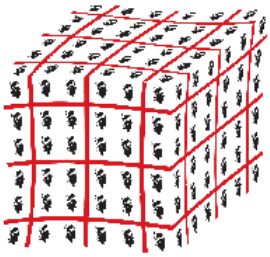

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QCD at finite chemical potential in a small hyperspherical box

Tuesday, 15 June 2010 15:50 (20 minutes)

We consider the phase diagram of QCD formulated in small spatial volumes. The benefit of the small spatial volume is that it allows for a perturbative calculation of the phase diagram which is valid for all temperatures and densities. The action of QCD is complex when the quarks are coupled to a non-zero chemical potential. This results in the sign problem which prevents lattice simulations using conventional techniques. From one-loop perturbation theory on S^1 x S^3 we calculate the phase diagram analytically in the T – mu plane in the large N and Nf limit by generalizing the matrix model technique of Gross and Witten for the case of a complex action. We compare with low temperature results for N = 3 obtained by performing the integrals over the gauge fields numerically. We calculate expectation values for several observables including the fermion number and the Polyakov loop (and its dagger which differs at non-zero chemical potential). For the fermion number an atomic-level-type structure is observed as a function of the chemical potential and each level transition coincides with a spike in the Polyakov loop and it's dagger, indicating partial-filling of the level. In the large N limit each level transition corresponds to discontinuities in the fermion number which result in third-order transitions of the Gross-Witten type. We confirm the appearance of the level-structure at low temperatures in lattice simulations of 2-color QCD where the sign problem is absent.

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talk

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