High Energy Physics - Phenomenology

Surface tension in the cold and dense chiral transition and astrophysical applications

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The surface tension of cold and dense QCD phase transitions has appeared recently as a key ingredient in different astrophysical scenarios, ranging from core-colapse supernovae explosions to compact star structure. If the surface tension is low enough, observable consequences are possible. Its value is however not known from first-principle methods in QCD, calling for effective approaches. Working within the framework of homogeneous nucleation by Langer, we discuss the steps that are needed to obtain the nucleation parameters from a given effective potential. As a model for deriving the effective potential for the chiral transition, we adopt the linear sigma model with constituent quarks at very low temperatures, which provides an effective description for the thermodynamics of the strong interaction in cold and dense matter, and predict a surface tension of Sigma ~ 5--15 MeV/fm^2, well below previous estimates. Including temperature effects and vacuum logarithmic corrections, we find a clear competition between these features in characterizing the dynamics of the chiral phase conversion.

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