Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 149, 1 (2018)	1-Jan-2018

Q(β^-)=3442 *5*; S(n)=8073.4 *17*; S(p)=10228 *7*; Q(α)=−7367.3 *26* 2017Wa10
S(2n)=14181.3 *17*, S(2p)=25380 *40* (2017Wa10).
First identification of ^{39}Cl nuclide by 1949Ha53.
Other reactions:
^{40}Ar(μ^-,X): 2008Kl02, 2003Gl07.
^{40}Ar(p,2p) E=1.93, 1.96 MeV; deduced dibaryon resonance: 1986Er07.
^{40}Ar(p,2p) E=460 MeV. Measured $\sigma(\theta)$, Q value: 1966Ty01.
Main reactions for production of ^{39}Cl: ^{40}Ar(γ,p); ^{40}Ar(α,αp); ^{37}Cl(t,p).
Additional information 1.
1999Ai02: ^{39}Cl beam produced by fragmentation of ^{55}Mn beam At 50, 90 MeV/nucleon with a ^{9}Be target. Measured energy-integrated cross sections; deduced strong absorption radii.

^{39}Cl Levels

Additional information 2.

Cross Reference (XREF) Flags

A	^{39}S β^- decay (11.5 s)	E	^{40}Ar(pol d,^{3}He),(d,^{3}He)
B	^{37}Cl(t,p)	F	^{40}Ar(t,α)
C	^{37}Cl(t,pγ)	G	^{160}Gd(^{37}Cl,^{39}Clγ)
D	^{40}Ar(γ,p)	H	^{208}Pb(^{40}Ar,Xγ)

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]	XREF	Comments
0	3/2$^+$	56.2 min *6*	ABCDEFGH	%β^-=100 J$^\pi$: L(pol d,^{3}He)=2 from 0$^+$; first forbidden-unique β^- decay to 7/2$^-$ in ^{39}Ar. T$_{1/2}$: from 1972En01 (average of four independent measurements). Others: 55.5 min *2* (1949Ha53,1950Ha77); 55 min, 58 min (1952Ru23), 1956Pe38. The value given in 1949Ha53 has not been used by the evaluators in averaging, even though it has a much lower uncertainty than that of 1972En01. Based on sharp discrepancies noted in half-life measurements, 1970Al21 pointed out that some of the older measurements had large counting statistics thus giving low uncertainties, but the systematic errors may have been larger than the statistical errors and may not have been included.
396.42 *7*	1/2$^+$	>1.4 ps	ABCDEF H	XREF: D(500)F(364). J$^\pi$: L(pol d,^{3}He)=0 from 0$^+$.
1301.21 *15*	(5/2$^+$)[&]	>2.1 ps	ABC E GH	XREF: E(?). J$^\pi$: 904.8γ to 1/2$^+$; not 1/2 from intensity ratio in (t,pγ); log *ft*=6.1 from (7/2)$^-$. T$_{1/2}$: <2.8 ns from pγ(t) in (t,pγ).
1697.66 *17*	5/2$^-$	0.8 ps *+10−3*	ABC e H	J$^\pi$: See *J*$^\pi$ comment for 1722 level; 1696.5γ to 3/2$^+$ and RUL rules out 7/2$^-$.
1722.5 *4*	5/2$^+$	0.30 ps *6*	BC e H	J$^\pi$: L(pol d,^{3}He)=2+3 for 1698+1722 gives 5/2$^-$,7/2$^-$ for one component and 5/2$^+$ for the other; 1326.0γ to 1/2$^+$ and RUL determines this level is the L=2, *J*$^\pi$=5/2$^+$ component while 1698 level is the L=3, *J*$^\pi$=5/2$^-$,7/2$^-$ component.
1744.93 *13*	(7/2$^+$)	0.90 ps *28*	BC e H	J$^\pi$: 1745.03γ to 3/2$^+$; not 1/2 from Iγ(0°)/Iγ(90°) in (t,pγ); 7/2$^+$ from

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Adopted Levels, Gammas (continued)

^{39}Cl Levels (continued)

