Coulomb excitation 1970Ro14

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	S. Kumar(a), J. Chen(b) and F. G. Kondev	NDS 137, 1 (2016)	31-May-2016

1970Ro14: ^{109}Ag(α,$\alpha'\gamma$), E=10 MeV, 10.7 MeV; ^{109}Ag(^{16}O,^{16}O$'\gamma$), E=45.5 MeV. α and ^{16}O beams were produced from the Oak Ridge 6 MV Van de Graaff accelerator. Targets are 98.4% enriched ^{109}Ag on 0.013 cm thick Ni discs. γ rays were detected with Ge(Li) detectors and NaI crystal. Measured Eγ, Iγ, $\gamma(\theta)$, $\gamma\gamma$-coin, Doppler-shift. Deduced levels, J^π, $T_{1/2}$, B(E2), γ-ray multipolarity, branching ratio and mixing ratio.

1967Bl08: ^{109}Ag(^{16}O,^{16}O$'\gamma$), E=40, 42 MeV beams were produced from the Stanford University FN Tandem accelerator. >99.5% isotopically enriched ^{109}Ag targets. γ rays were detected with Ge(Li) and NaI detectors. Measured Eγ, Iγ, $\gamma(\theta)$, $\gamma\gamma$-coin. Deduced levels, J^π, B(E2), γ-ray branching ratio.

1989Lo08: ^{109}Ag(Ar,Ar$'\gamma$), E=127 MeV beam was produced from the CYCLONE cyclotron of Louvain-la-Neuve. Target was 1 mg/cm^2 natural Ag. γ rays were detected by 60 cm^3 Ge(Li) spectrometers. Measured Eγ, Iγ, $\gamma(\theta)$, $\gamma\gamma$-coin. Deduced levels, J^π, $T_{1/2}$ by the Recoil Distance Method (RDM).

Other measurements:

1955Mc51, 1958Mc02: ^{109}Ag(p,p$'\gamma$), E=3 MeV.
1969Ro03: ^{109}Ag(α,$\alpha'\gamma$), E=9.5-10 MeV.
1970RoZS: ^{109}Ag(^{16}O,^{16}O$'\gamma$).
1973Co10: ^{109}Ag(α,$\alpha'\gamma$), E=4.8-7.2 MeV.
1974Mi02: ^{109}Ag(^{35}Cl,^{35}Cl$'\gamma$), E=64 MeV.
1984Ba72: ^{109}Ag(^{32}S,^{32}S$'\gamma$), E=90 MeV.
1984Wo08: ^{109}Ag(^{32}S,^{32}S$'\gamma$), E=100 MeV.
1986Ba14: ^{109}Ag(^{32}S,^{32}S$'\gamma$), E=80 MeV.
Additional information 1.

