Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 152, 1 (2018)	30-Sep-2017

Q(β^-)=4916.72 *22*; S(n)=6107.88 *8*; S(p)=10190.66 *21*; Q(α)=−7674.3 *8* 2017Wa10
S(2n)=16418.70 *10*, S(2p)=24125 *13* (2017Wa10).
First identification of ^{38}Cl nuclide was reported by Kenney and Seaborg in Phys Rev 57, 843 (1940), according to the 2012Th10 compilation of isotope discoveries.
Other reactions:
2008MoZV: ^{26}Mg(^{18}O,Xγ) E=3.72, 5.0 MeV/nucleon from JAEA tandem; measured Eγ, Iγ, $\gamma\gamma$-coin using GEMINI-II Ge detector array; deduced levels, J, π. In this short report, the authors mention that a level scheme of ^{38}Cl up to 4836 level is deduced based on their results; but no details are given. The following γ rays are from Fig.1 of a coincidence spectrum gated by 171γ+292γ+1191γ: 554, 638, 755, 1021, 1030, 2044, 2681.
Additional information 1.

^{38}Cl Levels

Cross Reference (XREF) Flags

A	^{38}S β^- decay (170.3 min)	E	^{37}Cl(d,p)	I	^{40}Ar(d,α)
B	^{38}Cl IT decay (715 ms)	F	^{37}Cl(d,pγ)	J	^{40}Ca(μ^-,ν2pγ)
C	^{37}Cl(n,γ) E=thermal	G	^{40}Ar(μ^-,2nγ)	K	^{208}Pb(^{36}S,Xγ)
D	^{37}Cl(n,γ),(n,n):resonances	H	^{40}Ar(p,^{3}He)	L	^{208}Pb(^{40}Ar,Xγ)

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          Isospin T=2 (quintuplet) states
 38Cl             38Ar                      ΔE
   0,2−        10631,(2−), T=2            0
 671,5−        11302,5− & 11308,5− T=2    0,+6
 755,3−        11351,3− & 11355,3− T=2    -35,-31
1309,4−        11928,4− T=2               -12
ΔE=E(38Ar)-E(38Cl)-10631
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E(level)‡	J$^\pi$	T$_{1/2}$&	XREF	Comments
0	2$^-$	37.230 min *14*	ABC EFGHIJKL	%β^-=100 μ=2.05 *2* (1972La22) J$^\pi$: L(d,α)=1 from 0$^+$ and L(d,p)=1+3 from 3/2$^+$; log *ft*=4.9 to 3$^-$ and 9.2 to 0$^+$; shape of spectrum of β transition to 0$^+$ (^{38}Ar g.s.) is characteristic of first-forbidden unique β transitions (1968Va06). T$_{1/2}$: Weighted average of 37.236 min *9* (1988An03), 37.4 min *2* (1972Em01), 37.18 min *7* (1969St23), 37.140 min *35* (1965KaZY), 37.0 min *1* (1963Wi11), 37.12 min *18* (1962Mo21), 37.29 min *4* (1950Co69). Others: 1955Ma99, 1954Ma95, 38.5 min *5* (1946Ho02), 1945Sl02, 1940Cu01, 1937Hu01, 37.0 min *3* (1936Va01). μ: polarized nuclei and β detection of NMR (1972La22). Compilation: 2014StZZ. Additional information 2.
671.365 *8*	5$^-$	715 ms *3*	BC EFGHIJKL	%IT=100 J$^\pi$: L(d,p)=3 from 3/2$^+$; 671.360γ M3 to 2$^-$. T$_{1/2}$: from 1972Br53 in ^{38}Cl IT decay. Additional information 3.
755.431 *11*	3$^-$	0.220 ps *37*	A C EFG IJKL	J$^\pi$: L(d,p)=1+3 from 3/2$^+$ and L(d,α)=3 from 0$^+$ give 2$^-$,3$^-$; J$^\pi$=2$^-$ would require an unreasonably large B(E2) for 553.605γ from 4$^-$. Additional information 4.