E(level)†	Jπ‡	$T_{1/2}$#	XREF	Comments
				shell-model calculations in ^{208}Pb(^{40}Ar,Xγ).
1785.86 *18*	(7/2$^-$)	>1.4 ps	ABC GH	Jπ: log *ft*=5.83 from (7/2)$^-$ in ^{39}S β^- decay; 484.64γ to (5/2$^+$); possibly the lowest 7/2$^-$ state, as expected from systematics. $T_{1/2}$: <2.8 ns from pγ(t) in (t,pγ).
2060.2 *9*	5/2$^+$	<35 fs	BC E H	Jπ: L(pol d, ^{3}He)=2 from 0$^+$ and L+1/2 transfer from analyzing power. Additional information 3.
2237.5 *7*	1/2$^+$	55 fs *28*	BC E H	Jπ: L(pol d,^{3}He)=0 from 0$^+$.
2423.7 *3*	(9/2$^+$)&	>1.2 ps	BC GH	Jπ: 637.7γ to (7/2$^-$), 678.8γ to (7/2$^+$), 1122.9γ to (5/2$^+$); 9/2$^+$ from shell-model calculations in (^{37}Cl,^{39}Clγ) (1994Fo04).
2489.4 *4*	5/2$^+$	70 fs *35*	BC E	Jπ: L(pol d,^{3}He)=2 from 0$^+$ and L+1/2 transfer from analyzing power.
2571.98 *25*	(9/2)$^-$		A H	Jπ: log *ft*=5.4 from (7/2)$^-$ in ^{39}S β^- decay (9/2$^-$) from shell-model predictions in (^{40}Ar,Xγ) (2013Sz02).
2586.0 *20*		<0.21 ps	BC	
2834.3 *3*	(11/2$^+$)&	>1.2 ps	BC GH	Jπ: from shell-model predictions in (^{40}Ar,Xγ) (2013Sz02).
2962.3 *6*	(11/2$^-$)		H	Jπ: from shell-model predictions in (^{40}Ar,Xγ) (2013Sz02).
3115.6 *6*		0.15 ps *4*	BC	
3171 *10*	5/2$^+$,1/2$^+$		E	Jπ: L(pol d,^{3}He)=2,0 and L+1/2 transfer from analyzing power.
3340?			B	
3475 *44*	5/2$^+$		E	E(level): from (pol d,^{3}He). Jπ: L(pol d,^{3}He)=2 and L+1/2 transfer from analyzing power.
3517.1 *9*	(15/2$^+$)&		GH	Jπ: from shell-model predictions in (^{40}Ar,Xγ) (2013Sz02).
3533.7 *6*	(5/2$^+$,7/2,9/2$^+$)	<0.14 ps	BC	Jπ: 1110.0γ to (9/2$^+$) and 2232.6γ to (5/2$^+$).
3907.2? *6*			BC	XREF: B(3910)C(?).
4013 *14*	5/2$^+$		E	Jπ: L(pol d,^{3}He)=2 and L+1/2 transfer from analyzing power.
4050.4? *7*			BC	XREF: B(?)C(?).
4.35×10^3@ *10*	(5/2$^+$)@		E	
4354.4? *19*			BC	XREF: B(4350)C(?).
4.63×10^3@ *18*	(5/2$^+$)@		B E	XREF: B(4830?).
5.18×10^3@ *18*	(5/2$^+$)@		E	
5.45×10^3@ *10*	(5/2$^+$)@		E	
5.70×10^3@ *15*	(5/2$^+$)@		E	
5.98×10^3@ *13*	(5/2$^+$)@		E	
7.6×10^3@ *15*	(5/2$^+$)@		E	

† From a least-squares fit to γ-ray energies for levels populated in γ-ray studies.

‡ When L(pol d, ^{3}He) is quoted as an argument, it implies that L value is from $\sigma(\theta)$, and L+1/2 or L-1/2 transfer is from analyzing powers.

From DSAM in (t,pγ) for excited states, unless otherwise noted.

@ Multiplet of levels in a range of 200 keV or more; the multiplet associated with pickup of $d_{5/2}$ proton. J=(5/2$^+$) is from L(pol d,^{3}He)=2 and L+1/2 transfer for the multiplet.

& The assignment consistent with sdfp (space)-shell model calculations with $\pi d_{3/2}$ for g.s. in (^{37}Cl,^{39}Clγ). The excitations correspond to $\pi d_{3/2}(\nu f^2_{7/2})$, seniority=3.

Adopted Levels, Gammas (continued)

