^{51}V(^{16}O,p2nγ),^{59}Co(^{7}Li,2nγ) 1977We10,1978We15,1977Al14

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 178, 41 (2021).	12-Nov-2021

1977We10, 1978We15: ^{59}Co(^{7}Li,2nγ),E(^{7}Li)=18 MeV; ^{51}V(^{16}O,p2nγ),E(^{16}O)=36-46 MeV. Measured Eγ, $\gamma\gamma$, $\gamma(\theta)$, γ(lin pol), and level half-lives by DSAM and recoil distance method at ORNL EN tandem Van de Graaff accelerator. 1978We15 use ^{59}Co(^{7}Li,2nγ) reaction, and focus primarily on linear polarization data, while 1977We10 present detailed spectroscopic data from both reactions.

1977Al14, 1976Le31: ^{51}V(^{16}O,p2nγ),E(^{16}O)=43, 50 MeV. Measured Eγ, Iγ, $\gamma(\theta)$, and level half-lives by DSAM and recoil distance method. 1976Le31 reported lifetime measurement for 2307,4^{+} and 3999,6^{+} levels by DSAM.

1983Ba69: ^{51}V(^{16}O,p2nγ),E(^{16}O)=51 MeV. Measured $\gamma\gamma(\theta$,H), ratio of g factors for 4635, 7^{-} level in ^{64}Zn and 4074, 6^{-} and 4250, 7^{-} levels in ^{66}Zn by recoil-into-gas (helium) integral perturbed angular correlation technique at the Bucharest FN-tandem Van de Graaff accelerator.

^{64}Zn Levels

E(level)†	J$^{\pi}$‡	T$_{1/2}$	Comments
0.0	0^{+}		
991.4 *4*	2^{+}	2.8 ps *7*	T$_{1/2}$: from 1977Al14, recoil distance.
1799.2 *4*	2^{+}	1.4 ps *7*	T$_{1/2}$: from 1977Al14, recoil distance. Other: 2.1 ps *14* (1977We10, DSAM).
2306.6 *4*	4^{+}	0.86 ps *25*	T$_{1/2}$: weighted average of 1.0 ps *6* (1977We10) and 0.83 ps *28* (1976Le31,1977Al14, DSAM).
2736.1 *4*	4^{+}	2.2 ps *6*	T$_{1/2}$: weighted average of 3.5 ps *21* for 429.8γ (1977We10), 1.7 ps *7* for 936.7γ (1977We10), 3.5 ps *14* (1977Al14, recoil distance).
2999.1 *5*	3^{-}	0.076 ps *35*	T$_{1/2}$: from 1977We10, DSAM.
3077.7 *5*	(4^{+})	1.0 ps *3*	T$_{1/2}$: weighted average of 0.97 ps *28* for 770.5γ, and 1.04 ps *35* for 2086.9γ (1977We10).
3924.6 *5*	5^{-}	<1.4 ps	T$_{1/2}$: from 1977Al14, recoil distance. Others: <1.7 ps (1977We10, DSAM).
3993.6 *5*	6^{+}	0.152 ps *35*	T$_{1/2}$: from 1977We10, DSAM. Other: <0.14 ps (1976Le31,1977Al14, DSAM).
4236.7 *5*	6^{+}	1.25 ps *21*	J$^{\pi}$: 5^{-} in 1977Al14. T$_{1/2}$: from 1977We10, DSAM. Other: 42 ps *21* (1977Al14, recoil distance) is in disagreement with other literature values.
4634.9 *6*	7^{-}	96 ps *10*	T$_{1/2}$: weighted average of 105 ps *13* for 398.3γ and 99 ps *10* for 641.3γ (1977We10, recoil-distance method); and 80 ps *14* (1977Al14, recoil distance). g factor ≈0.23 (1983Ba69) from the following measured ratio: g factor (4635, 7^{-} in ^{64}Zn): g factor (4074, 6^{-} in ^{66}Zn): g factor (4250, 7^{-} in ^{66}Zn)=1.00 *18*:0.64 *14*:0.60 *12*.
4981.0 *6*	7^{-}	1.32 ps *42*	T$_{1/2}$: from 1977We10, DSAM. Other: 3.1 ps *7* (1977Al14, recoil distance).
5681.3 *7*	8^{-}	0.97 ps *21*	J$^{\pi}$: (9^{-},8) in 1977Al14. E(level): with the reassignment of 1046γ in the Adopted dataset, based on results of 2004Ka18, this level corresponds to 6998, (11^{-}) in the Adopted Levels. T$_{1/2}$: from 1977We10, DSAM. Other: 4.0 ps *5* (1977Al14, recoil distance).

