Single-neutron excitations near ^{132}Sn

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An open question in nuclear structure is the evolution of shell structure in neutron-rich nuclei. While abundances of elements produced in r-process nucleosynthesis cannot be reproduced with the traditional shell model [1], there have been limited studies of the shell structure in neutron-rich N=50 and 82 nuclei. Recently [2,3], we have studied the single-neutron structure in ^{133}Sn, with 83 neutrons and 9 units away from stability. This work was enabled by (d,p) reactions with rare isotope beams of ^{132}Sn accelerated to ≈5 MeV/u at the Holifield Radioactive Ion Beam Facility at Oak Ridge National Laboratory. The energies and cross sections as a function of angle for the reaction protons were measured with the Oak Ridge Rutgers University Barrel Array (ORRUBA) of position-sensitive silicon strip detectors [4]. Four states were populated in ^{133}Sn. Essentially all of the expected $2f_{7/2}$ and $3p_{3/2}$ strength was observed in the $7/2^-$ ground and $3/2^-$ first excited states, respectively. The population of states at 1363 and 2005 keV is consistent with pure $3p_{1/2}$ and $2f_{5/2}$ configurations, respectively. Therefore, ^{132}Sn, with a half-life of only 40 seconds, is possibly the best example of a double-magic nucleus and a solid landmark when extrapolating to even more exotic neutron-rich nuclei.

The concentrated single-neutron strengths in ^{133}Sn have also been observed in lighter neutron-rich Sn isotopes and ^{134}Te [4,5,7]. The minimal fragmentation of single-neutron strength across the N=82 gap and at high excitations in ^{130}Sn, for example, was unexpected.

The present talk will summarize the recent (d,p) reaction studies with beams of neutron-rich Sn and Te isotopes and the fragmentation (or lack thereof) of single neutron strength near N=82.

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