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Analysis of Mass and Radius Sensitivity of a Crystalline Quark Star to a Strong Repulsive Equation of State.[1]

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— Recent data measuring the Quark-Gluon Plasma state from the Relativistic Heavy Ion Collider experiments have resulted in a more accurate determination of the QCD phase diagram. The high temperature results indicate that there exists a phase transition that gives rise to the deconfinement of quarks with the formation of the quark gluon plasma. Such a phase transition may play an important role in stable compact star core formation beyond the neutron star state but prior to reaching any black hole state. Here we numerically solve the Tolman-Openheimer-Volkov equations for a static spherically symmetric mass distribution with an effective crystalline quark cluster Equation of State with a phonon term following the method of Lai. The static multi-quark interaction potential is established for a specific crystalline lattice structure which gives rise to stable end states with higher masses and smaller radii than typical neutron stars. We determine mass, pressure, density and temperature radial profiles for these configurations. We then compare these states to the causality and general relativity bounds on stiff matter and determine the sensitivity to the exponent of the two body repulsive potential interaction for a stable crystalline quark star state.

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