$\gamma(^{39}Cl)$

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.	Comments
396.42	$1/2^+$	396.42 *7*	100	0	$3/2^+$		E_γ: others: 396.4 *1* from (^{40}Ar,Xγ), 396.50 *20* from ^{39}S β^- decay.
1301.21	$(5/2^+)$	904.8 *5*	6.6 *21*	396.42	$1/2^+$	[E2]	B(E2)(W.u.)<3.5 E_γ: weighted average of 903.8 *6* from ^{39}S β^- decay and 905.1 *3* from (t,pγ). I_γ: weighted average of 6.8 *21* from ^{39}S β^- decay and 6.4 *21* from (t,pγ).
		1301.1 *3*	100.0 *21*	0	$3/2^+$		E_γ: unweighted average of 1300.52 *16* from ^{39}S β^- decay, 1301.46 *10* from (t,pγ), and 1301.3 *3* from (^{40}Ar,Xγ).
1697.66	$5/2^-$	396.5 *1*	83 *7*	1301.21	$(5/2^+)$	[E1]	B(E1)(W.u.)=0.005 *4* E_γ: from (^{40}Ar,Xγ). Other: 396.50 *20* from ^{39}S β^- decay. I_γ: from ^{39}S β^- decay.
		1696.0 *6*	100 *8*	0	$3/2^+$	[E1]	B(E1)(W.u.)=8×10^{-5} *+6−5* E_γ: unweighted average of 1696.62 *17* from ^{39}S β^- decay and 1695.4 *6* from (t,pγ). I_γ: from ^{39}S β^- decay.
1722.5	$5/2^+$	421.3	14 *10*	1301.21	$(5/2^+)$		
		1326.0 *4*	100 *10*	396.42	$1/2^+$	[E2]	B(E2)(W.u.)=29 *+13−9*
		1722.5 *7*	90 *10*	0	$3/2^+$		
1744.93	$(7/2^+)$	443.66 *10*	59 *7*	1301.21	$(5/2^+)$		E_γ: weighted average of 443.66 *10* from (t,pγ) and 443.7 *3* from (^{40}Ar,Xγ). I_γ: other: 33 *5* from (^{40}Ar,Xγ).
		1745.01 *15*	100 *7*	0	$3/2^+$	[E2]	B(E2)(W.u.)=3.1 *+18−9* E_γ: weighted average of 1745.03 *15* from (t,pγ) and 1744.5 *8* from (^{40}Ar,Xγ).
1785.86	$(7/2^-)$	484.64 *10*	100	1301.21	$(5/2^+)$	[E1]	B(E1)(W.u.)<0.0037 E_γ: weighted average of 484.85 *24* from ^{39}S β^- decay (11.5 s), 484.61 *10* from (t,pγ), and 484.5 *4* from (^{40}Ar,Xγ).
2060.2	$5/2^+$	2060.1 *9*	100	0	$3/2^+$		E_γ: weighted average of 2060.3 *10* from (t,pγ) and 2060.0 *9* from (^{40}Ar,Xγ).
2237.5	$1/2^+$	1841.0 *7*	100 *8*	396.42	$1/2^+$		E_γ: weighted average of 1841.4 *7* from (t,pγ) and 1840.5 *7* from (^{40}Ar,Xγ).
		2237.4	30 *8*	0	$3/2^+$		
2423.7	$(9/2^+)$	637.7 *3*	100 *5*	1785.86	$(7/2^-)$	[E1]	B(E1)(W.u.)<0.0013 E_γ: weighted average of 637.7 *3* from (t,pγ) and 637.8 *7* from (^{40}Ar,Xγ). I_γ: other: 100 *20* from (^{40}Ar,Xγ).
		678.8	13 *5*	1744.93	$(7/2^+)$		
		1122.9 *4*	36 *5*	1301.21	$(5/2^+)$	[E2]	B(E2)(W.u.)<8.1 E_γ: weighted average of 1122.9 *4* from (t,pγ) and 1123 *1* from (^{40}Ar,Xγ). I_γ: other: 38 *9* from (^{40}Ar,Xγ).
2489.4	$5/2^+$	1188.2 *3*	100	1301.21	$(5/2^+)$		
2571.98	$(9/2)^-$	874.31 *18*	100	1697.66	$5/2^-$		
2586.0		1284.8 *20*	100	1301.21	$(5/2^+)$		
2834.3	$(11/2^+)$	410.65 *13*	100 *4*	2423.7	$(9/2^+)$		E_γ: other: 410.6 *4* from (^{40}Ar,Xγ).
		1089.2 *4*	15 *4*	1744.93	$(7/2^+)$	[E2]	B(E2)(W.u.)<5.1 E_γ: other: 1089 *1* from (^{40}Ar,Xγ).
2962.3	$(11/2^-)$	1176.4 *5*	100	1785.86	$(7/2^-)$		E_γ: from (^{40}Ar,Xγ).
3115.6		1370.6 *5*	100	1744.93	$(7/2^+)$		
3517.1	$(15/2^+)$	682.8 *8*	100	2834.3	$(11/2^+)$		E_γ: from (^{40}Ar,Xγ).

