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Probing the fission-landscape and the structure of superheavy nuclei

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Superheavy nuclei (SHN) with an extremely large number of protons (e.g., up to Z = 126) remain to be one of the main topics in nuclear physics [1]. One of the ultimate goals of this research is to explore the fission-stability of SHN at around Z = 114 – 126 and N = 184, where the next shell closures are predicted to occur [1]. The fission half-lives of those SHN were predicted to be much longer than the half-lives of neighboring ones. Accordingly, the fission-landscape of SHN regarding the half-lives should form an island in a sea of instability.

To date, SHN with Z up to 118 and neutron numbers up to N = 177 are known [2,3]. They were synthesized mostly in heavy-ion induced reactions with atom-at-a-time rates and were identified predominantly by their α-particle emission and rarely by fission. Corresponding experimental data, e.g., partial half-lives of these radioactive decays, confirm the concept of the island of stability.

However, still many properties of the SHN, such as their shell structure and its impact on their radioactive decay modes, which are necessary for building a more complete picture of the nuclear stability-landscape are poorly known [4-7]. This circumstance has a primary reason, which is the lack of comprehensive experimental spectroscopy data on their nuclear decays, such as the β-decay, α-decay fine structure and fission.

Intensive programs aimed at exploring the fission-landscape and the shell structure of SHN are ongoing world-wide, including the SHE-Chemistry department at GSI, Germany [8].

I will present the status and recent results of exploring the fission-landscape of SHN.

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