^{64}Zn(α,pγ), ^{53}Cr(^{16}O,pnγ) 1978Al32,1977Al35

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Huo Junde, Huang Xiaolong, J. K. Tuli	NDS 106, 159 (2005)	1-Apr-2005

1978Al32: E(α)=13-15 MeV; $\gamma\gamma$ coincidences, $\gamma(\theta)$, linear polarization, $T_{1/2}$ by DSAM and delayed coincidences. E(^{16}O)=35-51 MeV; Eγ, Iγ, $\gamma\gamma$ coincidences, $T_{1/2}$ by RDM.

1977Al35: E(α)=7-16 MeV; Eγ, Iγ, $\gamma\gamma$ coincidences, $\gamma(\theta)$, linear polarization, $T_{1/2}$ by DSAM.

1974Ha09: E(α)=12.2 MeV and 14.2 MeV for ^{64}Zn(α,pγ) reaction and E(α)=24 MeV and 31 MeV for ^{65}Cu(α,2nγ) reaction; Eγ, Iγ, $\gamma\gamma$ and pγ coincidences, $\gamma(\theta)$, γ yields, p$\gamma(\theta)$, linear polarization.

Data for all the levels below and above 2 MeV are taken from 1977Al35 and 1978Al32, respectively, unless noted otherwise.

^{67}Ga Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#]	Comments
0	3/2$^-$		
167	1/2$^-$	42 ns *21*	$T_{1/2}$: from delayed coincidence measurements (1978Al32).
359.2 *3*	5/2$^-$	49[@] ps *5*	
827.8 *6*	3/2$^-$	0.16 ps *7*	J$^\pi$: 3/2$^-$ from $\gamma(\theta)$ and polarization (1977Al35).
911.2 *7*	5/2$^-$	>0.14 ps	J$^\pi$: 5/2$^-$ from $\gamma(\theta)$ and polarization (1977Al35).
1081.5 *6*	1/2$^-$	0.28 ps *12*	J=1/2 from isotropic $\gamma(\theta)$ of 253γ and 1082γ (1977Al35).
1201.7 *9*	7/2$^-$	1.5[@] ps *10*	
1412.5 *9*	7/2$^-$	0.61 ps *24*	J=7/2 from $\gamma(\theta)$ and yield functions (1974Ha09).
1519.1 *9*	9/2$^-$	1.9[@] ps *8*	J$^\pi$: 9/2$^-$ from $\gamma(\theta)$ yield function and polarization (1974Ha09).
1554.4 *12*	5/2$^-$	0.17 ps *5*	J$^\pi$: 3/2$^+$, 5/2$^-$ from $\gamma(\theta)$ and polarization (1977Al35).
1639.6 *13*	3/2$^-$	0.14 ps *4*	J=3/2 from $\gamma(\theta)$ and polarization data of 1472 γ (1977Al35).
1809.7 *13*	3/2$^-$	0.23 ps *10*	J=5/2 from yield function of 981γ (1974Ha09).
1976.6 *16*		>0.09 ps	
