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Exploring the unknown facets of the visible universe through the lens of rare isotopes

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Exploring the unknown facets of the visible universe through the lens of rare isotopes

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Visible matter in our universe embody nature's strong force combining protons and neutrons into complex systems. While much has been understood about the stable nuclei, the rare isotopes approaching the limits of neutron and proton binding bring a wealth of new information. Their properties guide our understanding on the state of matter in exotic environments in our Universe. The reactions and decays of these isotopes drive the creation of majority of the heavy elements in our Universe.

The challenge of accessing these rare isotopes is possible in a few laboratories around the world with two different production techniques Isotope Separator Online (ISOL) and In-flight projectile fragmentation. The TRIUMF Advanced Rare Isotope Laboratory (ARIEL) is among the premier centres with capability of ISOL type production of rare isotope beams. The presentation will give an overview of the scientific scope of TRIUMF's rare isotope program from ISAC to ARIEL with state-of-the art experimental facilities. The stopped beam experiments on precision mass measurements, decay spectroscopy and tests of fundamental symmetries in nature allow to explore nuclear shells, shapes and look for signatures of physics beyond the known symmetries in nature. Nuclear reactions at astrophysical low-energies and with re-accelerated non-relativistic energy beams bring access to direct and indirect measurements of astrophysical reactions important for nucleosynthesis. Selected highlights of recent measurements will be presented.

I will also discuss key highlights from my research program with complementary relativistic energy rare isotope beams at RIKEN in Japan and GSI in Germany. This is leading to revelation of unconventional forms of nuclei such as nuclear halo and skin that unveil new features of nuclear shell evolution.

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