^{35}Cl(p,p),(p,p′γ) 1969Du08,1970Ta02,1972Br45

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen, John Cameron and Balraj Singh	NDS 112,2715 (2011)	20-Oct-2011

1969Du08: ^{35}Cl(p,p′γ), E=4.6-6.2 MeV 0.05 μA proton beam. Thin targets of $CdCl_2$ (99% ^{35}Cl), 100 μg/cm^2. A 300 μm annular surface-barrier detector on the beam axis and a movable 390 μm surface-barrier detector rotated from 20° to 148° relative to beam direction for detecting protons, FWHM=24 keV; a 7.62 by 7.62-cm-diam NaI(Tl) crystal and 15- and 35-cc Ge(Li) for detecting γ-rays. Measured σ(E$_p$,θ), Eγ, Iγ, pγ(θ). Deduced levels, J^π, branchings, mixing ratios, half-lives using Doppler Shift Attenuation Method (DSAM).

1970Ta02: ^{35}Cl(p,p′γ), E$_p$=4.24, 4.82, 5.08 and 5.11 MeV proton beams produced from the Universite Montreal EN tandem accelerator. Targets of 16 μg/cm^2 AgCl evaporated onto 0.013 cm gold foils, 99% in ^{35}Cl. A 12.70-cm-diam by 15.24-cm-long NaI(Tl) and a 30 cm^3 Ge(Li) detector for detecting γ-rays. Measured Eγ, Iγ, pγ(θ). Deduced levels, J^π, branchings, mixing ratios.

1972Br45: ^{35}Cl(p,p′γ) E=3.45-6.00 MeV protons produced from the University of Auckland folded tandem accelerator. Natural chlorine targets of AgCl, $PbCl_2$ and solid Cl (75.77% ^{35}Cl, 24.33% ^{37}Cl). A 25 cm^3 Ge(Li) detector for detecting γ-rays, FWHM=2.3 keV for Eγ=1.332 MeV. Measured Eγ. Deduced levels, half-lives using DSAM.

1972Va06: ^{35}Cl(p,p′γ) E=5.47-5.61 MeV protons from the 5.5 MV Van de Graaff accelerator of the Southern Universities Nuclear Institute. Targets of $BaCl_2$ (99% ^{35}Cl) on gold backings. A 57 cm^3 Ge(Li) detector. Measured Eγ. Deduced half-lives using DSAM.

1961St09: ^{35}Cl(p,p′γ), E$_p$=2.3-3.25 MeV. NaI(Tl) detector. Targets of AgCl. Measured σ(E$_p$,θ), γ(θ). Deduced levels, J for the levels of 1.22 and 1.76 MeV.

1966Er06: ^{35}Cl(p,p′γ), E$_p$=0.733-2.595 MeV protons produced from the Utrecht 3 MV Van de Graaff accelerator. $BaCl_2$ target (99.5% ^{35}Cl) on a tantalum backing. Cylindrical NaI assemblies, 10-cm by 10-cm. Measured Eγ, γ(θ). Deduced levels, J^π, mixing ratios, mainly for ^{36}Ar and for the ^{35}Cl level at E$_x$=1760.

1969Ta13,1971Ta02: ^{35}Cl(p,p), E$_p$=3.115 and 3.345 MeV protons produced from the Universite de Montreal Model EN tandem accelerator. AgCl target (99% ^{35}Cl) of 16 μg/cm^2 on gold backing. A 12.70-cm-diam by 15.24-cm-long NaI(Tl) for detecting γ-rays. Measured Eγ, Iγ, γ(θ). Deduced levels, J^π and mixing ratio for the level of 1763 keV.

1969An35: ^{35}Cl(p,p), E$_p$=6.03 MeV proton beams on an $CdCl_2$ target. Inelastic protons detected by a Si(Li) detector. Measured σ(E$_{p'}$,θ). Deduced levels, J.

