^{39}Cl β^- decay (56.2 min) 1987Wa12

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

Parent: ^{39}Cl: E=0; $J^\pi=3/2^+$; $T_{1/2}$=56.2 min *6*; Q(β^-)=3442 *5*; %β^- decay=100.0

^{39}Cl-J^π,$T_{1/2}$: From Adopted Levels of ^{39}Cl.

^{39}Cl-Q(β^-): From 2017Wa10.

1987Wa12: ^{39}Cl source was produced via the ^{37}Cl(t,p) reaction with E=3.1 MeV triton provided by the Van de Graaff accelerator at the Brookhaven National Laboratory on a $BaCl_2$ target (90.4% in ^{37}Cl). γ rays were detected with a Ge-Na(Tl) Compton-suppression spectrometer. Measured Eγ, Iγ. Deduced levels, β-decay and γ-ray branching ratios, log *ft*.

1972En01: ^{39}Cl source was produced via the ^{37}Cl(t,p) reaction with E=3.0 MeV triton provided by the Van de Graaff accelerator at the Brookhaven National Laboratory on a $BaCl_2$ target (96.1% in ^{37}Cl). γ rays were detected with a Ge(Li) detector and a NaI(Tl) detector. Measured Eγ, Iγ, $\gamma\gamma$-coin, γ(t). Deduced levels, β-decay and γ-ray branching ratios, log *ft*, parent $T_{1/2}$.

1956Pe38: ^{39}Cl source was produced via the ^{40}Ar(α,αp) reaction with alpha beam provided by the University of Washington 60-in cyclotron on a argon gas target. β particles and conversion electrons were detected with a scintillation spectrometer and γ rays were detected with NaI(Tl) scintillation spectrometers. Measured Eγ, Iγ, Eβ, Iβ, E(ce), I(ce), $\gamma\gamma$-coin, $\beta\gamma$-coin, γ(t). Deduced levels, J, π, $T_{1/2}$, β-decay branching ratios, log *ft*, β-decay end-point energies, γ-ray multipolarities.

1976Fa10: Measured $\beta\gamma(\theta$,circ pol). Deduced γ-ray multipolarities and mixing ratios for 250γ and 1517γ from 1517.5 level.

Others: isotopic identification and $T_{1/2}$: 1952Ru23, 1950Ha77, 1949Ha53.

Additional information 1.

The total average radiation energy released by ^{39}Cl β^- decay is 3444 keV *74* (calculated by evaluator using the computer program RADLST). This value agrees well with Q(β^-)=3442 keV *5* (2017Wa10) and shows the completeness of the decay scheme.

^{39}Ar Levels

E(level)[†]	J^π[‡]	$T_{1/2}$[@]	E(level)[†]	J^π[‡]
0	$7/2^-$		2503.418 *11*	$(5/2)^+$
1267.207 *8*	$3/2^-$	<0.5 ns	2523.7?[#]	
1517.540 *8*	$3/2^+$	0.95 ns *5*	2631.6?[#]	
2092.749 *19*	$5/2^-$		2651.1?[#]	
2342.2?[#]			2755.5?[#]	
2358.284 *11*	$1/2^+$		2829.934 *17*	$1/2^+$
2433.48 *3*	$3/2^-$		2949.95 *10*	$(3/2^+,5/2)$
2481.5?[#]			3287.0?[#]	

[†] From a least-squares fit to γ-ray energies with uncertainties if available, unless otherwise noted.

[‡] From Adopted Levels.

[#] Not populated in this decay and upper limit of β^- feeding given in 1987Wa12; energy is rounded-off value from Adopted Levels.

[@] From delayed coincidence (1956Pe38).

β^- radiations

E(decay)	E(level)	Iβ^-[†‡]	Log *ft*	Comments
(155[#] *5*)	3287.0?	<0.0029	>6.1	av Eβ=44.6 *16*
(492 *5*)	2949.95	0.027 *4*	6.85 *7*	av Eβ=164.7 *20*
(612 *5*)	2829.934	0.60 *2*	5.84 *2*	av Eβ=211.8 *20*
(687[#] *5*)	2755.5?	<0.0020	>8.5	av Eβ=241.9 *21*
(791[#] *5*)	2651.1?	<0.0008	>9.1	av Eβ=285.0 *21*
(810[#] *5*)	2631.6?	<0.0020	>8.8	av Eβ=293.1 *21*
(918[#] *5*)	2523.7?	<0.0015	>9.1	av Eβ=338.7 *22*