1977.6 *9*	5/2,7/2	>0.62 ps	J=7/2 from $\gamma(\theta)$ and polarization data of 1150γ (1977Al35).
2073.5 *7*	9/2$^+$	<6.9[@] ps	$T_{1/2}$: >1.04 ps from DSAM. J$^\pi$: 9/2$^+$ from $\gamma(\theta)$ and polarization (1978Al32).
2123.3 *11*	5/2$^-$	>0.31 ps	
2172.1 *13*	(3/2)$^-$		
2190.3 *12*	9/2$^-$	0.68 ps *21*	J$^\pi$: 9/2$^-$ from $\gamma(\theta)$ and polarization (1978Al32).
2262.7 *19*			
2263.8 *9*	9/2$^-$	0.68 ps *22*	J=9/2 from $\gamma(\theta)$ of 1062γ and 1353γ (1978Al32).
2373.6 *12*	3/2$^+$,7/2$^+$	>0.69 ps	J$^\pi$: 3/2$^+$, 5/2$^-$, 7/2$^+$ from $\gamma(\theta)$ and polarization (1977Al35).
2456.7 *10*	11/2$^-$	>1.04 ps	J$^\pi$: 7/2$^+$, 11/2$^-$ from $\gamma(\theta)$ and polarization (1977Al35).
2597 *1*			
2651.6 *10*	7/2$^-$	>1.04 ps	J$^\pi$: 7/2$^-$ from $\gamma(\theta)$ and polarization of 1132γ (1978Al32).
2797.3 *16*	(5/2$^-$,9/2$^-$)	0.38 ps *14*	J$^\pi$: (5/2$^-$,9/2$^-$) from $\gamma(\theta)$ and linear polarization of 1596γ (1978Al32).
2862.4 *6*	11/2$^+$	0.87 ps *28*	J$^\pi$: 11/2$^-$ from $\gamma(\theta)$ and linear polarization of 789γ and 1343γ (1978Al32). This experiment could not completely resolve 1343γ from 1353γ; which may explain J^π=11/2$^-$ obtained. J^π=11+/2 from ^{57}Fe(^{12}C,pnγ).
3031.7 *10*	13/2$^+$	4.5[@] ps *4*	J$^\pi$: 13/2$^+$ from $\gamma(\theta)$ and polarization of 958γ (1978Al32).
3160			
3190.8 *11*	11/2$^+$	>1.04 ps	J=11/2 from $\gamma(\theta)$ and polarization data for 1117γ (1978Al32).
3524.9 *8*	9/2$^+$, 13/2$^+$	>1.04 ps	J$^\pi$: 9/2$^+$, 13/2$^+$ from $\gamma(\theta)$ and polarization of 494γ (1978Al32).
3577.9 *11*	15/2$^+$	0.16[@] ns *4*	J=11/2, 15/2 from $\gamma(\theta)$ and polarization of 546γ (1978Al32).
3628.5 *12*	13/2$^+$, 17/2$^+$	>0.48 ps	J$^\pi$: 13/2$^+$,17/2$^+$ from $\gamma(\theta)$ and polarization of 596γ (1978Al32).
3855.7 *11*	17/2$^+$	11[@] ps *2*	
4199.1 *11*	(17/2$^+$)	<0.69[@] ps	
4221.1 *11*			
4290.1 *12*	19/2$^+$	12.5[@] ps *19*	

