Colloquium

MASS MEASUREMENTS AND SURFING OF THE SHORTEST-LIVED NUCLEI

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Wednesday, February 27 ❖ 4:00 P.M. ❖ 118 NSH

Refreshments at 3:30 P.M. in 202 NSH

Over the past decades, the high-precision direct mass measurements of short-lived nuclei have provided important information on a wide range of topics, including the neutron halo structure in very exotic nuclei. In some of the most neutron-rich systems, the last neutrons are extremely weakly bound resulting in their wavefunction extending far outside the nuclear core forming a so-called halo. The motion, size and deformation of the nuclear core was shown to be reflected in the charge radius, while the extent of the diffuse region was linked to the neutron separation energy of the valence, or halo, neutrons. Recent advances in laser spectroscopy and high-precision atomic physics calculations have allowed a precise, model-independent determination of the charge radius leaving the remaining source of uncertainty in the atomic mass value. We will present the first direct mass measurements of the halo nuclei ^{6,8}He using the TRIUMF Ion Trap for Nuclear and Atomic science (TITAN) Penning trap. Using the precise charge radii and binding energies obtained from the new masse measurements, we tested various *ab-initio* nuclear theories and give insight to the interactions at play in the nucleus.

Precision experiments with ion traps, such as mass measurements, require low-energy ion beams with minimal energy spread. Therefore, radioactive ions produced at high energies by fragmentation or fission reactions can only be used in precision experiments after they are thermalized in a gas cell. These short-lived nuclei are produced at low-yields so the efficient and quick transport through the buffer gas is critical. We will present the results of the extensive studies of a rapid transport method called “ion surfing” that have been performed at the National Superconducting Cyclotron Laboratory as part of the development of a next-generation beam thermalization system. Finally, we will present a long-range research plan to be carried out at the NSL that is based on a neutron-induced fission source that will include an “ion surfing gas cell” to produce and deliver neutron-rich nuclei of relevance for nuclear structure and astrophysics to a portable multi-purpose electrostatic ion beam trap.

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