Innsbruck Physics Colloquium

Multi-Reflection Time-of-Flight Devices in Nuclear Physics and Cluster Research

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Multi-reflection time-of-flight (MR-ToF) mass spectrometers combine the high sensitivity of single-ion detection with a high resolving power due to extended flight times. Such a device has been introduced a decade ago at ISOLDE/CERN for the study of exotic atomic nuclei. The powerful method for isobaric mass selection [1] and precision mass determination [2] complements the "traditional" Penning-trap approach and is now also an established tool for the analysis of the ISOLDE beam, used for many other nuclear physics experiments.

In the meantime, another MR-ToF apparatus has been developed at Greifswald for the study of atomic clusters [3]. Figure 1 gives an overview of this particular setup, which can also serve as an illustration for the MR-ToF technique in general. The ions are guided from the source (here a laser ablation device) to the MR-ToF section, which consists of two opposing ion mirrors at the ends of a drift tube. This electrode combination is also known as "electrostatic ion beam trap" [4]. The ions can be captured and released either by switching the "trapping potential" of the mirrors or by use of the drift electrode as an in-trap potential lift [5]. Once captured, the ions bounce back and forth between the mirrors until they are released onto the detector. The high resolving power of this multireflection mode allows the disentanglement of complex mass spectra [6]. In addition, further experimental steps can be implemented such as isolation of particular species of interest [7] and laser excitation for dissociation studies [8]. Recently, the setup has been further extended [9].

The presentation will give an introduction to the MR-ToF method and an overview of the applications at ISOLDE and Greifswald.

[1] R.N. Wolf *et al.*, *Phys. Rev. Lett.* 110, 041101 (2013);
[2] F. Wienholtz *et al.*, *Nature* 498, 346 (2013);
[3] S. Knauer *et al.*, Int. J. Mass Spectrom. 446, 116189 (2019);
[4] D. Zajfman *et al.*, *Phys. Rev. A* 55, R1577 (1997);
[5] R.N. Wolf *et al.*, Int. J. Mass Spectrom. 313, 8-14 (2012);
[6] P. Fischer *et al.*, *Phys. Rev. Res.* 4, 033229 (2022);
[7] P. Fischer *et al.*, Rev. Sci. Instrum. 89, 015114 (2018);
[8] P. Fischer *et al.*, *Phys. Rev. Res.* 1, 033050 (2019);
Phys. Rev. Res. 2, 043177 (2020); Eur. Phys. J. D 77, 27 (2023);
[9] P.F. Giesel *et al.*, Rev. Sci. Instrum. 95, 023201 (2024)

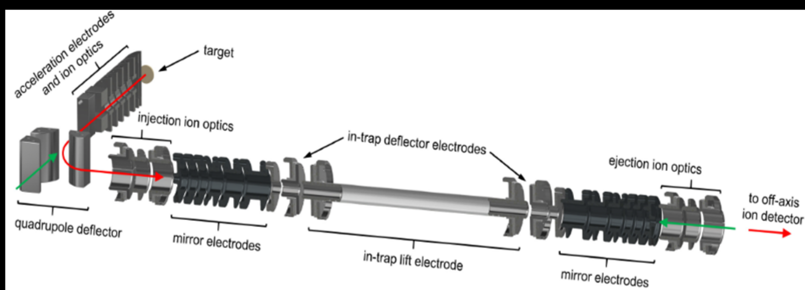

Figure 1: Experimental setup at Greifswald with laser-ablation source and MR-ToF mass analyzer

DK-ALM Pre-Talk: Shan Jin

Spectroscopy of Ionic Iron Compounds with Astrochemical Relevance

Time & Location: Tuesday, 11.06.2024, 16:30 h, HS C

Snacks will be provided in between the pre-talk and the colloquium.

Innsbruck Physics Colloquium, Organisation: K. Erath-Dulitz, H.-C. Nägerl, T. Schrabback