Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 199,1 (2025)	30-Sep-2024

Q(β^-)=−11619.0 *6*; S(n)=15740.0 *7*; S(p)=2276.8 *4*; Q(α)=−6475.4 *5* 2021Wa16
S(2n)=30111 *3*, S(2p)=11140.7 *4*, Q(ε)=5582.5 *4* (2021Wa16).
^{33}Cl first identified and produced in ^{32}S(d,n) reaction at 8 MeV bombarding energy (1940Ho01).
Mass measurement: 2011Tu09, 2003Bl17.
Theoretical calculations:
2023Se01: calculated ft value of β decay and magnetic moment.
2008Pe13: calculated magnetic moment, β-decay half-life, gyromagnetic ratio.
1974Wi04: calculated $\sigma(\theta)$ and spectroscopic factors of two-nucleon transfer.
1970Ba14: calculated levels, J, π, B(E2), B(M1), magnetic and quadrupole moments using vibration-particle coupling model.

^{33}Cl Levels

Cross Reference (XREF) Flags

A	^{33}Ar ε decay (174.3 ms)	E	^{32}S(p,p),(pol p,p):res	I	^{35}Cl(p,t)
B	^{35}Ca ε2p decay (25.7 ms)	F	^{32}S(d,n)	J	^{36}Ar(p,α)
C	^{2}H(^{32}S,nγ)	G	^{32}S(^{3}He,d)		
D	^{32}S(p,γ):res	H	^{32}S(^{3}He,dγ)		

E(level)†	J$^\pi$	T$_{1/2}$ or Γ‡	XREF	Comments
0.0	3/2$^+$	2.5059 s *23*	ABCD FGHIJ	%ε+%β^+=100 μ=+0.7547 *3* (2004Ma98,2019StZV) J$^\pi$: L(p,t)=0 from 3/2$^+$; L(^{3}He,d)=L(d,n)=2 from 0$^+$. T$_{1/2}$: weighted average of 2.5038 s *22* (2015Gr14), 2.507 s *8* (1977Az01), 2.513 s *4* (1973Ta04), 2.52 s *14* (1972Es02), 2.47 s *2* (1970Sc16), 2.51 s *2* (1960Ja12), and 2.53 s *2* (1958Mu05). Others: 2.8 s (1940Ho01), 2.4 s *2* (1941Wh02), 2.8 s (1948Sc20), 1.8 *1* (1951Bo56), 1.7 s (1954Ty33), 2.9 s *1* (1960Wa04), 1962Va27, 2.5 s *5* (1970Ba65). μ: from β-NMR method (2004Ma98).
810.57 *15*	1/2$^+$	1.25 ps *24*	A CD FGHIJ	Γ$_\gamma$=3.7×10^{-4} eV *6* J$^\pi$: L(^{3}He,d)=L(d,n)=0 from 0$^+$. T$_{1/2}$: from DSAM in ^{2}H(^{32}S,nγ). Other: >0.17 ps by DSAM in (p,γ):res.
1986.6 *4*	5/2$^+$	53 fs *12*	D FG IJ	Γ$_\gamma$=0.011 eV *3* J$^\pi$: spin from $\gamma\gamma(\theta)$ in (p,γ):res; parity=+ from L(p,t)=2 from 0$^+$.
2352.02 *26*	3/2$^+$	69 fs *21*	A D FG IJ	Γ$_\gamma$=0.007 eV *2* J$^\pi$: spin from $\gamma(\theta)$ in (p,γ); parity from 1541.5γ M1+E2 to 1/2$^+$.
2685.6 *4*	(5/2)$^-$	9 ps *+15−4*	D FG	Γ=5.0×10^{-5} eV *31*; Γ$_\gamma$=1.4×10^{-5} eV *6* (2J+1)Γ$_\gamma$Γ$_p$/Γ=9×10^{-5} eV *4* (1976Al01). J$^\pi$: L(d,n)=L(^{3}He,d)=3 from 0$^+$; 2685.5γ to 3/2$^-$; possible 1874.8γ to 1/2$^+$. But 7/2$^-$ from theoretical predictions (1976Al01) cannot be ruled out. T$_{1/2}$: deduced by the evaluators from Γ=5.0×10^{-5} eV *31* determined based on Γ$_\gamma$=1.4×10^{-5} eV *6* and Γ$_\gamma$/Γ=0.22 *8* in (p,γ):res (1976Al01).
2839.13 *30*	5/2$^+$	3 fs *1*	D	Γ$_\gamma$=0.14 eV *5* (2J+1)Γ$_\gamma$Γ$_p$/Γ=0.08 eV *1* (1976Al01). J$^\pi$: from $\gamma(\theta)$ and γ(lin pol) in (p,γ):res.
2846.43 *30*	3/2$^-$	≤0.7 fs	D FG	Γ$_\gamma$=0.07 eV *2* (2J+1)Γ$_\gamma$Γ$_p$/Γ=0.21 eV *3* (1976Al01). J$^\pi$: spin from $\gamma(\theta)$ and parity from γ(lin pol) in (p,γ):res; also L(d,n)=L(^{3}He,d)=1 from 0$^+$.

