M)=1.419×10⁻⁵ *20* α(N)=4.33×10⁻⁷ *6*
2551.8	(9/2⁺)	680.5 *1*	100.0 *23*	1871.3	7/2⁻	(E1)[@]	0.000258 *4*	α=0.000258 *4*; α(K)=0.000232 *4*; α(L)=2.29×10⁻⁵ *4*; α(M)=3.21×10⁻⁶ *5*; α(N+..)=9.77×10⁻⁸ *14* α(N)=9.77×10⁻⁸ *14*
		1336.0 *7*	1.2 *5*	1213.53	(5/2,7/2)⁻			E_γ: Poor fit to level energy difference.
		2550 *2*	6.1 *7*	0.0	3/2⁻			
2602.9	(9/2⁻)	1389.5 *5*	100	1213.53	(5/2,7/2)⁻			
2668.1	11/2⁻	485.9	100	2182.1	9/2⁻	(M1)[#]	0.001050 *15*	α=0.001050 *15*; α(K)=0.000943 *14*; α(L)=9.38×10⁻⁵ *14*; α(M)=1.320×10⁻⁵ *19*; α(N+..)=4.03×10⁻⁷ α(N)=4.03×10⁻⁷ *6*
		956.7	9	1711.4	7/2⁻			
2696.9	(7/2⁺,9/2⁺,11/2⁺)	1483.6 *4*	100 *3*	1213.53	(5/2,7/2)⁻			
		2695 *2*	4.5 *8*	0.0	3/2⁻			
2742.0	(13/2⁺)	74.0	28	2668.1	11/2⁻			
		189.9	100	2551.8	(9/2⁺)			
2756.9	(7/2⁺,9/2⁺,11/2⁺)	154.1 *1*	7.3 *10*	2602.9	(9/2⁻)			
		205.1 *1*	100 *4*	2551.8	(9/2⁺)			
		574.9 *1*	44.2 *25*	2182.1	9/2⁻			E_γ: 1988Bo06 placed this transition from a 2285.4 level.
2800.9	(7/2⁺,9/2⁺,11/2⁺)	104.1 *2*	25 *5*	2696.9	(7/2⁺,9/2⁺,11/2⁺)			
		249.1 *1*	100 *18*	2551.8	(9/2⁺)			
		1089.3 *4*	21 *8*	1711.4	7/2⁻			
2867.8	11/2⁻	996.3	100	1871.3	7/2⁻	(E2)[‡]	0.000269 *4*	α=0.000269 *4*; α(K)=0.000242 *4*; α(L)=2.40×10⁻⁵ *4*; α(M)=3.37×10⁻⁶ *5*; α(N+..)=1.024×10⁻⁷ *15* α(N)=1.024×10⁻⁷ *15*
3063.7		262.8 *2*	100	2800.9	(7/2⁺,9/2⁺,11/2⁺)			
3214.5	13/2(⁻)	546.2	100	2668.1	11/2⁻			

$^{69}_{29}Cu_{40}$-3

Adopted Levels, Gammas (continued)