Continued on next page (footnotes at end of table)

^{64}Zn(α,pγ), ^{53}Cr(^{16}O,pnγ) 1978Al32,1977Al35 (continued)

^{67}Ga Levels (continued)

E(level)[†]	J$^{\pi}$[‡]
4744.8 *12*	
5224.1 *14*	(23/2^{+})

† From 1977Al35 or 1978Al32.
‡ From Adopted Levels; supporting arguments from this reaction are indicated.
# From DSAM by 1977Al35 or 1978Al32, unless indicated otherwise.
@ From recoil distance measurements by 1978Al32.

^{64}Zn(α,pγ), ^{53}Cr(^{16}O,pnγ) 1978Al32,1977Al35 (continued)

$\gamma(^{67}Ga)$

E_i(level)	J_i^π	E_γ	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	α[a]	Comments
167	1/2$^-$	167		0	3/2$^-$	[M1]		0.01823	
359.2	5/2$^-$	359.2 *3*	100	0	3/2$^-$	M1+E2	−0.08 *1*		
827.8	3/2$^-$	469	<2	359.2	5/2$^-$				
		661.1 *5*	9.8 *12*	167	1/2$^-$	M1+E2	−0.36 *9*		
		827.9 *7*	90.2 *12*	0	3/2$^-$	M1+E2	−0.14 *4*		
911.2	5/2$^-$	553.3 *9*	1.7 *5*	359.2	5/2$^-$				
		743.2 *6*	2.2 *6*	167	1/2$^-$	E2(+M3)	−0.03 *7*		
		911.3 *7*	96.1 *10*	0	3/2$^-$	M1+E2	+0.32 *2*		
1081.5	1/2$^-$	253.1 *2*	8.1 *10*	827.8	3/2$^-$				
		915.4 *7*	68.0 *28*	167	1/2$^-$	(M1)			
		1081.8 *9*	23.9 *22*	0	3/2$^-$				Mult.: M1+E2 (1977Al35).
1201.7	7/2$^-$	842.3 *7*	23.5 *23*	359.2	5/2$^-$	M1+E2[@]	−2.3[@] *1*		
		1201.9 *10*	76.5 *23*	0	3/2$^-$	E2(+M3)[@]	−0.00[@] *2*		
1412.5	7/2$^-$	502.2 *4*	10.5 *9*	911.2	5/2$^-$	M1+E2	−0.11 *1*		
		1053.3 *8*	34.7 *21*	359.2	5/2$^-$	M1+E2	−2.0 *1*		
		1411.7 *11*	54.8 *23*	0	3/2$^-$	E2(+M3)	−0.00 *1*		
1519.1	9/2$^-$	1159.9 *9*	100	359.2	5/2$^-$	E2(+M3)	−0.00 *4*		Mult.: E2(+M3) from $\gamma(\theta)$ and polarization data (1974Ha09). δ: −0.00 *2* (1974Ha09).
1554.4	5/2$^-$	1195.3 *10*	57.1 *29*	359.2	5/2$^-$	M1+E2	−0.65 *3*		
		1554.2 *13*	42.9 *29*	0	3/2$^-$	M1+E2	+0.42 *4*		
1639.6	3/2$^-$	559	0.5 *2*	1081.5	1/2$^-$				
		729	26.2 *28*	911.2	5/2$^-$				
		812	10.2 *11*	827.8	3/2$^-$				
		1280	4.4 *5*	359.2	5/2$^-$				
		1472.2 *12*	52.4 *29*	167	1/2$^-$	M1+E2	−0.16 *2*		
		1640	6.3 *11*	0	3/2$^-$				
1809.7	3/2$^-$	729	8.5 *19*	1081.5	1/2$^-$				
		898	18.4 *18*	911.2	5/2$^-$				
		981	21.4 *15*	827.8	3/2$^-$				
		1451.9 *12*	11.5 *11*	359.2	5/2$^-$				
		1642	14.9 *19*	167	1/2$^-$				
		1810	25.3 *22*	0	3/2$^-$				
1976.6		1976.6 *16*	100	0	3/2$^-$				
1977.6	5/2,7/2	776 *1*		1201.7	7/2$^-$				
		1149.6 *9*		827.8	3/2$^-$				
2073.5	9/2$^+$	554.7 *4*	40.2 *15*	1519.1	9/2$^-$	E1(+M2)[#]	−0.00[#] *2*		
		871.5 *7*	59.8 *15*	1201.7	7/2$^-$	E1(+M2)[#]	−0.00[#] *2*		
2123.3	5/2$^-$	1295.5 *11*	100	827.8	3/2$^-$	(M1+E2)	≥+0.2		
2172.1	(3/2)$^-$	1343.7 *11*		827.8	3/2$^-$				
		2172.8 *15*		0	3/2$^-$				
2190.3	9/2$^-$	776.0[&] *10*		1412.5	7/2$^-$				

$^{67}_{31}Ga_{36}$-3

^{64}Zn(α,pγ), ^{53}Cr(^{16}O,pnγ) 1978Al32,1977Al35 (continued)

$\gamma(^{67}Ga)$ (continued)