† From a least-squares fit to Eγ data.

‡ As given in 1978We15, based on their $\gamma(\theta)$ and γ(lin pol) data, and earlier assignments for low-lying levels.

γ(^{64}Zn)

E$_i$(level)	J$_i^{\pi}$	E$_{\gamma}$†	I$_{\gamma}$†	E$_f$	J$_f^{\pi}$	Mult.‡	δ‡	Comments
991.4	2^{+}	991.2 *4*	100	0.0	0^{+}	E2		A$_2$=+0.14 *2*; A$_4$=−0.01 *2*; pol=+0.22 *3* (1978We15) A$_2$=+0.17 *2*; A$_4$=−0.01 *2* (1977We10) A$_2$=+0.19 *2*; A$_4$=+0.03 *3* (1977Al14) Relative Iγ=100 *6* (1977We10). Eγ=992, Iγ=100 (1977Al14).
1799.2	2^{+}	807.4 *4*	75 *5*	991.4	2^{+}	M1+E2	−1.3 *3*	A$_2$=−0.15 *2*; A$_4$=0.00 *2* (1977We10); pol=+0.11 *3* (1978We15) A$_2$=−0.09 *3*; A$_4$=0 (1977Al14) Relative Iγ=17.6 *26* (1977We10). Eγ=807, Iγ=15.2 *16*

Continued on next page (footnotes at end of table)

^{51}V(^{16}O,p2nγ),^{59}Co(^{7}Li,2nγ) 1977We10,1978We15,1977Al14 (continued)

γ(^{64}Zn) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	Comments
								(1977Al14). δ: from 1978We15. Others: −5.5 *40* or −0.8 *3* (1977We10), −0.45 *5* (1977Al14).
1799.2	2$^+$	1799.4 *4*	25 *5*	0.0	0$^+$	E2		A_2=+0.20 *8*; A_4=−0.01 *5* (1977We10) A_2=+0.12 *3*; A_4=−0.03 *3*; pol=0.0 *3* (1978We15) Relative Iγ=5.8 *9* (1977We10). Eγ=1799, Iγ=3.8 *4* (1977Al14).
2306.6	4$^+$	1315.3 *4*	100	991.4	2$^+$	E2		A_2=+0.30 *2*; A_4=−0.06 *2* (1977We10); pol=+0.38 *6* (1978We15) A_2=+0.32 *2*; A_4=−0.2 *2* (1977Al14) Relative Iγ=85 *5* (1977We10). Eγ=1315, Iγ=70 *6* (1977Al14).
2736.1	4$^+$	429.8 *4*	9 *3*	2306.6	4$^+$	M1+E2		A_2=+0.14 *7*; A_4=−0.09 *11* (1977We10) Relative Iγ=1.7 *5* (1977We10). Eγ=430, Iγ=1.8 *3* (1977Al14). δ: +1.7 *5* or −0.2 *3* (1977We10).
		936.7 *4*	88 *3*	1799.2	2$^+$	E2		A_2=+0.18 *4*; A_4=−0.02 *2* (1977We10) A_2=+0.13 *2*; A_4=0.00 *2*; pol=+0.21 *6* (1978We15) Relative Iγ=19.1 *29* (1977We10). Eγ=938, Iγ=18.1 *18* (1977Al14).
		1744.8 *4*	2.3 *5*	991.4	2$^+$	[E2]		Relative Iγ=0.50 *15* (1977We10). Eγ=1745, Iγ=0.4 *2* (1977Al14).
2999.1	3$^-$	2007.0 *4*	100	991.4	2$^+$	D		A_2=−0.06 *10*; A_4=−0.20 *10* (1977We10) A_2=+0.05 *10*; A_4=−0.09 *10*; pol=−0.2 *5* (1978We15) Relative Iγ=2.7 *8* (1977We10). δ: δ(Q/D)=+0.03 *11* or −5 *2* (1977We10).
3077.7	(4$^+$)	770.5 *4*	51 *5*	2306.6	4$^+$	(M1+E2)	−0.54 *12*	A_2=−0.12 *8*; A_4=+0.01 *8* (1977We10) A_2=0.00 *4*; A_4=−0.01 *4*; pol=+0.25 *12* (1978We15) Relative Iγ=3.0 *9* (1977We10). δ: from 1978We15.
		2086.9 *4*	49 *5*	991.4	2$^+$	(E2)		A_2=+0.22 *8*; A_4=+0.05 *8* (1977We10) A_2=+0.21 *8*; A_4=−0.04 *8*; pol=+0.2 *5* (1978We15) Relative Iγ=2.8 *8* (1977We10).
3924.6	5$^-$	924.9 *4*	14 *4*	2999.1	3$^-$	(E2)		A_2=+0.05 *10*; A_4=−0.02 *10* (1977We10) Relative Iγ=1.7 *5* (1977We10).
		1618.5 *4*	86 *4*	2306.6	4$^+$	E1(+M2)	+0.12 *4*	A_2=−0.25 *9*; A_4=+0.16 *6* (1977We10) A_2=−0.05 *6*; A_4=−0.01 *2*; pol=+0.44 *18* (1978We15) A_2=−0.35 *20*; A_4=+0.2 *2* (1977Al14) Relative Iγ=13.3 *20* (1977We10). Eγ=1618, Iγ=6.3 *13* (1977Al14). δ: from 1978We15. Others: −5.4 *7* (1977We10), +0.1 (1977Al14).
3993.6	6$^+$	1687.0 *4*	100	2306.6	4$^+$	E2		A_2=+0.23 *4*; A_4=−0.07 *2* (1977We10) A_2=+0.25 *3*; A_4=−0.05 *2*; pol=+0.55 *15* (1978We15) A_2=+0.32 *4*; A_4=+0.11 *9* (1977Al14) Relative Iγ=31.4 *19* (1977We10). Eγ=1687, Iγ=18.7 *13* (1977Al14).
4236.7	6$^+$	1500.6 *4*	100	2736.1	4$^+$	E2		A_2=+0.34 *8*; A_4=−0.14 *8* (1977We10) A_2=+0.25 *5*; A_4=−0.04 *3*; pol=+0.7 *3* (1978We15) A_2=+0.27 *10*; A_4=0 (1977Al14) Relative Iγ=11.7 *18* (1977We10). Eγ=1500, Iγ=5.9 *10* (1977Al14).
4634.9	7$^-$	398.3 *4*	13 *2*	4236.7	6$^+$	D		A_2=−0.27 *7*; A_4=−0.07 *4*; A_2=−0.24 *8*; A_4=+0.05 *6* (1977We10) A_2=−0.257 *37*; A_4=+0.02 *3* (1983Ba69) Relative Iγ=3.2 *10* (1977We10). Eγ=399, Iγ=3.2