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

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.	α[†]	Comments
3214.5	$13/2^{(-)}$	1032.9	29	2182.1	$9/2^-$			
3483.2	$15/2^-$	268.9	23	3214.5	$13/2^{(-)}$			
		615.3	100	2867.8	$11/2^-$	(E2)[‡]	0.000968 *14*	α=0.000968 *14*; α(K)=0.000868 *13*; α(L)=8.71×10^{-5} *13*; α(M)=1.222×10^{-5} *18*; α(N+..)=3.65×10^{-7} α(N)=3.65×10^{-7} *6*
		741.1	97	2742.0	$(13/2^+)$	(E1)[@]	0.000214 *3*	α=0.000214 *3*; α(K)=0.000192 *3*; α(L)=1.89×10^{-5} *3*; α(M)=2.66×10^{-6} *4*; α(N+..)=8.10×10^{-8} *12* α(N)=8.10×10^{-8} *12*
		815.3	49	2668.1	$11/2^-$	(E2)[‡]	0.000445 *7*	α=0.000445 *7*; α(K)=0.000399 *6*; α(L)=3.97×10^{-5} *6*; α(M)=5.58×10^{-6} *8*; α(N+..)=1.686×10^{-7} *24* α(N)=1.686×10^{-7} *24*
3692.0	$(19/2^-)$	208.8	100	3483.2	$15/2^-$	[E2]	0.0380	α(K)=0.0339 *5*; α(L)=0.00358 *5*; α(M)=0.000499 *7*; α(N+..)=1.376×10^{-5} *20* α(N)=1.376×10^{-5} *20* B(E2)(W.u.)=3.71 *19*
3828.0	$(17/2^+)$	613.6	100	3214.5	$13/2^{(-)}$	[M2]	0.00179 *3*	α=0.00179 *3*; α(K)=0.001605 *23*; α(L)=0.0001627 *23*; α(M)=2.29×10^{-5} *4*; α(N+..)=6.94×10^{-7} *10* α(N)=6.94×10^{-7} *10* B(M2)(W.u.)=0.29
		1085.8	85	2742.0	$(13/2^+)$	[E2]	0.000220 *3*	α=0.000220 *3*; α(K)=0.000198 *3*; α(L)=1.96×10^{-5} *3*; α(M)=2.75×10^{-6} *4*; α(N+..)=8.37×10^{-8} *12* α(N)=8.37×10^{-8} *12* B(E2)(W.u.)=0.00026

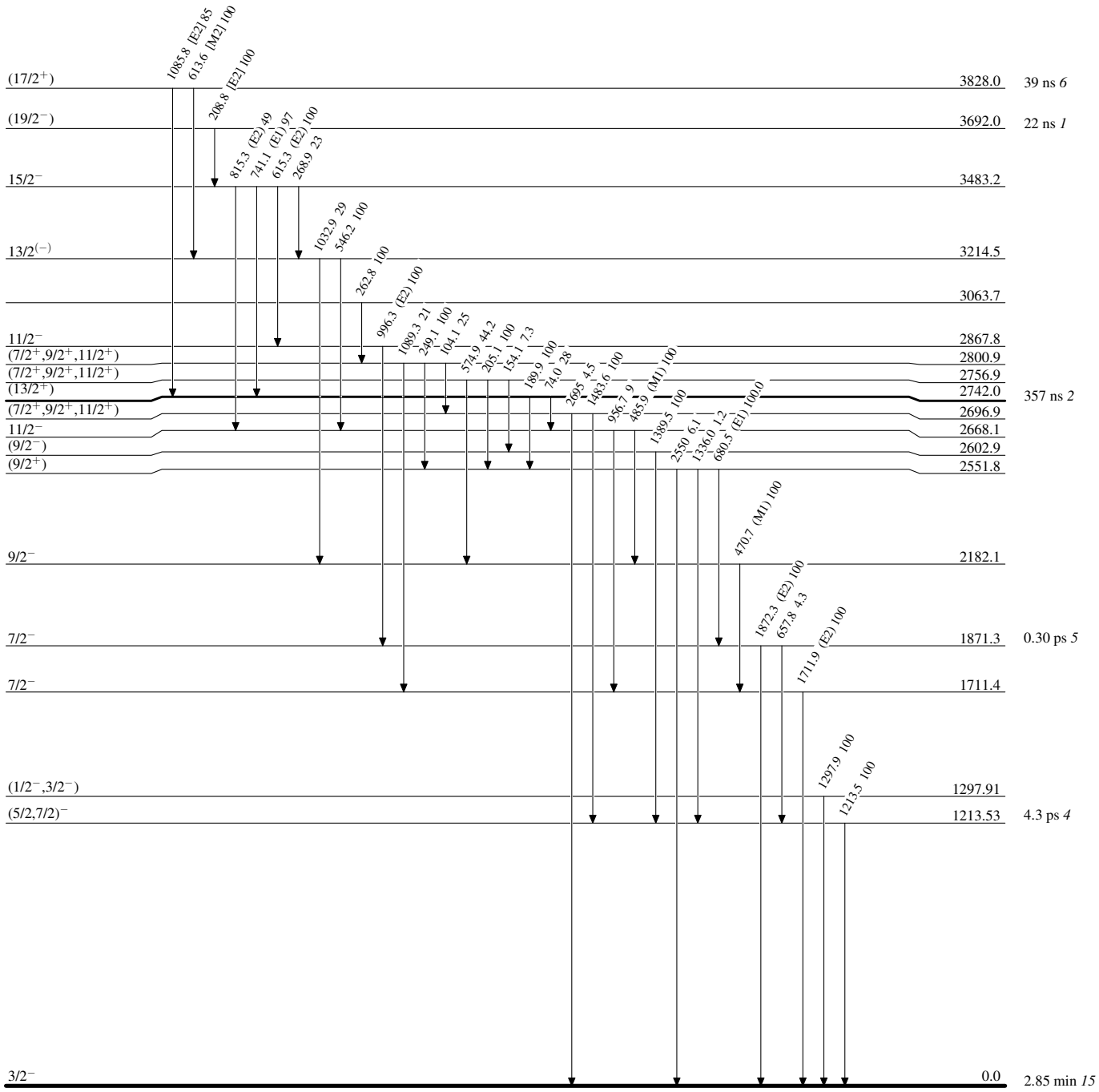
[†] Additional information 1.
[‡] ΔJ=2 from $\gamma(\theta)$ (2000Is01), Δπ=no from level scheme.
[#] ΔJ=1 from $\gamma(\theta)$ (2000Is01), Δπ=no from level scheme.
[@] ΔJ=1 from $\gamma(\theta)$ (2000Is01), Δπ=yes from level scheme.