E_i(level)	J_i^π	E_γ	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	Comments
2190.3	9/2$^-$	988[&] *2*		1201.7	7/2$^-$			
		1279.1 *10*		911.2	5/2$^-$	E2(+M3)[#]	−0.02[#] *2*	
2262.7		2262.7 *19*	100	0	3/2$^-$			
2263.8	9/2$^-$	1061.6 *9*	49.6 *16*	1201.7	7/2$^-$	M1+E2[#]	−2.4[#] *2*	
		1353.1 *11*	50.4 *16*	911.2	5/2$^-$			
2373.6	3/2$^+$,7/2$^+$	1462.4 *12*	100	911.2	5/2$^-$			
2456.7	11/2$^-$	1255 *1*	100	1201.7	7/2$^-$			
2597		1184 *1*	100	1412.5	7/2$^-$			
2651.6	7/2$^-$	1131.8 *9*		1519.1	9/2$^-$	M1+E2[#]	−3.7[#] *1*	
		1451[&] *2*		1201.7	7/2$^-$			
2797.3	(5/2$^-$,9/2$^-$)	1595.6 *13*	100	1201.7	7/2$^-$			Mult.: (M1+E2) (1978Al32). δ: +0.53 *12* or +2.2 *+13−7* for a 5/2$^-$ to 7/2$^-$ transition; −0.12 *5* for a 9/2$^-$ to 7/2$^-$ transition (1978AL32).
2862.4	11/2$^+$	789.3 *7*	31.6 *14*	2073.5	9/2$^+$	M1(+E2)[#]	−0.04[#] *4*	
		1342.6 *11*	68.4 *14*	1519.1	9/2$^-$	E1(+M2)[#]	−0.09[#] *4*	
3031.7	13/2$^+$	958.2 *8*	100	2073.5	9/2$^+$	E2(+M3)[#]	−0.00[#] *1*	
3160		1641	100	1519.1	9/2$^-$			
3190.8	11/2$^+$	1117.3 *9*	100	2073.5	9/2$^+$	M1+E2[#]	−1.60[#] *7*	
3524.9	9/2$^+$, 13/2$^+$	493.5 *4*		3031.7	13/2$^+$			Mult.: E2 for a 9/2$^+$ to 13/2$^+$ transition; M1+E2 for a 13/2$^+$ to 13/2$^+$ transition (1978AL32). δ: −0.00 *1* for a 9/2$^+$ to 13/2$^+$ transition; −0.33 *2* for a 13/2$^+$ to 13/2$^+$ transition (1978AL32).
		1451[&] *2*		2073.5	9/2$^+$			
3577.9	15/2$^+$	546.2 *4*	100	3031.7	13/2$^+$			
3628.5	13/2$^+$, 17/2$^+$	596.8 *7*	100	3031.7	13/2$^+$			Mult.: M1+E2 if J^π(3629)=13/2$^+$; E2(+M3) if J^π(3629)=17/2$^+$ (1978Al32). δ: +0.39 *9* for a 13/2$^+$ to 13/2$^+$ transition; +0.09 *6* for a 17/2$^+$ to 13/2$^+$ transition (1978AL32).
3855.7	17/2$^+$	824.0 *5*	100	3031.7	13/2$^+$			
4199.1	(17/2$^+$)	343.4 *3*		3855.7	17/2$^+$			
4221.1		365.4 *3*		3855.7	17/2$^+$			
4290.1	19/2$^+$	712.2 *4*		3577.9	15/2$^+$			
4744.8		889.1 *5*		3855.7	17/2$^+$			
5224.1	(23/2$^+$)	934 *1*		4290.1	19/2$^+$			

[†] Percent photon branching for each level.
[‡] From 1977al35, except as noted.
[#] From 1978Al32.

$^{67}_{31}Ga_{36}$-4

γ(^{67}Ga) (continued)

[@] From 1974Ha09.