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Adopted Levels, Gammas (continued)

^{38}Cl Levels (continued)

E(level)‡	J^π	$T_{1/2}$&	XREF	Comments
1309.051 *14*	4^-	0.37 ps *6*	C EFG IJKL	J^π: L(d,p)=3 from $3/2^+$ and L(d,α)=5 from 0^+; 1308.8γ to 2^- and 637.685γ to 5^-; RUL. Additional information 5.
1617.414 *15*	3^-#	1.52 ps *14*	C EFG iJKL	XREF: J(?). J^π: 945.89γ to 5^-; RUL. Additional information 6.
1692.463 *18*	$(1,2)^-$#	0.91 ps +*22*−*19*	A C EF i L	J^π: 936.9γ to 3^- and RUL; 3^- is less possible from small β feeding (log *ft*=8.0) from 0^+.
1745.74 *8*	$0^-,1^-$#	0.51 ps +*14*−*10*	A C EF L	J^π: log *ft*=6.8 from 0^+; 1745.74γ to 2^-; RUL.
1784.97 *13*	$2^-,3^-,4^-$	66 fs *15*	C EFGH KL	J^π: L(d,p)=3 from $3/2^+$ target; 1029.57γ to 3^-; RUL.
1820	(1^+)		I	J^π: L(d,α)=(0) from 0^+.
1941.998 *14*	1^+		A C F I L	XREF: I(1990). J^π: log *ft*=4.95 from 0^+.
1981.193 *16*	$2^-,3^-$#	0.26 ps *4*	C EF H	XREF: H(1999). J^π: 1225.67γ and 363.779γ to 3^-; RUL.
2452.5 *16*	(0 to $4)^+$		E I	XREF: I(2510). E(level): from (d,p). J^π: L(d,p)=2 from $3/2^+$.
2743.12 *11*	3^-#	28 fs *15*	C EF h	J^π: 2743.3γ to 2^- and 1433.98γ to 4^-; RUL.
2751.09 *7*	1^+		A hI	XREF: I(2810). J^π: log *ft*=4.13 from 0^+.
2895.2 *5*	$0^-,1^-,2^-,3^-$#		C E	
2952.6 *16*	$(1^+,2^+)$		E I	XREF: I(2970). E(level): from (d,p). J^π: L(d,p)=0 from $3/2^+$ for a weakly populated group.
3254.1 *4*	$0^-,1^-,2^-,3^-$#		E	
3293.5 *3*	$0^-,1^-,2^-,3^-$#		E	
3349.3 *3*	(7^+)		K	J^π: proposed in (^{36}S,Xγ) based on shell-model calculations.
3403.6 *3*	$0^-,1^-,2^-,3^-$#		E	
3538.4 *6*	$0^-,1^-,2^-,3^-$#		C E	
3565.8 *6*	$0^-,1^-,2^-,3^-$#		C E	
3639.6 *3*	(5,6)		K	J^π: proposed in (^{36}S,Xγ) based on shell-model calculations.
3685.2 *5*	$0^-,1^-,2^-,3^-$#		C E	
3756.8 *7*	$0^-,1^-,2^-,3^-$#		C E	
3809.3 *4*	(4,5,6)		K	J^π: proposed in (^{36}S,Xγ) based on shell-model calculations.
3822.6 *4*	$(1,2,3)^-$#		C E	J^π: 2205.1γ to 3^-.
3862.6 *5*	$(1,2,3)^-$#		C E	J^π: 2245.1γ to 3^-.
3893.56 *15*	$(1,2,3)^-$#		C E	J^π: 2276.3γ to 3^-.
3936.3 *6*	$0^-,1^-,2^-,3^-$#		E	
3974.7 *6*	$0^-,1^-,2^-,3^-$#		C E	
4011.29 *20*	$0^-,1^-,2^-,3^-$#		C E	
4063.0 *4*	$0^-,1^-,2^-,3^-$#		E	
4073.5† *6*	(0 to 4)		C	J^π: 2092.2γ to $2^-,3^-$; primary γ from $1^+,2^+$ in (n,γ) E=thermal.
4289.2 *6*	$0^-,1^-,2^-,3^-$#		C E	
4349.0 *16*	$0^-,1^-,2^-,3^-$#		E	
4405.4† *10*	(0 to 4)		C	J^π: 4405.1γ to 2^-; primary γ from $1^+,2^+$ in (n,γ) E=thermal.
4412.0 *6*	$0^-,1^-,2^-,3^-$#		E	
4506.0 *16*	$0^-,1^-,2^-,3^-$#		E	

