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New Stable Branches of Compact Stars Beyond the Maximum-Mass Turning Point

Compact stars lying beyond the maximum-mass turning point on the M(R) curve are usually regarded as dynamically unstable, based on the assumption that any Lagrangian fluid perturbation preserves instantaneous beta equilibrium. However, we show that when chemical equilibrium cannot be re-established during disturbances, previously overlooked sequences appear in models of purely hadronic stars, hybrid hadron–quark stars, and self-bound quark stars. Along these extended branches, linear-response calculations yield positive squared eigenfrequencies for the fundamental oscillation mode, confirming stability well past the classical mass peak. We discuss the microscopic mechanisms that suppress the growth of perturbations. Finally, we outline potential observational signatures and astrophysical implications of such configurations.

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