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Multi-reflection time-of-flight mass separation and spectrometry

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Precision mass measurements of radioactive nuclides give direct insight to one of the most fundamental properties of atomic nuclei, their binding energy. Investigating this property as a function of proton and neutron number is crucial for advancing theory in describing and predicting the structure of nuclei. Furthermore, the masses of nuclei far from stability are essential for the understanding of nucleosynthesis in supernovae and neutron stars.
Laboratory experiments are often extremely challenging due to the short half-lives and low production rates of the nuclides of interest. At the same time, longer-lived or stable contaminations are produced in orders of magnitude higher abundancies, demanding a high selectivity and resolving power of the mass spectrometer. ISOLTRAP at ISOLDE/CERN has already investigated over 500 isotopes on an uncertainty level down to dm/m=1x10-8 by use of Penning-trap techniques. To extend the range of accessible nuclides even further, the setup has been upgraded with a multi-reflection time-of-flight mass analyzer [1], see fig. 1. This device can be operated as a mass purifier or a mass spectrometer, which already allowed mass measurements for nuclear astrophysics applications [2] and tests of modern nuclear theory, i.e., valence-shell calculations based on three-nucleon forces [3]. The talk will give an overview of these developments and of recent further applications.

References
[1] R. N. Wolf et al., Int. J. Mass Spectrom., 349-350, 123-133 (2013)
[2] R. N. Wolf et al., Phys. Rev. Lett., 110, 041101 (2013)
[3] F. Wienholtz et al., Nature, 498, 346-349 (2013)

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