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New Developments in Penning Trap Mass Spectrometry

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Penning trap mass spectrometry is presently the method that provides masses of stable and short-lived nuclides with unrivaled accuracy. Even in the case of exotic radionuclides a ppm precision level has been reached in certain cases. Recent advances in gas stopping and advanced ion manipulation techniques have opened the door to access radioisotopes of essentially all elements. However, for rare isotopes in addition to a high precision, also short measurement times and highest sensitivity are crucial to maximize the reach towards nuclides far off stability. Recently several developments have been performed to address these issues. The novel phase-imaging ion-cyclotron-resonance (PI-ICR) technique for high-precision mass measurements has been developed at SHIPTRAP at GSI Darmstadt. It provides an increase in resolving power by a factor of forty and a gain in precision by a factor of five. This has been demonstrated for example in a recent measurement of the mass difference ^{187}Re - ^{187}Os with a precision of only 30 eV. Nondestructive electronic detection techniques, well established for ultraprecise measurements of fundamental properties, are being extended to radionuclides and will eventually allow mass measurements with only single ions. Such systems are presently under development for TRIGATRAP, SHIPTRAP, and LEBIT. In my presentation I will summarize the recent methodical and technical developments and present selected results of recent mass measurements.

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