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Numerical simulations of an effective model of QCD with two light quark flavors

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Content

The location of the —up to now hypothetical— critical end point and the exploration of the QCD phase diagram are important challenges both theoretically and experimentally. With two massless quark flavors the QCD Lagrangian has a $SU(2)_L \otimes SU(2)_R \simeq O(4)$ symmetry. This Lagrangian is the same as the four component Heisenberg ferromagnet which we use as an effective model. With degenerate quark masses, this symmetry breaks explicitly down to $SU(2) \simeq O(3)$, which our effective model accounts for by means of an external magnetic field. We present our results from the numerical simulations of the 3d O(4) Heisenberg ferromagnet with an external magnetic field where the topological charge plays the role of the baryon number. This is used as an effective model that avoids the notorious sign problem which has prevented numerical simulations at high baryon density. We plot the QCD phase diagram monitoring the crossover from a chemical potential between 0 MeV to 250 MeV. However, we did not observe the critical end point in this range of energies.

Area of contribution

Theory and Phenomenology

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