^{68}Zn(α,2nγ), ^{67}Zn(α,nγ)

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	G. Gürdal, E. A. Mccutchan	NDS 136, 1 (2016)	1-Jul-2016

1984Ef01: E=10,15 MeV ^{67}Zn(α,nγ); E=45 MeV ^{61}Ni(^{12}C,n2pγ); Ge(Li) detectors were used to measure γs. Measured $T_{1/2}$ by DSAM and RDM.

1982Cl02: E=47 MeV, ^{55}Mn(^{14}N, n2pγ); E=46 MeV, ^{56}Fe(^{16}O, 2pγ); Ge(Li) detectors were used to detect γs. Measured Eγ, Iγ, $T_{1/2}$ by RDM.

1979Ne09: E=23 MeV; in-beam measurement of absolute conversion coefficients using a mini-orange spectrometer with Si solid state detector.

1978Cl05: E=16 and 22.5 MeV for ^{68}Zn(α,2nγ) and ^{67}Zn(α,nγ) reactions; measured yield functions for Eα=13-21 MeV, $\gamma(\theta)$ at seven angles from 30°−148°, and linear polarization of γ at Eα=16 MeV. Ge(Li) detector and a "five-in-one" Ge(Li) detector used as a Compton polarimeter.

1977Mo20: E=30 MeV; $T_{1/2}$ by DSAM; Ge(Li) detector.

1976Mo15: E=24-40 MeV; measured yield functions of γ; mean lifetime of levels from electronic timing at E=33 MeV; $\gamma\gamma$ coin at 31 MeV; $\gamma(\theta)$ at 31 MeV. Enriched target, Ge(Li) detector.

Others: 1982AlZH, 1990Bo27.

^{70}Ge Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#]	Comments
0.0	0^+		
1039.22 *5*	2^+	1.3 ps *3*	J$^\pi$: E2 transition to 0^+ g.s. $T_{1/2}$: weighted average of 1.3 ps *3* (1984Ef01) and 1.5 ps *10* (1977Mo20).
1214.5 *10*			
1707.3 *6*	2^+	1.1 ps *+10−4*	$T_{1/2}$: Other: 4 ps *+2−1* (1977Mo20).
2152.6 *6*	4^+	0.8 ps *2*	J$^\pi$: E2 transition to 1039.2 level and yield function. $T_{1/2}$: weighted average of 0.6 ps *3* (1984Ef01) and 1.0 ps *3* (1977Mo20).
2450.9 *6*	3^+	1.7 ps *+10−3*	J$^\pi$: $\gamma(\theta)$ and the yield function of 744γ. $T_{1/2}$: Other: 3 ps *3* (1977Mo20).
2534.2 *10*		0.6 ps *2*	
2561.36 *9*	3^-	0.4 ps *1*	J$^\pi$: $\gamma(\theta)$ and linear polarization measurement of 1522γ (1978Cl05). $T_{1/2}$: unweighted average of 0.6 ps *1* (1984Ef01) and 0.3 ps *1* (1977Mo20).
2805.7 *12*	4^+	0.6 ps *2*	J$^\pi$: 1098γ E2 to 2^+. $T_{1/2}$: Other: 4 ps *+7−1* (1977Mo20).
3058.0 *6*	4^+	1.4 ps *3*	J$^\pi$: from 2019γ E2 to 2^+. $T_{1/2}$: Other: 0.20 ps *10-3* (1977Mo20).
3296.5 *6*	6^+	0.5 ps *1*	J$^\pi$: $\gamma(\theta)$ of 1144γ E2 transition and yield function. $T_{1/2}$: weighted average of 0.5 ps *1* (1977Mo20) and 0.6 ps *2* (1984Ef01).
3415.8 *6*	5^-	13.7 ps *10*	J$^\pi$: $\gamma(\theta)$ and yield function of 854γ. $T_{1/2}$: from 1982Cl02. Others: 3 ps *+4−2* (1977Mo20), 1.9 ps *9* (1984Ef01).
3666.2 *6*	6^-	35 ps *3*	J$^\pi$: J=6 from $\gamma(\theta)$ of 250γ (1976Mo15); parity from M1 transition to $J^\pi=5^-$ level at 3415.7. $T_{1/2}$: from 1982Cl02. Other: 40 ps *8* (1984Ef01).
3669.0? *12*		1 ps *1*	
3752.5 *15*	$(6)^+$	1.6 ps *5*	J$^\pi$: $\gamma(\theta)$ of 947γ suggests a 6^+ assignment but the yield function does not confirm this. $T_{1/2}$: Other: > 3 ps (1977Mo20).
3954.5 *6*	7^-	17.0 ps *10*	J$^\pi$: J=7 from $\gamma(\theta)$ of 288γ and 658γ (1976Mo15); parity from M1 transition to $J^\pi=6^-$ level at 3666.1 keV. $T_{1/2}$: weighted average of 17.5 ps *10* (1982Cl02) and 15 ps *2* (1984Ef01).
4202.8 *12*	8^+	8 ps *2*	J$^\pi$: 906γ E2 transition and yield function. $T_{1/2}$: Other: 7 ps *+14−2* (1977Mo20).
4299.0 *9*	7^+	3 ps *1*	J$^\pi$: J from $\gamma(\theta)$ of 344γ and 1003γ; absence of a transition to the 5^- level at 3415.7 may indicate a positive parity for this level.
4430.8 *12*	$(8)^+$	0.4 ps *2*	J$^\pi$: 1134γ E2 transition and yield function. $T_{1/2}$: Other: 0.8 ps *2* from 1977Mo20 which if corrected for the tail of the 1144γ is expected to be less than the reported value.

