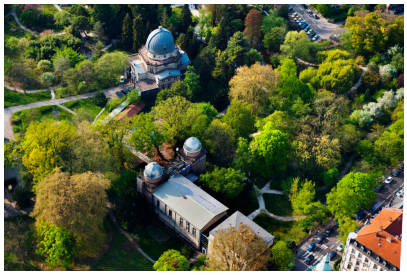

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Bulk Viscosity of Two-Flavor Color Superconducting Quark Matter in Neutron Star Mergers

Wednesday 29 October 2025 11:45 (25 minutes)

This work investigates the bulk viscosity of warm, dense, neutrino-transparent, color-superconducting quark matter, where damping of density oscillations in the kHz frequency range arises from weak-interaction-driven direct Urca processes involving quarks. We study the two-flavor red-green paired color-superconducting (2SC) phase, while allowing for the presence of unpaired strange quarks and blue color light quarks of all flavors. Our calculations are based on the SU(3) Nambu-Jona-Lasinio (NJL) model, extended to include both vector interactions and the ‘t Hooft determinant term. The primary focus is on how variations in the NJL Lagrangian parameters - specifically, the diquark and vector coupling strengths - affect both the static properties of quark matter, such as its equation of state and composition, and its dynamical behavior, including bulk viscosity and associated damping timescales. We find that the bulk viscosity and corresponding damping timescale can change by more than an order of magnitude upon varying the vector coupling by a factor of two at high densities and by a lesser degree at lower densities. This sensitivity primarily arises from the susceptibility of 2SC matter, with a smaller contribution from modifications to the weak interaction rates. In comparison, changes in the diquark coupling have a more limited impact. The damping of density oscillations in 2SC matter is similar quantitatively to nucleonic matter and can be a leading mechanism of dissipation in merging hybrid stars containing color superconducting cores.

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