1970Ta09: ^{35}Cl(p,p′γ), E$_p$=5.11 MeV. NaI(Tl) detector. Measured Eγ. Developed an analytical method to interpret the linear polarization measurement of two unresolved γ-rays: 3.00 and 3.16 MeV.

1971Ca40: ^{35}Cl(p,p′γ) E=4.15-6.15 MeV protons from the Oxford University Tandem accelerator. Targets of 20 μmg/cm$_2$ natural $BaCl_2$ on gold, lead and carbon backings. A 32 cm^3 Ge(Li) detector. Measured Eγ. Deduced half-lives for the levels of 2646 and 2695 keV using DSAM.

1974Hu09: ^{35}Cl(p,p′γ) E=5.65 MeV protons from the pulsed beam facility of the University of Alberta Van de Graaff accelerator. Targets of natural KCl on tantalum backing and $PbCl_2$ on gold backing. A 24 cm^3 coaxial Ge(Li) detector. Measured Eγ. Deduced half-life for the level of 3162 keV.

1985Ki07: ^{35}Cl(p,p′γ), E$_p$=2.4-4.2 MeV proton beam produced from the 5 MV Van de Graaff accelerator of the Institute of Nuclear Research, Debrecen. ^{35}Cl target made by pressing into pellets. A 25 cm^3 Ge(Li) detector for detecting γ-rays. Measured Eγ, Iγ. Deduced levels.

Others: 1972Lu02, 1974Jo02, 1975De16, 1993Bo40.

^{35}Cl Levels

E(level)†	J^π#	$T_{1/2}$‡	Comments
0	3/2$^+$@		
1219.4 *1*	1/2$^+$	0.150 ps *35*	$T_{1/2}$: weighted average of 0.19 ps *10* (1969Du08), 0.146 ps *35* (1972Br45) and 0.149 PS *52* (1972Va06).
1763.2 *1*	5/2$^+$	0.43 ps *20*	$T_{1/2}$: unweighted average of 0.80 ps *38* (1969Du08), 0.34 ps *6* (1972Br45) and 0.142 PS *52* (1972Va06).
2645.7 *2*	7/2$^+$	165 fs *35*	$T_{1/2}$: unweighted average of 240 fs *60* (1969Du08), 180 fs *40* (1972Br45) and 128 PS *35* (1972Va06). 1971Ca40 gives 58 fs *15*.

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^{35}Cl(p,p),(p,p′γ) 1969Du08,1970Ta02,1972Br45 (continued)

^{35}Cl Levels (continued)

E(level)†	Jπ#	$T_{1/2}$‡	Comments
2693.5 *1*	3/2+	44 fs *11*	$T_{1/2}$: weighted average of 44 fs *11* (1969Du08) and 45 fs *14* (1972Va06). 1971Ca40 gives 8 fs *5*.
3002.5 *5*	5/2+	18 fs *9*	$T_{1/2}$: weighted average of 21 fs *9* (1969Du08) and 12 fs *14* (1972Va06).
3162.6 *1*	7/2−	32 ps *4*	$T_{1/2}$: from 1974Hu09.
3930& *30*	3/2&		

† From 1972Br45, unless otherwise noted.
‡ From 1969Du08, 1972Br45 and 1972Va06 using DSAM, unless otherwise noted.
# From πγ(θ) in 1969Du08 and 1970Ta02, unless otherwise noted.
@ From Adopted Levels.
& From 1969An35.

γ(^{35}Cl)

