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Equation of state in two-, three-, and four-color QCD at nonzero temperature and density

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We calculate the equation of state at nonzero temperature and density from first principles in two-, three-, and four-color QCD with two fermion flavors in the fundamental and two-index, antisymmetric representation. By matching low-energy results (from a "hadron resonance gas") to high-energy results from (resummed) perturbative QCD, we obtain results for the pressure and trace anomaly that are in quantitative agreement with full lattice-QCD studies for three colors at zero chemical potential. Our results for nonzero chemical potential at zero temperature constitute predictions for the equation of state in QCD-like theories that can be tested by traditional lattice studies for two-color QCD with two fundamental fermions and four-color QCD with two two-index, antisymmetric fermions. We find that the speed of sound squared at zero temperature can exceed 1/3, which may be relevant for the phenomenology of high-mass neutron stars.

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