Adopted Levels, Gammas

History

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

Q(β^-)=7998.3 *22*; S(n)=7157.9 *30*; S(p)=13358.3 *26*; Q(α)=−11858 *4* 2021Wa16
S(2n)=12885.6 *23*, S(2p)=32209 *8*, Q(β^-n)=1410.9 *22* (2021Wa16).

This nucleus is at the edge of a small set of nuclei belonging to the "island of inversion" where the ground state is deformed from a spherical shell, investigations in 2005Ma86 show that it does not fall within this group.

Mass measurements: 2015Kw01.

Other measurements:

2021He04: measured hyperfine spectra using the COLLAPS collinear laser spectroscopy beam line at ISOLDE-CERN. Deduced magnetic dipole and electric quadrupole moments.

2016He09: measured β-detected nuclear quadrupole resonance (β-NQR) spectra using the β-NRM/NQR setup at LISE-GANIL. Deduced electric quadrupole moment.

2012Kw02: production cross section measurement in fragmentation of ^{40}Ar beam at 140 MeV/nucleon with ^{9}Be, Ni and ^{181}Ta targets by time-of-flight and energy loss measurements at NSCL facility.

2012Zh06: ^{9}Be(^{40}Ar,X) E=57 MeV/nucleon, measured fragment yield, momentum distributions at HIRFL facility; deduced target dependence on production cross section.

2009De25: measured electric quadrupole moment using β-NQR method with fragmentation-induced spin-polarized beam at LISE-GANIL facility.

Theoretical calculations: 24 primary references for structure and three for decay characteristics retrieved from the NSR database (www.nndc.bnl.gov/nsr/) are listed under 'document records'.

Additional information 1.

^{31}Al Levels

Cross Reference (XREF) Flags

A	^{31}Mg β^- decay (270 ms)	D	^{15}N(^{18}O,2p)
B	^{32}Mg β^-n decay (80.4 ms)	E	^{30}Si(^{18}O,^{17}F)
C	^{1}H(^{30}Mg,P):IAR		

E(level)†	Jπ	$T_{1/2}$‡	XREF	Comments
0.0	5/2(+)	644 ms *25*	AB DE	%β^-=100; %β^-n<1.6 (2008ReZZ,1995ReZZ) μ=+3.827 *5* (2021He04,2007Ue02,2006Hi18) Q=+0.1340 *16* (2009De25,2021He04) Jπ: spin from agreement of measured g-factor=1.517 *20* with free-nucleon g-factor=1.524 from shell-model calculations. In contrast theoretical g factor=0.804 for another low-lying predicted state 3/2$^+$. Parity is from shell-model predictions giving 5/2$^+$ and 3/2$^+$ as the lowest states. $T_{1/2}$ from timing of $\beta\gamma$-coin measurement (1973Go22), with an additional 10 ms systematic uncertainty included. Other: 0.94 μs *43* (1982Mu08) in β decay; 646 ms *45* (2008ReZZ); 620 ms (1982MuZX). μ: weighted average of +3.822 *11* from collinear laser spectroscopy with ^{27}Al as reference (2021He04), 3.824 *8* (2007Ue02) and 3.830 *5* (2006Hi18) from β-NMR method following β decay of ^{31}Al. Other: 3.79 *5* (2002Bo22,2002Bo49,2001Ne03, level−mixing resonance on oriented nuclei). 2019StZV evaluation gives +3.832 *5*, based on value from 2006Hi18. Q: 0.1340 *16* from 2009Na03 using β^-−NQR method, and sign is from Q=+0.156 *14* measured by 2021He04 using collinear laser spectroscopy with ^{27}Al as reference. Others: 0.1365 *23* (2016He09, β-NQR); 0.112 *32* (2009Na03,2008Na28), same method used as in 2009De25 at RIKEN-RIPS facility. 2007Ka68 (from the same group as 2009Na03) gave a preliminary value of 0.104 *9*. 2021StZZ evaluation gives a value of 0.134 *2*, without sign, from 2009De25.

