

Roles of Axial Anomaly on Neutral Strongly Interacting Matter — New Critical Points at Low Temperature and the Absence of Chromomagnetic Instability —

We investigate effects of the axial anomaly term with a chiral-diquark coupling on the phase diagram within a two-plus-one-flavor Nambu-Jona-Lasinio (NJL) model under the charge-neutrality and β -equilibrium constraints. We find that when such constraints are imposed, the new anomaly term plays a quite similar role as the vector interaction does on the phase diagram, which the present authors clarified in a previous work. Thus, there appear several types of phase structures with multiple critical points at low temperature T , although such phase diagrams with low- T critical point(s) are never realized without these constraints even within the same model Lagrangian. This drastic change is attributed to an enhanced interplay between the chiral and diquark condensates due to the anomaly term at finite temperature; the u-d diquark coupling is strengthened by the relatively large chiral condensate of the strange quark through the anomaly term, which in turn definitely leads to the abnormal behavior of the diquark condensate at finite T , inherent to the asymmetric quark matter. We also show that the chromomagnetic instability of the neutral asymmetric homogenous two-flavor color superconducting (2CSC) phase is suppressed and can be even completely cured by the enhanced diquark coupling due to the anomaly term and/or by the vector interaction

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