^{63}Cu(γ,γ') 1976Sw01,1981Ca10

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 196,17 (2024)	30-Sep-2023

1976Sw01: E=1.5-4.7 MeV photons were produced by bremsstrahlung with electron beam from the Bartol accelerator. Scattered γ rays were detected with a Ge(Li) detector. Measured $\gamma(\theta)$. Deduced levels, J, π, widths, γ-ray branching ratios, multipolarities, mixing ratios.

1981Ca10: E=0.5-1.65 MeV photons from bremsstrahlung. Scattered γ rays were detected with a Ge(Li) detector. Measured $\gamma(\theta)$. Deduced levels, J, π, widths, mixing ratios.

1960Cu03: measured $T_{1/2}$ of 669 and 962 levels using nuclear resonance fluorescence technique with self-absorption method.

1961Ro06: measured $T_{1/2}$ of 669 and 962 levels using resonance scattering method.

1964Bo22: E=0.5-3.0 MeV. Measured σ.

1967Mo26: measured $T_{1/2}$ of 669 level.

1968Al13: E=0.8-3.0 MeV. Measured σ. Deduced widths.

1968Ta04: measured $T_{1/2}$ of 962 level 1972Wh08: measured $T_{1/2}$ of 670, 962, 1327, 1412 levels.

1977Ca14: measured $T_{1/2}$ of 669, 962, 1327 levels.

Other: 1975Bo40.

^{63}Cu Levels

g=(2J_x+1)/(2J_0+1), where J_x is the spin of excited level and J_0=3/2 is the spin of ground state.

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$	gΓ_0^2/Γ (eV)[#]	Comments
0.0	3/2$^-$			
669.724[‡] *6*	1/2$^-$	196 fs *7*		$T_{1/2}$: weighted average of 192 fs *7* (1977Ca14,1981Ca10), 204 fs *17* (1960Cu03), 215 fs *21* (1961Ro06), 243 fs *90* (1967Mo26), 194 fs *16* (1975Bo40), and 284 fs *76* (1972Wh08), using resonance scattering method. gΓ_0=1.19×10^{-3} eV *4* (1981Ca10).
962.145[‡] *8*	5/2$^-$	0.57 ps *3*		$T_{1/2}$: weighted average of 0.55 ps *3* (1977Ca14,1981Ca10), 0.50 ps *12* (1960Cu03), 0.62 ps *10* (1961Ro06), 0.76 ps *11* (1968Ta04), and 0.82 ps *21* (1972Wh08), using resonance scattering method. gΓ_0=1.25×10^{-3} eV *6* (1981Ca10).
1327.0 *5*	7/2$^-$	0.53 ps *+6−5*	1.28×10^{-3} *13*	$T_{1/2}$: weighted average of 0.58 ps *8* (1977Ca14,1981Ca10), 0.50 ps *32*, (1972Wh08), and 0.50 ps *+6−5* (from gΓ_0^2/Γ in 1976Sw01 and adopted Γ_0/Γ=0.838 *4*). W(θ)gΓ_0^2/Γ=1.04×10^{-3} eV *14* (1981Ca10).
1412.0 *10*	5/2$^-$	1.15 ps *+28−19*	3.1×10^{-4} *6*	$T_{1/2}$: from gΓ_0^2/Γ in 1976Sw01 and adopted branching ratio Γ_0/Γ=0.721 *5*. Other: <0.54 ps (1972Wh08). W(θ)gΓ_0^2/Γ=0.260×10^{-3} eV *38* (1981Ca10).
1547.0 *5*	3/2$^-$	114 fs *+16−13*	2.5×10^{-3} *3*	J$^\pi$: 1/2$^-$ excluded from $\gamma(\theta)$ of resonantly scattered γ. $T_{1/2}$: from Γ=4.0×10^{-3} eV *5*, weighted average of 3.4×10^{-3} eV *22* (from gΓ_0=2.6×10^{-3} eV *17*, 1981Ca10) and 4.0×10^{-3} eV *5* (from gΓ_0^2/Γ=2.5×10^{-3} eV *3*, 1976Sw01), using adopted Γ_0/Γ=0.787 *9*.
1861.0 *10*	7/2$^-$	0.65 ps *+16−11*	4.2×10^{-4} *8*	$T_{1/2}$: from Γ=7.0×10^{-4} eV *14*, deduced from gΓ_0^2/Γ and adopted Γ_0/Γ=0.548 *11*.
2011.1 *5*	3/2$^-$	44 fs *+7−5*	2.8×10^{-3} *3*	J$^\pi$: 1/2$^-$ is excluded from $\gamma(\theta)$ of resonantly scattered γ. $T_{1/2}$: from Γ=0.0105 eV *14*, deduced from gΓ_0^2/Γ and adopted Γ_0/Γ=0.517 *19*.
2062.45[‡] *8*	(3/2)$^-$		<0.16×10^{-3}	
2082.4 *10*	5/2$^-$	175 fs *+65−37*	0.76×10^{-3} *17*	J$^\pi$: 3/2$^-$ excluded from g$\Gamma_{\gamma 0}^2/\Gamma$ (1976Sw01).

