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Employing proton knock-out to produce and study neutron unbound nuclei: 13Be and 16B

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Unbound nuclei, at the border between bound nuclear systems and the continuum, offer a unique way to increase understanding of the nuclear interaction. Radioactive ion beams at high energies provide the possibility to create and study unbound nuclei using e.g. knock-out reactions. These reactions imply little interaction with the spectator part of the nucleus and are thus a versatile tool for spectroscopy.

The present work is based on an experiment performed in 2010 using the LAND/R3B setup at GSI. Secondary beams with an energy around 450 AMeV in the Z = 4 to Z = 10 region were employed. This multipurpose experiment aimed not only at the study of unbound nuclei using proton knock-out reactions but also on single-particle spectroscopic factors, the shell structure of neutron rich nuclei and (n,gamma)-rates of astrophysical relevance in this region of the nuclear chart.

The LAND/R3B setup allows for event-by-event detection in complete kinematics having an almost 4 acceptance due to the relativistic forward-focusing of the reaction-products. It is therefore ideal for studying unbound nuclei using proton knock-out reactions. In particular the unbound nuclei 16B and 13Be, produced by proton knock-out from 17C and 14B respectively, are the subject of this work.

The relative energy of the bound core + neutron systems is studied as well as their gamma-spectra,yielding information about the orbital momenta of the unbound systems.

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