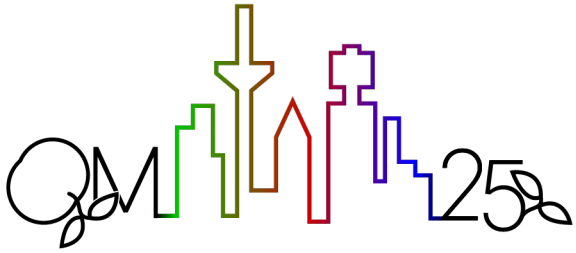

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Color-superconducting phases in compact stars within the RG-consistent NJL model

We explored the astrophysical properties of compact stars in the framework of renormalization Group (RG)-consistent three-flavor color superconductivity (CSC) using the Nambu-Jona-Lasinio (NJL) model with a Renormalization Group (RG)-consistent approach. We analyzed how variations in the vector interaction coupling (η_V) and diquark coupling (η_D) affect the equation of state (EoS), gap parameters, the 2SC and CFL phases, and the speed of sound. Our results show that stronger diquark and vector couplings stiffen the EoS, leading to higher maximum masses for compact stars, satisfying the 2.0 $M_\odot$ constraint from heavy neutron star observations. We found that the CFL phase is stable within our RG-consistent approach and that the speed of sound exceeds the conformal limit for non-vanishing vector couplings. Additionally, our analysis suggests that the mass-radius relationship of quark stars varies from self-bound configurations to gravitationally bound ones, with no absolutely stable configurations across the entire parameter space. Based on the observation that in a possible hybrid construction to our model, 2.0 $M_\odot$ can be mostly reached if the pure quark branch can already support 2.0 $M_\odot$, we find the parameter range that satisfies this condition. We found that within all our studied parameters, the maximum mass configurations always have a CFL core.

Category

Theory

Collaboration (if applicable)

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