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Development of a fast and highly selective ISOLDE MR-ToF device

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As experimental methods for fundamental science and applications at radioactive ion beam (RIB) facilities are expanding our scientific horizon, their demands on the quality of the RIB perpetually increase. In this regard, (isobaric) contaminants in the RIB have long been identified as a major obstacle. Indeed, when probing nuclides towards the limits of nuclear existence, an overwhelming amount of contaminants commonly prevents the study of the most exotic nuclides available at today's (low energy branches of) RIB facilities. Similarly closer to stability, applications such as medical isotope production or solid state physics suffer from sizeable contamination levels.

Multi-Reflection Time-of-Flight (MR-ToF) devices such as the one operated very successfully by ISOLTRAP [1] at ISOLDE have over the last few years gained enormously in importance at RIB facilities for mass measurements as well as mass separation. This is due to their superb performance in terms of mass resolving power $R=M/\Delta M > 10^5$ attainable in a few ms [2]. Naturally, such an MR-ToF device would be of great benefit for the entire ISOLDE community in order to provide purified beams of exotic nuclides to experimenters.
For this reason, a project to develop such a general purpose ISOLDE MR-ToF instrument has now been initiated at ISOLDE and proceeds in close collaboration with the construction of the Multi Reflection Ion Apparatus for Collinear Laser Spectroscopy (MIRACLS) [3]. The novel aspect of the ISOLDE MR-ToF device will be its unprecedented ion-beam energy of 30 keV compared to a few keV in today's instruments. Combined with advanced beam-preparation methods, this opens a path to a higher, mass separated ion flux. In this regard conventional, slower MR-ToF setups suffer from space-charge effects which compromise the superb mass resolving power when too many ions are stored in the trap simultaneously. In the ISOLDE MR-ToF device these space-charge effects are outwitted by keeping the number of ions trapped at a time below this limit but processing the mass separation significantly faster.

This poster contribution will introduce the project of the ISOLDE MR-ToF device and explain its status, challenges and potentials.

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[2] F. Wienholtz et al., Physica Scripta 2015(T166), 014,068 (2015)
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S. Lechner et al., Hyperfine Interact 240, 95 (2019)
see also poster by V. Lagaki

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