Overview of the recent high-precision mass measurements at TRIGA-TRAP

C. Smorra[1,2], T. Beyer[2], K. Blaum[2], M. Block[3], Ch. E. Düllmann[3,4,5], K. Eberhardt[4,5], J. Grund[4], Sz. Nagy[2], W. Nörtershäuser[2,3,6], D. Renisch[2], F. Schneider[2,7], and K. Wendt[7]

[1] CERN, CH-1211 Geneva 23, Switzerland
[2] Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg
[3] GSI Helmholtzzentrum für Schwerionenforschung, Planckstrasse 1, D-64291 Darmstadt
[4] Institut für Kernchemie, Johannes Gutenberg-Universität, Fritz-Strassmann-Weg 2, D-55128 Mainz
[5] Helmholtz-Institut Mainz, Johann-Joachim-Becher-Weg 36, D-55128 Mainz
[6] Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany
[7] Institut für Physik, Johannes Gutenberg-Universität, 55128 Mainz, Germany

Highly-precise measurements of atomic masses in Penning traps provide important insights into various fields in physics. Recently, the Penning-trap mass spectrometer TRIGA-TRAP has pursued mass measurements for two different purposes. One set of measurements is dedicated to provide more accurate information on the mass surface in the region of transuranium elements, and the second one to determine Q-values of beta transitions relevant for neutrino physics experiments.

The experimental mass data of nuclides beyond uranium is strongly relying on the decay chains anchored to several uranium isotopes, since direct mass measurements in this region are scarce. The decay energy measurements in these chains can be affected by insufficient information on the level schemes and decay paths. By determining the mass of a nuclide in measurements of the cyclotron frequency ratio of the ion of interest to carbon cluster ions $^{12}C_n^+$, direct links of the mass surface to the atomic mass standard are provided. Thereby, the precision of atomic masses is improved up to the heaviest elements.

In neutrino physics, the end-points of beta decay or electron capture spectra are studied to constrain the neutrino mass. Furthermore, experiments are undergoing the search for neutrinoless double-beta transitions to investigate the Majorana character of the neutrino. In both cases, precise Q values of the studied transitions are required to constrain the end-points of the decay spectra, the position of neutrinoless double-beta decay signals, or the decay constants of the involved transitions. The latter is particularly important for nuclides that could possibly undergo neutrinoless double-electron capture, where the decay rate may be resonantly enhanced in case of energy degeneracy between the ground state in the mother nuclide and an excited two-electron hole state in the daughter nuclide.

In my talk, I will present an overview of the recent mass measurements at TRIGA-TRAP and their physics applications.