Nuclear Masses and their Importance for Nuclear Structure Studies

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The mass of the nucleus reflects the total energy of this many-body system and thus is a key property for a variety of nuclear structure investigations. It is obvious that the knowledge of nuclear masses is indispensable for developing the theory of the nucleus.

Modern experimental techniques, like storage ring or Penning trap mass spectrometry, have pushed in recent years the limits of sensitivity, resolution and accuracy. This has allowed to access exotic species very far from the valley of beta-stability. This could be done due to tremendous progress in production and preparation techniques for short-lived nuclides, e.g. by new target and ion sources combinations and the development of a multi-reflection time-of-flight separator.

The use of new manipulation techniques for stored ions has improved the resolving power by almost two orders of magnitude giving access to low lying isomeric states. The mass accuracy achieved even for very short-lived species in the ms regime and below allowed, e.g., to probe the shell structures and their evolution toward the neutron dripline or to perform in some regions fine examinations of the mass surface. The latter includes many exciting results like, for instance, an intriguing observation in the heavy mass region reflecting either a $N = 134$ subshell closure or an octupolar deformation, testing of isospin symmetry in mirror nuclei, behavior of proton-neutron interaction across the closed shells, sensitivity of masses to collective structure of the nucleus and many others.

In this review recent trends in the determination of nuclear masses, their impact on nuclear structure studies and the comparison to modern calculations will be presented.