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Out-of-equilibrium perturbations in hybrid stars and their impact on stable branch configurations

Our recent investigation has shown that out-of-equilibrium oscillations can extend the stable branch of hadronic stars. Motivated by these results, we explore whether similar effects can arise in hybrid stars (HSs), composed of hadronic and quark matter in their outer and inner cores, respectively. The hadronic equation of state includes nucleons, hyperons, and Delta-resonances, and is analyzed under both chemical equilibrium and frozen composition. For the quark core, we assume full chemical equilibrium, given the fast timescales of the relevant reactions. By computing adiabatic indices and radial mode frequencies, we assess whether sharp transition to quark matter under these conditions can give rise to stable HSs beyond the peak mass not only in the slow hadron-quark conversion regime but also when it is rapid. Our results aim to clarify the role of chemical (non-)equilibrium in the formation of extended stable branches in HSs.

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