E_i(level)	J_i^π	E_γ†	I_γ&	E_f	J_f^π	Mult.	δ	Comments
1219.4	1/2+	1219.3	100	0	3/2+			Γ_γ=27.43×10^{-4} eV (1969Du08). pol=0.99 *3* (1969Ta13). A_2=−0.025 *29* for E_p=3.115 MeV; +0.007 *8* for E_p=3.345 MeV (1969Ta13). A_2=+0.02 *6*, A_4=+0.05 *9* (1969Du08). B(M1)(W.u.)=0.073 if δ=0, B(E2)(W.u.)=185.7 if δ=∞ (1969Du08). B(M1)(W.u.)=0.087 *22*, B(E2)(W.u.)=2.38 *26* (1972Br45) MeV (1969Ta13).
1763.2	5/2+	1763.3	100 *2*	0	3/2+	M1+E2	−2.87 *12*	δ: weighted average of +3.0 *5* (1966Er06), +2.64 *12* (1969Ta13,1971Ta02) and +2.99 *9* (1972Br45). Others: δ<−0.4 or δ> +0.4 (1969Du08). Γ_γ(E2)=6.97×10^{-4} eV, Γ_γ(M1)=0.77×10^{-4} eV (1969Du08). pol=2.23 *7* (1969Ta13). A_2=−0.365 *9*, A_4=+0.209 *13* (1969Ta13). A_2=−0.02 *2*, A_4=+0.07 *2* (1969Du08). B(M1)(W.u.)=0.007;B(E2)(W.u.)=12 (1966Er06). B(M1)(W.u.)=0.0007, B(E2)(W.u.)=7.46 (1969Du08). B(M1)(W.u.)=10.4×10^{-4} *10*, B(E2)(W.u.)=11.5 *9* (1972Br45).
2645.7	7/2+	882.3 *3*	10 *3*	1763.2	5/2+	M1+E2	−0.21 *5*	δ: weighted average of −0.17 *5* (1970Ta02) and −0.25 *5* (1972Br45). Γ_γ=2.99×10^{-4} eV (1969Du08). B(M1)(W.u.)=0.021 if δ=0, B(E2)(W.u.)=101.6 if δ=∞ (1969Du08). B(M1)(W.u.)=1.17×10^{-2} *2*, B(E2)(W.u.)=1.6 *9* (1970Ta02). B(M1)(W.u.)=0.026 *6*, B(E2)(W.u.)=7.9 *31* (1972Br45).
		1425‡	<1	1219.4	1/2+			
		2645.6	90 *3*	0	3/2+	E2(+M3)#	0#	Γ_γ(E2)=16.95×10^{-4} eV (1969Du08). A_2=+0.22 *5*, A_4=−0.13 *6* (1969Du08). B(E2)(W.u.)=2.38 (1969Du08).

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^{35}Cl(p,p),(p,p′γ) 1969Du08,1970Ta02,1972Br45 (continued)

