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The TRIUMF-ISAC Radioactive Ion Beam (RIB) Facility: Recent Highlights and Future Plans

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The availability of a wide variety of intense beams of exotic nuclei from the next generation of radioactive ion beam facilities such as the Isotope Separator and Accelerator (ISAC) facility at TRIUMF provides an unprecedented opportunity to address key questions of current interest in nuclear astrophysics, nuclear structure physics, fundamental symmetries and molecular and material science. The short-lived isotopes are produced at ISAC by the ISOL (on-line isotope separation) method using a beam of up to 100uA of 500 MeV protons from the TRIUMF H- cyclotron to bombard thick production targets. The targets can be coupled to a wide variety of ion sources including: surface, laser (TRILIS) and plasma (FEBIAD) sources, to produce the world' s most intense RIB beams for certain isotopes such as 11Li. A license was obtained in November 2009 to run with uranium targets at < 2 μA for a total of 1000 μA hr. The first UCx production target was run in December 2010. This target produced high yields of short-lived neutron-rich and actinide isotopes; one highlight was the development of a TiSa laser ionization scheme for At. We are currently seeking a license upgrade to operate UCx targets at beam currents up to 10 μA for a total of 5000μA hr.

Low-energy (<60 keV) RIBs have been available at ISAC since 1999, and over the past decade a large number of state of the art experimental facilities have been developed. Recent research highlights include: high charge state mass measurements of 74-76Rb using the TITAN ion trap facility, co-linear laser spectroscopy of cooled bunched beams including 74-78Rb and 206-8Fr, a high-precision branching ratio measurement of the superallowed β-emitter 74Rb using 8π gamma-ray spectrometer, and microscopic investigations by βNMR of proximity effects in metal- superconductor bilayers. Fundamental symmetry studies including a test of time reversal symmetry using polarized 8Li, the search for a permanent EDM in odd A radon isotopes and PNC in francium isotopes.

An RFQ and variable energy DTL provide reaccelerated radioactive beams at energies from 0.15-1.8 A MeV for nuclear reaction studies of importance in explosive nucleosynthesis environments such as Novae and X-ray bursts. Most recently the DRAGON recoil separator was used to study the 33S(p,γ)34Cl reaction, to determine if 33S abundance in pre-solar grains could indicate nova origin.

Since January 2007 a Superconducting LINAC installed at ISAC-II has made nuclear reaction studies possible with radioactive beams at energies up to 5 A MeV for A < 30. Recent studies using exotic beams of halo nuclei include, the search for a soft dipole resonance state in 11Li via (p,p) scattering, a study of halo effects in the scattering of 11Li on 208Pb at energies near the Coulomb barrier, and a study of the halo structure of 12Be studied via the 11Be(d,p) reaction. In 2009, the TUDA particle detector array was move to ISAC-II for astrophysically motivated studies of the 18F(p,α)15O and 21Na(p,α)18Ne reactions. The potential for nuclear structure studies at ISAC-II was greatly enhanced in the summer of 2010 with the installation of high-beta cavities which when combined with a charge state booster will provide radioactive beams up to 7 A MeV for A < 150.

The gamma-ray spectroscopy program at ISAC-II is centered on TIGRESS, a next generation array of high-efficiency segmented HPGe detectors with digital signal processing that is specifically designed to meet the challenges of experiments with high-energy radioactive ion beams. A number of auxiliary detectors are also under development for use with TIGRESS including: a DSSSD barrel for detecting charged particles SHARC, an array of neutron detectors DESCANT, the TIGRESS Integrated Plunger TIP, and a recoil mass spectrometer EMMA. During the past two years, the experimental studies included: the Coulomb excitation of 10-11Be and the first experiments with SHARC including a measurement of the 25Na(d,p)26Na reaction as part of a program to follow the evolution of shell structure of neutron-rich sd-shell nuclei.

Recent highlights from the research programs at ISAC I and ISAC II will be presented together with an overview of the ARIEL project which includes the construction of a 50 MeV, 500 kW superconducting e-linac to provide intense beams of neutron-rich nuclei via the photo-fission of actinide targets.

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