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Adopted Levels, Gammas (continued)

^{31}Al Levels (continued)

E(level)†	Jπ	T$_{1/2}$‡	XREF	Comments
				Measured (small) quadrupole moment of the ground state (2021He04,2016He09,2009De25,2009Na03) suggests that ^{31}Al lies outside the "island of inversion" with a dominant sd-shell configuration, and with a possible small admixture of 2p-2h neutron states.
				Reduced strong absorption radius r_o^2=1.03 fm^2 *5* (2006Kh08). Other: 1.16 fm^2 *7* (1997Ai02).
				Relative mean-square charge radius δ<r^2>(^{31}Al,^{27}Al)=+0.301 *16*(stat)*178*(syst), with an additional systematic uncertainty of 0.250 in the calculations of atomic field shift and mass shift factors (2021He04).
946.7 *4*	1/2$^{(+)}$,3/2		A E	Jπ: 946.7γ to 5/2$^{(+)}$; log *ft*=6.1 from 1/2$^+$.
1613.0 *3*	1/2$^+$,3/2$^+$#		A E	
2.09×10^3 *11*			D	E(level): from (^{18}O,2p).
2676 *28*			E	E(level): from (^{18}O,^{17}F).
3239.3 *5*	1/2$^+$,3/2$^+$#		A	
3433.3 *5*	1/2$^+$,3/2$^+$#		A	
3623.0 *6*	1/2$^+$,3/2$^+$#		A D	XREF: D(3700).
4143.3 *4*	1/2$^+$,3/2$^+$#		A	
4320 *90*			D	E(level): from (^{18}O,2p).
4563.7 *5*	1/2$^+$,3/2$^+$#		A	
4640.4 *11*	1/2$^+$,3/2$^+$#		A	Jπ: β feeding (log *ft*=5.8) from 1/2$^+$.
4809.2? *12*			A D	
5046.5 *14*	1/2$^+$,3/2$^+$#		A	
5149.7 *11*	1/2$^+$,3/2$^+$#		A E	XREF: E(5164).
5729 *24*			E	E(level): from (^{18}O,^{17}F).
6480 *35*			E	E(level): from (^{18}O,^{17}F).
15804 *5*	1/2$^+$@	15 keV *8*	C	
15867 *3*	3/2$^+$@	1.3 keV *13*	C	
16026 *4*	(3/2)$^-$@	109 keV *2*	C	

† From a least-squares fit to γ-ray energies for levels connected with γ transitions and from particle-transfer reactions for others, unless otherwise noted.
‡ Γ from R-matrix analysis in ^{1}H(^{30}Mg,p):IAR (2014Im02).
# Allowed β transitions (log *ft*=4.9-5.7) from 1/2$^+$ (^{31}Mg g.s.).
@ From R-matrix analysis in ^{1}H(^{30}Mg,p):IAR (2014Im02) and identification as IAR of states in ^{31}Mg.

γ(^{31}Al)

E$_i$(level)	J$_i^\pi$	Eγ†	Iγ†	E$_f$	J$_f^\pi$
946.7	1/2$^{(+)}$,3/2	946.7 *5*	100	0.0	5/2$^{(+)}$
1613.0	1/2$^+$,3/2$^+$	665.9 *7*	31.4 *20*	946.7	1/2$^{(+)}$,3/2
		1612.8 *4*	100	0.0	5/2$^{(+)}$
3239.3	1/2$^+$,3/2$^+$	1626.2 *5*	100.0 *27*	1613.0	1/2$^+$,3/2$^+$
		2291.7 *14*	1.7 *4*	946.7	1/2$^{(+)}$,3/2
3433.3	1/2$^+$,3/2$^+$	1820.0 *8*	100 *18*	1613.0	1/2$^+$,3/2$^+$
		2487.4 *12*	37 *6*	946.7	1/2$^{(+)}$,3/2
		3432.8 *8*	90 *24*	0.0	5/2$^{(+)}$

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Adopted Levels, Gammas (continued)

γ(^{31}Al) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π
3623.0	1/2$^+$,3/2$^+$	2675.8 *9*	42 *5*	946.7	1/2$^{(+)}$,3/2
		3623.0 *8*	100 *9*	0.0	5/2$^{(+)}$
4143.3	1/2$^+$,3/2$^+$	903.8 *8*	40 *6*	3239.3	1/2$^+$,3/2$^+$
		2529.7 *9*	70 *7*	1613.0	1/2$^+$,3/2$^+$
		3196.6 *10*	100 *11*	946.7	1/2$^{(+)}$,3/2
		4143.2 *6*	8.6 *31*	0.0	5/2$^{(+)}$
4563.7	1/2$^+$,3/2$^+$	2949.4 *10*	100 *10*	1613.0	1/2$^+$,3/2$^+$
		3617.7 *12*	33 *9*	946.7	1/2$^{(+)}$,3/2
		4563.5 *7*	14 *5*	0.0	5/2$^{(+)}$
4640.4	1/2$^+$,3/2$^+$	3693.0 *19*	100 *28*	946.7	1/2$^{(+)}$,3/2
		4640.3 *13*	22 *8*	0.0	5/2$^{(+)}$
4809.2?		4808.8[‡] *12*	100	0.0	5/2$^{(+)}$
5046.5	1/2$^+$,3/2$^+$	3433.3 *14*	100	1613.0	1/2$^+$,3/2$^+$
5149.7	1/2$^+$,3/2$^+$	4202.7 *10*	100	946.7	1/2$^{(+)}$,3/2

[†] From ^{31}Mg β^- decay.
[‡] Placement of transition in the level scheme is uncertain.