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^{68}Zn(α,2nγ), ^{67}Zn(α,nγ) (continued)

^{70}Ge Levels (continued)

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]	Comments
4551.8 *14*	(8)	104 ps *+70–35*	J$^\pi$: from 253γ to 7$^+$.
4851.0 *12*	(8$^-$)	>3 ps	J$^\pi$: J suggested by the $\gamma(\theta)$ of the 896γ; this is not confirmed by the yield function. T$_{1/2}$: from 1977Mo20.
4984.5 *12*			
5047.8 *12*			
5242.0 *15*			E(level): existence of this level established by coincidence intensity data.
5298.1 *12*			
5539.9 *15*	(10$^-$)	5 ns *2*	T$_{1/2}$: from 1976Mo15. J$^\pi$: the T$_{1/2}$ for this level suggests that the 1109γ may be M2 with an assignment of J^π=10$^-$.

[†] From a least-squares fit to Eγ's by evaluators.
[‡] From multipolarities of γ-rays deduced from $\gamma(\theta)$ and linear polarization measurements in 1978Cl05, unless otherwise stated.
[#] From 1984Ef01 using DSAM, unless otherwise stated.

γ(^{70}Ge)

E$_i$(level)	J$_i^\pi$	E$_\gamma$[†]	I$_\gamma$[‡]	E$_f$	J$_f^\pi$	Mult.	δ[&]	Comments
1039.22	2$^+$	1039.21 *5*	100	0.0	0$^+$	E2[#]		δ: 0.00 *2* (1978Cl05).
1214.5		175.25	100	1039.22	2$^+$			
1707.3	2$^+$	668.14	100 *4*	1039.22	2$^+$			
		1707.27	53 *2*	0.0	0$^+$	E2[@]		
2152.6	4$^+$	1113.38	100 *2*	1039.22	2$^+$	E2[@]		δ: −0.1 *2* (1976Mo15).
2450.9	3$^+$	743.56 *7*	100 *6*	1707.3	2$^+$	M1[#]		
		1411.7	46 *8*	1039.22	2$^+$			
2534.2		1495.0	100 *36*	1039.22	2$^+$			
2561.36	3$^-$	1522.12 *7*	100 *3*	1039.22	2$^+$	E1+M2[#]	−0.11 *10*	
2805.7	4$^+$	1098.3	100 *9*	1707.3	2$^+$	E2[@]		δ: −0.2 *2* (1976Mo15).
3058.0	4$^+$	906.2	100	2152.6	4$^+$			
		2019.0	28	1039.22	2$^+$	E2[@]		δ: +0.2 *2* (1976Mo15). I$_\gamma$: 906γ and 2019γ from 1976Mo15.
3296.5	6$^+$	1143.89 *2*	100 *4*	2152.6	4$^+$	E2[@]		δ: 0.0 *2* (1976Mo15).
3415.8	5$^-$	357.72 *5*	59 *4*	3058.0	4$^+$	E1+M2[#]	−0.06 *3*	