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Adopted Levels, Gammas (continued)

^{33}Cl Levels (continued)

E(level)[†]	J^π	$T_{1/2}$ or Γ[‡]	XREF	Comments
2975.54 *30*	7/2$^+$	60 fs *14*	D G I	Γ_γ=7.7×10^{-3} eV *18* XREF: I(2950). J^π: spin from $\gamma(\theta)$ in (p,γ):res and parity from L(p,t)=2 from 3/2$^+$.
3816.34 *30*	5/2$^+$		D	Γ_γ>8.8×10^{-3} eV (2J+1)$\Gamma_\gamma\Gamma_p/\Gamma$=0.053 eV *7* (1976Al01). J^π: spin from $\gamma(\theta)$ in (p,γ):res; parity from 1464.4γ M1+E2 to 3/2$^+$. Additional information 1.
3971.16 *20*	3/2$^+$	≤0.3 keV	A D I	Γ_γ=0.23 eV *4* XREF: I(3990). (2J+1)$\Gamma_\gamma\Gamma_p/\Gamma$=0.03 eV *2* (1976Al01). J^π: spin from $\gamma(\theta)$ and $\gamma\gamma(\theta)$ in (p,γ); parity from 3970.9γ M1+E2 to 1/2$^+$. Γ: from 2006Tr10 in (p,γ):res. Others: 0.6 keV (1968Li07), 5 keV *3* (1976Al01).
3979.06 *20*	5/2$^-$	<0.6 keV	D	J^π: spin from $\gamma(\theta)$ in (p,γ):res; parity from 1132.6γ M1+E2 to 3/2$^-$. (2J+1)$\Gamma_\gamma\Gamma_p/\Gamma$=0.38 keV *4* in (p,γ):res (1976Al01).
4099.5 *11*	(1/2$^+$,3/2,5/2$^+$)		D	Additional information 2. E(level): from E_p in (p,γ):res. J^π: 2113γ to 5/2$^+$, 3289γ to 1/2$^+$. (2J+1)$\Gamma_\gamma\Gamma_p/\Gamma$=0.019 eV *8*.
4112.28 *20*	3/2$^+$	≤0.6 keV	A D	J^π: spin from $\gamma\gamma(\theta)$ in (p,γ):res; parity from 3301.4γ M1+E2 to 1/2$^+$. Γ: other: <3 keV from ^{33}Ar ε+β$^+$ decay. (2J+1)$\Gamma_\gamma\Gamma_p/\Gamma$=0.07 eV *2* (1976Al01).
4118 *2*	3/2$^-$[#]	9.3 keV *15*	DEFG	XREF: F(4130). Additional information 3. E(level): from E_p in (p,γ):res. J^π: also supported by L(d,n)=L(^{3}He,d)=1 from 0$^+$. Γ: weighted average of 14 keV *4* (1976Al01) and 10 keV *3* (1992Il01) in (p,γ):res and 8.5 keV *15* (1958Ol16) in (p,p):res. (2J+1)$\Gamma_\gamma\Gamma_p/\Gamma$=0.19 eV *7* (1976Al01).
4439.02 *20*	1/2$^+$	2 keV *1*	A D g	XREF: g(4450). J^π: spin=1/2,3/2 from $\gamma(\theta)$ in (p,γ):res; parity from allowed ε+β$^+$ feeding (log *ft*=4.81 *5*) from 1/2$^+$ parent; 1/2 from (p,p) in a private communication by the evaluator of 1978En02 in 1977 with V. Meyer, one of the authors of the later publications of 1980Wa28 and 1983Wa28. Γ: from ^{33}Ar ε+β$^+$ decay and (p,γ):res. (2J+1)$\Gamma_\gamma\Gamma_p/\Gamma$=0.30 eV *4* (1976Al01).
4464.4 *4*	3/2$^+$	<2[@] keV	A D g	XREF: g(4450). J^π: spin from $\gamma(\theta)$ in (p,γ):res: parity from allowed ε+β$^+$ feeding (log *ft*=5.638 *8*) from 1/2$^+$ parent. (2J+1)$\Gamma_\gamma\Gamma_p/\Gamma$=0.14 eV *2* (1976Al01).
4516 *4*	1/2$^-$[#]	55[#] keV *5*	EF	XREF: F(4550).
4746.8 *15*	5/2$^+$	<2.3 fs	D	Additional information 4. E(level): from E_p in (p,γ):res. J^π: spin=5/2 from $\gamma(\theta)$ in 1970PrZW; M2 for 3936γ to 1/2$^+$ ruled out by RUL and $T_{1/2}$<2.3 fs. $T_{1/2}$: deduced by the evaluators from Γ>0.2 eV based on (2J+1)$\Gamma_\gamma\Gamma_p/\Gamma$=1.4 eV *2* (1976Al01).

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Adopted Levels, Gammas (continued)

^{33}Cl Levels (continued)