Continued on next page (footnotes at end of table)

^{51}V(^{16}O,p2nγ),^{59}Co(^{7}Li,2nγ) 1977We10,1978We15,1977Al14 (continued)

γ(^{64}Zn) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	Comments
							6 (1977Al14).
							δ(M2/E1)=−0.3 *3* (1977We10), 0.00 *3* (1977Al14).
4634.9	7$^-$	641.3 *4*	87 *2*	3993.6	6$^+$	E1	A_2=−0.29 *4*; A_4=+0.04 *2* (1977We10); pol=+0.33 *6* (1978We15)
							A_2=−0.21 *4*; A_4=0 (1977Al14)
							A_2=−0.282 *22*; A_4=+0.03 *3* (1983Ba69)
							Relative Iγ=20.9 *13* (1977We10). Eγ=642, Iγ=18.3 *18* (1977Al14).
							δ(M2/E1)=−0.01 *3* (1978We15), −0.2 *3* (1977We10), 0.00 *3* (1977Al14).
4981.0	7$^-$	745[#]		4236.7	6$^+$		Eγ=745, Iγ=2.7 *8*. This γ from 4981 level is reported by 1977Al14 only. Evaluators consider its placement doubtful and do not include in the Adopted dataset.
		1056.3 *4*	100	3924.6	5$^-$	E2	A_2=+0.27 *5*; A_4=−0.02 *4* (1977We10)
							A_2=+0.28 *2*; A_4=−0.05 *2*; pol=+0.26 *18* (1978We15)
							Relative Iγ=14.9 *22* (1977We10). Eγ=1057, Iγ=6.6 *16* (1977Al14).
5681.3	8$^-$	1046.3 *4*	100	4634.9	7$^-$		A_2=+0.11 *5*; A_4=+0.10 *4* (1977We10)
							Relative Iγ=11.1 *17* (1977We10). Eγ=1046, Iγ=4.3 *13* (1977Al14).
							δ(E2/M1)=+7.5 *15* (1977We10) for 8$^-$ to 7$^-$ transition.

