

Status and Further Development of the Single Ion Penning Trap (SIPT) Mass Spectrometer

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Precision mass measurements are necessary in almost all aspects of nuclear physics, including nuclear structure, nuclear astrophysics, and fundamental symmetries. Currently, the Low Energy Beam and Ion Trapping (LEBIT) facility employs two well-established techniques: Time-of-Flight Ion Cyclotron Resonance (TOF-ICR) and Phase-Imaging Ion Cyclotron Resonance (PI-ICR). While these two techniques perform well for precision measurements, the drawback is that they require tens to hundreds of ions to produce the measurement. With the Facility for Rare Isotope Beams (FRIB) now online, new rare isotopes are being produced, albeit at very low rates. In order to best use these rates, a different measurement technique called Fourier-Transform Ion Cyclotron Resonance (FT-ICR) is to be used in the Single Ion Penning Trap (SIPT) system. This technique is non-destructive and can theoretically be done with one ion. The system was commissioned, and general studies were produced, including a proof of concept measurement of $\text{Rb}85^+$. From these studies, there is a clear path forward for further hardware development to improve the sensitivity of the system. Additionally, progress has been made with using machine learning algorithms to aid with the analysis process. The recent progress will be reviewed, and the path forward for SIPT will be discussed.

Author: ERINGTON, Hannah (Facility for Rare Isotope Beams (Michigan State University))

Co-authors: IRELAND, Christian (Michigan); BOLLEN, Georg (Michigan State University); RINGLE, Ryan (Michigan State University); Mr CAMPBELL, Scott (Michigan State University, Facility for Rare Isotope Beams); MAIER, Franziska (Facility for Rare Isotope Beams)

Presenter: ERINGTON, Hannah (Facility for Rare Isotope Beams (Michigan State University))

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