E(level)†	J^π	$T_{1/2}$ or Γ‡	XREF	Comments
4777 *3*	7/2$^-$	0.25# keV *5*	DEFG	XREF: F(4790). Additional information 5. E(level): from E_p in (p,γ):res and (p,p):res. J^π: 1930γ E2 to 3/2$^-$; L(^{3}He,d)=3 from 0$^+$. 7/2$^-$ also from R-matrix analysis of σ(θ) data in (p,p):res. (2J+1)$\Gamma_\gamma\Gamma_p/\Gamma$=0.093 eV *19* (1976Al01).
4835 *2*	3/2$^+$	<2@ keV	A D	Additional information 6. E(level): from ^{33}Ar ε+β$^+$ decay. J^π: spin=3/2 from γ(θ) in (p,γ):res; parity from allowed ε+β$^+$ feeding (log *ft*=5.509 *8*) from 1/2$^+$ parent.
5002 *2*	3/2$^-$#	6.0# keV *20*	DE	Additional information 7. E(level): from E_p in (p,p):res. Other: 5002 in (p,γ):res.
5090 *2*	7/2$^-$#	≤0.5# keV	DE G	Additional information 8. E(level): from E_p in (p,p):res. Other: 5090 *20* from (^{3}He,d).
5106 *2*	3/2$^+$#	1.5# keV *5*	A DE	Additional information 9. E(level): from ^{33}Ar ε+β$^+$ decay. Other: 5105 *2* from (p,p):res.
5117 *15*	1/2$^-$#	298# keV *31*	EF	XREF: F(5090). E(level): the evaluators consider 5090, 1/2$^-$ level in (d,n) the same level as 5117 *15* in (p,p):res.
5200 *50*			I	E(level): likely a multiplet (1971Vi02).
5276 *2*	5/2$^-$#	0.34# keV *6*	DEF	Additional information 10. E(level): from E_p in (p,p):res.
5300 *2*	(3/2)$^+$	<10@ keV	A	J^π: allowed ε+β$^+$ feeding (log *ft*=5.84 *6*) from 1/2$^+$ parent; 3/2 favored in barrier-penetration calculations (2010Ad03).
5374 *2*	5/2$^+$#	0.44# keV *8*	E	
5448 *1*	1/2$^+$#	30# keV *2*	E	
5548.4 *5*	1/2$^+$#	105# eV *9*	A DE i	T=3/2 XREF: i(5550). Γ: others: <2 keV in (p,γ):res, <0.8 keV in ^{33}Ar ε+β$^+$ decay. IAS of 1/2$^+$ g.s. in ^{33}Ar. (2J+1)$\Gamma_\gamma\Gamma_p/\Gamma$=0.76 eV *18* (1972Es02).
5555 *1*	7/2$^-$#	0.73# keV *13*	E G i	XREF: i(5550). E(level): from (p,p):res. Other: 5550 *30* from (^{3}He,d). J^π: also supported by L(^{3}He,d)=3 from 0$^+$.
5651 *10*	3/2$^-$#	100# keV *10*	a Ef	XREF: a(5669)f(5660). J^π,Γ: from R-matrix analysis of σ(θ) data in (p,p). Additional information 11.
5694 *9*			a D f	XREF: a(5669)f(5660). E(level): from E_p in (p,γ):res.
5734 *3*	1/2$^+$#	38 keV *5*	A E	E(level): weighted average of 5732 *3* from ^{33}Ar ε+β$^+$ decay and 5738 *5* from (p,p). Γ: weighted average of 30 keV *10* from ^{33}Ar ε+β$^+$ decay and 40 keV *5* from (p,p).
5867 *3*	1/2$^+$,3/2$^+$	1.4@ keV *5*	A	J^π: allowed ε+β$^+$ feeding (log *ft*=5.40 *7*) from 1/2$^+$ parent.
5879 *2*	5/2$^-$#	1.50# keV *30*	DEFG	E(level): from (p,p):res. Other: 5870 *20* from (^{3}He,d), 5890 from (d,n). Γ: other: 15 keV for E(level)=5879 *9* from (p,γ):res, the large width could indicate a composite peak.
6149 *3*	5/2$^+$#	0.40# keV *10*	A DE	XREF: A(6118?). E(level): weighted average of 6142 *9* from (p,γ):res and 6150 *3* from

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Adopted Levels, Gammas (continued)

^{33}Cl Levels (continued)

