Exploring quark interaction in the instanton medium

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Abstract

The selfconsistent approach to the quark interactions in the instanton liquid is developed in the context of new method to calculate the basic functional integral where the quark impact is described by the variation of the instanton solution parameters. The singular nature of the instanton solution makes the multipole expansion of these parameters effective to construct relevant variational procedure. The effective Lagrangian obtained includes colorless scalar field interacting with quarks. The origin of this dynamical field as an interaction carrier in soft momentum region is discussed. Besides we study light quark interactions in the instanton liquid at finite quark/baryon number density analyzing chiral and diquark condensates and investigate the behaviors of quark dynamical mass and both condensates together with instanton liquid density as a function of quark chemical potential. We conclude the quark influence (estimated in the tadpole approximation) on the instanton liquid could shift color superconducting phase transition to higher values of the chemical potential bringing critical quark matter density to the values essentially higher than conventional nuclear one.