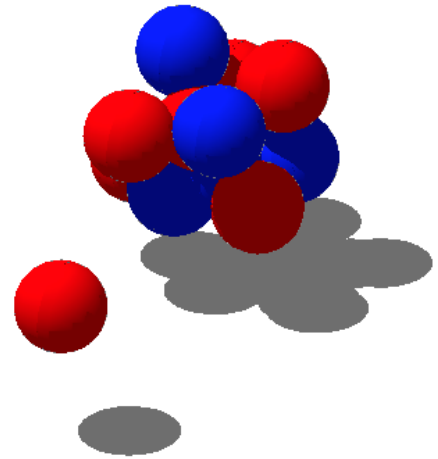
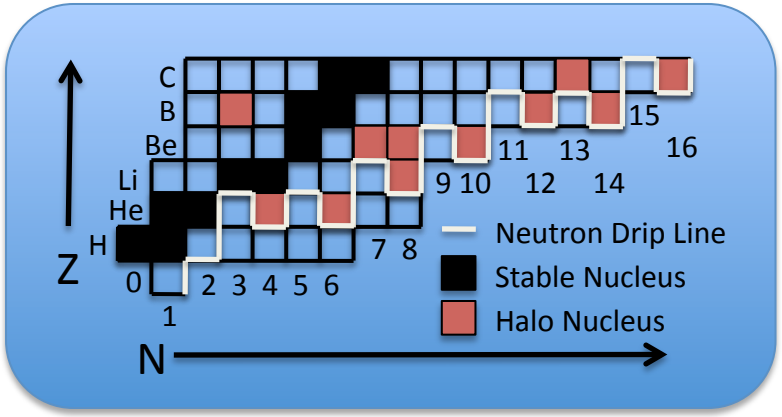
Studying the excited states of a nuclear halo



The structure of exotic nuclei is a primary interest of scientists in the field of nuclear physics. These nuclei, which lie far from the valley of stability on the nuclear chart, often have extraordinary structural properties. Halo structure is one of such features.

Halo nuclei with one or two nucleons spending most of the time far away from the central core have a very large radius compared to stable nuclei with the same total number of particles. Indeed, the spatial extent of halo neutrons in ^{11}Li is close to that of ^{208}Pb.

The archetypal example of a one neutron halo nucleus is ^{11}Be, which exhibits this characteristic structure in both of its bound states. Little is known, however, about the unbound states, or resonances. A recent experiment at the Holifield Radioactive Ion Beam Facility is shedding light on the excited states of this nucleus. These states were populated by transferring one neutron to ^{10}Be, a long-lived isotope which was formed into a beam of ions. Information about the states populated in ^{11}Be is revealed through the energies and angles of protons emitted in the reaction with deuterons in the target.



This experiment has been made possible by state-of-the-art silicon detector arrays with large angular coverage. A team, led by researchers from the University of Tennessee, is analyzing this high statistics data set. Preliminary analysis indicate good agreement with reaction models.