E(level)†	J$^{\pi}$	T$_{1/2}$ or Γ‡	XREF	Comments
				(p,p). Γ: other: 13 keV from (p,γ):res, the large width could indicate a composite peak.
6192 *3*	3/2^{-}#	1.0# keV *2*	dE	XREF: d(6198). E(level): 6198 *6* from (p,γ):res could be a doublet of 6192 *3* and 6203 *3* in (p,p):res. Γ: other: <10 keV for E(level)=6198 *6* in (p,γ):res.
6203 *3*	3/2^{+}#	5.0# keV *5*	dE	XREF: d(6198).
6247 *5*	(3/2^{-})#	6.5# keV *15*	dE	XREF: d(6253). E(level): 6253 *6* from (p,γ):res could be a doublet of 6247 *5* and 6256 *5* in (p,p):res. Γ: other: <6 keV for E(level)=6253 *6* in (p,γ):res.
6255 *2*	1/2^{+}	2@ keV *1*	A dE	XREF: d(6253). E(level): from ^{33}Ar ε+β^{+} decay. Other: 6256 *5* from (p,p). J$^{\pi}$: 1/2^{+},3/2^{+} from allowed ε+β^{+} feeding (log *ft*=4.589 *16*) from 1/2^{+} parent; (1/2^{+},7/2^{+}) from R-matrix analysis of σ(θ) data in (p,p):res. Γ: others: 6 keV *3* from (p,p):res; <6 keV for E(level)=6253 *6* in (p,γ):res.
6290 *3*	7/2^{-}#	4.0# keV *10*	EFG	XREF: G(6250). E(level): from (p,p):res. Others: 6290 from (d,n), 6250 *30* from (^{3}He,d). J$^{\pi}$: also supported by L(d,n)=(3) and L(^{3}He,d)=3 from 0^{+}.
6314 *2*	1/2,3/2		A D	XREF: D(6308). E(level): from ^{33}Ar ε+β^{+} decay. Other: 6308 *9* from (p,γ):res. J$^{\pi}$: ε+β^{+} feeding (log *ft*=6.28 *20*) from 1/2^{+} parent.
6392 *5*	3/2^{-}#	69# keV *7*	EF	XREF: F(6440).
6593 *5*	1/2,3/2		A G	XREF: G(6580). E(level): from ^{33}Ar ε+β^{+} decay. Other: 6580 *30* in (^{3}He,d). J$^{\pi}$: ε+β^{+} feeding (log *ft*=6.69 *7*) from 1/2^{+} parent. But L(^{3}He,d)=(3,4) suggests (5/2^{-},7/2,9/2^{+}).
6626 *3*	5/2^{+}#	5# keV *2*	dE	XREF: d(6629). E(level): 6629 *9* from (p,γ):res could be a doublet of 6626 *3* and and 6230 *5* in (p,p):res. Γ: other: 33 keV for E(level)=6629 *9* in (p,γ):res.
6630 *5*	(5/2)$^{-}$#	25# keV *3*	dEF	XREF: d(6629)F(6660). J$^{\pi}$: also supported by L(^{3}He,d)=(3) for a group at 6660.
6672 *9*			D	
6698 *3*	5/2^{+}#	5.5# keV *9*	E	
6850	3/2^{+}#	0.36# keV *15*	DEf	T=3/2 XREF: f(6840).
6855 *3*	3/2^{+},5/2^{+}#	30# keV *10*	DEf	XREF: f(6840). E(level): from (p,p):res. Other: 6855 *9* in (p,γ):res.
6901			D	
6920 *3*	5/2^{-}#	20# keV *2*	E	
6949 *2*	1/2$^{(+)}$,3/2$^{(+)}$		A D i	XREF: D(6938)i(6950). E(level): from ^{33}Ar ε+β^{+} decay. Other: 6938 *9* in (p,γ):res, 6050 *50* from (p,t). J$^{\pi}$: probable allowed ε+β^{+} feeding (log*ft*=5.94 *3*) from 1/2^{+} parent.
6983 *3*	3/2^{+}#	10# keV *1*	DE i	T=3/2 XREF: i(6950). E(level): from (p,p):res. Other: 6984 *9* in (p,γ):res.

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Adopted Levels, Gammas (continued)

^{33}Cl Levels (continued)

E(level)†	J^π	$T_{1/2}$ or Γ‡	XREF	Comments
6993 *3*	5/2$^-$#	7.0# keV *7*	EF	XREF: F(6970).
7094 *3*	5/2$^+$#	18# keV *2*	E	
7142 *5*	1/2,3/2		A	J^π: $\varepsilon+\beta^+$ feeding (log*ft*=7.14 *6*) from 1/2$^+$ parent.
7178 *8*	3/2$^-$#	13.0# keV *13*	E	
7211 *4*	5/2$^+$#	2.6# keV *5*	dE	XREF: d(7221).
7230 *40*	5/2$^-$,7/2$^-$		d G	XREF: d(7221). E(level): from (^{3}He,d). J^π: L(^{3}He,d)=3 from 0$^+$.
7265 *6*	3/2$^+$#	30# keV *3*	dE	XREF: d(7280).
7275 *4*	3/2$^-$#	20# keV *3*	dE	XREF: d(7280). E(level): 7280 *9* from (p,γ):res could be a doublet of 7264 *6* and and 7275 *4* in (p,p):res. Γ: other: 29 keV for E(level)=7280 *9* in (p,γ):res.
7289 *6*	(3/2)$^+$	10@ keV *5*	A	J^π: 1/2$^+$,3/2$^+$ from allowed $\varepsilon+\beta^+$ feeding (log *ft*=5.59 *8*) from 1/2$^+$ parent; 3/2 favored from barrier-penetration calculations (2010Ad03).
7301 *3*	9/2$^+$#	4.0# keV *4*	Ef	XREF: f(7330).
7323 *50*	7/2$^-$#	3.0# keV *3*	DEf i	XREF: D(7343)f(7330)i(7350). E(level): from (p,p):res. Others: 7343 *9* from (p,γ):res, 7350 *50* from (p,t). J^π: other: (9/2$^+$,7/2$^-$) for a group at 7330 in (d,n).
7392 *2*	5/2$^+$#	108# eV *7*	dE i	T=3/2 XREF: d(7397)i(7350). E(level): 7297 *9* from (p,γ):res could be a doublet of 7392 *2* and and 7399 *3* in (p,p):res. Γ: other: <2 keV for E(level)=7297 *9* in (p,p):res. (2J+1)$\Gamma_\gamma\Gamma_p/\Gamma$=1.50 eV *37* (1972Es02).
7399 *3*	5/2$^+$#	11.0# keV *11*	de i	XREF: d(7397)e(7399)i(7350).
7404 *10*	1/2,3/2		A	J^π: $\varepsilon+\beta^+$ feeding (log *ft*=6.73 *5*) from 1/2$^+$ parent.
7449 *4*	3/2$^-$#	35.0# keV *35*	dE	XREF: d(7463).
7471 *3*	7/2$^+$#	1.50# keV *15*	dE	XREF: d(7463).
7482 *2*	1/2$^+$	6.5@ keV *20*	A DE	E(level): from ^{33}Ar $\varepsilon+\beta^+$ decay. Others: 7486 *6* in (p,γ):res and 7482 *4* in (p,p):res. J^π: from R-matrix analysis of $\sigma(\theta)$ data in (p,p); allowed $\varepsilon+\beta^+$ feeding (log *ft*=4.35 *6*) from 1/2$^+$. Γ: others: <8 keV from (p,γ):res, 13.0 keV *13* from (p,p):res.
7490	(1/2$^-$,3/2$^-$)		F	E(level): probably the same level as 7482, but J^π is inconsistent. J^π: L(d,n)=(1) from 0$^+$.
7540 *4*	1/2$^+$,3/2$^+$	<4@ keV	A	J^π: allowed $\varepsilon+\beta^+$ feeding (log *ft*=4.94 *12*) from 1/2$^+$ parent.
7551 *2*	1/2$^+$,3/2$^+$	<10@ keV	A	J^π: allowed $\varepsilon+\beta^+$ feeding (log *ft*=5.19 *4*) from 1/2$^+$ parent.
7667 *4*	1/2$^+$,3/2$^+$	8@ keV *4*	A	J^π: allowed $\varepsilon+\beta^+$ feeding (log *ft*=5.10 *11*) from 1/2$^+$ parent.
7720	(5/2$^-$,7/2$^-$)		D F	XREF: D(7706). J^π: L(d,n)=(3) from 0$^+$.
7766 *5*	(1/2)$^+$	10@ keV *6*	A	J^π: allowed $\varepsilon+\beta^+$ feeding (log *ft*=5.32 *6*) from 1/2$^+$ parent; 1/2 favored from proton decay to 0$^+$ g.s. and 0$^+$ excited state, possible L(p)=0 transition.
7930	(5/2$^-$,7/2$^-$)		F	J^π: L(d,n)=(3) from 0$^+$.
8077 *3*	1/2$^+$,3/2$^+$	34@ keV *6*	A i	T=1/2+3/2 XREF: i(8100). J^π: allowed $\varepsilon+\beta^+$ feeding (log *ft*=4.10 *7*) from 1/2$^+$ parent.
8110	(5/2$^-$,7/2$^-$)		FG i	XREF: G(8150)i(8100).

