Nucleons, Diquarks and Quarks at Finite Density

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In the first part of this paper we discuss a recent extension of the quark-diquark picture based on the NJL model to finite density, and describe the properties of the resulting nuclear matter equation of state [1]. Particular emphasis is put on the connection between the stability of nuclear matter and the density dependence of the sigma meson mass, and on several effects which arise due to the internal structure of the nucleon like the suppression of Z-graphs, nucleon loop contributions, etc. This nuclear matter equation of state has recently been used to discuss the structure functions at finite density, i.e., the EMC effect in nuclear matter [2].

In the second part we use the same model to calculate the quark matter equation of state including the effects of diquark condensation (color superconductivity), and investigate the conditions for a phase transition from nuclear matter to quark matter at high densities [3]. We describe the various phases and transitions between them as they emerge from our calculation, i.e., a gas of nucleons and ordinary nuclear matter at low and normal densities, and color superconducting quark matter at high densities. The resulting gaps in the excitation spectra for these phases are discussed. Special emphasis is put on the dependence of the results on the strength of the pairing interaction in the scalar diquark channel.

References

[1] W. Bentz and A.W. Thomas, Nucl. Phys. **A 696** (2001) 138.
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