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Chiral critical point via scalar-dilaton coupling in soft-wall AdS/QCD

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The AdS/CFT correspondence, which connects strongly coupled conformal field theories in N dimensions to gravity in $N+1$ dimensional Anti-de Sitter space, has provided valuable insights into the non-perturbative aspects of QCD. Soft-wall AdS/QCD is a phenomenological model that uses a dilaton field to introduce confinement, while a scalar field is dual to the chiral condensate. The thermodynamics of the deconfined state are introduced using an asymptotically AdS Reissner-Nordström black hole, which includes both temperature and baryon chemical potential. Minimal models of this type yield a chiral phase transition that is not affected by the chemical potential, and thus lack a critical point.

In this work, we investigate the chiral phase transition in an AdS/QCD action that includes a coupling between the scalar and dilaton fields. Our results reveal that the scalar-dilaton coupling produces a rich phase structure, with the emergence of a critical point at finite temperature and density. The location and presence of the critical point is found to be highly sensitive to the strength of the scalar-dilaton coupling. We present results for both 3-flavor symmetric and 2+1 flavor cases. This work provides a foundation for future phenomenological applications, as well as dynamical models, which solve the scalar and dilaton fields using the gravitational equations of motion.

Category

Theory

Collaboration (if applicable)

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