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Adopted Levels, Gammas (continued)

^{33}Cl Levels (continued)

E(level)†	J^{π}	$T_{1/2}$ or Γ‡	XREF	Comments
				J^{π}: L(d,n)=L(^{3}He,d)=(3) from 0^+.
8130 *3*	$1/2^+,3/2^+$		A i	XREF: i(8100). J^{π}: allowed $\varepsilon+\beta^+$ feeding (log *ft*=5.34 *16*) from $1/2^+$ parent.
8183 *5*	$(1/2)^+$	22@ keV *6*	A	T=1/2+3/2 J^{π}: allowed $\varepsilon+\beta^+$ feeding (log *ft*=4.27 *12*) from $1/2^+$ parent; 1/2 favored in barrier-penetration calculations (2010Ad03).
8290	$(5/2^-,7/2^-)$		FG	XREF: G(8350). J^{π}: L(d,n)=L(^{3}He,d)=(3) from 0^+.
8316 *6*	$1/2^+,3/2^+$		A	J^{π}: allowed $\varepsilon+\beta^+$ feeding (log *ft*=4.91 *12*) from $1/2^+$ parent.
8490 *6*	$(1/2)^+$		A F	J^{π}: allowed $\varepsilon+\beta^+$ feeding (log *ft*=5.74 *6*) from $1/2^+$ parent; 1/2 favored from proton decay to 0^+ g.s. and 0^+ excited state, possible L(p)=0 transition. However, L(d,n)=(3) from 0^+ for a group at 8490 suggests $(5/2^-,7/2^-)$.
8558 *5*	$(3/2)^+$		A	J^{π}: allowed $\varepsilon+\beta^+$ feeding (log *ft*=4.57 *9*) from $1/2^+$ parent; 3/2 favored in barrier-penetration calculations (2010Ad03). Additional information 12.
8710 *50*	$5/2^-,7/2^-$		G	J^{π}: L(^{3He}He,d)=3 from 0^+.
8813 *8*	1/2,3/2		A	J^{π}: $\varepsilon+\beta^+$ feeding (log*ft*=6.04 *7*) from $1/2^+$ parent.
8849 *5*	$1/2^+,3/2^+$		A f	XREF: f(8860). J^{π}: allowed $\varepsilon+\beta^+$ feeding (log*ft*=4.65 *18*) from $1/2^+$ parent. But L(d,n)=(3) from 0^+ for a group at 8860 suggests $(5/2^-,7/2^-)$.
8864 *10*	1/2,3/2		A f	XREF: f(8860). J^{π}: $\varepsilon+\beta^+$ feeding (log *ft*=6.28 *13*) from $1/2^+$ parent. But L(d,n)=(3) from 0^+ for a group at 8860 suggests $(5/2^-,7/2^-)$.
8964 *8*	$(1/2)^+$		A	J^{π}: allowed $\varepsilon+\beta^+$ feeding (log *ft*=4.35 *11*) from $1/2^+$ parent; 1/2 favored in barrier-penetration calculations (2010Ad03).
9117 *6*	$(3/2)^+$		A	J^{π}: allowed $\varepsilon+\beta^+$ feeding (log *ft*=4.69 *5*) from $1/2^+$ parent; 3/2 favored in barrier-penetration calculations (2010Ad03).
9154 *6*	$(3/2)^+$		A	J^{π}: allowed $\varepsilon+\beta^+$ feeding (log *ft*=4.61 *5*) from $1/2^+$ parent; 3/2 favored in barrier-penetration calculations (2010Ad03).
9193 *9*	$1/2^+,3/2^+$		A	J^{π}: allowed $\varepsilon+\beta^+$ feeding (log *ft*=5.32 *5*) from $1/2^+$ parent.
9560	$(5/2^-,7/2^-)$		F	J^{π}: L(d,n)=(3) from 0^+.
9583 *6*	$1/2^+,3/2^+$		A	J^{π}: allowed $\varepsilon+\beta^+$ feeding (log *ft*=4.94 *11*) from $1/2^+$ parent.
9780	$(5/2^-,7/2^-)$		F	J^{π}: L(d,n)=(3) from 0^+.

