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Higher order density functionals for hybrid neutron stars

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This work extends the thermodynamics of a chirally symmetric confining energy density functional approach for quark matter to higher-order Taylor expansion in the quark bilinears, which goes beyond the standard current-current form [1] and encodes confining effects inn the medium dependence of the Taylor expansion coefficients [2]. These higher
order interaction terms allow for a softness of quark matter at the deconfinement transition to entail a strong first-order with large latent heat but simultaneously a sufficient stiffening at higher densities to describe massive hybrid neutron stars with color superconducting quark matter cores. We introduce nonlocality of the quark currents inspired by generalized gradient approximations in electronic structure theory; the extended functional optimizes predictive accuracy for inhomogeneous systems [3]. We discuss the solutions of the Tolman-Oppenheimer Volkoff equation in comparison with multi-messenger observations of pulsars.

References

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