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A novel method for precision experiments with thermalized short lived nuclides produced at relativistic energies

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At the Low-Energy Branch of the Super-FRS, projectile and fission fragments will be produced at relativistic energies, separated in-flight, energy-bunched, slowed down and then thermalized in a cryogenic stopping cell (CSC) filled with ultra-pure helium gas. After extraction from the CSC the ions will be delivered to the high precision experiments MATS and LaSpec. The prototype of the CSC and the multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS), part of the MATS experiment, has been tested at the FRS Ion Catcher experiments with heavy uranium projectile fragments and fission fragments produced at 1000 MeV/u at GSI. Thermalized inos are identified and measured using alpha-spectroscopy and precision mass measurements in the MR-TOF-MS. A new record was achieved for the areal density of stopping cells operated with beam (6.3 mg/cm2), a factor of three larger than for any other stopping cell with RF structures with extraction efficiencies in excess of 60%. First direct mass measurements of several nuclides using the MR-TOF-MS at mass resolving powers of up to 400,000 were performed. Access to rare (few detected ions per hour) and very short-lived (half-lives of a few milliseconds) nuclides was demonstrated. The measurement of isomeric states with an MR-TOF-MS as isomer separator was demonstrated for the first time, thus open up a unique perspective for isomer-resolved studies. Results from the online experiments and the design of final CSC will be presented and discussed in detail.

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