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Adopted Levels, Gammas (continued)

^{38}Cl Levels (continued)

E(level)‡	Jπ	XREF	Comments
4812.5 16	$0^-,1^-,2^-,3^-$#	E	
4836.0 20	$0^-,1^-,2^-,3^-$#	C E	
4973 15	(1 to 5)$^{(-)}$	E	Jπ: L(d,p)=(3) from 3/2$^+$.
5068 15	(1 to 5)$^{(-)}$	E	Jπ: L(d,p)=(3) from 3/2$^+$.
5098 15	(0 to 4)$^{(+)}$	E	Jπ: L(d,p)=(2) from 3/2$^+$.
5498 15	(0 to 4)$^{(+)}$	E	Jπ: L(d,p)=(2) from 3/2$^+$.
6115.96 8	2^+@	D	
6132.74 8	1^+@	D	
6134.98 8		D	
6139.22 8		D	
6149.14 8		D	
6153.15 9	2^+@	D	
6158.07 8		D	
6161.56 9		D	
6161.82 9		D	
6172.83 8		D	
6172.96 10		D	
6191.85 11		D	
6198.57 11	(2^+)@	D	
6203.20 10		D	
6219.60 10		D	
6229.84 10		D	
6230.09 10		D	
6232.3 6		D	
6232.7 7		D	
6239.7 8		D	
6240.6 8		D	
6247.82 12		D	
6248.42 12		D	
6254.01 13		D	
6254.61 14		D	
6261.29 13		D	
6268.49 13		D	
6269.97 13		D	
6270.78 13		D	
6272.39 13		D	
6279.95 13		D	
6280.82 13		D	
6283.00 14		D	
6283.06 14		D	
6289.96 14		D	
6293.56 14		D	
6293.98 14		D	
6310.78 15		D	
6315.50 15		D	
6316.40 15		D	
6319.83 15		D	
6320.79 15		D	
6321.78 15		D	
6323.21 15		D	
8216 25	0^+	H	T=3 Jπ: L(p,^{3}He)=0, IAS of ^{38}S g.s.

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Adopted Levels, Gammas (continued)

^{38}Cl Levels (continued)

† Additional information 7.
‡ From a least-squares fit to γ-ray energies for levels connected with γ rays and from (d,p) for the rest, unless otherwise noted.
# L(d,p)=1 from $3/2^+$ gives $0^-,1^-,2^-,3^-$. Additional arguments, if required, are given under comments.
@ From ^{37}Cl(n,γ),(n,n):resonances.
& From DSAM in (d,pγ), unless otherwise noted.

γ(^{38}Cl)

