Contribution ID: **316** Type: **Poster**

Probing deconfinement with chiral effective models at imaginary chemical potential

The sign problem in lattice QCD prevents us from directly evaluating thermodynamics at real quark chemical potential since the Dirac determinant takes complex value. At imaginary chemical potential, this quantity becomes real thus Monte-Carlo simulation is possible.
One needs an analytic continuation to relate a quantity obtained at imaginary chemical potential to a real one. Some characteristic features, however, have been found also at the imaginary chemical potential as realization of the symmetries possessed by QCD. Therefore, the imaginary chemical potential provides us additional information on the rich phase structure of QCD.

In this work, we investigate the phase structure of Polyakov loop-extended chiral effective models at imaginary chemical potential with a particular emphasis on the confinement-deconfinement transition.
First we discuss the phase transitions in the PNJL and PQM models for different implementations of the Polyakov loop potential, within the mean field approximation. We find a critical endpoint of the deconfinement transition at imaginary chemical potential, of which origin is shown to nicely illustrate interplay between the chiral transition and the deconfinement.
Second, we discuss how to characterize the deconfinement transition by utilizing the imaginary chemical potential in analogy with the so-called dual order parameter. Finally, we discuss the effect of the quantum fluctuation on the determination of the phase diagram in the PQM model by making use of the functional renormalization group approach.

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Track Classification: QCD phase diagram