Adopted Levels

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 184, 29 (2022)	24-Jun-2022

Q(β^-)=−18360 *SY*; S(n)=19780 *24*; S(p)=264 *3*; Q(α)=−8800 *10* 2021Wa16
ΔQ(β^-)=200 (syst,2021Wa16).
S(2n)=37200 *190* (syst), S(2p)=4660 *3*, Q(εp)=5877 *3*, Q(ε)=12008 *3* (2021Wa16).
Mass measurement: 2016Ka15 (mass excess=−7034.7 keV *34*), 1977Be13 (−7070 keV *50*).
Other measurements:
1982Ay01: ^{31}Cl from ^{32}S(p,2n) E=33 MeV, Oslo cyclotron, ZnS target. Measured β-delayed proton spectra, γ-ray spectra.
2006Ka11: ^{31}Cl from ^{32}S(p,2n) E=40,45 MeV, IGISOL, ZnS target. Measured delayed proton energies E(p), Eγ, I(p), Iγ and pγ coin.
2011Fu11: ^{31}Cl from ^{9}Be(^{36}Ar,X) E=82 MeV/nucleon at RIBLL-HIRFL and incident on a carbon target. Measured longitudinal fragment momentum distribution of ^{30}S after one-proton removal from ^{31}Cl.
2011SaZM: ^{31}Cl produced in ^{32}S(p,2n) E=40 MeV/nucleon reaction and separated using MARS recoil spectrometer at Texas A&M University accelerator facility. Measured Eγ, Iγ, $\gamma\gamma$, Ep, Ip, half-life.
2016Ka15: mass excess of ^{31}Cl, produced in ^{32}S(p,2n), E=40 MeV, measured using JYFLTRAP double-Penning-trap mass spectrometer at the IGISOL facility. Analysis of IMME for T=3/2 quartet in A=31 nuclides.
Measured mass excess=−7034.7 keV *34* (2016Ka15). From this value, authors deduce S(p)(^{31}Cl)=264.6 keV *34* (value in 2021Wa16: AME-2020 is 264 keV *3*). The new value of S(p) combined with the β-delayed proton decay data for ^{31}Ar is used by 2016Ka15 to obtain revised values of level energies and proton resonances of ^{31}Cl. Authors analyze quadratic form of the isobaric multiplet mass equation (IMME) for T=3/2 quartet at A=31 (^{31}Cl, ^{31}S, ^{31}P and ^{31}Si), and find that the quadratic form of the IMME breaks down giving reduced χ^2=11.6, while a cubic equation fits with a non-zero cubic term d=−3.5 keV *11* or −4.3 keV 11 if energy of the IAS state in ^{31}S is used as 6279.0 keV *6* from 2016Be05. This value of IAS gives reduced χ^2 of 16.2 for a quadratic fit. The two lowest levels in ^{31}Cl are relevant to radiative resonant proton captures in the rp process.
2018Be12, 2016Be05, 2016Be19: ^{31}Cl from ^{9}Be(^{36}Ar,X) E=150 MeV/nucleon at NSCL. Measured Eγ, Iγ, $\beta\gamma$-coin. IMME analysis.
Theoretical calculations: 11 primary references for structure and two for decay characteristics retrieved from the NSR database (www.nndc.bnl.gov/nsr/) are listed under 'document records'.
Additional information 1.

^{31}Cl Levels

Cross Reference (XREF) Flags

A ^{31}Ar ε decay (15.0 ms)
B Pb(^{31}Cl,^{31}Cl′)

E(level)†	J$^\pi$	T$_{1/2}$	XREF	Comments
0	3/2$^+$	190 ms *1*	AB	%ε+%β^+=100; %εp=2.4 *2* %εp is deduced by the evaluators from ^{31}Cl to ^{31}S decay scheme based on γ and proton data from 2011SaZM. Other: %εp=0.65 *5* from 2006Ka11 is in disagreement. J$^\pi$: log *ft*=4.94 to 1249, 3/2$^+$ and log *ft*=4.44 to 2235, 5/2$^+$ levels in ^{31}S. Some evidence of β^+ feeding (log *ft*=5.5) to 8509, 1/2$^+$ level in ^{31}S. Also mirror state of ^{31}Si g.s., 3/2$^+$, and evidence of strong $\varepsilon+\beta^+$ feeding of 6280, 3/2$^+$ (lowest T=3/2 state) in ^{31}S which is identified as the IAS of the ^{31}Cl g.s. T$_{1/2}$: from mass-separated ^{31}Cl and 17 different runs (2011SaZM). Other: 150 ms *+25−20* (1982Ay01, yield ratios with different counting windows used). Dominant d-wave component for the valence proton in ^{31}Cl deduced from the measured momentum distribution and Glauber analysis in ^{12}C(^{31}Cl,^{30}S) reaction (2011Fu11).
737 *22*	(1/2$^+$)		AB	E(level): weighted average of 726 *16* (2016Ka15) and 782 *32* (2014La09). Other: 745 *16* (2009Wr03, IMME analysis).