E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f	Mult.	α#	Comments
671.365	5^-	671.360 *8*	100	0	2^-	M3	6.01×10^{-4}	B(M3)(W.u.)=0.01185 *5* E_γ: other: 671.0 *10* in (d,pγ). Mult.: from α(exp) in IT decay.
755.431	3^-	755.425 *11*	100	0	2^-			E_γ: others: 755.30 *12* from (d,pγ), 754.6 *3* from (^{36}S,Xγ), 755.0 *3* from (^{40}Ar,Xγ).
1309.051	4^-	553.605 *26*	23.5 *18*	755.431	3^-			E_γ: others: 553.59 *14* from (d,pγ), 554.3 *6* from (^{36}S,Xγ), 553.6 *6* from (^{40}Ar,Xγ). I_γ: others: 24 *4* from (d,pγ), 28 *11* from (^{36}S,Xγ), 24 *4* from (^{40}Ar,Xγ).
		637.685 *15*	100.0 *18*	671.365	5^-			E_γ: others: 637.60 *7* from (d,pγ), 637.7 *5* from (^{36}S,Xγ), 638.0 *7* from (^{40}Ar,Xγ).
		1308.8 *4*	8.7 *18*	0	2^-	[E2]		B(E2)(W.u.)=3.5 *9* I_γ: other: 11 *4* from (d,pγ).
1617.414	3^-	308.362 *6*	100 *3*	1309.051	4^-			E_γ: others: 308.34 *6* from (d,pγ), 307.6 *5* from (^{36}S,Xγ), 308.4 *6* from (^{40}Ar,Xγ). I_γ: other: 100 *33* from (^{36}S,Xγ), 71 *14* from (^{40}Ar,Xγ).
		862.04 *4*	51 *4*	755.431	3^-			E_γ: others: 862.07 *13* from (d,pγ), 862.4 *7* from (^{36}S,Xγ), 862.0 *3* from (^{40}Ar,Xγ). I_γ: weighted average of 55 *6* from (n,pγ) E=thermal and 49 *4* from (d,pγ). Others: 61 *17* from (^{36}S,Xγ), 100 *29* from (^{40}Ar,Xγ).
		945.89 *20*	6.6 *17*	671.365	5^-	[E2]		B(E2)(W.u.)=2.2 *6*
		1617.12 *14*	37.2 *17*	0	2^-			E_γ: other: 1617.2 *7* from (d,pγ). I_γ: other: 41 *4* from (d,pγ).
1692.463	$(1,2)^-$	383.4@ *4*	<4	1309.051	4^-			E_γ: other: 383.5 *5* from (d,pγ). I_γ: <5 from (d,pγ).
		936.9 *3*	8.3 *14*	755.431	3^-			E_γ: weighted average of 936.8 *3* from (n,γ) E=thermal and 937.0 *5* from (d,pγ). E_γ: weighted average of 8.1 *14* from (n,γ) E=thermal and 8.7 *22* from (d,pγ).
		1692.04 *23*	100.0 *24*	0	2^-			E_γ: unweighted average of 1692.64 *8* from β^- decay, 1692.11 *14* from (n,γ) E=thermal, 1691.6 *4* from (d,pγ) and 1691.8 *7* from (^{40}Ar,Xγ).
1745.74	$0^-,1^-$	1745.74‡ *8*	100	0	2^-			E_γ: weighted average of 1745.77 *4* from ^{38}S β^- decay, 1745.31 *17* from (n,γ) E=thermal, 1745.3 *6* from (d,pγ). Other: 1746 *3* from (^{40}Ar,Xγ).
1784.97	$2^-,3^-,4^-$	1029.57 *15*	100	755.431	3^-			E_γ: others: 1029.6 *7* from (d,pγ), 1029.9 *5* from (^{36}S,Xγ), 1029.6 *9* from (^{40}Ar,Xγ).

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Adopted Levels, Gammas (continued)

$\gamma(^{38}Cl)$ (continued)