γ(^{35}Cl) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[&]	E_f	J_f^π	Mult.	δ	Comments
								B(E2)(W.u.)=2.8 *9* (1970Ta02). B(E2)(W.u.)=3.2 *8* (1972Br45).
2693.5	3/2$^+$	931.3 *3*	14.7 *20*	1763.2	5/2$^+$	M1+E2[#]	−0.09[#] *3*	Γ_γ=14.86×10^{-4} eV (1969Du08). B(M1)(W.u.)=0.089 if δ=0, B(E2)(W.u.)=385.3 if δ=∞ (1969Du08). B(M1)(W.u.)≥0.19, B(E2)(W.u.)≥3.0 (1970Ta02). B(M1)(W.u.)=0.088 *30*, B(E2)(W.u.)=390 *130* (1972Br45).
		1475 *2*	6.3 *20*	1219.4	1/2$^+$	M1+E2[#]	+0.63[#] *21*	Γ_γ=7.43×10^{-4} eV (1969Du08). B(M1)(W.u.)=0.012 if δ=0, B(E2)(W.u.)=19.34 if δ=∞ (1969Du08). B(M1)(W.u.)≥0.01, B(E2)(W.u.)≥4.8 (1970Ta02). B(M1)(W.u.)=0.011 *5*, B(E2)(W.u.)=19 *8* (1972Br45).
		2694.6	79 *2*	0	3/2$^+$	M1+E2	−0.25 *2*	δ: weighted average of −0.26 *2* (1970Ta02) and −0.17 *8* (1972Br45). Γ_γ=83.87×10^{-4} eV (1969Du08). B(M1)(W.u.)=0.021 if δ=0, B(E2)(W.u.)=10.75 if δ=∞ (1969Du08). B(M1)(W.u.)≥0.04, B(E2)(W.u.)≥1.2 *9* (1970Ta02). B(M1)(W.u.)=0.020 *5*, B(E2)(W.u.)=0.30 *21* (1972Br45).
3002.5	5/2$^+$	1238[‡]	2 *1*	1763.2	5/2$^+$			
		1783.1	3.2 *10*	1219.4	1/2$^+$	E2(+M3)[#]	0[#]	Γ_γ(E2)=6.37×10^{-4} eV (1969Du08). B(E2)(W.u.)=6.44 (1969Du08). B(E2)(W.u.)≥6 (1970Ta09). B(E2)(W.u.)=7.3 *37* (1972Br45).
		3002.2	93 *2*	0	3/2$^+$	M1+E2	−0.08 *2*	δ: weighted average of −0.07 *2* (1970Ta02) and −0.09 *3* (1972Br45). Others: −20<δ<−0.3 or +0.2<δ<+5 (1969Du08); −0.02<δ<0.09 (1970Ta09). Γ_γ(E2)=1.32×10^{-4} eV, Γ_γ(M1)=204.6×10^{-4} eV (1969Du08). 0.37<pol<0.58 (1970Ta09). A_2=−0.30 *4*(1969Du08). B(M1)(W.u.)=0.037, B(E2)(W.u.)=0.099 (1969Du08). B(M1)(W.u.)≥0.02, B(E2)(W.u.)≥0.02 (1970Ta02). B(M1)(W.u.)=0.041 *17*, B(E2)(W.u.)=0.14 *8* (1972Br45).
3162.6	7/2$^-$	517.0 *8*	10 *2*	2645.7	7/2$^+$	E1(+M2)[@]	0[@]	Γ_γ=0.018×10^{-4} eV (1969Du08). B(E1)(W.u.)=1.8×10^{-5} if δ=0, B(M2)(W.u.)=301.7 if δ=∞ (1969Du08). B(E1)(W.u.)≤1×10^{-5} (1970Ta02). B(E1)(W.u.)=2.8×10^{-5} *8* (1972Br45).
		1399[‡]	<1	1763.2	5/2$^+$			B(E1)(W.u.)≤5×10^{-8} (1970Ta02).
		1942[‡]	<1	1219.4	1/2$^+$			
		3162.5	90 *2*	0	3/2$^+$	M2+E3	+0.17 *3*	δ: unweighted average of +0.14 *7* (1969Du08), +0.25 *4* (1970Ta02) and +0.15 *2* (1972Br45). Other: −0.31<δ<−0.21

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^{35}Cl(p,p),(p,p′γ) 1969Du08,1970Ta02,1972Br45 (continued)

γ(^{35}Cl) (continued)