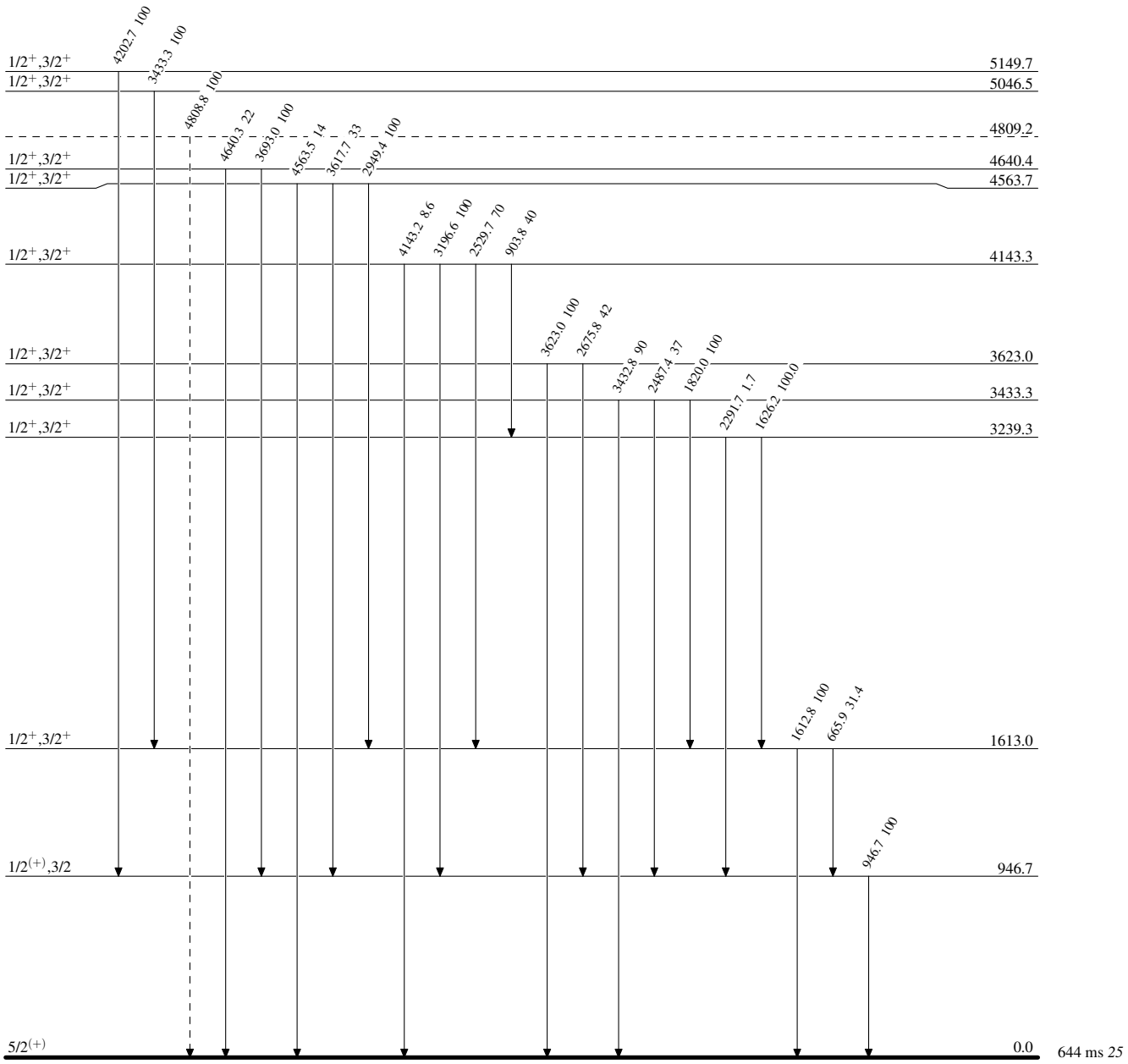
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

- - - - - - ► γ Decay (Uncertain)



$^{31}_{13}Al_{18}$