FIRST OBSERVATION OF EXCITATION ACROSS THE ^{100}Sn CORE

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Doubly-magic nuclei and their nearby neighbors are of great experimental and theoretical interest. Not only do they furnish the single-particle energies and two-body matrix elements needed for accurate determination of the effective interactions, but they also provide an excellent testing ground for large-scale shell-model calculations. Being the heaviest particle-stable self-conjugate nucleus, ^{100}Sn occupies a unique place among doubly-magic nuclei. However, despite numerous experimental efforts, little is known about the excited states in this nucleus or its immediate neighbors. Therefore, information about the single particle and core excitation energies above N,Z=50 magic particle numbers have to be inferred indirectly. In this work, we will report on ^{105}Sb and the first observation of core-excitation across N,Z=50 in ^{99}Cd and ^{101}In nuclei.

In this experiment, a ^{50}Cr target was bombarded with a ^{58}Ni beam. The detector setup consisted of the GAMMASPHERE, the Microball, and an array of 30 neutron detectors placed at forward laboratory angles. A total of 27 residual nuclei were observed, including ^{102}Sn (α2n), and ^{98}Cd (2α2n), which is the weakest channel identified in this reaction.

We have identified for the first time excited states in the known proton emitter ^{105}Sb, which is now the lightest Sb isotope and one of the lightest proton emitters with known excited states. The high spin level scheme of ^{105}Sb resembles the level scheme of ^{107}Sb up to I=19/2. When compared to ^{107}Sb the ^{105}Sb level scheme shows similar trends as when going from ^{106}Sn to ^{104}Sn. The level scheme also implies that the observed proton emission is from the ground state. Results of large scale shell model calculations are in good agreement with the experimental level scheme.

We have also obtained new information about excited states in the T_z=3/2 nuclei ^{99}Cd and ^{101}In. The $I^{\pi}=7/2^{+}$ state in ^{99}Cd was identified. This state was missing in the only previous study of excited states in ^{99}Cd. Its wave function is dominated by the neutron $g_{7/2}$ configuration coupled to the two $g_{9/2}$ proton holes. Its experimental excitation energy will help predicting the neutron $g_{7/2}$ single particle energy above the N=50 shell gap. We have also observed high spin states that cannot be reached by coupling two proton holes in the Z=28-50 shell to a neutron in the N=50-82 shell. These states must, therefore, be due to particle-hole excitations across the N=Z=50 shell closures. This represents the first observation of the break-up of the doubly magic ^{100}Sn core. High-spin states of the same type were also observed in ^{101}In, where only one excited state was previously known.

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