FLUCTUATIONS IN THE INHOMOGENEOUS CHIRAL TRANSITION

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Chiral pair fluctuation are considered near the phase boundary of the inhomogeneous chiral phase (iCP). The fluctuations are then bosonized and an effective meson action is basically constructed by considering the ring diagram of the polarization function. The inclusion of the simple ring diagram without any interaction among fluctuations may be a popular treatment. We go beyond this treatment by taking into account the nonlinear effects; we evaluate the self-energy and effective four point interaction among fluctuations in a consistent way. The peculiar momentum dependence of the meson Green's function, reflecting the spatially inhomogeneous transition, gives rise to interesting and qualitative results. Thermal fluctuations prohibit the second-order transition, while the effect of the quantum fluctuations is rather modest: the curvature of the effective potential at the origin is always positive due to the thermal fluctuations. Quantum and thermal fluctuations changes the second-order transition to the first one by changing the sign of the effective four-point interaction between effective mesons.

These features may be observed by relativistic heavy-ion collisions through the analysis of the thermodynamic observables. For the usual chiral transition the second moment has been proved to be divergent at the critical point; the quark-number susceptibility exhibits a divergence as the effect of the fluctuations. However, the situation is quite different in iCP: the first moment such as entropy production shows a peculiar behavior due to fluctuations, which is one of the signals of the phase transition to iCP.

Some similar aspects are also remarked between iCP and the FFLO state in superconductivity.