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^{39}Cl β^- decay (56.2 min) 1987Wa12 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^-[†][‡]	Log *ft*	Comments
(939 *5*)	2503.418	2.23 *7*	5.97 *2*	av Eβ=347.4 *22*
(961[#] *5*)	2481.5?	<0.0017	>9.1	av Eβ=356.8 *22*
(1009[#] *5*)	2433.48	<0.008	>8.5	av Eβ=377.4 *22*
(1084 *5*)	2358.284	2.55 *8*	6.16 *2*	av Eβ=410.1 *22*
(1100[#] *5*)	2342.2?	<0.0008	>9.7	av Eβ=417.2 *22*
(1349[#] *5*)	2092.749	<0.011	>8.9	av Eβ=527.8 *23*
(1924 *5*)	1517.540	83 *3*	5.65 *2*	av Eβ=791.5 *24* Iβ^-: 85 *6* (1956Pe38). E(decay): end-point energy=1910 *20* (1956Pe38).
(2175 *5*)	1267.207	4.7 *17*	7.1 *2*	av Eβ=908.7 *24* Iβ^-: 98 *14* (1956Pe38). E(decay): end-point energy=2180 (1956Pe38).
(3442 *5*)	0	7 *2*	9.3[1u] *2*	av Eβ=1530.4 *24* Iβ^-: from the analysis of the β spectrum in 1956Pe38. E(decay): end-point energy=3450 *20* (1956Pe38).

[†] Deduced from γ-ray intensities imbalances (by evaluator) at each level and the g.s. β^- feeding=7 *2* from 1956Pe38.
[‡] Absolute intensity per 100 decays.
[#] Existence of this branch is questionable.

$\gamma(^{39}Ar)$

Iγ normalization: From ΣIγ(γ to g.s.)=93 *2* from %β^-(g.s.)=7 *2* in 1956Pe38.
A(circ pol)=asymmetry coefficient of circularly polarized $\beta\gamma(\theta)$.

E_γ †	I_γ ‡@	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α&	Comments
198.3#a	<0.005#	2829.934	1/2+	2631.6?					%Iγ=0.0013 *14*
250.333 *3*	86 *3*	1517.540	3/2+	1267.207	3/2−	E1		9.86×10^{-4}	%Iγ=46.1 *11* α(K)=0.000905 *13*; α(L)=7.41×10^{-5} *11*; α(M)=7.21×10^{-6} *10* E_γ: others: 250.26 *7* (1972En01), 246 *3* (1956Pe38). I_γ: others: 87 *3* (1972En01), 90 *10* (1956Pe38). Mult.: from A(circ pol)=+0.111 *12* (1976Fa10); α(exp)<0.0021 in 1956Pe38 implies E1 or M1.
306.2#a	<0.003#	2829.934	1/2+	2523.7?					%Iγ=0.0008 *8*
326.5#a	<0.030#	2829.934	1/2+	2503.418	(5/2)+				%Iγ=0.008 *8*
396.46 *4*	0.082 *3*	2829.934	1/2+	2433.48	3/2−				%Iγ=0.0440 *19*
410.690 *20*	0.179 *4*	2503.418	(5/2)+	2092.749	5/2−				%Iγ=0.096 *4*
446.61 *13*	0.026 *5*	2949.95	(3/2+,5/2)	2503.418	(5/2)+				%Iγ=0.014 *3*
471.6#a	<0.015#	2829.934	1/2+	2358.284	1/2+				%Iγ=0.004 *4*
538.8#a	<0.004#	2631.6?		2092.749	5/2−				%Iγ=0.0011 *11*
825.533	0.017 *8*	2092.749	5/2−	1267.207	3/2−				%Iγ=0.009 *5*
840.775 *25*	0.248 *6*	2358.284	1/2+	1517.540	3/2+				%Iγ=0.133 *5* E_γ,I_γ: other: Eγ=841.4 *13*, Iγ=0.10 *6* (1972En01).
915.86 *10*	0.010 *7*	2433.48	3/2−	1517.540	3/2+				%Iγ=0.005 *4*
985.861 *9*	3.90 *7*	2503.418	(5/2)+	1517.540	3/2+				%Iγ=2.09 *7* E_γ,I_γ: other: Eγ=985.79 *14*, Iγ=4.0 *2* (1972En01).
1091.056 *8*	4.51 *9*	2358.284	1/2+	1267.207	3/2−				%Iγ=2.42 *8* E_γ,I_γ: other: Eγ=1090.97 *11*, Iγ=4.7 *2* (1972En01).
1166.25 *5*	0.057 *5*	2433.48	3/2−	1267.207	3/2−				%Iγ=0.031 *3*
1236.19 *5*	0.112 *5*	2503.418	(5/2)+	1267.207	3/2−				%Iγ=0.060 *3* E_γ,I_γ: other: Eγ=1235.4 *10*, Iγ=0.21 *8* (1972En01).
1267.191 *11*	100.0	1267.207	3/2−	0	7/2−				%Iγ=53.6 *13* E_γ: others: 1267.20 *5* (1972En01), 1266 *10* (1956Pe38). α(exp)<0.0016 (1956Pe38).
1312.360 *20*	0.469 *11*	2829.934	1/2+	1517.540	3/2+				%Iγ=0.252 *9* E_γ,I_γ: other: Eγ=1312.1 *10*, Iγ=0.53 *6* (1972En01).
1432.27 *15*	0.024 *3*	2949.95	(3/2+,5/2)	1517.540	3/2+				%Iγ=0.0129 *17*
1517.498 *10*	73.2 *16*	1517.540	3/2+	0	7/2−	M2+E3	+0.20 *4*	6.78×10^{-5} *10*	%Iγ=39.3 *10* α=6.78×10^{-5} *10*; α(K)=3.80×10^{-5} *6*; α(L)=3.11×10^{-6} *5*; α(M)=3.04×10^{-7} *5* α(IPF)=2.64×10^{-5} *4*

