Equation of state in PNJL model with magnetic field

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Introduction

The strong ineraction as described by Quantum chromo dynamics (QCD) is a remarkable branch of physics that shows a phase structure at finite temperature and density.At low temperature and density the dominate degree of freedom in our nature are color-singlet bound state of hadrons.However,because of asymptotic freedom of QCD it is expected that at very high temperatures and densities these hadrons break up to liberate quarks and gluons and form the quark-gluon plasma(QGP).QCD thermodynamics has been the subject of intense investigation in recent years.The equation of state of strongly interacting matter is now at hand as a function of temperature T and in a limited range of quark chemical potential u.Taylor series expansion methods and analytic continuation from imaginary chemical potential provide lattice data for the pressure entopy density energy density and selected susceptibility. [1]. In this brief paper, we are calculating thermodynamic properties of QCD using Polykov-loop-extended Nambu Jona Lasinio (PNJL) model in presence of magnetic field.The behaviour of the polykov loop as a function of temoerature is obtained by minimizing the thermodynamic potential of the system. [2]. A taylor series expansion of the pressure is performed.Pressure difference and quark number density are then evaluated uo to sixth order in quark chemical potential. [3, 4] then we calculating the energy density,pressure and entropy by solving the thermodynamical potential of the system. we explore the capability of PNJL model in magnetic field to describe essentials of QCD thermodynamics around and above Tc.We use a pnjl model in magnetic field with an improved effective potential for the Polykov loop field .

In brief, we directly calculate the energy density pressure and entory with PNJL model in magnetic field.

The paper is arranged as: In Sec.1 we present introduction. In Sec.2 we describe the equation of state and in Sec.3 we give results and conclusion.

The equation of state with PNJL model in magnetic field .

as [**?**]

$$L = *\psi(\imath\gamma_\mu D_\mu - m)\psi + \frac{G}{2}[(*\psi\psi)^2 + (*\psi\imath\gamma_5\tau\psi)^2] - -u(\phi, *\phi, T) - \frac{1}{4}F_{\mu,\nu}F_\mu \quad (1)$$

where,

$$u(\phi, *\phi, T) = -\frac{1}{2}b_2(T)*\phi\phi + b_4(T)\lg[1 - 6*\phi\phi + 4(*\phi^3 + \phi^3) - 3(*\phi\phi)^2] \quad (2)$$

in which

$$b_2(T) = a_0 + a_1\frac{T0}{T} + a_2\frac{T_0^2}{T^2}b_4(T) = b_4\frac{T_0^3}{T^3} \quad (3)$$

and other symbols are the usual standard parameters [2]. After performing a bosonization of the PNJL lagrangian the thermodynamical potential is

$$\Omega = u(\phi, *\phi, T) + \frac{\sigma^2}{2G} - 6\int \frac{3p}{2pi^3}E_p - 6TqB\int e^(-\frac{E_p}{T})\frac{3p}{2pi^3}$$

(4)

where $\Omega isthethermodynamicalpotentialofthesystem.Nowwecalculate$

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Results and conclusions

The results are shown in the figures. We calculate the energy density and pressure for the PNJL model in magnetic field.The PNJL model correctly describe the step from the first order deconfinement transition observed in pure gauge lattice QCD ($withT_c = 250Mev$) to the crssover transition($T_c = 150Mev$)$when$$N_f = 2$ light quark flavour are added.The model also reproduces the quark number density at various chemical potential. taylor expansion in powers of the chemical potential indicate rapid convergence of the power series in μ.

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