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Neutron sd-shell excitations for light nuclei with N ≥8

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In light nuclei, the separation between the p and sd shells decreases with increasing N/Z near N=8, and the energy of the 1s1/2 orbital drops below that of the 0d5/2 level. This behavior is largely responsible for the halo-like nature of neutron-rich N=9 nuclei, which contain a loosely-bound 1s1/2 neutron. We have used HELIOS to study neutron transfer with the (d,p) reaction using beams of the unstable nuclei 12B, 13B, and 15C, leading to 13B, 14B, and 16C, corresponding to neutron numbers of N=8, 9, and 10. Of particular interest are the properties of states with one or two neutrons in the 1s0d shell. The exotic beams were produced using the in-flight method. Protons were detected at backward laboratory angles using HELIOS, in coincidence with and forward-recoiling beam-like recoils identified in an array of silicon-detector telescopes. HELIOS is designed specifically to study such reactions in inverse kinematics, and to optimize the excitation-energy resolution in the center-of-mass system. Excitation-energy spectra and angular distributions for these reactions will be presented, as well as relative spectroscopic factors. The data will be compared to the predictions of shell-model calculations for this region. This work was supported by the U.S. Department of Energy, Office of Nuclear Physics under contracts DE-FG02-04ER41320 and DE-AC02-06CH11357, and NSF Grant Nos. PHY-02-16783 and PHY-10-68217.

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