^{39}Cl β^- decay (56.2 min) 1987Wa12 (continued)

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

E_γ [†]	I_γ [‡@]	E_i(level)	J_i^π	E_f	J_f^π	Comments
						E_γ: others: 1517.36 *8* (1972En01), 1520 *10* (1956Pe38). I_γ: others: 71.0 *15* (1972En01), 85 *5* (1956Pe38). Mult.,δ: from A(circ pol)=−0.028 *14* (1976Fa10). α(exp)<0.0032 (1956Pe38).
1562.704 *25*	0.535 *12*	2829.934	$1/2^+$	1267.207	$3/2^-$	%Iγ=0.287 *10* E_γ,I_γ: other: Eγ=1561.6 *10*, Iγ=0.58 *6* (1972En01).
2019.7[#a]	<0.007[#]	3287.0?		1267.207	$3/2^-$	%Iγ=0.0019 *19*
2092.74 *3*	0.173 *4*	2092.749	$5/2^-$	0	$7/2^-$	%Iγ=0.093 *3* E_γ,I_γ: other: Eγ=2093.0 *10*, Iγ=0.15 *2* (1972En01).
2342.1[#a]	<0.002[#]	2342.2?		0	$7/2^-$	%Iγ=0.0005 *6*
2358.2[#a]	<0.01[#]	2358.284	$1/2^+$	0	$7/2^-$	%Iγ=0.003 *3*
2433.49 *8*	0.0208 *13*	2433.48	$3/2^-$	0	$7/2^-$	%Iγ=0.0112 *8*
2481.4[#a]	<0.004[#]	2481.5?		0	$7/2^-$	%Iγ=0.0011 *11*
2503.28 *7*	0.010 *1*	2503.418	$(5/2)^+$	0	$7/2^-$	%Iγ=0.0054 *6*
2523.6[#a]	<0.003[#]	2523.7?		0	$7/2^-$	%Iγ=0.0008 *8*
2651.0[#a]	<0.002[#]	2651.1?		0	$7/2^-$	%Iγ=0.0005 *6*
2755.4[#a]	<0.005[#]	2755.5?		0	$7/2^-$	%Iγ=0.0013 *14*
2830.2[a] *4*	<0.003	2829.934	$1/2^+$	0	$7/2^-$	%Iγ=0.0008 *8*

[†] Values with uncertainties are from 1987Wa12 and those without uncertainties are from level-energy differences, unless otherwise noted.
[‡] Relative intensities normalized to Iγ(1267γ)=100. Quoted values are from 1987Wa12, unless otherwise noted.
[#] γ not seen and upper intensity limit quoted by 1987Wa12.
[@] For absolute intensity per 100 decays, multiply by 0.536 *13*.
[&] 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.
[a] Placement of transition in the level scheme is uncertain.

$^{39}_{18}Ar_{21}$-4

^{39}Cl β^- decay (56.2 min) 1987Wa12

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays