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Surface and Curvature Tensions of Cold, Dense Quark Matter under Compact Star Conditions

Understanding the microphysical properties of cold, dense quark matter is crucial for modeling the interior of compact stars. In this work, we study the surface and curvature tensions of three-flavor quark matter under conditions relevant to different astrophysical scenarios, including cold neutron stars, proto-neutron stars, and post-merger remnants. The analysis is performed within the Nambu–Jona-Lasinio (NJL) model with vector interactions, imposing weak equilibrium and both local and global electric charge neutrality. Finite-size effects are incorporated via the multiple reflection expansion formalism. We explore how the surface and curvature tensions depend on temperature and the presence of trapped neutrinos (modeled through their chemical potential), as well as on key parameters such as the vector coupling ratio η_V, the droplet radius R, and the charge-per-baryon ratio ξ. Our results provide input for future studies of phase transitions and structured phases in dense quark matter under compact star conditions.

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