

Penning traps are one of the most important recent developments in mass spectrometry, and have been used successfully in the study of stable particles and short-lived, rare isotopes. The Low Energy Beam and Ion Trap facility (LEBIT) at NSCL was the first to implement Penning trap mass spectrometry at a high-energy, rare-isotope facility using projectile fragmentation. LEBIT was designed to be efficient and sensitive in order to make optimal use of the most exotic beams available at NSCL. Contaminant isotopes of similar masses also enter the trap and need to be identified and cleaned before recording data. To optimize experimentation time the stored waveform inverse Fourier transform (SWIFT) was implemented to quickly clean contaminants from the trap. This method removed the need to individually identify specific contaminants by application of a broadband cleaning RF excitation. The ion of interest will only respond to a very narrow band excitation, and every contaminant will be cleaned by applying an RF field at all other frequencies. This study was carried out to characterize the application of SWIFT to high-precision Penning trap mass spectrometry. In offline tests with ^{39}K ions, a resolving power of 7,400 was demonstrated and resolving powers of $>10^5$ are possible.