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Status update on the next-generation Penning-trap mass spectrometry at TITAN

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Mass spectrometry plays an important role in many fields of physics research such as nuclear astrophysics, nuclear structure, and fundamental symmetries. Precise knowledge of masses is critical to these studies. For example, a relative mass precision of ≤10^-8 is required to probe the Standard Model and beyond. This level of precision with radioactive species has been achieved only with Penning trap mass spectrometry. Penning trap mass spectrometry relies on measuring the cyclotron frequency of an ion in a homogeneous magnetic field. Coupling the Penning trap to a charge breeder allows for further improvement in precision by boosting the charge state of the ions. In order to extend storage time of these highly charged ions, the TITAN Penning trap system has been upgraded recently to cool the trap to cryogenic temperatures using cryoabsorption and cryocondensation, attaining a vacuum of ~10^-11 mbar. Consequently, a complete characterization of the cryogenic trap, including a study of its error budget and a verification of its accuracy, are being performed. In parallel, a phase-based technique to determine the frequency is being implemented which will allow the TITAN Penning trap mass spectrometer to achieve relative precisions <10^-9. The characterization of the cryogenic trap and the upgrade towards phase-based frequency determinations will be presented.

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