† From a least-squares fit to Eγ values with ΔEγ up to 5548 level, from E_p in (p,γ):res or (p,p):res for levels up to 7471 level, and from ^{33}Ar $\varepsilon+\beta^+$ decay for levels above that, unless otherwise noted.

‡ Half-lives by DSAM and widths up to 4835 level are from (p,γ):res, widths for levels up to 7471 level are from (p,p):res, and widths for levels above that are from ^{33}Ar $\varepsilon+\beta^+$ decay, unless otherwise noted.

From analysis of $\sigma(\theta)$ data in (p,p):res using dispersion theory (up to 5448 level) or R-matrix theory (above 5448 level).

@ From the measured peak shape of delayed-proton and the calculated recoil broadening in ^{33}Ar $\varepsilon+\beta^+$ decay (1993Sc16).

$\gamma(^{33}Cl)$

Additional information 13.

E_i(level)	J_i^π	E_γ†	I_γ†	E_f	J_f^π	Mult.†	δ†	α‡	Comments
810.57	1/2+	810.57 *16*	100	0.0	3/2+	[M1]			B(M1)(W.u.)=0.0331 *+75−53* E_γ: weighted average of 810.6 *2* from ^{33}Ar $\varepsilon+\beta^+$ decay, 810.7 *3* from (p,γ):res, and 810.51 *16* from (^{3}He,dγ). Additional information 14.
1986.6	5/2+	1176.0#	<6	810.57	1/2+	[E2]		4.51×10^{-5} *6*	B(E2)(W.u.)<55 Additional information 15.
		1986.5 *4*	100	0.0	3/2+	M1+E2	+0.53 *6*	2.68×10^{-4} *5*	B(M1)(W.u.)=0.040 *+12−8*; B(E2)(W.u.)=11.7 *+41−29*
2352.02	3/2+	1541.5 *5*	100.0 *27*	810.57	1/2+	M1+E2	+0.44 *4*	9.99×10^{-5} *16*	B(M1)(W.u.)=0.054 *+23−13*; B(E2)(W.u.)=18.0 *+83−49* E_γ: from ^{33}Ar $\varepsilon+\beta^+$ decay. I_γ: other: 100 *9* from ^{33}Ar $\varepsilon+\beta^+$ decay.
		2351.9 *3*	35.1 *27*	0.0	3/2+	M1+E2	−1.3 *4*	4.62×10^{-4} *18*	B(M1)(W.u.)=0.0024 *+17−9*; B(E2)(W.u.)=3.0 *+13−11* E_γ: weighted average of 2352.4 *6* from ^{33}Ar $\varepsilon+\beta^+$ decay and 2351.8 *3* from (p,γ):res. I_γ: other: 35 *4* from ^{33}Ar $\varepsilon+\beta^+$ decay.
2685.6	(5/2)−	699.0	100 *16*	1986.6	5/2+	(E1)			B(E1)(W.u.)=1.41×10^{-4} *+72−92* Mult.: D(+Q) with δ=−0.0 *6* from $\gamma(\theta)$ in (p,γ):res; $\Delta\pi$=yes from level scheme; M2 ruled out by RUL.
		1875.0	≤14.5	810.57	1/2+				Additional information 16.
		2685.5 *4*	45 *9*	0.0	3/2+				
2839.13	5/2+	2028.49	1.0 *4*	810.57	1/2+	[E2]		3.41×10^{-4} *5*	B(E2)(W.u.)=8.6 *+58−37*
		2839.0 *3*	100.0 *4*	0.0	3/2+	M1+E2	−0.10 *2*	6.06×10^{-4} *9*	B(M1)(W.u.)=0.31 *+15−8*; B(E2)(W.u.)=1.6 *+11−6*
2846.43	3/2−	2035 *15*	100 *8*	810.57	1/2+	E1		6.74×10^{-4} *14*	B(E1)(W.u.)≥0.054 Mult.: from $\gamma(\theta)$ in 1958Va22 and γ(lin pol) in (p,γ):res (1959Su55).
		2846.3 *3*	85 *8*	0.0	3/2+	E1		1.17×10^{-3} *2*	B(E1)(W.u.)≥0.017 Mult.: from $\gamma(\theta)$ in 1958Va22 and γ(lin pol) in (p,γ):res (1959Su55).
2975.54	7/2+	988.9	18 *5*	1986.6	5/2+	M1+E2	+0.31 *3*		B(M1)(W.u.)=0.053 *+21−16*; B(E2)(W.u.)=21.2 *+96−71* Additional information 17.
		2975.4 *3*	100 *5*	0.0	3/2+	E2		7.77×10^{-4} *15*	B(E2)(W.u.)=5.4 *+21−14* Mult.: Q(+O) with δ=−0.09 *9* from $\gamma(\theta)$ in (p,γ):res; M2(+E3) and M3 component in E2+M3 ruled out by RUL.
3816.34	5/2+	840.8	18.6 *23*	2975.54	7/2+				
		977.2	28 *5*	2839.13	5/2+	M1+E2	+0.47 *16*		
		1464.3	100 *7*	2352.02	3/2+	M1+E2	+0.17 *4*	7.51×10^{-5} *11*	
		1829.7	49 *7*	1986.6	5/2+	M1+E2	−0.22 *3*	1.94×10^{-4} *3*	