[†] From 1977We10 and 1978We15. Branching ratios are from 1978We15. Relative Iγ values from 1977We10 and 1977Al14 are listed under comments.
[‡] From $\gamma(\theta)$ and γ(pol) in 1978We15; and application of RUL when level lifetime is known.
[#] Placement of transition in the level scheme is uncertain.

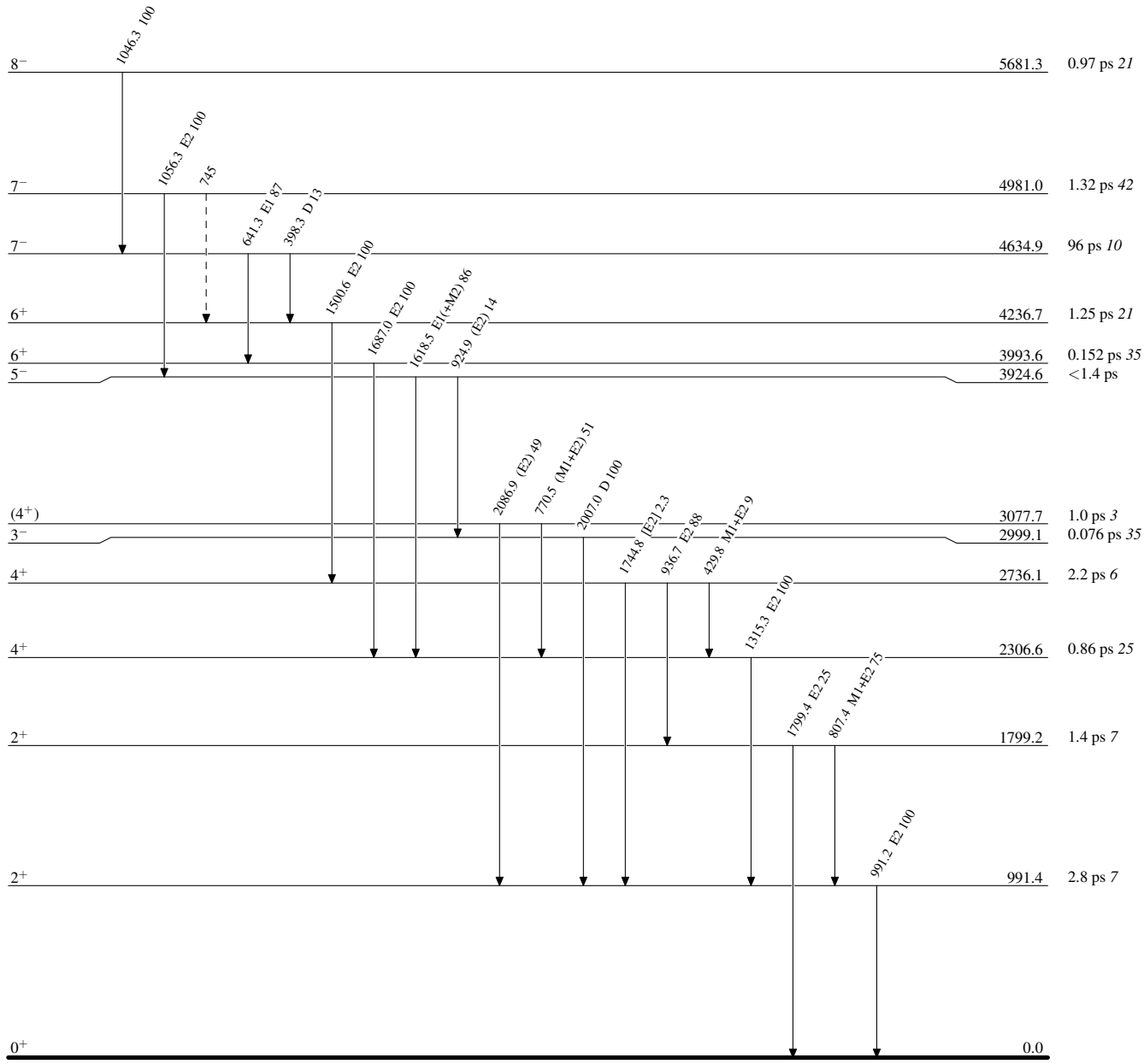
$^{51}V(^{16}O,p2n\gamma),^{59}Co(^{7}Li,2n\gamma)$ 1977We10,1978We15,1977Al14

Legend

Level Scheme

Intensities: % photon branching from each level

γ Decay (Uncertain)



$^{64}_{30}Zn_{34}$