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Penning-trap mass spectrometry and search for long-lived isomers in neutron-deficient Au and At isotopes

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Various experiments on neutron-deficient isotopes around the magic proton number Z = 82 suggest a complex behavior in the proton-neutron valence space. The occupation of intruder proton orbitals leads to shape coexistence, or sudden transitions from spherical or slightly-deformed to deformed shape. One important example is the shape transition which occurs in the Au isotopic chain at mass number A = 186 and persists as neutrons are further removed from the nucleus.

We present here recent ISOLTRAP measurements of the ground-state and isomer masses of neutron-deficient Au (Z = 79) and At (Z = 85) isotopes, below and around the neutron subshell N = 112. These measurements address the onset of collectivity observed in this region of the nuclear chart.

Isomers have already been studied with ISOLTRAP's Penning traps, using their high resolution to determine the ordering of the nuclear states, as well as the corresponding excitation energies. The results presented here were completed by an investigation of the hyperfine structure of the measured isotopes. This was achieved, in collaboration with RILIS, by using the new ISOLTRAP multi-reflection time-of-flight mass separator (MR-TOF MS). The high separation power of the MR-TOF MS offers the possibility of in-source laser spectroscopy with reduced or, in many cases, no background from contaminating ions. Together with the advantages of using direct ion detection, the MR-TOF MS offers a complementary approach to conventional decay-based detection methods.

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