International Conference on Electromagnetic Isotope Separators and Related Topics (EMIS 2015)

Contribution ID: **110** Type: **Poster Presentation**

Mass Measurements of Rare Isotopes with a Single Ion

Monday, 11 May 2015 16:30 (0 minutes)

Several scientific applications require high-precision mass data. In particular calculations of the astrophysical r-process, nuclear structure studies, tests of nuclear mass models, and fundamental interactions are examples with very high impact. Mass measurements of radioactive nuclides are particularly challenging as the production rates decrease with increasing distance from stability

Rare isotopes are produced at the National Superconducting Cyclotron Laboratory (NSCL) by relativistic heavy-ion fragmentation and in-flight separation. This fast, chemically-insensitive production technique provides access to nuclei far from stability. The new Facility for Rare Isotope Beams (FRIB) under construction at MSU will provide even more exotic isotopes.

High-precision mass measurements of rare isotopes are performed at NSCL by the Penning trap mass spectrometer LEBIT, being the only one worldwide located at a fast beam facility, using the well-known time of flight ion cyclotron resonance (TOF-ICR) technique. This very universal technique requires minimal effort to change from one ion species to another. However, a single resonance curve requires on the order of 100 detected ions. As one moves further from the valley of beta stability, production rates of the exotic isotopes typically decline and a more sensitive technique is needed in order to access rare isotopes being delivered at rates of about 1 ion/hour, or less. Thus, the Single Ion Penning Trap project (SIPT) is being developed at NSCL allowing for high-precision mass measurements with a single ion employing the narrow-band Fourier-Transform Ion Cyclotron Resonance (FT-ICR) technique. It aims for mass measurements in the neutron-rich region where half-lives are usually sufficiently long for FT-ICR measurements. SIPT is being implemented in a 7-T superconducting magnet sharing the beam line with LEBIT. An optimal signal-to-noise ratio is ensured by employing a superconducting NbTi resonator coil, and by cooling the trap and detection electronics down to 4.2K with a pulsed-tube cooler.

With this combination of isotope production by fragmentation, and the complementary use of mass measurements with FT-ICR at SIPT as well as TOF-ICR at LEBIT, the reach of Penning trap mass spectrometry will be greatly enhanced at the NSCL now, and at FRIB in the future.

Primary author: Dr EIBACH, Martin (National Superconducting Cyclotron Laboratory)

Co-authors: Mr VALVERDE, Adrian (Michigan State University / National Superconducting Cyclotron Laboratory); Mr IZZO, Christopher (National Superconducting Cyclotron Laboratory/ Michigan State University); BOLLEN, Georg (Michigan State University); Dr GULYUZ, Kerim (NSCL); Dr REDSHAW, Matthew (Central Michigan University); Ms SANDLER, Rachel (National Superconducting Cyclotron Laboratory/Michigan State University); Dr RINGLE, Ryan (NSCL); Dr SCHWARZ, Stefan (NSCL)

Presenter: Dr EIBACH, Martin (National Superconducting Cyclotron Laboratory)

Session Classification: Poster Session A