Contribution ID: **25** Type: **Poster contribution**

Toward the Creation and Detection of Molecular Beams at CANREB

Tuesday, 21 October 2025 18:46 (1 minute)

We assess the feasibility of creating molecular beams within an RFQ cooler-buncher (ARQB) at the CANREB (CANadian Rare isotope facility with Electron Beam ion source) facility at TRIUMF. Selective ion–gas phase chemistry is used to form molecules inside the ARQB between +1 ions and neutral gases, with the goal of delivering those molecular ion beams into the CANREB-TRIUMF beamline system. This effort supports the long-term objective of providing radioactive molecular beams for next-generation, beyond-the-Standard-Model physics experiments at TRIUMF.
The ARQB has been outfitted with a gas mixing system, enabling the controlled introduction of reactive gases to tune ion–molecule reactions with +1 beams of up to 30 keV. We employ quantum chemistry calculations (ORCA) and master equation solver (MESMER) to evaluate the favorability and kinetics of candidate reactions. Design considerations for enabling ion–gas reaction chemistry within an RFQ beamline environment are discussed, and we outline our detection strategy using time-of-flight monitors and a Nier-type spectrometer.

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Funding Agency

TRIUMF

Classification

Applications of radioactive ion beams

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Session Classification: Poster Session

Track Classification: Applications of radioactive ion beams