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Spectral function analysis of the hydrodynamical mode around the QCD critical point with use of functional renormalization group

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One of the unique points of QCD phase diagram is the existence of QCD critical point (CP), which is the end point of the phase boundary of the first-order chiral transition at low temperature. It is noteworthy that the phase transition turns to a second order at the CP, where fluctuations of some physical quantities should be divergent in the system with infinite degrees of freedom. People are thus interested in identifying such physical quantities which divergent behavior can be nicely detectable in experiment. It has been suggested that the soft modes at the QCD CP are hydrodynamical modes such as the baryon density fluctuation (particle-hole excitation) and entropy fluctuation, using RPA analysis of Nambu-Jona-Lasinio model and time-dependent Ginzburg-Landau theory [1, 2]. A notable point is that these modes are coupled to the scalar mode or the fluctuating mode of the chiral order parameter at finite chemical potential off the chiral limit. We examine whether this suggestion remain valid even when the thermodynamic fluctuations are fully taken into account. For this purpose, we calculate the spectral function of the collective modes coupled to the scalar mode using functional renormalization group. We employ the quark-meson model and set spatial momentum finite to investigate particle-hole excitations. On the basis of the numerical calculation of the spectral function around the QCD CP, we explore possible development and softening of the collective modes in the space-like as well as the time-like region.

[1] H. Fujii and M. Ohtani, Phys. Rev. D 70, 014016 (2004).

[2] D. T. Son and M. A. Stephanov, Phys. Rev. D 70, 056001 (2004).

On behalf of collaboration:

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