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Helium-Jet Ion-Source development for commensal operation at NSCL/FRIB.

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NSCL is a national user facility with a mission to provide beams of rare isotopes for researchers from around the world. Presently, a rare-isotope beam can only be delivered to one experimental end station. The Helium-Jet Ion Guide System (HJ-IGS) project is aimed at delivering a second radioactive ion beam to another end station by collecting rare isotopes that are not delivered to the primary user. This will be done by thermalizing rare isotopes in a stopping cell placed at suitable focal plane(s) off the ion-optical axis of the A1900 fragment separator. The cell is filled with high pressure helium gas mixed with aerosols. The gas/aerosol mixture is then transported through a capillary to a high temperature plasma ion source, where rare isotopes are separated from Helium, then ionized and accelerated to produce low energy ion beams. Subsequently, these beams will be mass-separated using an isotope separator and delivered to various experimental systems. Essential for the implementation of this concept is that the thermalizing cell and the extraction mechanisms are compact and compatible with existing fragment separator infrastructure.
A unique feature of the HeJet stopping technique compared to other techniques is the absence of space charge limitations, as stopping and ionization regions are physically separate. Stopping efficiencies that are independent of the incident ion rate are expected even at the highest rates to be available at FRIB.
The proof of principle of this concept was tested using 252Cf fission fragments at HRIBF, ORNL. Several dozen n-rich isotopes were thermalized, extracted from the cell and identified from decay gamma rays after transporting to a distance of about 100 ft. Subsequently, a high voltage system and optics was developed and neutron-rich rare isotopes were identified in the extracted as low energy ion beam.
At NSCL, a new isotope separator with matching optics will be added for producing mass separated ion beams. The eventual goal is to then cool these beams using a RFQ cooler and transport the rare isotopes to one of the low-energy experimental end stations or the NSCL re-accelerator. The installation and the initial testing of stopping and transport efficiencies have been completed and preparation for a beam test is in progress.
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