^{109}Ag Levels

E(level)†	J^π#	$T_{1/2}$	Comments
0.0	1/2⁻		
88.032	7/2⁺	39.79 s *21*	J^π,$T_{1/2}$: From Adopted Levels.
132.74	9/2⁺	2.60 ns *12*	
311.33 *23*	3/2⁻	5.9 ps *4*	B(E2)↑=0.228 *12* B(E2)↑: weighted average of 0.222 *19* (1970Ro14), 0.210 *18* (1973Co10) and 0.249 *17* (1958Mc02). $T_{1/2}$: weighted average of 5.9 ps 7, using Recoil Distance Method in Coulomb Excitation (1974Mi02) and 5.9 ps 5 from BE2=0.228 12 and δ(311.3γ)=0.192 *7* in Coulomb Excitation. Others: 6.9 ps *7* by RDM (1970MiZS) and 6.3 ps *18* (1970Ro14). Q=−0.54 *10*, −0.64 *10*, −0.81 *10* or −0.91 *10*, depending on the relative sign of matrix elements (1972Th16). g-factor: +0.73 6, weighted average of 0.79 12 (1984Ba72), +0.77 10 (1984Wo08) and 0.66 10 (1986Ba14). Other: 0.58 24 (1970RoZS).
415.08 *24*	5/2⁻	33.4 ps *13*	B(E2)↑=0.317 *18* B(E2)↑: weighted average of 0.320 *26* (1970Ro14) and 0.315 24 (1973Co10). Other: 0.377 *26* (1958Mc02). $T_{1/2}$: weighted average of 32.6 ps *16* (1989Lo08) and 34.7 ps *21* (1974Mi02), using the RDM method. Others: 35 ps *4* (1970MiZS,RDM), 40 ps *3* (1970Ro14), 40.2 ps *23* from B(E2)=0.317 *18* and δ(103.5γ)=−0.039 *17*. g-factor: +0.34 3, weighted average of 0.36 6 (1984Ba72), +0.36 5 (1984Wo08) and 0.29 6 (1986Ba14). Q=−0.16, −0.26, −0.33, or −0.43, depending on the relative sign of matrix elements (1972Th16).
702.0 *4*	3/2⁻	0.27 ps *7*	B(E2)↑=0.00087 *19* (1970Ro14) $T_{1/2}$: weighted average of 0.24 ps *7* (1974Er05) and 0.5 ps *2* (1970Ro14), using the DSAM method.
862.4 *3*	5/2⁻	1.39 ps *19*	B(E2)↑=0.0173 *17* (1970Ro14) $T_{1/2}$: weighted average of 1.42 ps 21 from BE2=0.0173 17 (1970Ro14) and 1.3 ps 4 from

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Coulomb excitation 1970Ro14 (continued)

^{109}Ag Levels (continued)

E(level)†	J^{π}#	$T_{1/2}$	Comments
			DSAM (1970Ro14). Other: 1.3 ps *+8−4* (1974Er05,DSAM).
912.3‡ *4*	7/2⁻		B(E2)↑<0.018 J^{π}: from $\gamma(\theta)$ in 1989Lo08.
1090.6‡ *6*	9/2⁻	1.9 ps *3*	B(E2)↑<0.006 J^{π}: from $\gamma(\theta)$ in 1989Lo08. $T_{1/2}$: from RDM in 1989Lo08.
1324.2 *8*	3/2⁻	0.31 ps *9*	B(E2)↑=0.0123 *18* (1970Ro14) $T_{1/2}$: from 1970Ro14 by DSAM. J^{π}: 1012.9$\gamma(\theta)$ results are consistent with J=3/2 or, with smaller probability, J=5/2 (1970Ro14). 1970Ro14 suggest J=3/2 based on spin of analogous level in ^{107}Ag.

† From a least-squares fit to γ-ray energies.

‡ Level is weakly excited by α bombardment but strongly observed with ^{16}O excitation (1970Ro14). Thus, the direct E2 excitation of the level is small, and the B(E2) value given is an upper limit for direct E2 excitation.

From deduced γ-ray transition multipolarities based on $\gamma(\theta)$ in 1970Ro14, unless otherwise noted.