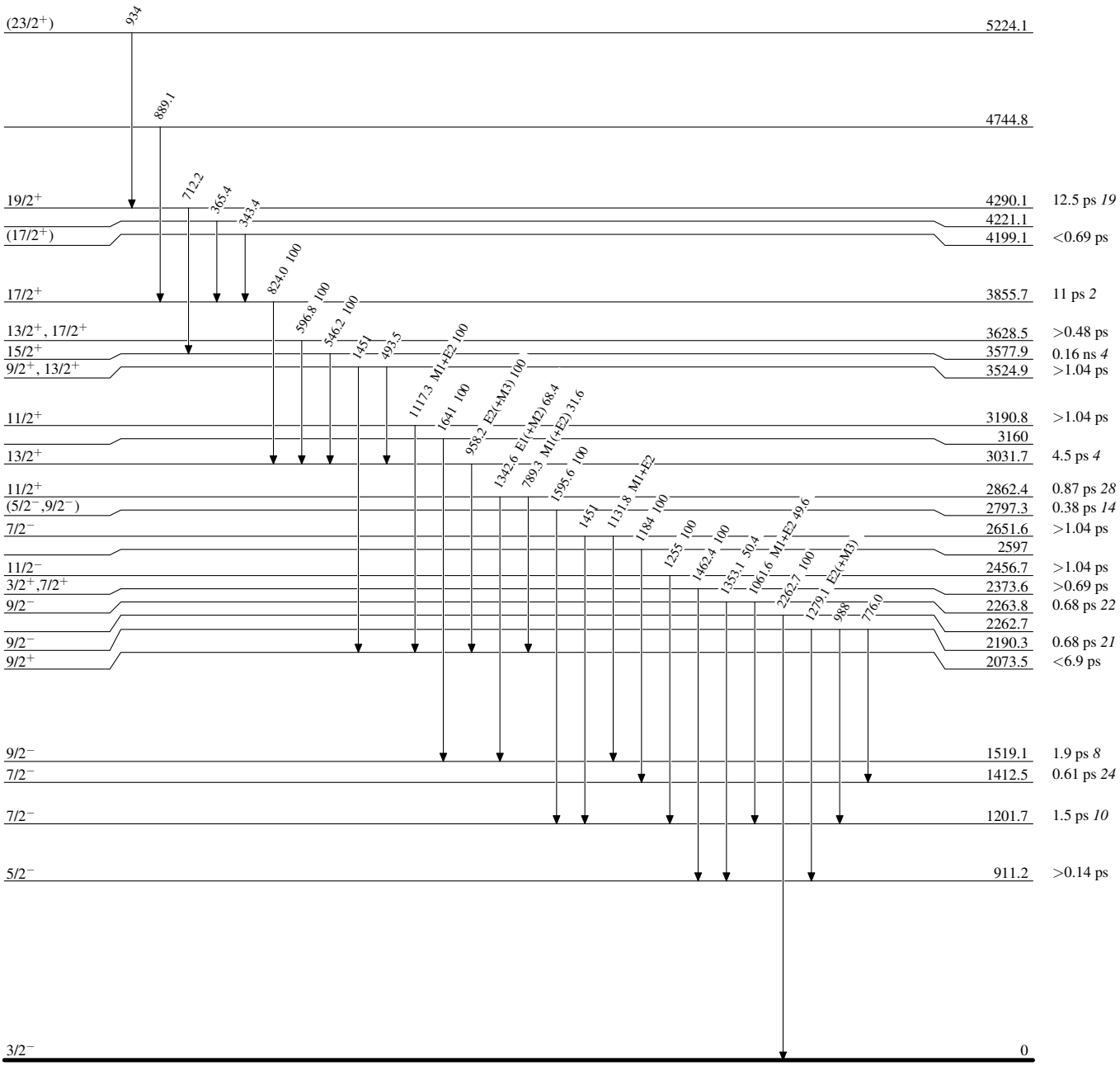
[&] Part of unresolved doublets and triplets.

