Adopted Levels

S(p)=−3.45×10^3 *7*;
S(p): from E(3p+^{14}O)$_{rel}$=4.85 MeV *6* and S$_{2p}$(^{16}Ne)=1.40 MeV *2*.
Evidence for resonant structure in ^{17}Na has been reported in the ^{9}Be(^{17}Ne,^{17}Na) reaction (2017Br07). The nucleus ^{17}Na is unbound to proton decay and has been observed in a reconstruction of 3p+^{14}O events. A broad group is observed in the 3p+^{14}O invariant mass spectrum at E$_{rel}$≤4.85 MeV *6*; the group is thought to represent either the ^{17}Na ground state or, more likely, a group of low-lying states. Prior to this discovery information on ^{17}Na was theoretical in nature.
Mass models:
1966Ke16: Developed phenomenological model for predicting the mass of proton-rich nuclides. Deduced a mass excess ΔM=35.61 MeV. See also (1992Av03).
2013Ti01: An improved Kelson-Garvey mass relations model is presented that includes participation of many more relevant masses for the prediction of unmeasured proton-rich nuclear masses. The ^{17}Na mass excess ΔM=35.346 MeV *23* is predicted.
Theoretical analysis:
2010Ti02: A microscopic cluster model based on the ^{17}C mirror nucleus is explored, which includes consideration of excitations of the ^{16}Ne core. Discussion on seven proton-unbound states, with E$_x$ ranging from 0 to 3.01 MeV and Jπ=1/2$^+$, 3/2$^+$, 5/2$^+$, 7/2$^+$, (5/2$^+$ or 3/2$^+$), (3/2$^+$ or 5/2$^+$) and 9/2$^+$, respectively, is given. Partial widths are given for decay to either the Jπ=0$^+$ ^{16}Ne$_{g.s.}$ or Jπ=2$^+$ state at E$_x$=1.7 MeV. The authors suggest the ground state should be a broad resonance with *l*=0 character.
2012Am01: A multichannel algebraic scattering (MCAS) approach is developed, which relates the ^{17}Na structure with the mirror nuclide ^{17}C and related n+^{16}C interactions. Low-lying collective excitations in the core are taken into account and predictions are made for the low-energy levels of ^{17}Na.
2012Am06: The authors evaluate three approaches for predicting the ground state mass: use of mass formulae based on analysis of isobar multiplets, consideration of mirror nuclei structures and spectra, and systematic evaluation of mass values and excited state energy trends in nearby nuclides. Predicted ground-state energies, rangeing from 1 to 4.3 MeV above the the p+^{16}Ne binding threshold, are discussed within the framework of several models. See also (2013Am01).
2010Fo06, 2014Fo23, 2017Fo18: In 2010Fo06, predictions for the lowest three levels of ^{17}Na are obtained based on a ^{17}Na model where wave function amplitudes are based on those of the bound ^{17}C states. The wavefunctions are developed by coupling either a *s*- or *d*-wave nucleon with A=16 states whose energies are computed in a core plus two-nucleon space based on the known ^{16}C levels. Level energies, relative to the p+^{16}Ne threshold, and partial widths for decay to either the ground or first excited state of ^{16}Ne are given and compared with results from (2010Ti02). In 2014Fo23, the shell-model is updated results are compared with the prior literature. In 2017Fo18, a potential model utilizing the earlier shell model results is used to estimate the partial widths for the proton decay of ^{17}Na to ^{16}Ne states.

^{17}Na Levels

E(level)	J$^\pi$	Comments
0	(1/2$^+$)	T=3/2 E(level): from E(3p+^{14}O)$_{rel}$=4.85 MeV *6*. The group is twice as broad as expected and may represent a collection of unresolved Jπ=1/2$^+$, 3/2$^+$ and 5/2$^+$ levels. J$^\pi$: from expected systematics.

^{9}Be(^{17}Ne,^{17}Na) 2017Br07

XUNDL set compiled by J.H. Kelley and C.G. Sheu, May 2017.

The authors report the first evidence for a resonant structure in ^{17}Na. They also reported on a variety of one- and two-proton unbound levels in other nuclides that were populated in the bombardment of a ^{9}Be target by either a 68 MeV/nucleon ^{9}C beam or a 58 MeV/nucleon ^{17}Ne beam. The reactions produced short-lived levels that proton decayed before exiting the target.

In this case, a ^{17}Ne beam was produced at the NSCL by fragmenting a ^{20}Ne beam in the A1900 beam separator. The ^{17}Ne beam impinged on a 1 mm thick ^{9}Be target, which populated ^{17}Na states, presumably by charge-exchange reactions. The ^{17}Na states quickly decayed via proton emission.

The complete kinematics of the charged-particle reaction products were measured using the HiRA array, which comprised a set of 14 64 mm × 64 mm position sensitive ΔE-E telescopes that covered the forward direction of the outgoing beam ($\theta_{lab}\approx2^\circ$ to 13.9°). The telescopes were arranged in verticle towers with a 2-3-4-3-2 configuration where the central tower had a gap between the upper and lower two telescopes to permit the beam a downstream exit at $\theta=0^\circ$.

In addition, 158 CsI(Na) crystals from the CAESAR array covered polar angles between $\theta_{lab}=57.5^\circ$ and 142.4° and measured the coincident γ-ray deexcitations.

A peak with $\Gamma\approx1150$ keV was observed in the invariant mass spectrum at $E(3p+^{14}O)_{rel}=4.85$ MeV *6* . The spectrum also shows an excess of counts near $E(3p+^{14}O)_{rel}\approx3$ MeV, however the sparse statistics are inconclusive for establishing this as a state. The $E(3p+^{14}O)_{rel}=4.85$ MeV peak is broader than expected, and the authors suggest it may represent unresolved $J\pi=1/2^+$, $3/2^+$ and $5/2^+$ levels that are expected in the low-lying structure. As a result, a limit $E(3p+^{14}O)_{rel}\leq4.85$ MeV is indicated for $^{17}Na_{g.s.}$. A structureless background, associated with misidentified ^{15}O ejectiles, is discussed and subtracted.

A private communication with R.J. Charity (May 4, 2017) determines -3.45 MeV$\leq S_{1p}\leq1.4$ MeV. In their analysis, the authors may find evidence for involvement of the 1st excited state of ^{16}Ne, however the low statistics and high background prevent conclusive determination of a sequential decay path, which would add further constraint to S_{1p} and the mass excess (29.90 MeV$\leq\Delta M\leq$34.72 MeV).

The authors give a significant discussion on the existing ^{17}Na ground state energy predictions.

^{17}Na Levels

E(level)	J^π	Comments
0	$(1/2^+)$	T=3/2 E(level): from $E(3p+^{14}O)_{rel}=4.85$ MeV *6*. The group is twice as broad as expected and may represent a collection of unresolved $J\pi=1/2^+$, $3/2^+$ and $5/2^+$ levels. E(level): $E(3p+^{14}O)_{rel}=4.85$ MeV *6* implies $S_p=-3.45$ MeV *6* using $S_{2p}(^{14}O)=-1.40$ MeV *2* (2012Wa38). J^π: from expected systematics.

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