Continued on next page (footnotes at end of table)

^{63}Cu(γ,γ') 1976Sw01,1981Ca10 (continued)

^{63}Cu Levels (continued)

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$	$g\Gamma_0^2/\Gamma$ (eV)[#]	Comments
				$T_{1/2}$: from Γ=0.0026 eV *7*, deduced from $g\Gamma_0^2/\Gamma$ and adopted Γ_0/Γ=0.443 *33*.
2092.48[‡] *5*	7/2$^-$		<0.17×10^{-3}	
2337.0 *10*	5/2$^-$	1.3 ps *+4–3*	0.23×10^{-3} *5*	$T_{1/2}$: from Γ=3.6×10^{-4} eV *9*, deduced from $g\Gamma_0^2/\Gamma$ and adopted Γ_0/Γ=0.649 *25*.
2497.5 *10*	(3/2)	101 fs *+25–17*	3.0×10^{-3} *6*	$T_{1/2}$: from Γ=0.0045 eV *9*, deduced from $g\Gamma_0^2/\Gamma$ and adopted Γ_0/Γ=0.820 *5*.
2513.2 *10*	(3/2)$^+$		2.3×10^{-3} *3*	
2536.0 *10*	5/2$^-$	109 fs *+39–23*	0.5×10^{-3} *1*	$T_{1/2}$: from Γ=0.0042 eV *11*, deduced from $g\Gamma_0^2/\Gamma$ and adopted Γ_0/Γ=0.281 *20*.
2697.0 *10*	1/2$^-$,3/2$^-$,5/2$^-$		0.7×10^{-3} *4*	
2780.1 *10*	(3/2$^-$)		4.5×10^{-3} *5*	
2858.5 *10*	(1/2$^-$,3/2$^-$)		3.7×10^{-3} *6*	
2977.4 *10*	1/2$^-$,3/2$^-$,5/2$^-$		18×10^{-3} *2*	J$^\pi$: 1/2, 3/2, 5/2 from $\gamma(\theta)$ of resonantly scattered γ.
3045.4 *10*	(5/2)$^-$		2.5×10^{-3} *4*	
3100.9 *10*	1/2$^-$,3/2$^-$		0.5×10^{-3} *3*	
3405.1 *10*			32×10^{-3} *4*	
3430.7 *10*	(3/2)$^-$		14×10^{-3} *2*	
3458.6 *10*	5/2$^+$		12×10^{-3} *2*	
4038 *2*	(3/2$^-$)		22×10^{-3} *4*	
4117 *2*	(1/2$^+$)		18×10^{-3} *5*	
4294 *2*	1/2$^-$,3/2$^-$		44×10^{-3} *6*	
4358 *2*	(1/2$^-$,3/2$^-$)		66×10^{-3} *7*	
4513 *2*	(5/2$^-$,7/2$^-$)		97×10^{-3} *10*	

[†] From 1976Sw01, except as noted.
[‡] From Adopted Levels.
[#] From 1976Sw01.

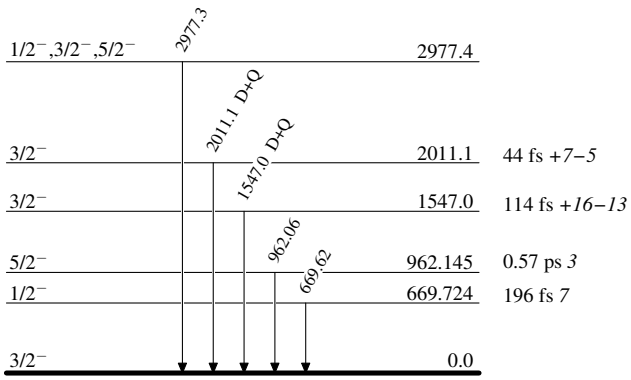
$\gamma(^{63}Cu)$

E_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	Comments
669.62	669.724	1/2$^-$	0.0	3/2$^-$			
962.06	962.145	5/2$^-$	0.0	3/2$^-$			
1547.0	1547.0	3/2$^-$	0.0	3/2$^-$	D+Q	+0.27 *5*	δ: other: +1.7 *2*, which yields a large B(E2) (1976Sw01).
2011.1	2011.1	3/2$^-$	0.0	3/2$^-$	D+Q		δ: +0.41 *14* or +1.4 *3* (1976Sw01).
2977.3	2977.4	1/2$^-$,3/2$^-$,5/2$^-$	0.0	3/2$^-$			

[†] From level-energy differences.
[‡] From $\gamma(\theta)$ of resonantly scattered γ in 1976Sw01.

^{63}Cu(γ,γ′) 1976Sw01,1981Ca10

Level Scheme



$^{63}_{29}Cu_{34}$