PHASE DIAGRAM IN ENTANGLEMENT PNJL MODEL*

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Effects of vector interaction on the structure of the phase diagram are studied in the Nambu–Jona-Lasinio model with Polyakov loop in combination with entanglement interaction between quark and pure gauge sector. We showed that the first order chiral phase transition and its critical point disappear for sufficiently large values of the vector interaction constant $G_{\rm v}$.

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For a description of matter at high temperature and density, effective models of the Nambu–Jona-Lasinio-type have proven most useful. On the basis of the NJL-type models, it is possible to describe the chiral restoration transition and deconfinement transition, when the Polyakov loop is included (PNJL model) [1].

The phase diagram of the PNJL model satisfies the modern view on the QCD phase diagram structure: there are the crossover transition at high temperature (low density) and first order transition at low temperature (high density), which ended as a second order transition at a critical point. In this work, we considered the dependence of the first order phase transition line and its critical endpoint in the PNJL model phase diagram on the following aspects: including of the quarks repulsion (vector interaction) [2–4]; an additional interaction between quarks and pure gauge sector [5].

The including of the vector interaction in the PNJL model [2–4] leads to the dependence of equation of state on the vector coupling constant $G_{\rm v}$. It was shown that the first order transition area becomes smaller and the critical point appears at higher chemical potential and when constant $G_{\rm v}$ reaches critical value, the first order transition region disappears (see Fig. 1, top left panel).

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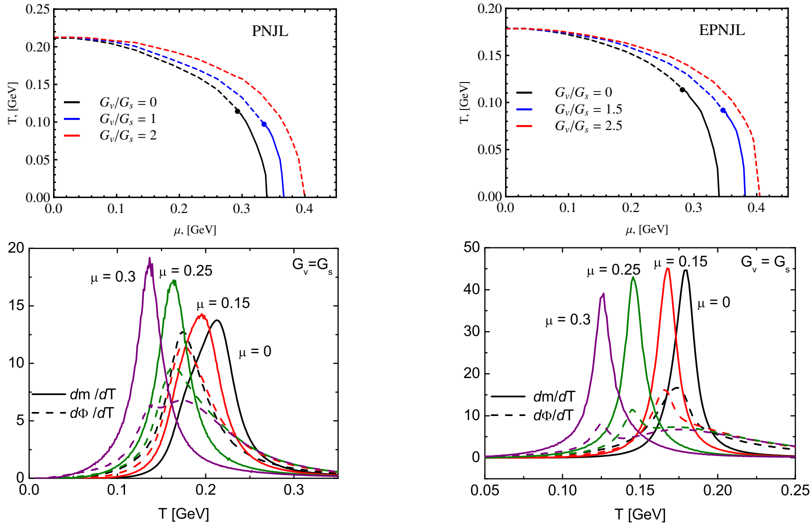

Fig. 1. Phase diagram of the PNJL (left panel) and phase diagram of the EPNJL (right panel) for various $\tilde{G}_{\rm v} = \tilde{G}_{\rm s}$.

In the PNJL model, chiral phase transition and deconfinement transition take place at different temperatures (see Fig. 1, bottom left panel), while the lattice results show their coincidence.

An additional entanglement between chiral and deconfinement transition [5] (EPNJL) can be introduced as functional dependence of coupling constants on Polyakov loop field [4] (Fig. 1, right panels). In that case, the critical temperature at $\mu = 0$ coincide with the lattice calculations and the appropriate critical end-points are situated at higher temperature than in the PNJL case. As in the PNJL model at $G_{\rm v} \neq 0$, the first order transition region becomes smaller and then disappears. Moreover, as can be seen in Fig. 1, bottom right panel, in the EPNJL temperatures of chiral phase transition and deconfinement transition coincide.

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