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# Exploring Self-Bound Quark Matter Stars in the Quark-Mass Density-Dependent Model

We revisit and extend the quark-mass density-dependent model (QMDDM) for dense quark matter, addressing longstanding thermodynamic inconsistencies by formulating it in the canonical ensemble. We consider both flavor-blind and flavor-dependent mass formulas, exploring self-bound two-flavor (ud), self-bound three-flavor (uds), and hybrid self-bound ud–uds quark matter.

Excluded volume effects are included via the Helmholtz free energy, accounting for finite quasiparticle repulsive interactions, which stiffen the equation of state and improve agreement with astrophysical constraints. Charge-neutral three-flavor matter in chemical equilibrium is analyzed.

By systematically exploring the parameter space, we characterize all resulting stellar configurations, focusing on stability, causal behavior, and mass-radius relations. We find universal relations for self-bound and hybrid stars compatible with predictions from a completely different model, the vector MIT bag model, providing a unified, thermodynamically consistent framework for dense quark matter in astrophysical contexts.

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