$\gamma(^{109}Ag)$

E_i(level)	J_i^π	E_γ[‡]	I_γ[‡]	E_f	J_f^π	Mult.[@]	δ[@]	α[†]	$I_{(\gamma+ce)}$	Comments
88.032	7/2+	88.0336 *10*		0.0	1/2−	E3				E_γ,Mult.: From adopted gammas.
132.74	9/2+	44.77 *13*		88.032	7/2+	M1+E2	0.14 *6*			E_γ,Mult.,δ: From adopted gammas.
311.33	3/2−	311.3 *3*	100	0.0	1/2−	M1+E2	−0.192 *7*	0.0200		α(K)=0.01744 *25*; α(L)=0.00212 *3*; α(M)=0.000402 *6* α(N)=6.96×10^{-5} *10*; α(O)=3.24×10^{-6} *5* Mult.: from $\gamma(\theta)$: A_2=−0.395 *16* (1970Ro14), −0.39 *2* (1955Mc51), −0.388 *7* (1958Mc02), A_2=−0.710 *7* (1970RoZS), and −0.654 *36* (1989Lo08). δ: weighted average of 0.193 *10* (1970RoZS), −0.196 *27* (1970Ro14), and 0.19 *1* (1958Mc02). Others: 0.19 (1955Mc51).
415.08	5/2−	103.5 *5*	4.6[#] *11*	311.33	3/2−	M1+E2	−0.039 *17*	0.382 *8*	6.4[#] *15*	ce(K)/(γ+ce)=0.240 *4*; ce(L)/(γ+ce)=0.0299 *7*; ce(M)/(γ+ce)=0.00570 *13* ce(N)/(γ+ce)=0.000984 *22*; ce(O)/(γ+ce)=4.51×10^{-5} *10* α(K)=0.331 *7*; α(L)=0.0413 *9*; α(M)=0.00787 *17*; α(N)=0.00136 *3*; α(O)=6.24×10^{-5} *13* I_γ: Others: I(103.5γ)/I(415.1γ)=0.054 *5* from 1989Lo08, 0.09 *1* from 1967Bl08; I(103.5γ)=4.9 *5* and I(415.1γ)=95.3 *5* from 1970Ro14. δ: from $\gamma(\theta)$ in 1970Ro14. Mult.: A_2=−0.239 *17* (1970Ro14).
		282[&]	≤0.05[#]	132.74	9/2+	[M2]		0.1169	0.05[#]	ce(K)/(γ+ce)=0.0895 *12*; ce(L)/(γ+ce)=0.01240 *18*; ce(M)/(γ+ce)=0.00239 *4* ce(N)/(γ+ce)=0.000412 *6*; ce(O)/(γ+ce)=1.83×10^{-5} *3* α(K)=0.0999 *14*; α(L)=0.01385 *20*; α(M)=0.00267 *4*; α(N)=0.000461 *7*; α(O)=2.05×10^{-5} *3* E_γ: from level energy difference, very weak branch observed by 1973Co10.
		327[&]	0.37[#] *9*	88.032	7/2+	[E1]		0.00583	0.37[#] *9*	ce(K)/(γ+ce)=0.00507 *7*; ce(L)/(γ+ce)=0.000597 *9*; ce(M)/(γ+ce)=0.0001128 *16* ce(N)/(γ+ce)=1.94×10^{-5} *3*; ce(O)/(γ+ce)=8.77×10^{-7} *13* α(K)=0.00510 *8*; α(L)=0.000600 *9*; α(M)=0.0001134 *16*; α(N)=1.95×10^{-5} *3*; α(O)=8.82×10^{-7} *13* E_γ: from level energy difference, weak branch seen by 1973Co10. I_γ: 1970Ro14 set upper limit for branching of this γ as <0.2%.
		415.1 *3*	93.2[#] *15*	0.0	1/2−	E2		0.01099	93.2[#] *15*	ce(K)/(γ+ce)=0.00935 *14*; ce(L)/(γ+ce)=0.001245 *18*; ce(M)/(γ+ce)=0.000238 *4* ce(N)/(γ+ce)=4.04×10^{-5} *6*; ce(O)/(γ+ce)=1.620×10^{-6} *23*

Coulomb excitation 1970Ro14 (continued)

