High-precision mass measurements of neutron-rich Cd, Kr, Zn, and Sn radionuclides with the Penning trap mass spectrometer ISOLTRAP

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The mass is one of the required parameters for the investigation of nuclear structure and element formation as described by the nucleosynthesis. Being closely related to the binding energy, the mass characterizes the nuclide and gives valuable information, e.g., with respect to the Q-value for possible decays or excitation energies. Since most of the nuclides of interest are short-lived and production yields decrease far away from the valley of stability, the experimental determination of precise and accurate mass values is a challenge.

In general, Penning trap mass spectrometers have proven to allow very precise mass measurements [1,2]. ISOLTRAP at ISOLDE/CERN, as the prototype experiment for the investigation of the atomic mass of short-lived nuclides, can reach a relative mass uncertainty with a lower limit of $\delta m/m = 8 \times 10^{-9}$ [3]. The atomic masses of neutron-rich zinc, krypton, tin and cadmium isotopes have been determined within the last two years, where the masses of ^{79,81}Zn and ^{94,95}Kr were measured for the first time and many mass values were improved by at least one order of magnitude.

These neutron-rich nuclides are of importance especially for the investigation of the r-process, where elements heavier than iron are formed by rapid neutron capture. The path of the r-process is determined by and reflects nuclear structure. For example at the neutron shell $N = 50$ it crosses through the waiting point nuclide ^{80}Zn. The doubly magic nuclide ^{132}Sn ($Z = 50$, $N = 82$) represents another waiting point nuclide. As for these prominent cases and the surrounding neutron-rich nuclides, slight deviations in the experimental parameters, e.g., the nuclear mass, can lead to large discrepancies in the modeling of the subsequent nucleosynthesis processes. A summary of recent mass-measurement results as well as preliminary data from the latest beam times will be presented and their application discussed.

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