Chiral limit of 2-color QCD at strong couplings

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Abstract: We study 2-color QCD in the chiral limit with staggered fermions using a novel directed path algorithm. The new algorithm allows us to see some of the rich properties of the enhanced U(2) symmetry, present in this model, with unprecedented precision. In particular we show that the finite temperature phase transition is a very weak first order transition in three spatial dimensions. Interestingly the epsilon expansion predicts a fluctuation driven first order transition. Further, the symmetry remains unbroken at any finite temperature in two spatial dimensions consistent with the Mermin-Wagner-Coleman theorem. On the other hand the quantum phase transition between a baryon superfluid phase to a symmetric phase driven by the baryon chemical potential is a mean field transition in both two and three spatial dimensions. We can also connect our Monte Carlo results with many low energy effective field theory predictions.