Present and future experiments with stored exotic nuclei at relativistic energies

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Abstract

Recent progress is presented from experiments on masses and lifetimes of bare and fewelectron exotic nuclei at GSI. Relativistic rare isotopes produced via projectile fragmentation and fission were separated in flight by the fragment separator FRS and injected into the storage ring ESR. This worldwide unique experimental technique gives access to all fragments with half-lives down to the microsecond range.
The great research potential is also demonstrated by the discovery of new isotopes along with simultaneous measurements of mass and lifetime. Representative results from time-resolved Schottky mass spectrometry are compared with modern theoretical predictions. The measured isospin dependence of pairing-gap energies is not reproduced by conventional mass models.

The first direct observation of bound-state beta decay has been achieved. Single particle decay measurements and the continuous recording of both stored mother and daughter nuclei open up a new era for spectroscopy. The combination of stochastic and electron cooling has allowed us to measure with Schottky analysis for the first time short-lived isomers. The future international NUSTAR facility at FAIR consisting of a new large-acceptance in-flight separator (Super-FRS) will be an ideal tool to study the *r*- and *rp*-process nuclei.

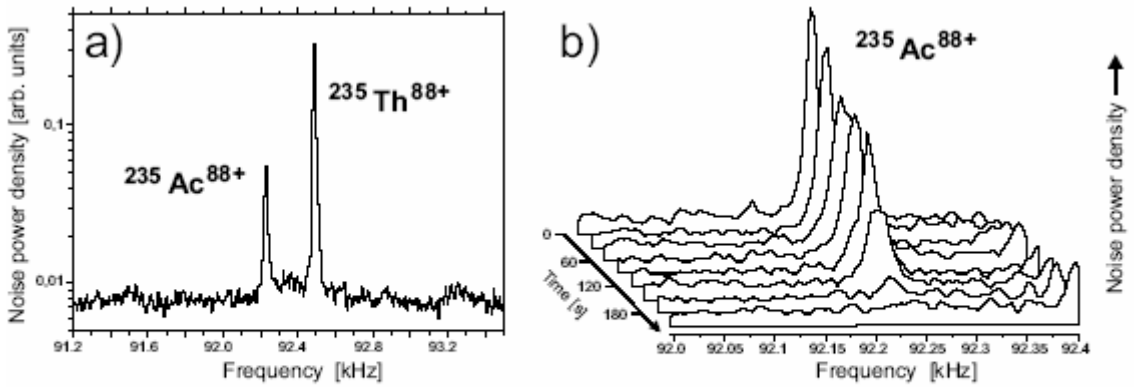

FIGURE 1. Discovery of the new isotope ^{235}Ac along with its mass and lifetime measurements applying SMS. The mass value has been extracted by calibrating with the well known mass for ^{235}Th (panel a), whereas the half-life has been extracted from the time evolution of the peak-area (panel b).