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Second look to the Polyakov loop Nambu–Jona-Lasinio model of quark matter in hybrid stars

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We revisit the Polyakov Loop coupled Nambu-Jona-Lasinio model that maintains the Polyakov loop dynamics in the limit of zero temperature. For this purpose we re-examine the form of the potential for the deconfinement order parameter at finite baryonic densities. Secondly, and the most important, we explicitly demonstrate that a modification of this potential at any temperature is formally equivalent to assigning a baryonic charge to gluons. In order to avoid this spurious effect we develop a more general formulation of the present model that cures this defect and is normalized to match the asymptotic behaviour of the QCD equation of state given by $\mathcal{O}(\alpha_s^2)$ and partial $\mathcal{O}(\alpha_s^3 \ln^2 \alpha_s)$ perturbative results. Incorporation of the Polyakov loop dynamics to the model leads to significant stiffening of the quark matter equation of state, which is important for reaching the limit of two solar masses of compact stars.

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