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^-)=1.882×10^4 *45*; S(n)=2.93×10^3 *45*; S(p)=20510 *syst*; Q(α)=−1.879×10^4 *69* 2021Wa16

ΔS(p)=680 (syst,2021Wa16).

S(2n)=4610 *450*, S(2p)=47640 *700* (syst), Q(β^-n)=16540 *450* (2021Wa16). Q(β^-2n)=10760 *450*, Q(β^-3n)=8450 *450*, Q(β^-4n)=2110 *450*, deduced by the evaluators from relevant masses in 2021Wa16.

1972Kl04: first identification and production of ^{32}Na nuclide in U(p,X) reaction at E=24 GeV, CERN-ISOLDE facility. Measured isotopic half-life. Later publications from the same laboratory dealing with spectroscopic measurements: 1978De39, 1984Gu19.

Mass measurements: 2012Ga45, 2007Ju03, 1991Or01.

Measurement of mean square radii using ^{33}Na beam: 2006Kh08.

Production and cross section measurements: 1979We10, 1991Or01, 1997Ha11, 1998NoZW (also 1998NoZZ,1999YoZW), 2002Ra16 (also 2004Co29).

Structure calculations:

2022Ot01: calculated nuclear moments.

2020Ts03,2014Ca21: calculated levels, J, π.

1994Po05: calculated levels, binding energies.

Additional information 1.

^{33}Ne is particle unstable thus does not decay by β^- to ^{33}Na. ^{34}Ne possibly decays by delayed-neutron decay to ^{33}Na but no details are known about this mode. The ^{35}Ne nuclide which could possibly decay by delayed-two neutron decay to ^{33}Na has not been identified.

This nuclide is of possible relevance to “island of inversion” near N=20.

^{33}Na Levels

Cross Reference (XREF) Flags

A ^{9}Be(^{38}Si,^{33}Naγ)
B ^{12}C(^{34}Na,^{33}Naγ)
C C(^{36}Mg,^{33}Naγ)

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$	XREF	Comments
0[#]	(3/2$^+$)	8.1 ms *3*	ABC	%β^-=100; %β^-n=47 *6* (2001Nu02,2002Ra16); %β^-2n=13 *3* (2001Nu02,2002Ra16) %β^-3n=?; %β^-4n=? Others: %β^-n=52 *20*, %β^-2n=12 *5* (1984Gu19); %β^-n+2(%β^-2n)=77 *15* (1984La03). Theoretical T$_{1/2}$=2.7 ms, %β^-n=63, %β^-2n=3, %β^-3n=0, %β^-4n=0 (2019Mo01). Theoretical T$_{1/2}$=11.8 ms, %β^-n=92.6, 93.9; %β^-2n=3.98, 3.56; %β^-3n=1.29, 1.07; %β^-4n=0 (2021Mi17, two values for different fission barriers). J$^\pi$: from systematics of odd Na nuclides and comparison with shell-model calculations, which predict 3/2$^+$ for g.s. and 5/2$^+$ for an almost degenerate state at 59 keV (2010Do05); 3/2$^+$ predicted by Monte-Carlo shell-model and conventional shell-model calculations in 2011Ga15, 2014Do05. T$_{1/2}$: weighted average of 8.0 ms *3* (2002Ra16, average of three measurements: 7.9 ms *4* (β timing), 8.0 ms *7* (neutron timing) and 8.1 ms *4* (γ timing), also 8.0 ms *3* in 2001Nu02); 8.0 ms *6* (1984La03); 8.2 ms *4* (1981ThZV, earlier value of 20 ms *15* in 1972Kl04 and 1974Ro31). Others: 8.5 ms *4* (1998NoZW, preliminary value); 6.3 ms *46* (1995ReZZ,2008ReZZ). Mean square radius=1.42 fm^2 *14* (2006Kh08 in Si(^{33}Na,X)) reaction at E=33.79 and 38.79 MeV/nucleon, also measured energy-integrated cross sections.
427[#] *5*	(5/2$^+$)		ABC	XREF: B(467). J$^\pi$: systematics of odd-A Na nuclides; 5/2$^+$ from shell-model predictions in 2011Ga15 and 2014Do05.
1115[#] *8*	(7/2$^+$)		A C	For a possible 1117-keV transition to the g.s., branching ratio is calculated as 4.2%

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{33}Na Levels (continued)

E(level)†	Jπ‡	XREF	Comments
			(2011Ga15), too weak to be seen in the work of 2011Ga15.
1875# *15*	(9/2+)	C	

† From Eγ data.
‡ From shell-Model calculations using the SPDF-M effective interaction (2014Do05, 2011Ga15), unless otherwise noted.
# Band(A): Possible $K^\pi=(3/2^+)$ band. $K^\pi=3/2^+$ rotational band predicted in shell-model calculations (2011Ga15, 2014Do05).

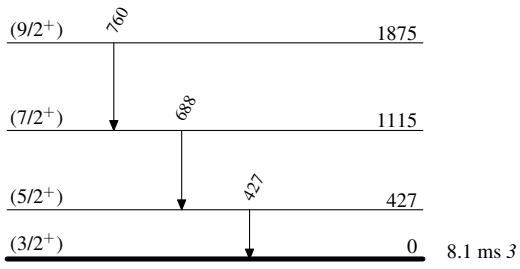
γ(^{33}Na)

E_i(level)	J_i^π	E_γ†	E_f	J_f^π	Comments
427	(5/2+)	427 *5*	0	(3/2+)	E_γ: weighted average of 429 *5* from (^{38}Si,^{33}Naγ) and 425 *5* from (^{36}Mg,^{33}Naγ). Other: 467 *13* from (^{34}Na,^{33}Naγ) seems discrepant.
1115	(7/2+)	688 *6*	427	(5/2+)	E_γ: other: 690 *13* from (^{36}Mg,^{33}Naγ) is in agreement with the adopted values, but less precise.
1875	(9/2+)	760 *13*	1115	(7/2+)	

† From ^{9}Be(^{38}Si,^{33}Naγ).

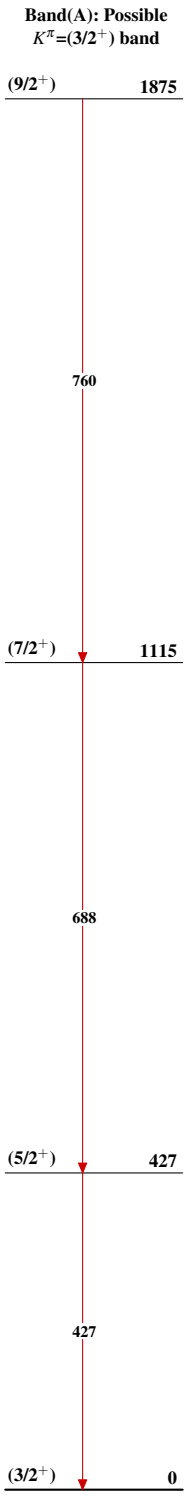
Adopted Levels, Gammas

Level Scheme



$^{33}_{11}Na_{22}$

Adopted Levels, Gammas



$^{33}_{11}Na_{22}$