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SIPT—An Ultrasensitive Mass Spectrometer for Rare Isotopes¹

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Over the last few decades, advances in radioactive beam facilities like the Coupled Cyclotron Facility at the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University (MSU) have made short-lived, rare-isotope beams available for study in various science areas, and new facilities, like the Facility for Rare Isotope Beams (FRIB) under construction at MSU, will provide even more exotic rare isotopes. The determination of the masses of these rare isotopes is of utmost importance since it provides a direct measurement of the binding energy of the nucleons in the atomic nucleus. For this purpose we are currently developing a dedicated Single-Ion Penning Trap (SIPT) mass spectrometer at NSCL to handle the specific challenges posed by rare isotopes. These challenges, which include short half-lives and extremely low production rates, are dealt with by employing the narrowband FT-ICR detection method under cryogenic conditions. Used in concert with the 9.4-T time-of-flight mass spectrometer, the 7-T SIPT system will ensure that the LEBIT mass measurement program at MSU will make optimal use of the wide range of rare isotope beams provided by the future FRIB facility, addressing such topics as nuclear structure, nuclear astrophysics, and fundamental interactions.

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