$\gamma(^{109}Ag)$ (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[‡]	E_f	J_f^π	Mult.[@]	δ[@]	α[†]	Comments
									α(K)=0.00945 *14*; α(L)=0.001258 *18*; α(M)=0.000240 *4*; α(N)=4.09×10^{-5} *6*; α(O)=1.638×10^{-6} *24* Mult.: A_2=+0.124 *23* (1970Ro14), A_2=+0.248 *4*, A_4=−0.039 *9* (1955Mc51). Other values: A_2=+0.556 *15*, A_4=−0.432 *28* (1989Lo08), A_2=−0.515 *10*, A_4=−0.401 *11* (1970RoZS).
702.0	3/2$^-$	285[&]	4 *4*	415.08	5/2$^-$				
		390.9 *6*	16 *3*	311.33	3/2$^-$				
		701.9 *5*	80 *5*	0.0	1/2$^-$	M1+E2	0.029 *7*	0.00273	α(K)=0.00239 *4*; α(L)=0.000280 *4*; α(M)=5.31×10^{-5} *8* α(N)=9.23×10^{-6} *13*; α(O)=4.41×10^{-7} *7* Mult.,δ: from A2=−0.32 6 ($\gamma(\theta)$) in 1970Ro14.
862.4	5/2$^-$	447.3 *3*	50 *3*	415.08	5/2$^-$	M1+E2	−0.16 *4*	0.00801	α(K)=0.00699 *10*; α(L)=0.000834 *12*; α(M)=0.0001583 *23* α(N)=2.74×10^{-5} *4*; α(O)=1.296×10^{-6} *19* I_γ: Other: 43 3 (1967Bl08). Mult.: A_2=+0.124 *23* (1970Ro14), A_2=+0.32 *10*, A_4=−0.11 *15* (1989Lo08). δ: From $\gamma(\theta)$ in 1970Ro14; Other: −0.12 *14* (1988Br31).
		551.1 *3*	41 *2*	311.33	3/2$^-$	M1+E2	−0.28 *3*	0.00482	α(K)=0.00421 *6*; α(L)=0.000501 *7*; α(M)=9.49×10^{-5} *14* α(N)=1.646×10^{-5} *24*; α(O)=7.77×10^{-7} *11* I_γ: other: 49 2 (1967Bl08). Mult.: A_2=−0.441 *29* (1970Ro14).
		862.8 *8*	9 *1*	0.0	1/2$^-$	E2		1.51×10^{-3}	α(K)=0.001313 *19*; α(L)=0.0001583 *23*; α(M)=3.00×10^{-5} *5* α(N)=5.18×10^{-6} *8*; α(O)=2.35×10^{-7} *4* I_γ: other: 8 1 (1967Bl08). Mult.: A_2=+0.28 *13* (1970Ro14).
912.3	7/2$^-$	497.2 *4*	80 *3*	415.08	5/2$^-$				I_γ: other: 82 2 (1967Bl08). A_2=−0.51 *6* (1989Lo08).
		601.1 *7*	20 *3*	311.33	3/2$^-$				I_γ: other: 18 2 (1967Bl08). A_2=+0.8 *3*, A_4=+0.6 *3* (1989Lo08).
1090.6	9/2$^-$	675.5 *5*	100	415.08	5/2$^-$				A_2=+0.48 *5*, A_4=−0.26 *7* (1989Lo08).
		781[&]		311.33	3/2$^-$				E_γ,I_γ: seen in 1967Bl08 only with I(781γ)/I(675.5γ)=0.39 *3*.
1324.2	3/2$^-$	909[&]	6 *3*	415.08	5/2$^-$				
		1012.9 *10*	81 *3*	311.33	3/2$^-$	M1+E2	−0.09 *3*	1.19×10^{-3}	α(K)=0.001042 *15*; α(L)=0.0001211 *18*; α(M)=2.29×10^{-5} *4* α(N)=3.98×10^{-6} *6*; α(O)=1.91×10^{-7} *3* Mult.: A_2=+0.20 *5* (1970Ro14).
		1324.2 *10*	13 *3*	0.0	1/2$^-$				

[†] Additional information 2.
[‡] From 1970Ro14, unless otherwise noted.
[#] From 1973Co10. Values of Iγ are deduced from I(γ+ce) using calculated conversion coefficients by BrIcc.

$^{109}_{47}Ag_{62}$-4

$\gamma(^{109}$Ag) (continued)

@ From $\gamma(\theta)$ in 1970Ro14, unless otherwise noted.
& Placement of transition in the level scheme is uncertain.

$^{109}_{47}$Ag$_{62}$-5

Coulomb excitation 1970Ro14