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Towards a Stability Analysis of Inhomogeneous Phases in QCD

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Understanding the phase structure of Quantum Chromodynamics (QCD) is of paramount importance for nuclear and particle physics. At large densities and low temperatures, many complex phases are expected to appear. This is where the lattice sign problem is unavoidable and extrapolation methods such as Taylor expansions are out-of-bounds. Alongside colour-superconductivity, quarkyonic matter, and so on, the possibility of a crystalline phase has been studied for over twenty years. In simplified models of QCD such as NJL or quark-meson models, these phases are present. However, no unambiguous determination exists that they appear in QCD. In our work, we develop a method of stability analysis that is compatible with full QCD via Dyson-Schwinger Equations. We present some results for homogeneous phase transitions which illustrate well how the method works and discuss what is to be done for a definite stability analysis of inhomogeneous phases in QCD.

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