MASS MEASUREMENTS OF RARE ISOTOPES WITH A SINGLE ION

Georg Bollen[1,2], Martin Eibach[1,3], Kerim Gulyuz[1], Christopher Izzo[1,2], Ryan Ringle[1], Rachel Sandler[1,2], Stefan Schwarz[1], Adrian Valverde[1,2]

[1] Facility for Rare Isotope Beams, Michigan State University, East Lansing, Michigan 48824, USA
[2] Department of Physics and Astronomy, Michigan State University, East Lansing, Michigan 48824, USA
[3] Institut für Physik, Ernst-Moritz-Arndt-Universität, 17487 Greifswald, Germany

In fundamental science high-precision nuclear mass measurement data is an integral part in several different fields. Calculations of the astrophysical r-process, nuclear structure studies, and investigations of fundamental interactions require mass measurements of rare isotopes. Particularly challenging are mass measurements far away from stability, where the production rates can be very small.

Heavy-ion fragmentation and subsequent in-flight separation is employed at the National Superconducting Cyclotron Laboratory (NSCL) for the production of rare isotopes. At NSCL high-precision mass measurements of rare isotopes are performed with the Penning trap mass spectrometer LEBIT which uses the well-understood, but destructive, time-of–flight ion cyclotron resonance (TOF-ICR) technique. This universal technique requires minimal effort to change from one ion species to another but needs on the order of hundred detected ions for a single measurement.

As one moves further from the valley of stability, production rates of the exotic isotopes decline. In order to access rare isotopes being delivered at rates of about 1 ion/hour or less, a more sensitive technique is required. Therefore, the Single Ion Penning Trap (SIPT) is being developed at NSCL enabling high-precision mass measurements with a single ion using the Fourier-Transform Ion Cyclotron Resonance (FT-ICR) technique. It aims for mass measurements around double magic rare isotopes far away from stability where the half-lives are usually sufficiently long for FT-ICR measurements. SIPT is currently under construction and ions have been sent through the beam line and detected in front of the magnet.