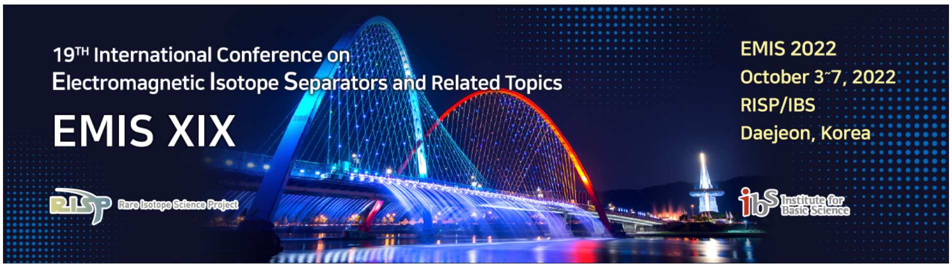

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High-precision MRTOF mass measurements of radioactive isotopes at RIKEN's RIBF facility: Recent projects for ion selection, wideband mass accuracy, and mirror potentials

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During the last decade, the multi-reflection time-of-flight mass spectrograph (MRTOF-MS) [1] became a powerful device for precise mass measurements of short-lived isotopes. Exotic ions produced at radioisotope facilities are stored in an electrostatic ion trap with nearly closed-path trajectories at kinetic energies on the order of a few keV, *i.e.* the ions are reflected back and forth between two electrostatic ion mirrors, and ultimately ejected to a detector for time-of-flight determination. The growing popularity of these spectrometers is mainly due to the short measurement duration of typically $t < 50\,\mathrm{ms}$, a high mass resolving power (typically $R_m > 100,000$), and a mass measurement precision reaching $\delta m/m < 10^{-7}$.
At the new MRTOF-MS setup located downstream of the BigRIPS separator and ZeroDegree spectrometer at RIBF/RIKEN [2,3], efforts have been made to improve the overall performance of state-of-the-art MRTOF technology. The resolving power of the system has been optimized using a pulsed drift tube outside of the MRTOF-MS to obtain a useful overview of the ions' TOF-energy dispersion. Combined with subsequent fine tuning, a remarkable resolving power of $R_m > 10^6$ has been achieved, which allows for resolution of low-lying nuclear isomers.
Furthermore, a new in-MRTOF deflector [4] has been installed with the ability to transmit one or several chosen ion species at the same time, while deflecting all other ion species. To this end, a pre-calculated pulse pattern is used, which guarantees for an undisturbed transport of the ions of interest.
In order to tackle the accuracy challenge for large mass differences between the ions of interest and the ions used as a mass reference, new efforts have been made. By identification and elimination of non electrostatic contributions to the ions' time-of-flight, we aim to solve long-standing difficulties for the mass accuracy achieved in wideband MRTOF mass measurements. The presently known causes of uncertainties and our approaches will be discussed.
As a new development, a campaign for studying electrostatic mirror potential distributions is now being performed based on simulations (in one and in three dimensions) with the goal to fully replace the presently used field distribution, and to enable targeting at any wanted TOF-energy dispersion required for a high mass resolving power. An approximately isochronous transport covering a range of as much as $1\,\mathrm{keV}$ of kinetic energies is anticipated. The applied method and first results of this study will be presented as an outlook to future operation.

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