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Conjecture about the QCD Phase Diagram

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We present a phase diagram study of the $O(4)$ model as an effective theory for 2-flavor QCD. Both theories perform spontaneous symmetry breaking with isomorphic groups, which suggests that they belong to the same universality class. Since we are interested in high temperature, we further assume dimensional reduction to the 3d $O(4)$ model, which implies topological sectors. As conjectured by Skyrme and others, this topological charge represents the baryon number. Hence the baryon chemical potential μ_B appears as an imaginary vacuum angle, which can be included in the lattice simulation without any sign problem. We present numerical results for the critical line in the chiral limit, and for the cross-over in the presence of light quark masses. The shapes of these lines are compatible with other predictions, but up to about $\mu_B = 300$ MeV we did not find a Critical Endpoint, although there are indications that it could be near-by.

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