$^{33}_{17}Cl_{16}$-7

$\gamma(^{33}Cl)$ (continued)

E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f	Mult.†	δ†	α‡	Comments
3816.34	5/2+	3005.62	7.0 *23*	810.57	1/2+				
		3816.1 *3*	30 *5*	0.0	3/2+	M1+E2	−2.5 *3*	1.09×10^{-3} *2*	
3971.16	3/2+	1132.0	16 *8*	2839.13	5/2+				
		1619.10	16 *4*	2352.02	3/2+				
		1984.5	32 *4*	1986.6	5/2+				
		3160.43	36 *4*	810.57	1/2+	(M1(+E2))	−0.00 *2*		Mult.: D(+Q) from $\gamma(\theta)$ in (p,γ):res; $\Delta\pi$=no from level scheme.
		3970.9 *2*	100 *6*	0.0	3/2+	M1+E2	+0.50 *4*	1.06×10^{-3} *2*	
3979.06	5/2−	1003.5	0.33 *22*	2975.54	7/2+				
		1132.6	2.4 *5*	2846.43	3/2−	M1+E2	−0.23 *8*		
		1139.9	1.33 *33*	2839.13	5/2+	(E1(+M2))	−0.03 *15*		Mult.: D(+Q) from $\gamma(\theta)$; $\Delta\pi$=yes from level scheme.
		1293.4	2.5 *5*	2685.6	(5/2)−	M1+E2	−0.9 *3*		δ: for J(2685)=5/2. Other: +0.25 *6* or +7 *2* for J=7/2.
		1992.4	3.9 *6*	1986.6	5/2+				
		3978.8 *2*	100.0 *11*	0.0	3/2+	(E1(+M2))	−0.01 *2*	1.68×10^{-3} *2*	Mult.: D(+Q) from $\gamma(\theta)$; $\Delta\pi$=yes from level scheme.
4099.5	(1/2+,3/2,5/2+)	1253.0	6.7 *17*	2846.43	3/2−				
		2112.8	100 *7*	1986.6	5/2+				
		3288.8	30 *5*	810.57	1/2+				
		4099.2	30.0 *33*	0.0	3/2+				
4112.28	3/2+	3301.53	100 *10*	810.57	1/2+	M1+E2	−0.10 *5*		
		4112.0 *2*	100 *10*	0.0	3/2+				
4118	3/2−	1272	1.5 *7*	2846.43	3/2−				
		3307	100 *6*	810.57	1/2+				
		4118	29 *6*	0.0	3/2+				
4439.02	1/2+	1592.6	1.4 *5*	2846.43	3/2−				
		2086.93	8.0 *11*	2352.02	3/2+				
		3628.24	4.6 *11*	810.57	1/2+				
		4438.7 *2*	100.0 *23*	0.0	3/2+				
4464.4	3/2+	2477.7	55 *6*	1986.6	5/2+				
		3653.6	57 *6*	810.57	1/2+				
		4464.1 *4*	100 *9*	0.0	3/2+				
4746.8	5/2+	1771.2	14.1 *26*	2975.54	7/2+				
		1907.6	1.3 *4*	2839.13	5/2+				
		2061.1	0.51 *26*	2685.6	(5/2)−				
		2394.7	2.1 *4*	2352.02	3/2+				
		2760.1	10.3 *26*	1986.6	5/2+				
		3936.0	0.8 *4*	810.57	1/2+	[E2]		1.15×10^{-3} *2*	B(E2)(W.u.)>0.12 Mult.: M2 ruled out by RUL and $T_{1/2}$<2.3 fs from Γ>0.2 eV of 4747 level deduced from $(2J+1)\Gamma_\gamma\Gamma_p/\Gamma$=1.4 eV *2*.
		4746.4	100.0 *26*	0.0	3/2+				
4777	7/2−	1801	<5.7	2975.54	7/2+				

$^{33}_{17}Cl_{16}$-8

$\gamma(^{33}Cl)$ (continued)

