^{9}Be(^{20}Mg,P17NE) 2012Mu05

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. H. Kelley, G. C. Sheu	ENSDF	29-July-2015

There are two experiments that utilized nucleon knockout reactions on ^{20}Mg to populate states in ^{18}Na. The first work was carried out at 43 MeV/nucleon (2004Ze05) and focused on a reconstruction of the p+^{17}Ne invariant mass spectrum. The second effort was carried out at 450 MeV/nucleon and focused on analysis of the p_1-^{17}Ne, p_2-^{17}Ne and p_1-$p_2$particle correlations following population of ^{19}Mg states and their subsequent two-proton decays, which have branches that proceed sequentially through levels in ^{18}Na. The ground state of ^{18}Na was observed in both experiments.

2004Ze05:

The discovery of ^{18}Na is credited to (2004Ze04). A beam of 43 MeV/nucleon ^{20}Mg ions was produced by fragmenting a ^{24}Mg beam on a thick ^{12}C target using the ALPHA spectrometer and SISSI solenoids at GANIL. The beam was transported to the SPEG spectrometer where it impinged on a 47 mg/cm^2 ^{9}Be foil in the target position. Light ion ejectiles were detected in the position sensitive Si/CsI ΔE-E MUST array, while heavier ions were detected in spectrometer focal plane detectors. The invariant mass spectrum was generated for each p+17Ne pair observed in the experiment. The resulting spectrum indicated two peaks that are attributed to proton decay from ^{18}Na to ^{17}Ne.

The two peaks are consistent with mass excesses of 24.19 MeV *16* and 25.04 MeV *17*. The interpretation of the two peaks remains unclear since no γ-ray detectors were used in the measurement; this missing information creates an ambiguity in interpretation for the case where a level in ^{18}Na decays to an excited state of ^{17}Ne. Significant discussion on the determination of the ground state level and assignment of J^π values is given in the article.

The prefered analysis accepts the ground state mass excess of 25.04 MeV *17* with Γ=0.48 MeV *14* and $J^\pi=1^-$ (by comparison with ^{18}N). The peak appearing in the invariant mass spectrum at 24.19 MeV *16* with Γ=0.23 MeV *10* is attributed to decay from an excited state of ^{18}Na to and excited state of ^{17}Ne; in this case the experiment doesn′t provide sufficient information to assign an energy to the ^{18}Na level.

2012Mu05:

The authors measured the decay of proton unbound states in ^{19}Mg and ^{18}Na by fragmenting a ^{20}Mg beam in a ^{9}Be target and analyzing the p_1-p_2, p_1-^{17}Ne and p_2-^{17}Ne particle correlations.

A beam of ^{20}Mg ions (produced by fragmenting a 450 MeV/A ^{24}Mg beam) impinged on a 2 g/cm^2 ^{9}Be target at the midplane of the GSI FRS. The target was surrounded by an array of four position sensitive detector telescopes that measured the breakup charged particle angular correlations (p_1-p_2, p_1-^{17}Ne and p_2-^{17}Ne). Two prominent peaks appear in the p-^{17}Ne angular correlation distribution; first is a peak consistent with 2p decay of the ^{19}Mg$_{g.s.}$ directly to ^{17}Ne+2p with E_{res}=0.75 MeV *5*, second is a peak corresponding to ^{19}Mg excited states decaying sequentially through proton unbound states in ^{18}Na.

The excited states in ^{19}Mg appear as “arc bands” in the $\theta(p_1$-^{17}Ne) vs. $\theta(p_2$-^{17}Ne) angular correlation spectrum. Analysis of events along a fixed or constant radius provides details about the initial ^{19}Mg state and the ^{18}Na states populated in the sequential decay to ^{17}Ne$_{g.s.}$+2p. Evidence for two states is visible in the spectrum. Monte Carlo simulations are used to extract “best fit” values for energies and widths of ^{19}Mg and ^{18}Na states.

Finally arguments based on the extracted widths and the Wigner Limits are used to constrain J^π values.

Also see earlier analysis of data in (2008Mu13).

See (2003Gr01) for further discussion on the role of ^{18}Na states in ^{19}Mg 2p decay.

^{18}Na Levels

E(level)	J^π	Γ	Comments
0	$(1)^-$	<0.2 MeV	%p≈100. In (2012Mu05) E_{res}(p+^{17}Ne)=1.23 MeV *15* while (2004Ze05) report 1.27 MeV *17*. Excitation energies are reported with respect to 1.25 MeV *11*, the accepted value in (2012Wa38). Γ: <0.2 MeV (2012Mu05); also see Γ=0.48 MeV *14* (2004Ze05).
0.30×10^3 *13*	2^-	0.25 MeV *25*	%p≈100. from E_{res}(p+^{17}Ne)=1.55 MeV *7* (2012Mu05) and ^{18}Na$_{g.s.}$=E_{res}(p+^{17}Ne)=1.25 MeV *11*. Γ: 0.25 MeV *+25−15* (2012Mu05).

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^{9}Be(^{20}Mg,P17NE) 2012Mu05 (continued)

^{18}Na Levels (continued)

E(level)	J^π	Comments
0.83×10^3?	3^-	from $E_{res}(p+^{17}Ne)$=2.084 MeV from (2011AsZX) and $^{18}Na_{g.s.}=E_{res}(p+^{17}Ne)$=1.25 MeV *11*. This state is not conclusively observed; however in (2012Mu08) including this $J^\pi=3^-$ state at $Q(p+^{17}Ne)$=2.084 MeV permits a quantitative reproduction of the correlation spectra.