$^{69}_{29}Cu_{40}$-4

Adopted Levels, Gammas

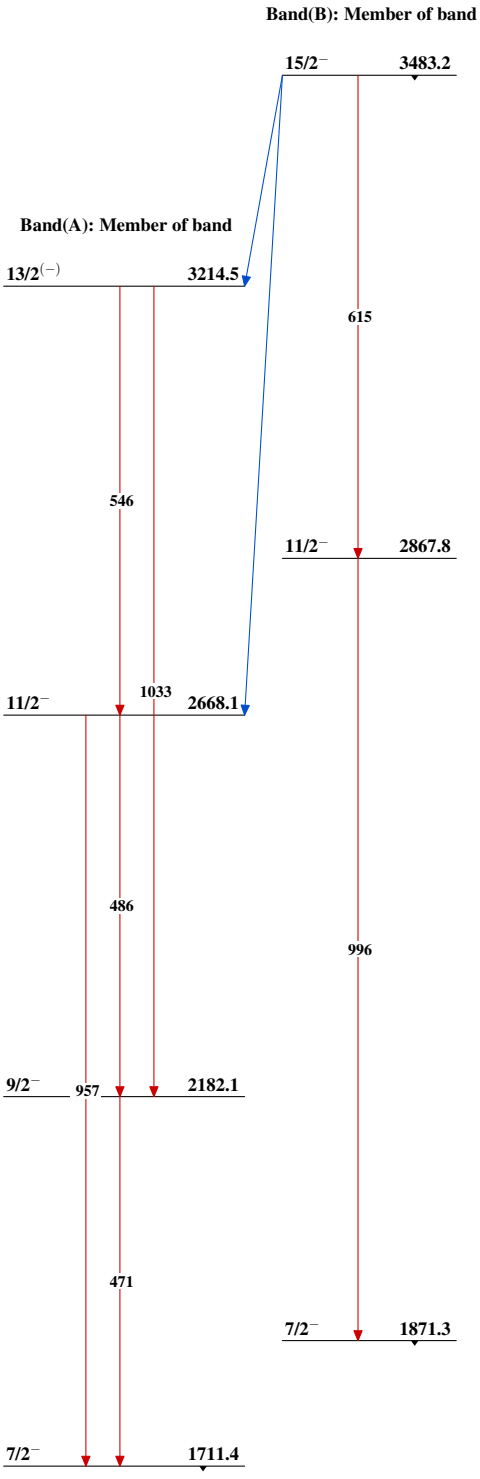
Level Scheme

Intensities: Relative photon branching from each level



$^{69}_{29}Cu_{40}$

Adopted Levels, Gammas



$^{69}_{29}Cu_{40}$