E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f	Mult.	Comments
1941.998	1^+	196.19	0.10 *3*	1745.74	$0^-,1^-$		E_γ: from level-energy difference.
		1941.945‡ *14*	100.0	0	2^-		E_γ: other: 1941.6 *3* from (n,γ) E=thermal, 1941.7 *2* from (d,pγ), 1942 *3* from (^{40}Ar,Xγ).
1981.193	$2^-,3^-$	288.729 *10*	24.2 *20*	1692.463	$(1,2)^-$		E_γ: other: 288.69 *6* from (d,pγ). I_γ: other: 38 *3* in (d,pγ).
		363.779 *4*	50.5 *20*	1617.414	3^-		E_γ: other: 363.92 *6* from (d,pγ). I_γ: other: 97 *6* in (d,pγ).
		1225.67 *11*	54.6 *20*	755.431	3^-		E_γ: other: 1226.0 *9* from (d,pγ). I_γ: other: 78 *6* from (d,pγ).
		1980.87 *17*	100.0 *20*	0	2^-		E_γ: other: 1980.7 *10* from (d,pγ).
2743.12	3^-	958.17 *17*	75 *8*	1784.97	$2^-,3^-,4^-$		E_γ: weighted average of 958.20 *17* from (n,γ) E=thermal and 957.9 *5* from (d,pγ). I_γ: weighted average of 77 *8* from (n,γ) E=thermal and 73 *9* in (d,pγ).
		1125.7 *2*	38 *6*	1617.414	3^-		E_γ: weighted average of 1125.7 *2* from (n,γ) E=thermal and 1126.2 *9* from (d,pγ). I_γ: weighted average of 42 *8* from (n,γ) E=thermal and 36 *6* in (d,pγ).
		1433.98 *16*	100 *8*	1309.051	4^-		E_γ: weighted average of 1433.98 *16* from (n,γ) E=thermal and 1434.2 *11* from (d,pγ).
		1987.4 *4*	21 *6*	755.431	3^-		E_γ: weighted average of 1987.5 *3* from (n,γ) E=thermal and 1986.4 *8* from (d,pγ). I_γ: weighted average of 27 *8* from (n,γ) E=thermal and 18 *6* in (d,pγ).
		2743.3 *5*	66 *9*	0	2^-		E_γ: weighted average of 2743.1 *5* from (n,γ) E=thermal and 2743.5 *5* from (d,pγ). I_γ: weighted average of 58 *8* from (n,γ) E=thermal and 76 *9* in (d,pγ).
2751.09	1^+	2750.98‡ *7*	100	0	2^-		
2895.2	$0^-,1^-,2^-,3^-$	2895.1 *5*	100	0	2^-		
3349.3	(7^+)	2039.8 *3*	31 *11*	1309.051	4^-	[E3]	E_γ,I_γ: from (^{36}S,Xγ).
		2677.7 *7*	100 *19*	671.365	5^-	[M2+E3]	E_γ,I_γ: from (^{36}S,Xγ).
3538.4	$0^-,1^-,2^-,3^-$	3538.2 *6*	100	0	2^-		
3565.8	$0^-,1^-,2^-,3^-$	1818.7 *9*	≈22	1745.74	$0^-,1^-$		
		3566.2 *10*	100 *22*	0	2^-		
3639.6	(5,6)	290.2 *2*	81 *27*	3349.3	(7^+)		E_γ,I_γ: from (^{36}S,Xγ).
		2968.1 *5*	100 *22*	671.365	5^-		E_γ,I_γ: from (^{36}S,Xγ).
3685.2	$0^-,1^-,2^-,3^-$	1992.8 *5*	<76	1692.463	$(1,2)^-$		
		3683.7 *18*	100 *10*	0	2^-		
3756.8	$0^-,1^-,2^-,3^-$	1971.8 *6*	100	1784.97	$2^-,3^-,4^-$		
3809.3	(4,5,6)	169.6 *2*	71 *15*	3639.6	(5,6)		E_γ,I_γ: from (^{36}S,Xγ).
		3138.4 *6*	100 *24*	671.365	5^-		E_γ,I_γ: from (^{36}S,Xγ).
3822.6	$(1,2,3)^-$	2205.1 *4*	100	1617.414	3^-		
3862.6	$(1,2,3)^-$	2245.1 *5*	100	1617.414	3^-		
3893.56	$(1,2,3)^-$	1912.25 *20*	44 *9*	1981.193	$2^-,3^-$		
		2201.0 *4*	17 *9*	1692.463	$(1,2)^-$		
		2276.3 *3*	22 *9*	1617.414	3^-		
		3137.9 *4*	100 *9*	755.431	3^-		
		3892.8 *20*	61 *30*	0	2^-		
3974.7	$0^-,1^-,2^-,3^-$	3974.5 *6*	100	0	2^-		

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Adopted Levels, Gammas (continued)

$\gamma(^{38}Cl)$ (continued)

