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High-Resolution Mass Measurements at the FRS Ion Catcher in the vicinity of 100Sn

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The study of exotic nuclei far from the valley of stability provides basic information for a better understanding of nuclear structure and the synthesis of the elements in the universe. It is of special interest to probe the edges of stability with their unexpected and novel properties. The nucleus ^{100}Sn is the heaviest self-conjugate doubly-magic nucleus in the chart of nuclides, and therefore, attracts a broad interest from both fields, experimental and theoretical nuclear physics. The experimental access to ^{100}Sn is still limited, most of the data obtained originate from nuclei in its vicinity. Therefore, the knowledge of their detailed structure is essential in understanding this region of the chart of nuclides.

At the FRS Ion Catcher [1] at GSI precision experiments on exotic nuclei are performed with the combination of a cryogenic stopping cell (CSC) and a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS). This setup enables to perform high precision mass measurements with the MR-TOF-MS of thermalized exotic ions produced at relativistic energies with mass resolving powers (FWHM) of up to 1,000,000 and relative mass uncertainties down to $1.7 \cdot 10^{-8}$ [2].

The nuclei ^{97}Ag and $^{101-109}$In and their long-living isomeric states were investigated in previous experiments [3]. In the isotope ^{97}Ag, a long-lived ($1/2^-$) isomeric state was discovered, and its excitation energy was determined to be 618(38) keV. This marks the first discovery of a nuclear isomeric state by an MR-TOF-MS. The properties of nuclear isomers are significant for the understanding of nuclear structure because they provide stringent tests for nuclear models. The measured excitation energies were compared to large-scale shell-model calculations, which indicate the importance of core excitation around ^{100}Sn. Furthermore, advanced mean-field calculations for the ^{97}Ag nucleus and relevant neighboring nuclei were performed, which support the discovery of the isomeric state in ^{97}Ag in a global shell-evolution scheme.

References:

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