Structure of $^{18}$B

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The investigation of the light neutron-rich dripline nuclei, including in particular those exhibiting halos, is a central theme of nuclear structure physics. In the present work a series of measurements, aimed at elucidating the structure of the two heaviest candidate two-neutron halo systems, $^{19}$B and $^{22}$C,$^{1-3}$ and the associated unbound sub-systems $^{18}$B and $^{21}$C, the level schemes of which are critical to the defining the $^{17}$B+n and $^{20}$C+n interactions for three-body models, have been undertaken. In addition to being of direct importance to halo physics, $^{18,19}$B and $^{21,22}$C are of considerable interest in terms of the evolution of shell-structure far from stability as they span the N=14 and 16 sub-shell closures below doubly-magic $^{22,24}$O.

The measurements were accomplished using the SAMURAI spectrometer$^{4}$ coupled to the large area neutron array NEBULA$^{5}$ and were performed as part of the first phase of SAMURAI experiments. The analysis to date has concentrated on the fragment+neutron channels and, in particular, $^{17}$B+n which is known to exhibit a strongly interacting virtual s-wave threshold state$^{6}$. Beyond the intrinsic physics interest noted above, a well defined threshold state provides an ideal means to validate the calibration and analysis procedures.

In addition to populating $^{18}$B via proton removal from $^{19}$C (which should populate almost exclusively s-wave strength), the complementary probe of neutron removal from a $^{19}$B beam has been investigated. Figure 1 shows the reconstructed $^{17}$B+n invariant mass (or relative energy) spectra for the two reactions. As may be clearly seen the proton removal populates a very narrow threshold structure, the form of which is consistent with the s-wave virtual state deduced by Spyrou et al.$^{6}$). The neutron removal, however, in addition to the threshold peak shows clear evidence for the population of a state or states in the region of 0.5–1 MeV.

The further analysis of these preliminary results is currently underway as are the data sets for the analogue reactions populating $^{21}$C.

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References