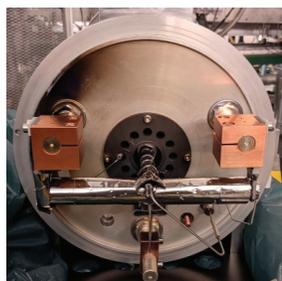
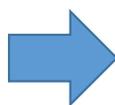


At the Facility for Rare Isotope Beams (FRIB) a plethora of by-product radionuclides will be created that are of immense societal value for a number of disciplines, viz. nuclear medicine, plant biology, material science, astrophysics and stockpile stewardship science. It is an ambitious endeavor to collect these rare radionuclides at sub-nanomolar levels from the vast amount of cooling water, radiochemically purify them, and finally transfer them into a chemical form that is required for the specific applications. So far, the feasibility of 'isotope harvesting' was already probed at the National Superconducting Cyclotron Laboratory (NSCL). The next step will involve a translation towards the conditions at FRIB, where challenges like considerably increased levels of radioactivity, diluted in a greatly larger water volume will be met.

Additionally, in the normal operation mode of FRIB a broad variety of multiple isotopes of each element will be created, and often direct harvesting efforts will not yield radioisotopically pure samples. Currently this limitation is addressed by focusing on the collection of so-called 'radionuclide generator pairs', where the decaying parent radionuclide generates the desired daughter radionuclide. An option to further increase the spectrum of available pure radioisotopes would be through the implementation of mass separation. For this task, we envision to utilize the on-site available Re-Accelerator (ReA) facility.

in the last decades. We will introduce the necessary modifications at ReA and develop mass separation capabilities for the harvested radionuclides.

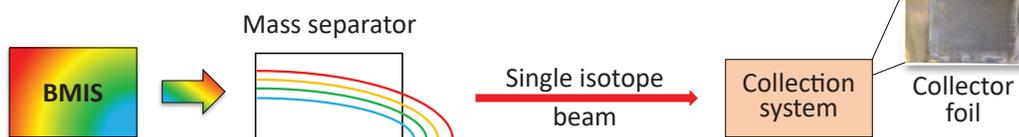
Radioactive Targetry for Neutron Studies and Ion Sources – Particular focus will be directed towards collecting and separating radionuclides which are of interest for scientific studies, such as neutron reaction studies. Precise measurement of neutron capture cross sections is imperative to elucidate the processes in cosmic environments as well as to address national security questions within the framework of the Stockpile Stewardship Program. Theoretical calculations of these cross sections are often afflicted with large uncertainties, as such only experimental efforts can address these data needs. However, a great challenge in the performance of neutron cross section studies with radioactive samples is to obtain the necessary amount of material (up to microgram quantities) at high radioisotopic purity. For the Stockpile Stewardship Program the isotopes of Eu, Lu and Tm are of priority, while the s-process branch-point isotopes viz. ^{63}Ni , ^{79}Se , ^{147}Nd , $^{147,148}\text{Pm}$, ^{153}Gd , ^{160}Tb , etc. are of interest for astrophysics research. To address these nuclear data needs, we will use the obtained mass-separated samples to manufacture radioisotopically pure targets. These targets will be utilized in neutron reaction studies, where we would like to collaborate with neutron source facilities and research reactors.



^{32}Si ion source (left) to facilitate the stand-alone operation of the ReA-facility. The ion sources are introduced into the Batch Mode Ion Source module (right).

Within this approach, the introduced isotopic mixtures will be separated according to the different mass-to-charge ratio, followed by the collection of the purified isotopes. This concept is inspired by the isotope separator facilities CERN-MEDICIS, Switzerland and TRIUMF, Canada, which pioneered this technique

Additionally, to compensate for the utilization of ReA's mass separator, we will support the stand-alone operation of this facility by the preparation of radioactive ion sources with the harvested radionuclides. The establishment of such a synergistic approach will facilitate the development of multi-user capabilities at FRIB. For the preparation of ion sources for the ReA, a high isotopic purity is not necessary and the chemically purified radioactive solutions can be used directly, without a preceding mass separation step. The experience acquired with the neutron reaction targets will be directly translatable towards the manufacturing of ReA ion sources. 📌



Development of the mass separation capability by using the on-site available ReA facility. In the Batch Mode Ion Source (BMIS) the introduced sample will be ionized, followed by extraction and separation in the mass separator. A single ion beam will be selected and implanted into a collector foil, placed inside the collection system.



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