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Nuclear properties at neutron-rich region

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Nucleosynthesis heavier than iron is critically driven by the rapid neutron capture process (r-process), where atomic nuclei capture neutrons faster than they undergo beta decay. The r-process requires a neutron-rich environment and involves the formation of neutron-rich nuclei. This study investigates the physical properties of neutron-rich nuclei, focusing on octupole deformation and the neutron drip line.

In this work, we employed Skyrme-type density functional theory and have performed systematic calculations using the HFBTHO code (the Skyrme-Hartree–Fock–Bogolyubov solver using the harmonic oscillator basis), that is able to describe axially symmetric deformations without reflection symmetry. This presentation will focus on nuclei in the actinide region, which are known to exhibit octupole deformation. We will report the changes of canonical single-particle neutron energies as a function of octupole deformation.

Additionally, we explored the connection between the limits of nuclear existence in neutron-rich regions and the influence of electromagnetic interaction. Our findings demonstrate that electromagnetic force can expand the neutron drip line in multiple nuclei. The mechanisms of this phenomenon will be reported from a quantum mechanical perspective.

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