Nuclear structure effects probed by precision atomic mass measurements*

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The atomic mass of a nucleus is a fundamental property, which carries information on masses of its constituents and the binding energy. The latter is directly connected to both macroscopic and microscopic structure of the nucleus. Thus precise mass measurements may reveal information, which by other means would not be accessible. In nuclear astrophysics, the binding energies are one of the most important ingredients for reliable calculations. They affect the rates of the relevant reactions and they influence the time-scale and energy production of nucleosynthesis. In high temperature conditions, they adjust the balance, which defines the process paths. Precision measurements provide important data for fundamental studies of the weak interaction. Of particular interest are measurements related to super-allowed beta decays, which test the CVC hypothesis and the unitarity of the CKM-matrix [1].

Accurate mass measurements have been restricted to stable or almost stable nuclei for a long time. A combination of the ISOL-method and Penning trap technology has opened up the possibility to extend direct precision measurements to radioactive isotopes, as exemplified by the ISOLTRAP experiment at ISOLDE-CERN [2]. In JYFL we have introduced a complementary approach, where Penning trap technology on mass spectrometry has been coupled to the IGISOL-technique. Thus precision studies of atomic masses can be expanded to short-lived exotic isotopes without target-ion source chemistry related restrictions [3].

A Penning trap is well suited for mass spectroscopy, since radial eigenmotions in the trap sum up to a cyclotron motion, the frequency which in the given magnetic field is mass dependent ($\omega_c = \left(q/m \right) B$). By measuring periodically the cyclotron frequency of the unknown isotope and a well known reference ion, it is possible to deduce the mass of the unknown isotope with accuracy in the range of a few keV. In this contribution, the measurement technique will be shortly described.

Since commissioning of the JYFLTRAP facility we have performed numerous studies. We will review the mass measurements of neutron-rich nuclei in the transitional region from Kr (Z=36) to Pd (Z=46) nuclei [4], where more than 50 atomic masses has been recently measured at JYFL. This region offers an interesting playground to look for nuclear structure signatures in the mass surface. The results are discussed in comparison to other spectroscopic information and theoretical studies. In addition, we will compare our results to the recent Atomic Mass Evaluation [5]. The observed local deviations of tabulated values from precision measurements will be discussed.

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