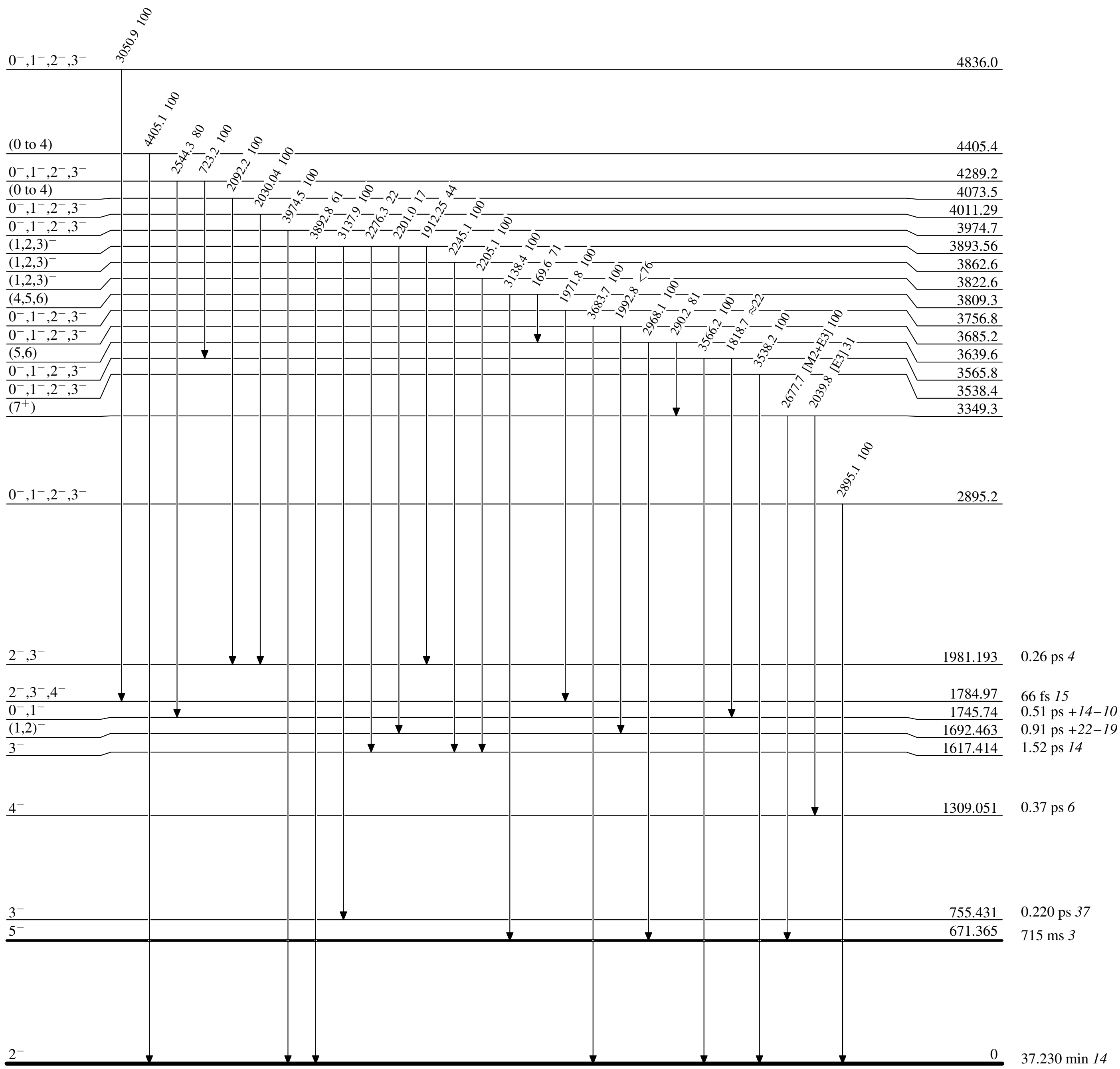
E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f
4011.29	$0^-,1^-,2^-,3^-$	2030.04 *20*	100	1981.193	$2^-,3^-$
4073.5	(0 to 4)	2092.2 *6*	100	1981.193	$2^-,3^-$
4289.2	$0^-,1^-,2^-,3^-$	723.2 *3*	100 *40*	3565.8	$0^-,1^-,2^-,3^-$
		2544.3 *10*	80 *40*	1745.74	$0^-,1^-$
4405.4	(0 to 4)	4405.1 *10*	100	0	2^-
4836.0	$0^-,1^-,2^-,3^-$	3050.9 *20*	100	1784.97	$2^-,3^-,4^-$

[†] From (n,γ) E=thermal, unless otherwise noted.
[‡] From β^- decay.
[#] 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.
[@] Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



