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Study of the phase diagram of dense QC_2D with $N_f = 2$ within lattice simulation

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In this talk we present our results on the low-temperature scan of the phase diagram of dense two-color QCD with $N_f = 2$ quarks. The study is conducted using lattice simulation with rooted staggered quarks. At small chemical potential we observe the hadronic phase, where the theory is in a confining state, chiral symmetry is broken, the baryon density is zero and there is no diquark condensate. At the critical point $\mu = m_\pi/2$ we observe the expected second order transition to Bose-Einstein condensation of scalar diquarks. In this phase the system is still in confinement in conjunction with non-zero baryon density, but the chiral symmetry is restored in the chiral limit. We have also found that in the first two phases the system is well described by chiral perturbation theory. For larger values of the chemical potential the system turns into another phase, where the relevant degrees of freedom are fermions residing inside the Fermi sphere, and the diquark condensation takes place on the Fermi surface. In this phase the system is still in confinement, chiral symmetry is restored and the system is very similar to the quarkyonic state predicted by SU(N_c) theory at large N_c.

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