		854.22	97 *6*	2561.36	3$^-$	E2[@]		δ: 0.02 *+4–5* (1982Cl02).
		1263.09 *6*	100 *6*	2152.6	4$^+$	E1(+M2)[#]	−0.05 *5*	
3666.2	6$^-$	250.46 *5*	100 *4*	3415.8	5$^-$	M1(+E2)[#]		δ: 0.03 *+2–5* (1982Cl02).
3669.0?		1218.1	100	2450.9	3$^+$			I$_\gamma$: very weak γ.
3752.5	(6)$^+$	946.8	100	2805.7	4$^+$	E2[@]		δ: −0.2 *2* (1976Mo15).
3954.5	7$^-$	288.33 *5*	100	3666.2	6$^-$	M1(+E2)[#]		δ: 0.01 *+2–3* (1982Cl02).
		657.7	20	3296.5	6$^+$			I$_\gamma$: for 288γ and 658γ from 1976Mo15.
4202.8	8$^+$	906.22	100	3296.5	6$^+$	E2[@]		δ: −0.2 *2* (1976Mo15).
4299.0	7$^+$	344.2	61	3954.5	7$^-$			
		1002.6	100	3296.5	6$^+$			I$_\gamma$: for 344γ and 1003γ from 1976Mo15.
4430.8	(8)$^+$	1134.22	100 *21*	3296.5	6$^+$	E2[@]		δ: −0.1 *2* (1976Mo15).
4551.8	(8)	252.8	100	4299.0	7$^+$			
4851.0	(8$^-$)	896.4	100	3954.5	7$^-$	(M1+E2)[@]	0.4 *2*	
4984.5		1029.9	100	3954.5	7$^-$			
5047.8		1381.6	100	3666.2	6$^-$			I$_\gamma$: very weak γ.

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^{68}Zn(α,2nγ), ^{67}Zn(α,nγ) (continued)

γ(^{70}Ge) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.	Comments
							E_γ: populates 3954.7 keV 7^- level in 1978Cl05 (Figure 1). From the energy level differences this γ-ray should populate 3666.2 keV 6^- level.
5242.0		1039.2	100	4202.8	8^+		
5298.1		1343.5	100	3954.5	7^-		I_γ: very weak γ.
5539.9	(10^-)	1109.1	100	4430.8	$(8)^+$	(M2)	I_γ: very weak γ. Mult.: suggested by $T_{1/2}$ of decaying state; $\gamma(\theta)$ could not be measured because of mixing with 1114γ.

[†] From 1978Cl05 and 1979ClZX; uncertainties given where available.
[‡] Relative photon branching from each level at θ=55° from 1975EbZZ except where indicated otherwise.
[#] From $\gamma(\theta)$ and linear polarization data (1978Cl05).
[@] From $\gamma(\theta)$ and $T_{1/2}$ of parent level (1976Mo15).
[&] From 1978Cl05 and 1976Mo15.