[a] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

^{64}Zn(α,pγ), ^{53}Cr(^{16}O,pnγ) 1978Al32,1977Al35

Level Scheme

Intensities: % photon branching from each level

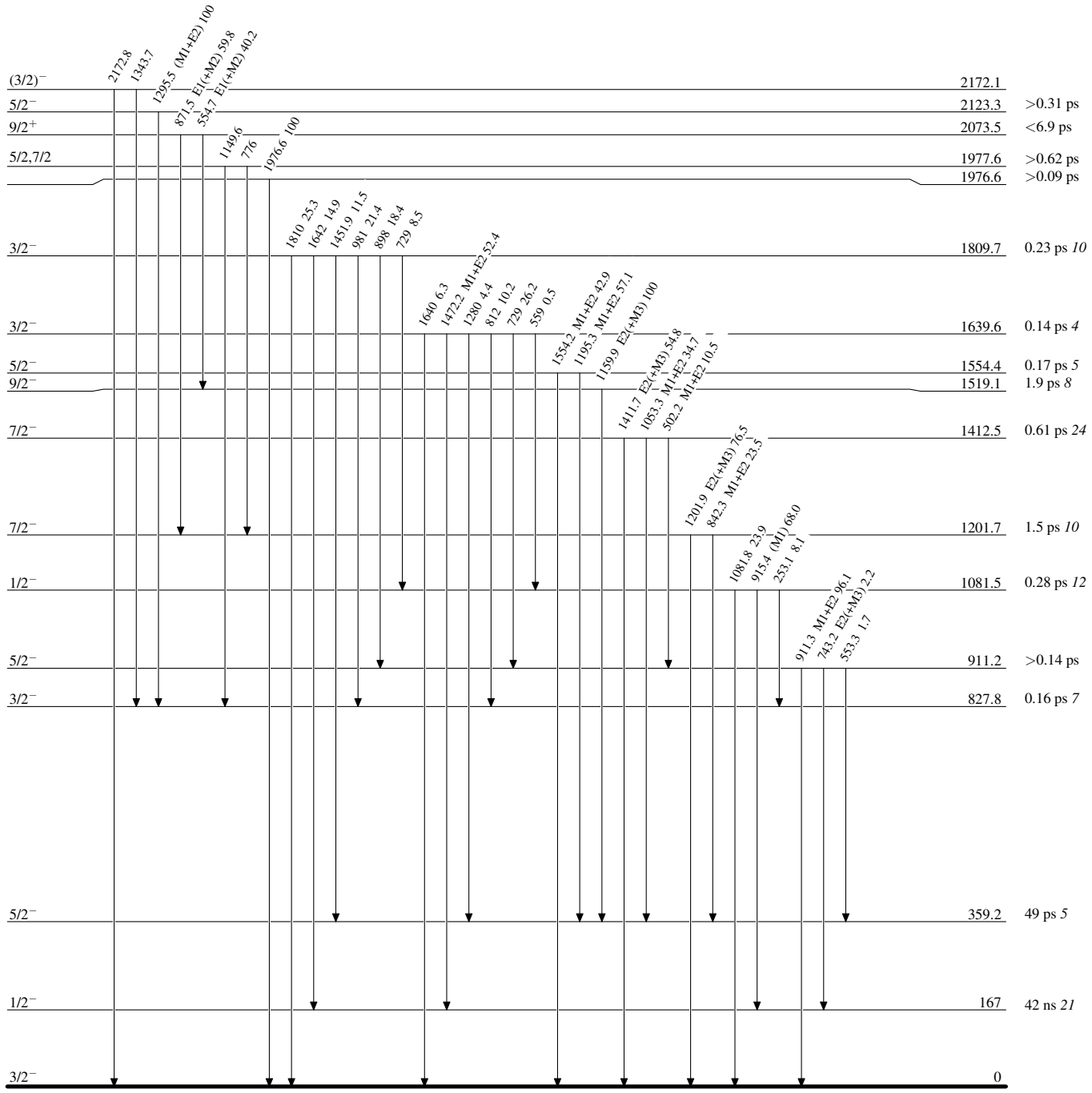


$^{67}_{31}Ga_{36}$

^{64}Zn(α,pγ), ^{53}Cr(^{16}O,pnγ) 1978Al32,1977Al35

Level Scheme (continued)

Intensities: % photon branching from each level

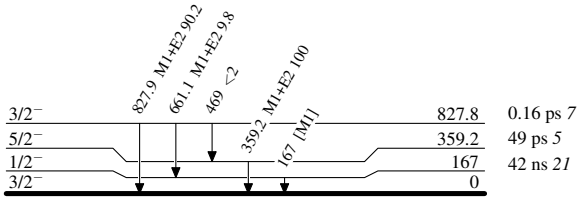


$^{67}_{31}Ga_{36}$

^{64}Zn(α,pγ), ^{53}Cr(^{16}O,pnγ) 1978Al32,1977Al35

Level Scheme (continued)

Intensities: % photon branching from each level



$^{67}_{31}Ga_{36}$