TRIUMF Advanced Rare Isotope Laboratory (ARIEL)

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MRTOF-MS at RIBF/BigRIPS: Recent measurements and developments, and dealing with rare events

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Tackling the increasing challenge to determine the mass of isotopes having low production yields and short half-lives, multi-reflection time-of- flight (MRTOF) mass spectrometry has grown from an initially rarely-used technology to the world's most commonly-used method for measurements with a relative mass precision down to $\delta m/m = 10^{-8}$. This technology has been developed at RIKEN's RIBF facility for about two decades in combination with gas-filled ion catchers for low-energy access of isotopes produced by the in-flight method. In the recent years, three independent systems operating at different access points at RIBF, have provided substantial data in the medium- and heavy-mass region of the nuclear chart, reaching out to the superheavy nuclides. Recent achievements like high mass resolving power [1] followed by the development of α/β-TOF detectors [2] and in-MRTOF ion selection have tremendously increased the selectivity of the systems [3]. The combined application allows for background-free identification of the rarest isotopes.
In this contribution, I will give a short overview about the success of MRTOF atomic mass measurements using BigRIPS in the recent past [4]. I will discuss instrumentation plans, with a view to a new type of β-TOF detector potentially useful for future mass measurements using ARIEL. Furthermore I will discuss challenges for the analysis of contaminated spectra with a low rate of wanted events.

References:
[1] M. Rosenbusch et al., Nucl. Instrum. Meth. A 1047, 167824 (2023).
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[3] W. Xian, M. Rosenbusch, V. H. Phong et al., Front. Phys. 13 (2025).
[4] S. Kimura et al., Phys. Rev. Lett. 135, 152701 (2025).

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Session Classification: Perspectives on rare isotope experiments at ARIEL with ion trapping & manipulation