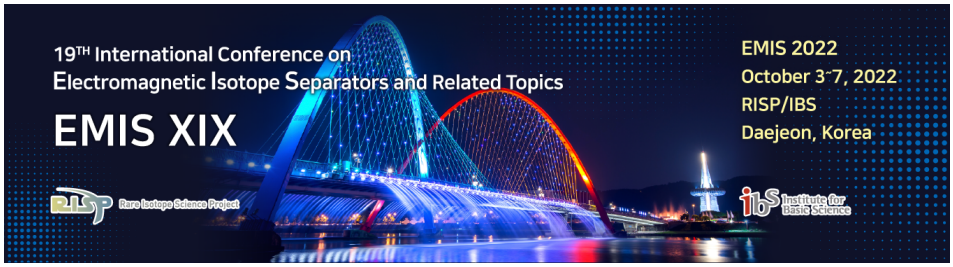

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Developments for actinide molecular ion beams at CERN-ISOLDE

Wednesday, 5 October 2022 10:00 (20 minutes)

The ISOLDE facility at CERN provides experiments with a wide range of isotopes across the nuclear chart, produced in reactions from 1.4 GeV protons with thick targets. The reaction products are typically delivered in the form of charged atomic ions, but molecular species can also be extracted. The development of molecular beams is motivated by improvements to beam extraction and purity as well as interest in studying the radioactive molecules themselves.

Molecules have been studied as a method to efficiently deliver beams of release-limited elements by forming and extracting volatile molecules [1,2] of otherwise refractory species such as carbon [3], boron [4] or refractory metals [5]. Additionally, delivering isotopes on a molecular sideband shifts the mass of interest, and can therefore be used as a technique to improve beam purity by changing the isobaric contamination situation. Beyond their use for enhanced extraction, molecules provide additional opportunities to search for fundamental symmetry violations and contribute to the development of new physics beyond the standard model [6,7]. Recent studies of radium fluoride at ISOLDE [8] demonstrate the experimental capabilities to study beams of radioactive molecules produced at radioactive ion beam facilities and further motivate the development of radioactive molecules.

We will present the first results of ongoing work on molecular ion beams of heavy elements at ISOLDE. Uranium carbide targets were used to produce molecular beams via injection of reactive tetrafluoro methane (CF_4) gas. The ion beam composition was studied using: the ISOLTRAP Multi-Reflection Time-of-Flight Mass Spectrometer (MR-ToF MS) [9] for identification by ToF mass measurements, online ɣ-ray spectroscopy at the ISOLDE tape station [10,11], and off-line α- and ɣ-ray spectrometry of ion-implanted samples. The results contribute to beam developments for actinide elements and radioactive molecules for fundamental physics research.

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