

Investigating the nuclear structure of the heaviest elements with the SHIPTRAP mass spectrometer @GSI

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Abstract

Probing the limit of existence at the uppermost corner of the nuclear chart requires a deep understanding of the nuclear properties of very heavy nuclides and their evolution in the superheavy region. Superheavy nuclei owe their existence to nuclear shell effects, which enhance their stability. The latter is also expressed in terms of increased binding energies, which can be experimentally investigated through direct mass measurements performed with Penning traps, providing information on the nuclear shell structure.

Moreover, heavy and superheavy nuclides feature often metastable excited states with half-lives that can exceed the one of the ground state. Long-lived isomeric states can have excitation energies of only few tens of keV or below, therefore, their identification is challenging, especially in decay-based measurements. On the other hand, Penning trap mass spectrometry can provide sufficient resolving power to allow the separation of isomeric states when they are populated in the same reaction as the ground state.

In recent years, we have established tailored and highly sensitive experimental methods allowing us to extend the reach of Penning-trap mass spectrometry with the SHIPTRAP setup to heavy elements well beyond uranium. In my talk, I will review the latest mass measurements of nuclides up to $Z=105$, obtained as part of the FAIR phase-0 campaigns.