$^{38}_{17}Cl_{21}$

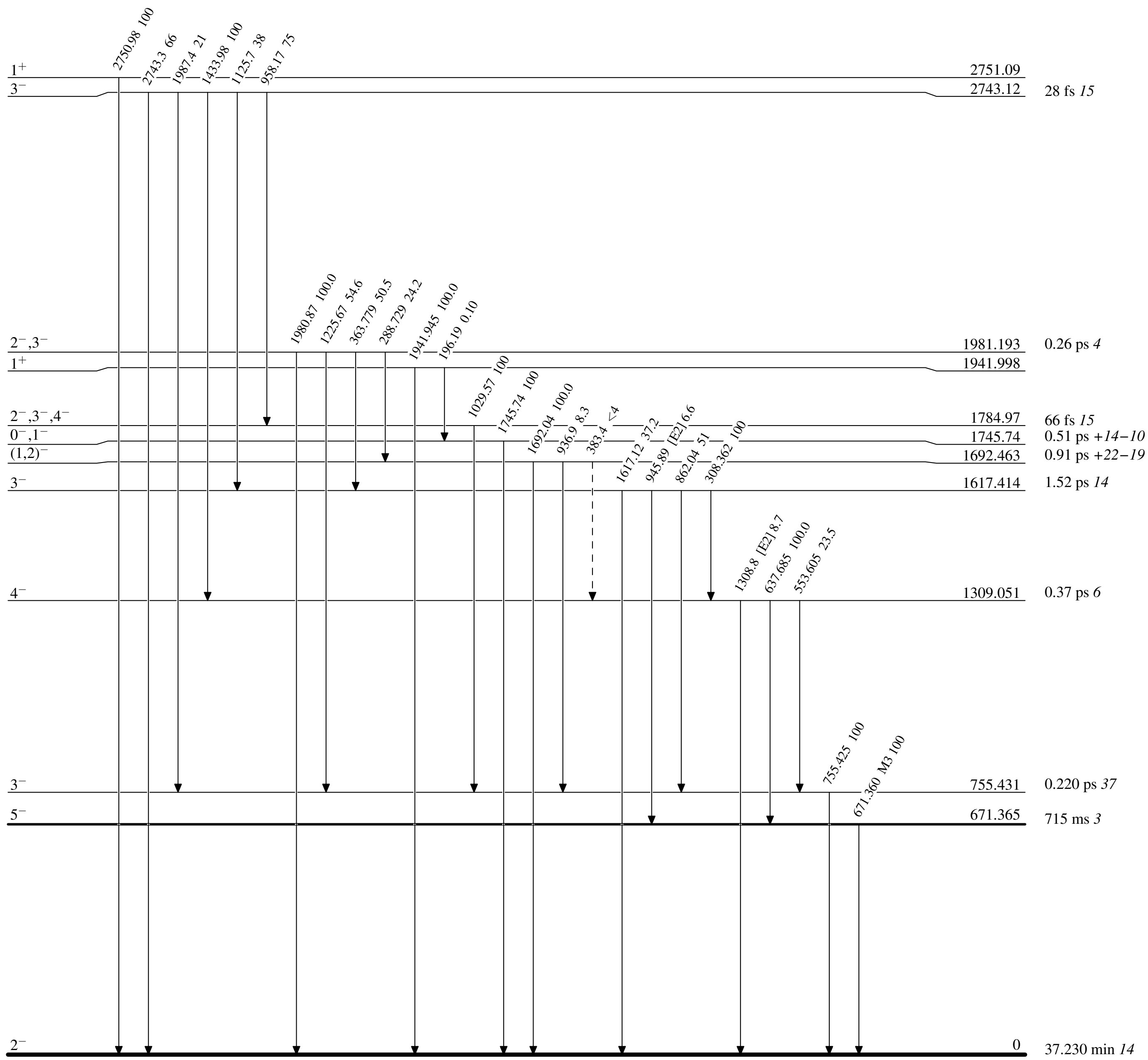
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level

Legend

γ Decay (Uncertain)



$^{38}_{17}Cl_{21}$