Int. Workshop “Shapes and Dynamics of Atomic Nuclei: Contemporary Aspects”
ed. Nikolay Minkov, Heron Press, Sofia 2021

Mass measurements at the FRS Ion Catcher and their application to nuclear structure studies

D. Amanbayev for the FRS Ion Catcher Collaboration
Justus-Liebig-Universität Gießen, D-35392 Gießen, Germany

Abstract

The FRS Ion Catcher (FRS-IC) enables precision experiments with thermalized exotic nuclei produced and separated in-flight in the Fragment Separator (FRS) at GSI. An unprecedented mass resolving power of almost 1000000 was achieved with the multiple-reflection time-of-flight mass-spectrometer (MR-TOF-MS) of the FRS-IC. Such high resolving power provides an exceptional opportunity to measure masses of short-lived exotic nuclei with down to few tens of keV uncertainty.

The results of experiments focused on various regions of the nuclide chart will be presented. These include:

- Several masses measured directly for the first time allowed to examine the evolution of two-neutron separation energy in a region above ^{208}Pb. Masses of ^{204}Au and ^{205}Au measured for the first time revealed deviations of up to 2.5σ compared to Atomic Mass Evaluation 2020 (AME20) extrapolated values. This resulted in a large change in the two-neutron separation energy at N=126.

- In the vicinity of ^{100}Sn, an isomeric state in ^{97}Ag was discovered for the first time using an MR-TOF-MS. This discovery was supported by mean-field calculations. The comparison of measured excitation energies of the 1/2$^-$ isomers in odd indium isotopes $^{101-109}$In with shell-model calculations showed the importance of including core excitations around ^{100}Sn.

- Direct mass measurements in the vicinity of ^{70}Br allowed to study a proton-neutron interaction strength in N = Z region and provide a hint regarding the 500 keV discrepancy in the mass value of ^{70}Br, which impacts the Ft world average value for the superallowed $0^+ \rightarrow 0^+$ β-decays.

- A special mid-shell region above ^{100}Sn forms an island of nuclei with an α-decaying branch - Te, I, Xe, Cs, and Ba. Mass measurements of ^{114}I and ^{116}I allowed to estimate the α-decay partial half-life of ^{114}I with 2 orders of magnitude lower $\pm 1\sigma$ uncertainty and thus redefined the heaviest reported such an isotope of iodine which used to be ^{113}I.