The XXI International Scientific Conference of Young Scientists and Specialists (AYSS-2017)

Contribution ID: **226** Type: **Oral**

SU(4) Polyakov linear-sigma model: Quark-hadron phase structure of QCD matter in finite temperature and density

In mean-field approximation, the SU(4) Polyakov linear-sigma model (PLSM) is constructed in order to characterize the quark-hadron phase structure in a wide range of temperatures and densities. The chiral condensates σl, σs and σc for light, strange and charm quarks, respectively, and the deconfinement order-parameters φ and φ* shall be analysed at finite temperatures and densities. We conclude that, the critical temperatures corresponding to charm condensates are greater than that to strange and light ones, respectively. Thus, the charm condensates are likely not affected by the QCD phase-transition. Furthermore, increasing the chemical potentials decreases the corresponding critical temperatures. In wide range of temperatures and chemical potential, various thermodynamic observables including trace anomaly, speed of sound squared, entropy density, specific heat are determined. Meson phenomenology of nonet and axial states are described, as well. Wherever available these results are confronted to recent lattice QCD calculations.

Summary

In mean fild approximation the PLSM is constructed in order to characterize the quark-hadron phase structure, the pure mesonic potential is formulated for Nf = 4. Accordingly, the extra degrees-of-freedom modify the thermodynamic antiquark-quark potential and the energy-momentum dispersion relations. The parameters added to the SU(4) model. We have introduced how the charm quark mass is coupled to g and the charm quark condensate in vacuum. We present the temperature dependence of the chiral condensates and deconfinement order-parameters at varying baryon chemical potentials. We notice the critical temperatures increases when moving from light to strange to charge quark chiral condensate.

Furthermore, in mean field approximation, we have constructed the partition function and then estimated various thermodynamic quantities, such as the trace anomaly (interaction measure), the speed of sound squared, the entropy density, and the specific heat. We have studied their dependences on temperature in both hadron and parton phases. We have compared our calculations with recent lattice simulations.

In characterizing the temperature and density dependences of the chiral phase-structure of pseudoscalars, scalars, vectors and axial-vectors meson states in finite magnetic fields, we utilize SU(4) Polyakov linear-sigma model (PLSM) in
mean-field approximation. The temperature and density characteristics of
axial and nonet meson states normalized to the lowest bosonic Matsubara frequencies are analysed. Our mass spectrum calculations agree well with the recent Particle Data Group compilations and PNJL, lattice QCD calculations, and QMD/UrQMD simulations.

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Track Classification: Theoretical Physics