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Radial Oscillations in Hybrid Stars: Investigating Slow Quark Phase Transition

This study delves into the radial oscillations of hybrid neutron stars, which possess a unique structure comprising hadronic external layers and a quark matter core. Using a density-dependent relativistic mean-field model incorporating hyperons and Δ baryons to describe hadronic matter, along with a density-dependent quark model for quark matter, we explore the ten lowest eigenfrequencies and their corresponding oscillation functions. Our investigation centers on neutron stars with equations-of-state involving N, N+Δ, N+H, and N+H+Δ, featuring a phase transition to quark matter.

A key focus is on the effects of a slow phase transition at the hadron-quark interface. We observe that the maximum mass is reached before the fundamental mode's frequency decreases for slow phase transitions. This observation suggests the stability of stellar configurations with higher central densities than the maximum mass, termed Slow Stable Hybrid Stars (SSHSs), even under minor radial perturbations. The length of these SSHS branches depends on the energy density jump between the two phases and the stiffness of the quark EoS.

References:
1. Radial Oscillations of Hybrid Stars and Neutron Stars including Delta baryons: The Effect of a Slow Quark Phase Transition, arXiv:2401.07789v2 (2024).

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