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Dissecting the moat regime

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Dense QCD matter can feature a moat regime, where the static energy of mesons is minimal at nonzero momentum. We elucidate various features of this regime in this work. To capture the main effects, we use a two-flavor quark-meson model and put forward an efficient renormalization scheme to account for the nontrivial momentum dependence of meson self-energies in the moat regime.
We show that the extent of the moat regime critically depends on the interaction of quarks and mesons, and analyze quark and meson correlation functions in this regime. Since it arises from particle-hole fluctuations of quarks in a dense medium, the resulting spatial modulations manifest in various different meson correlations, including scalar, pseudoscalar, vector and axialvector mesons. We clarify the nature of these modulations based on the analytic structure of meson self-energies, demonstrating in particular their distinction from Friedel oscillations which also occur in the presence of a Fermi surface. In contrast, while quark correlations are enhanced in the moat regime, they do not show oscillatory behavior.

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