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SWIFT beam purification at LEBIT

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In high precision Penning trap mass spectrometry of rare isotopes, beam purity is an important consideration when making measurements because the contamination of the ions of interest with other particles results in a shift of the measured mass. This is of particular concern at the Low Energy Beam and Ion Trap (LEBIT) facility [1] at the National Superconducting Cyclotron Laboratory - a rare isotope beam facility utilizing particle fragmentation - as molecular contaminant ions with similar charge-to-mass ratios can be created in the beam thermalization process. Previously, beam purification at LEBIT has relied on the use of dynamic capture in the Penning trap as a time-of-flight mass separator, and on dipole cleaning [2]. Dipole cleaning relies on driving contaminant ions to a sufficiently large radius so that they do not interfere with the measurement through the quick dipolar excitation of specific contaminants at their specific reduced cyclotron frequencies. This requires the identification of all contaminants, an inefficient use of rare isotope beam time. The stored waveform inverse Fourier transform (SWIFT) [3] beam purification technique, which has been recently implemented in the 9.4 T LEBIT Penning trap mass spectrometer [4], offers a method of exciting a range of frequencies, providing for broadband excitation in a user-defined mass range as an alternative to the dipole cleaning method already in use at LEBIT. We will discuss both the implementation of SWIFT at the LEBIT facility, as well as its use in recent rare isotope beam experiments.

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[3] S. Guan and A. G. Marshall, Int. J. Mass Spectrom.157-158 5 (1996)
[4] A. A. Kwiatkowski et al, Int. J. Mass Spectrom. (2014)

Primary author: Mr VALVERDE, Adrian (Michigan State University / National Superconducting Cyclotron Laboratory)

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

Presenter: Mr VALVERDE, Adrian (Michigan State University / National Superconducting Cyclotron Laboratory)

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