Contribution ID : **18** Type : **Poster**

The θ-angle in QCD at finite isospin density

We examine the influence of the θ-angle on QCD with nonzero isospin charge and as a function of the number of matter fields. Our investigation delves into the impact on vacuum properties, the pattern of chiral symmetry breaking, and the overall spectrum of the theory. Introducing the CP-violating topological operator adds complexity to the vacuum structure, leading us to unveil novel phases and scrutinize the order of transitions that characterize flavor dynamics.

Moreover, we explore the critical chemical potential, a key determinant in distinguishing between the normal and superfluid phases of the theory, as a function of the θ-angle. Our findings provide valuable insights for guiding numerical simulations and devising new tests to scrutinize the model's dynamics.

To enhance our analysis, we employ an effective approach that incorporates Goldstone and dilaton degrees of freedom, augmented by topological terms in the theory. We specifically investigate how dilaton potentials, for which a systematic counting scheme can be established, affect the results. Via state-operator correspondence we compute the corrections to the would-be conformal dimensions of the lowest large charge operators as a function of the θ-term and dilaton potential.

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Track Classification : Particle Physics