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Relativistic density functional approach to a unified description of quark-hadron matter

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The principal element of a unified description of strongly interacting matter within effective theories is the hadronization of quarks at low temperatures and baryonic densities, while the partonic degrees of freedom are being suppressed in this regime. I present a novel approach to attack this problem, which is formulated based on a relativistic density-functional motivated by the string-flip model. Dynamical restoration of chiral symmetry within this approach is ensured by construction of the density functional. The low density/temperature suppression of quark degrees of freedom is provided by increase of the corresponding self-energy already at the mean-field level. I also discuss the connection of the present approach to a Nambu-Jona-Lasinio-type model with density dependent (pseudo-)scalar coupling. Supplemented with the vector repulsion and diquark pairing channels it is applied to model cold quark matter. The corresponding couplings are limited by confronting the results of modeling compact stars with quark cores to the observational data. This allows to construct the mean-field phase diagram of strongly interacting matter. Effects of hadronization of strongly interacting matter are considered as a result of quark correlations beyond the mean field. The correlations caused by (pseudo-)scalar interaction channels are considered within the Gaussian approximation. This explicitly introduces mesonic states into the model. Their contribution to the thermodynamic potential is analyzed within the Beth–Uhlenbeck framework. Due to the different response of the mass spectrum of bound and continuum states to changes of the medium properties the Mott dissociation of mesonic bound states occurs and is interpreted as physical mechanism of the deconfinement transition.

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