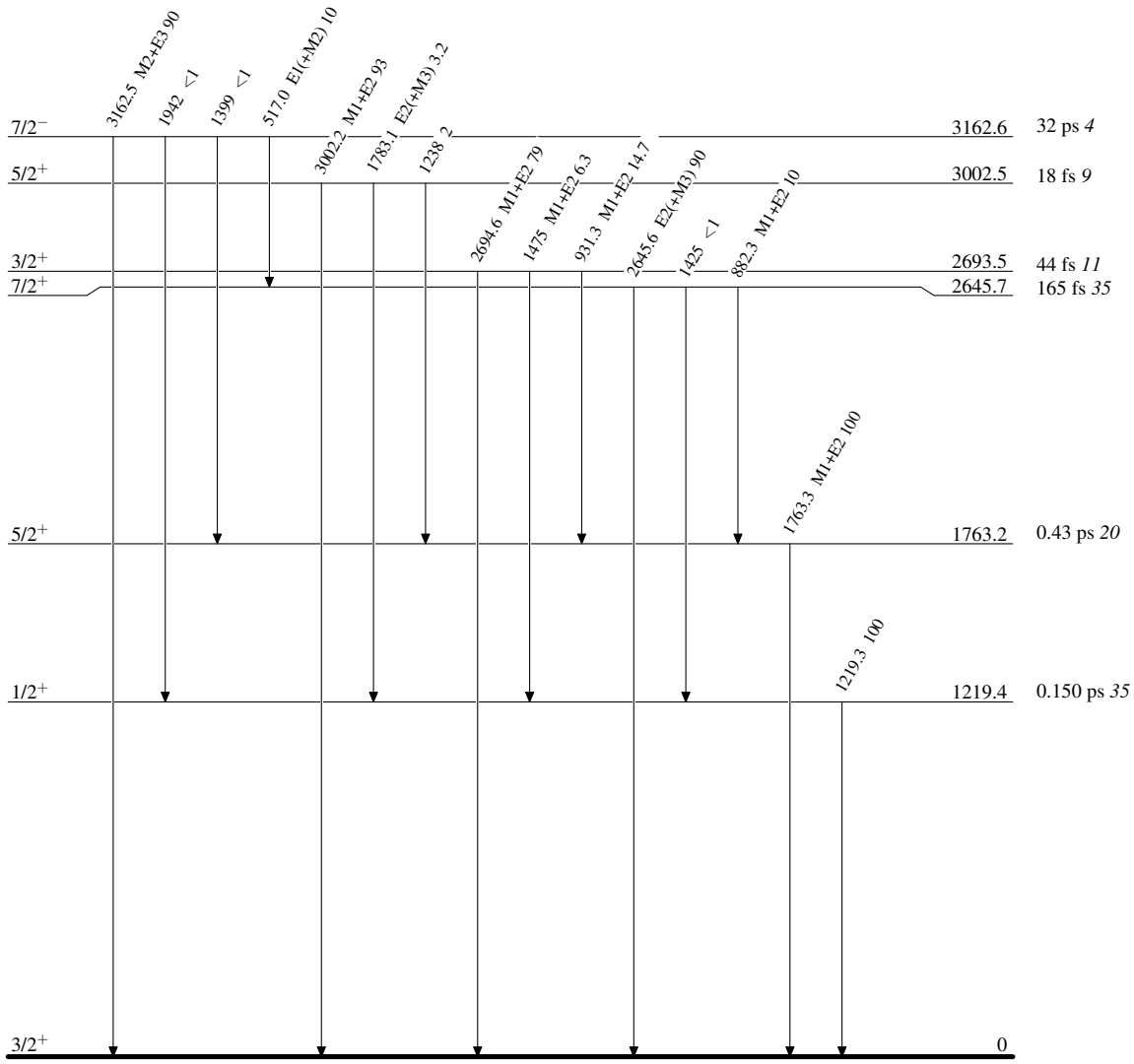
E_i(level)	E_γ †	Comments
		(1970Ta09).
		0.09<pol<0.46 (1970Ta09).
		Γ_γ(E3)=0.0023×10^{-4} eV, Γ_γ(M2)=0.090×10^{-4} eV (1969Du08).
		A_2=+0.48 *21*, A_4=−0.13 *73* (1969Du08).
		B(M2)(W.u.)=0.180, B(E3)(W.u.)=2.66 (1969Du08).
		B(M2)(W.u.)=0.19 *3*, B(E3)(W.u.)=6.5 *20* (1970Ta02).
		B(M2)(W.u.)=0.21 *3*, B(E3)(W.u.)=3.2 *12* (1972Br45).
		B(M2)(W.u.)=0.26 *3*, B(E3)(W.u.)=3.9 *7* (1974Hu09).

† Values with uncertainties from 1969Du08 and others from level energy difference.
‡ From 1970Ta02.
# From 1970Ta02.
@ From 1972Br45.
& From 1969Du08 and 1970Ta02. Weighted average taken if values are available from both, unless otherwise noted.

^{35}Cl(p,p),(p,p′γ) 1969Du08,1970Ta02,1972Br45

Level Scheme

Intensities: % photon branching from each level



$^{35}_{17}Cl_{18}$