



Contribution ID: 55

Type: Oral

Isomer and ground-state properties of stored exotic nuclei

Thursday, 24 May 2012 10:40 (20 minutes)

The ILIMA (Isomeric states, Lifetimes and Masses) collaboration at FAIR builds on experiences at GSI with the combination of the in-flight separator (FRS) [1] and the storage-cooler ring (ESR) [2] for the measurement of masses, lifetimes and decay modes of nuclear isomers and ground states. The two complementary techniques of isochronous mass spectrometry (IMS) and Schottky mass spectrometry (SMS) [3] enable masses to be measured for nuclear lifetimes below 0.1 ms (with IMS) and with an uncertainty that can be as low as 10 keV (with SMS). The decay mode of a single ion can be characterised through accurate mass determination before and after the decay event. Recent highlights include the mass of ^{208}Hg [4] determined from a single stored ion; the direct observation of a high-spin, shell-model isomer in ^{133}Sb [5]; and the discovery of long-lived high-K isomers in neutron-rich Hf and Ta isotopes [6]. The ILIMA collaboration is developing the next generation of experiments, based on the Super-FRS [7] separating and injecting exotic nuclei into new storage rings, with the overall capability to improve access to stored fragments by a factor of at least one thousand. The first new ring to be commissioned (CR) [8] will focus on measurements of the masses and lifetimes of the most-exotic proton- and neutron-rich nuclides, along the rp- and r-process nucleosynthesis pathways. Recent results and future plans will be presented.

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Session Classification: Nuclear Structure far from Stability

Track Classification: Nuclear structure far from stability