



Contribution ID: 42

Type: **Poster**

Instability toward the chiral inhomogeneous phase with the functional renormalization

Monday, 24 June 2019 17:00 (20 minutes)

In this talk, we present our functional-renormalization-group (FRG) study of the collective excitations around the chiral phase transition line. In particular, we intensively investigate the sigma-mesonic and pionic collective modes around the QCD critical point (CP) by calculating the spectral functions with the FRG. Such an FRG study gives beyond-mean-field pictures of the collective modes since it incorporates the large fluctuations involved in the second-order phase transition. We find that one-particle excitation showing tachyonic instability in the sigma-mesonic channel appears as the quark chemical potential approaches that of the QCD CP from the hadronic phase with a fixed temperature. Such an unstable mode has finite momentum, which suggests the instability associated with the transition to the chiral inhomogeneous phase. We give an explanation for the origin of this phenomenon: The level repulsion between the one- and two-particle modes in the sigma-mesonic channel causes the instability in the one-particle mode. Since there is no such instability in the pionic channel, our result suggests the real kink crystal occurs.

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Session Classification: Poster session