

ExtreMe Matter Institute EMMI

EMMI Featured Talk / GSI-FAIR Colloquium

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Precision Mass Spectrometry of Exotic Nuclei in Heavy-Ion Storage Rings



Atomic masses are among the most fundamental nuclear properties. They encode the sum of all nuclear interactions and, through irregularities in the otherwise smooth mass surface, reveal shell structure, deformation, and nucleon correlations. Furthermore, nuclear masses are an indispensable input for modelling nucleosynthesis processes. Of particular interest are the masses of the most exotic nuclei far from the valley of beta stability, which are inevitably short-lived and produced at vanishingly small rates.

Addressing such nuclei is a major experimental challenge. The measurement must be sensitive enough to detect even a single stored ion, efficient enough to study many different nuclei at the same time, precise enough to distinguish nuclear species with very similar masses, and fast enough to be compatible with half-lives of milliseconds or less. Meeting all of these requirements has motivated the development of complementary advanced mass-measurement techniques at the Experimental Storage Ring (ESR) at GSI, Darmstadt, and the Experimental Cooler-Storage Ring (CSR) at IMP, Lanzhou. Exciting results have been achieved at both facilities, while the developments have now culminated in the implementation and commissioning of the new storage ring SRing at the HIAF facility.

This presentation will discuss the requirements that mass spectrometry techniques need to meet, present the complementary strengths of the methods utilized at the ESR and CSR, and highlight recent results and the prospects for exploring increasingly exotic nuclei at HIAF and, later, FAIR.