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Super-Heavy Elements: Theoretical Perspective[1]

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The superheavy nuclei represent the limit of nuclear mass and charge; they inhabit the remote corner of the nuclear landscape whose extent is unknown. The discovery of new elements with $Z \geq 110$ has brought much excitement to the atomic and nuclear physics communities. The very existence of nuclei that are so heavy hangs on a subtle balance between the attractive nuclear force and the disruptive Coulomb repulsion between protons that favors fission. In this work, we model the interplay between strong and electromagnetic interactions using the self-consistent energy density functional theory, which can describe the phenomenon of the spontaneous breaking of spherical symmetry. We predict that the long-lived superheavy elements can exist in a variety of shapes, including spherical, axial, and triaxial. In some cases, we anticipate the existence of metastable states and shape isomers that can affect decay properties; hence nuclear half-lives.

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