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Shape Coexistence in Gold, Mercury and Bismuth Isotopes Studied by In-source Laser Spectroscopy at RILIS-ISOLDE

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The competition between spherical and deformed configurations at low energy gives rise to shape coexistence in the neutron-deficient isotopes around Z~82 and N~104 [1]. Along the isotope chain of a number of elements this leads to an abrupt change in the mean-square charge radius of the nuclear ground state when entering the neutron-deficient region. The most notorious case is the shape staggering in the Hg isotopes [2]. An extended experimental campaign to study the mean-square charge radii of the ground and isomeric states of these nuclides, and thereby investigating such regions of nuclear shape changes, is being conducted at ISOLDE by the RILIS-Windmill-ISOLTRAP collaboration. The measurements rely on the high sensitivity achieved by combining in-source laser resonance ionization spectroscopy, ISOLDE mass separation, the Windmill spectroscopy setup [3] and the Multi-Reflection Time-of-Flight (MR-ToF) mass separation technique [4].
In this contribution, we will present the systematics of charge radii and electromagnetic moments recently obtained at ISOLDE for the long isotopic chains of gold (IS534), mercury (IS598) and bismuth isotopes (IS608). For the lightest Au isotopes, a persistence of the strong deformation up to 180Au was demonstrated for the first time, followed by what we call a 'jump back to sphericity', whereby 176mg,177,179Au possess much lower deformation compared with strongly deformed 180-186Au. For the Hg chain, a termination of shape staggering and transition to more spherical shapes in the lightest 177-180Hg isotopes were deduced. A large odd-even shape staggering at 187-189Bi, similar to the well-known staggering in the Hg isotopes, was observed at the same neutron number. These three chains clearly demonstrate striking similarities in the shape staggering and shape changes when approaching the neutron mid-shell at N=104, while the lightest gold and mercury chains show the strong tendency towards the smooth nearly-spherical behavior. The data will be compared to mean-field based calculations and discussed within a generic shell-model approach for shape coexistence.
References:
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