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Adopted Levels, Gammas (continued)

$\gamma(^{39}Cl)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π
3533.7	$(5/2^+,7/2,9/2^+)$	1110.0 *5*	100 *17*	2423.7	$(9/2^+)$
		1788.7	55 *17*	1744.93	$(7/2^+)$
		2232.4	17 *14*	1301.21	$(5/2^+)$
3907.2?		1483.4[‡] *5*		2423.7	$(9/2^+)$
		2606.7[‡] *20*		1301.21	$(5/2^+)$
4050.4?		3654[‡]		396.42	$1/2^+$
		4050[‡]		0	$3/2^+$
4354.4?		2567.8[‡] *20*		1785.86	$(7/2^-)$
		3059[‡] *6*		1301.21	$(5/2^+)$

[†] From (t,pγ), unless otherwise noted. Quoted energy values without uncertainties are from level-energy differences. Upper limits of intensities are given for many transitions in (t,pγ); they are not listed here. See (t,pγ) dataset for details.

[‡] Placement of transition in the level scheme is uncertain.

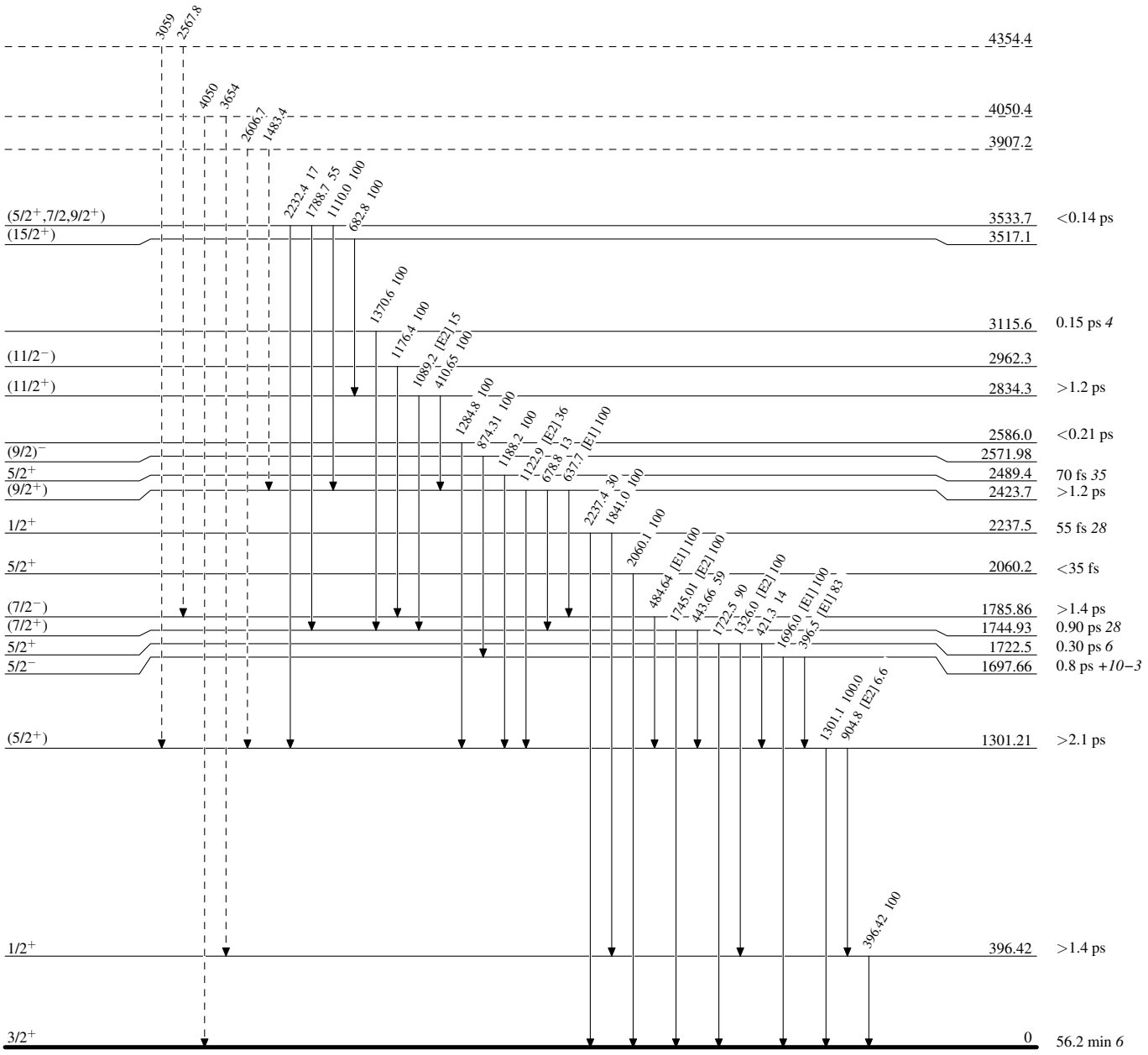
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{39}_{17}Cl_{22}$