TRIUMF Advanced Rare Isotope Laboratory (ARIEL)

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Nuclear structure studies from precision mass measurements at ISAC and in the ARIEL era

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Precision mass measurements of exotic nuclei provide a direct and model-independent probe of nuclear structure, giving access to binding energies and derived observables such as two-neutron separation energies, shell-gap indicators, and odd-even staggering. At TRIUMF-ISAC, these techniques have enabled detailed studies of neutron-rich nuclei relevant to shell evolution, deformation, and the astrophysical r-process. In this contribution, we will present recent precision mass measurements of neutron-rich isotopes, including our work on Sn isotopes beyond N=82 and on heavy neutron-rich Yb isotopes. These results illustrate how high-precision masses can reveal the persistence and evolution of shell structure, and identify structural reorganisation in the rare-earth region approaching a predicted N~116 shape-transition region. Beyond their importance for nuclear structure, such measurements provide key experimental input for r-process calculations through neutron-separation energies and decay Q values.

We will discuss several science opportunities for precision mass measurements in the ARIEL era, particularly in neutron-rich regions where progress depends on sustained beam access and more systematic campaigns across isotopic chains. Two especially promising directions are the extension of mass measurements below 132Sn, for example in the In, Ag, and Pd chains, to probe the evolution of shell structure below Z=50 and improve constraints on nuclei feeding the second r-process peak, and expanded studies of neutron-rich rare-earth nuclei, towards the Tb-Lu region, to map the evolution of deformation and pairing and to constrain the mass surface relevant for rare-earth peak formation. The emphasis will be on how precision masses, combined with complementary spectroscopy, can address open questions in neutron-rich nuclear structure and nucleosynthesis in the years ahead.

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