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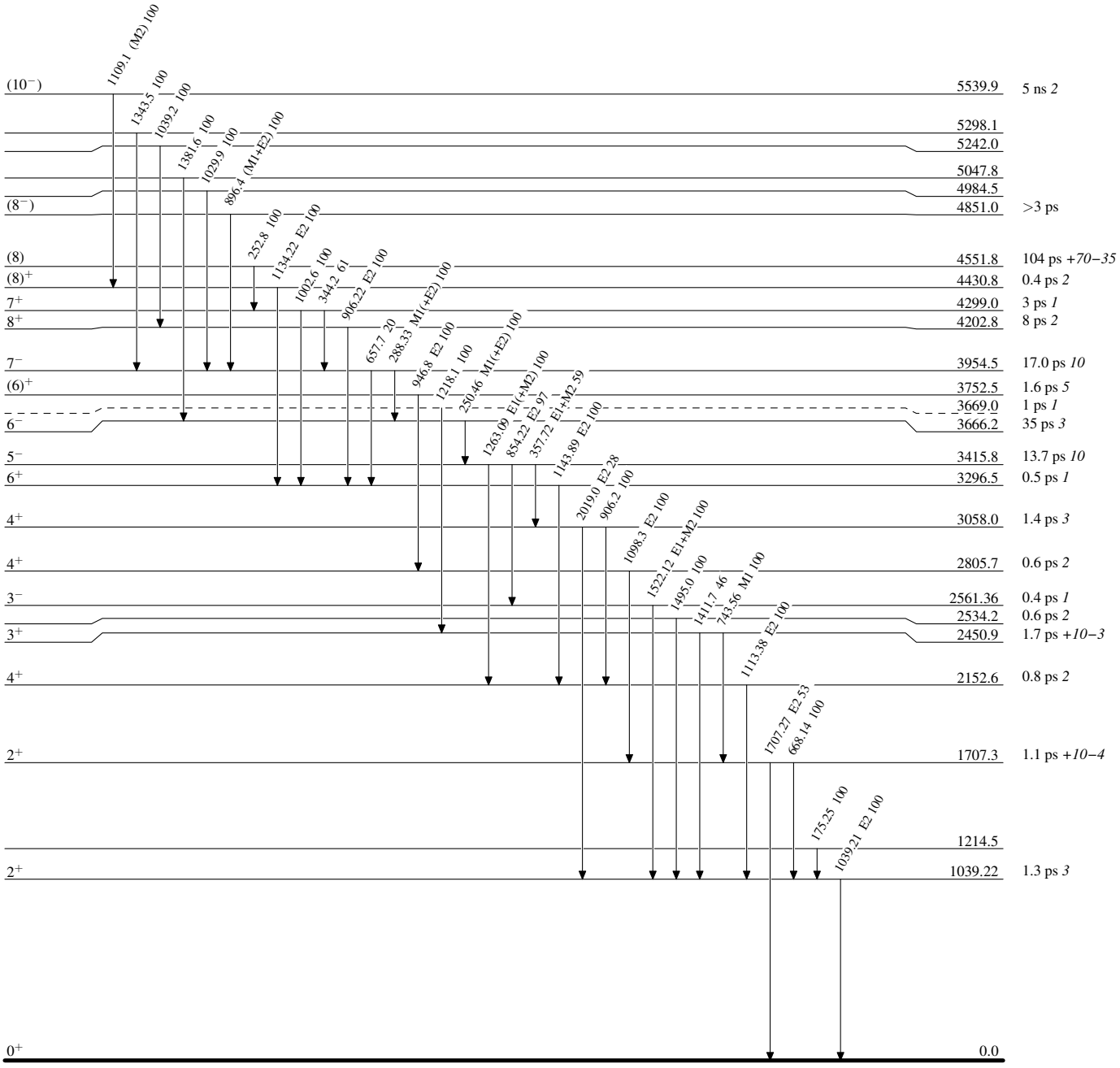
Level Scheme

Intensities: Relative photon branching from each level



$^{70}_{32}Ge_{38}$