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Adopted Levels (continued)

^{31}Cl Levels (continued)

E(level)[†]	Jπ	XREF	Comments
			E(level)=726 *16* from measured E(p)(lab)=446 keV *15* (E(p)(c.m.)=461 *15* (1998Ax02, from ^{31}Ar decay) and measured S(p)=264.6 *34* (2016Ka15). Others: 782 *32* (measured by 2014La09); 745 *16* from IMME analysis by 2009Wr03. Resonance energy E(p)=472 keV *14* as average of measured values of E(p)(lab)=446 *15* or E(p)(c.m.)=461 *15* (1998Ax02); and E(p)(c.m.)=517 *32* (from level energy=782 *32* in 2014La09 and S(p)=264.6 *34* from 2016Ka15). Evaluators obtain a weighted average of 471 *22* from the two values. E(level)=782 *32* (2014La09, from excitation spectrum in Pb(^{31}Cl,^{31}Cl′). First excited state of ^{31}Cl is expected to be $1/2^+$ at approximately 750 keV as a mirror state of ^{31}Si known at 752.23 keV. In 1998Ax02 a very weak proton group from ^{31}Ar decay was proposed at 446 *15* leading to excited state in ^{31}Cl at 740 *50*, but in their later paper 2000Fy01 this peak was not discussed and the low energy portion of the proton spectrum in 1998Ax02 was ascribed mostly to delayed two proton decay. Jπ: from shell-model predictions (2014La09), and mirror analogy to 752.23, $1/2^+$ level in ^{31}Si.
1728 *4*	$(5/2)^+$[‡]	AB	XREF: B(1793). E(level): from measured E(p)(lab)=1416 keV *2* or E(p)(c.m.)=1463 *2* (2000Fy01) and S(p)=264.6 *34* (2016Ka15). Others: 1793 *26* (measured by 2014La09); 1746 *7* from IMME analysis (2009Wr03); 1746 *5* from ε decay of ^{31}Ar, 1749 *5* (1998Ax02), 1820 (1992Ba01). Resonance energy E(p)=1464 keV *2*, as average of measured values of E(p)(lab)=1416 *2* or E(p)(c.m.)=1463 *2* (2000Fy01) and E(p)(c.m.)= 1528 *26* (from level energy=1793 *26* in 2014La09 and S(p)=264.6 *34* from 2016Ka15). Evaluators obtain a weighted average of 1463 *5* from the two values. Jπ: $(5/2^+)$ from shell-model predictions (2014La09).
2418 *4*	$(3/2,5/2,7/2)^+$[‡]	A	
2593 *4*	$(3/2,5/2,7/2)$[#]	A	
2669 *5*	$(3/2,5/2,7/2)^+$[‡]	A	
3622 *5*	$(3/2,5/2,7/2)$[#]	A	
4020 *4*	$(3/2,5/2,7/2)^+$[‡]	A	
5365 *4*	$(3/2,5/2,7/2)^+$[‡]	A	
5598 *4*	$(3/2,5/2,7/2)^+$[‡]	A	
5731 *7*	$(3/2,5/2,7/2)^+$[‡]	A	
6512 *4*	$(3/2,5/2,7/2)^+$[‡]	A	
6640 *7*	$(5/2,7/2)^+$[@]	A	
6825 *14*	$(3/2,5/2,7/2)$[#]	A	
7361 *3*	$(3/2,5/2,7/2)^+$[‡]	A	
7465 *9*	$(3/2,5/2,7/2)^+$[‡]	A	
7576 *10*	$(3/2,5/2,7/2)$[#]	A	
7919 *8*	$(3/2)^+$[@]	A	
9416 *5*	$(3/2,5/2,7/2)^+$[‡]	A	
12282 *7*	$5/2^+$	A	E(level),Jπ: log *ft*=3.01 from $5/2^+$; IAS of $5/2^+$ g.s. of ^{31}Ar.
12521 *30*	$(3/2,5/2,7/2)^+$[‡]	A	

[†] From ^{31}Ar ε decay, unless otherwise noted.
[‡] $(3/2,5/2,7/2)^+$ from log *ft*<5.9 from $5/2^+$.
[#] From log *ft*>5.9, log $f^{1u}t$<8.5 from $5/2^+$.
[@] From 2014Ko17 in ^{31}Ar ε decay based on pp(θ) analysis.