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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 worlds most intense RIB beams for certain isotopes such as 11Li.

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 precision mass measurements of halo nuclei using the TITAN ion trap, measurements of the ground state quadrupole moments of 8,9,11Li using βNQR, implications for neutrinoless double electron capture via β-decay studies of 112Ag and 112In using the 8pi gamma-ray spectrometer, and microscopic investigations by βNMR of proximity effects in metal- superconductor bilayers. Fundamental symmetry studies including the search for a permanent EDM in odd A radon isotopes and PNC in francium isotopes using RIBs from a UC2 production target are under development.

An RFQ and variable energy DTL provide reaccelerated radioactive beams in the energy range 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 23Mg(p,γ)24Al reaction, of critical importance in the transition between the Ne-Na and Mg-Al cycles.

Since January 2007 the new 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. The initial studies using exotic beams of halo nuclei included: a measurement of the two-halo neutron transfer reaction 1H(11Li, 9Li) 3H at 3 A MeV carried out using the active target detector MAYA brought to TRIUMF from GANIL, 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 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, and a recoil mass spectrometer EMMA. During the past year, the experimental studies included: the Coulomb excitation of 10Be and the first experiment with SHARC, 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.

The potential for nuclear structure studies at ISAC-II will be greatly enhanced during the coming year with the installation of high-beta cavities and a charge state booster to provide radioactive beams up to 7 A MeV for A < 150.

Recent highlights from the research programs at ISAC I and ISAC II will be presented together with an overview of future plans which include 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.

Is this an invited talk? (please answer yes or no)

yes

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