



Contribution ID: 62

Type: Poster

Isospin asymmetric, chiral imbalanced dense quark matter in the framework of NJL₄ model.

Monday, 21 May 2018 18:30 (0 minutes)

Isospin asymmetry is the well-known property of dense quark matter, which exists in the compact stars and is produced in heavy ion collisions. On the other hand, the formation of dense quark matter in both of these cases is usually accompanied by a magnetic field strong enough to promote chiral magnetic effect (CME).

To investigate quark matter under these conditions, we take into account baryon $-\mu_B$, isospin $-\mu_I$ and chiral isospin $-\mu_{I5}$ chemical potentials and study QCD phase diagram using NJL₄ model generalized to two massive u- and d- quarks that could condense into the pion condensation.

At first, we have shown that the chiral isospin chemical potential μ_{I5} generates pion condensation in isospin asymmetric quark matter. Also, we have found some interesting discrete symmetry (duality) between chiral and pion condensates in the case of massless quarks, which stay relatively instructive even if the quarks are massive.

To describe hot dense quark matter, in addition to the above-mentioned chemical potentials, we introduce non-zero temperatures into consideration and compare our NJL₄-model results with the known lattice investigations. For example, we have shown that dependences of the critical temperature T_c on the chiral chemical potential for lattice and NJL₄ are qualitatively similar.

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Session Classification: Poster Session