E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f	Mult.†	δ†	Comments
4777	7/2⁻	1931	17 *4*	2846.43	3/2⁻	E2		
		1938	100 *10*	2839.13	5/2⁺	(E1(+M2))	−0.02 *2*	Mult.: D(+Q) from $\gamma(\theta)$ in (p,γ):res; $\Delta\pi$=yes from level scheme.
		2091	72 *10*	2685.6	(5/2)⁻	M1+E2	+0.21 *4*	δ: for J(2685)=5/2. Other: −0.32 *4* for J(2685)=7/2.
		2790	<1.9	1986.6	5/2⁺			
4835	3/2⁺	2848	3.8	1986.6	5/2⁺			
		4024	21.3	810.57	1/2⁺			
		4835	100	0.0	3/2⁺			
5002	3/2⁻	2650	19.6	2352.02	3/2⁺			
		3015	8.7	1986.6	5/2⁺			
		4191	89	810.57	1/2⁺			
		5002	100	0.0	3/2⁺			
5090	7/2⁻	4279	41	810.57	1/2⁺	[E3]		
		5090	100	0.0	3/2⁺			
5106	3/2⁺	2754	9.3	2352.02	3/2⁺			
		4295	7	810.57	1/2⁺			
		5106	100	0.0	3/2⁺			
5276	5/2⁻	2924	22	2352.02	3/2⁺			
		3289	25	1986.6	5/2⁺			
		5276	100	0.0	3/2⁺			
5548.4	1/2⁺	4737.5 *5*	100 *2*	810.57	1/2⁺			E_γ: weighted average of 4734 *3* from ^{33}Ar $\varepsilon+\beta^+$ decay and 4737.6 *4* from (p,γ):res.
		5548.0 *20*	9.5 *20*	0.0	3/2⁺			

† From (p,γ):res, unless otherwise noted. Eγ values without uncertainties are deduced by the evaluators from level-energy differences. Mult and δ are from analysis of measured $\gamma(\theta)$ and/or $\gamma\gamma(\theta)$; magnetic or electric nature is determined based on RUL and measured $T_{1/2}$ or width where available.

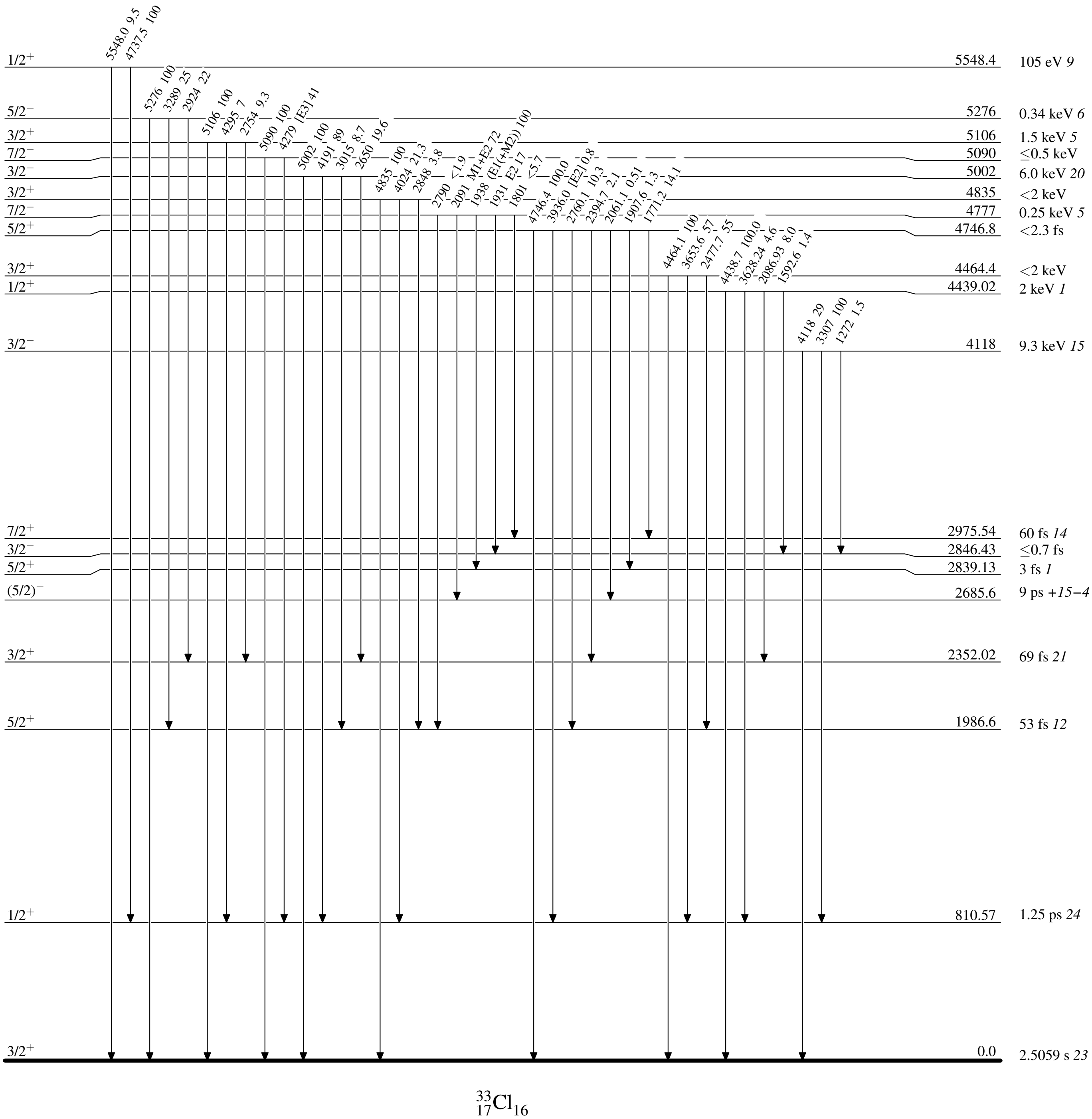
‡ Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

Placement of transition in the level scheme is uncertain.

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level