Noncongruence

First-order phase transitions (PTs) with more than one globally conserved charge are called noncongruent PTs. They differ fundamentally from congruent PTs, with only one globally conserved charge, because the concentrations of the charges can be exchanged between the two phases. The term “noncongruent” is commonly used for PTs in terrestrial applications with chemically reacting plasmas [2]. Noncongruence is also well known in heavy-ion collisions, nuclear physics and astrophysics [3,4], where usually the terms “Maxwell” and “Gibbs” are used instead.

Chiral SU(3) EOS

The chiral SU(3) equation of state (EOS) is an effective quantum relativistic mean-field model, with interactions mediated by meson exchange in a chirally invariant Lagrangian [5]. Quarks (u,d,s) and hadrons (baryon octet) are included as a chemical mixture of quasi-particle degrees of freedom.

The chiral SU(3) model gives a continuous transition from hadronic to quark matter above a critical point (CP), and a first order PT below. To obtain such a behavior, it is essential to have both hadronic and quark degrees of freedom within a unified EOS model. With 2-EOS models, where quark and hadronic matter are described with separate Lagrangians, this is impossible, they cannot contain CPs.

Results and discussion

Because of isospin symmetry of the strong interactions, for the symmetric system with $Y_Q=0.5$ one obtains a congruent PT. This is the behavior of an azeotropic substance. The QCD PT in asymmetric systems ($Y_Q\neq0.5$) is noncongruent.

Critical points and 2-EOS approaches

The chiral SU(3) model gives a continuous transition from hadronic to quark matter above a critical point (CP), and a first order PT below. To obtain such a behavior, it is essential to have both hadronic and quark degrees of freedom within a unified EOS model. With 2-EOS models, where quark and hadronic matter are described with separate Lagrangians, this is impossible, they cannot contain CPs.

References