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Thermodynamic and magnetic properties of hot QCD medium in a strong magnetic field

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We have investigated the equation of state of a hot QCD medium with two light flavors in a strong magnetic field, which may be produced in the non-central events at RHIC and LHC. We have cal- culated the thermodynamic observables up to one-loop perturbatively in real-time formalism, where the quark contribution is largely affected by the magnetic field whereas the gluon component is least affected except for the softening of the screening mass. For example, the presence of a strong magnetic field makes the pressure of hot QCD medium larger and the dependence of pressure on the tempera- ture becomes less steep compared to the dependence of the pressure on the magnetic field. This can be understood from the dominant scale of thermal medium in the strong magnetic field, being the magnetic field, in the same way that the temperature dominates in a thermal medium in the absence of magnetic field. the dependence of pressure on the temperature becomes less steep. Consistent with the above observations, the entropy density is found to decrease with the temperature in the presence of a strong magnetic field which is again consistent with the fact that the strong magnetic field restricts the dynamics of quarks to two dimensions, hence the phase-space becomes squeezed resulting in the reduction of the number of microstates. Due to the aforesaid reasoning, the energy density of hot QCD medium is seen to decrease, hence the speed of sound of thermal is increased due to the presence of a strong magnetic field. These findings could have implications on the expansion of the medium produced at RHIC and LHC and influence the outcomes of various signatures. Finally we determine the magnetization and susceptibility for several temperatures in strong magnetic field, where the paramagnetic response increases with the temperature. Hence a portion of QGP may be squeezed perpendicular to the direction of magnetic field, which is quantified by the enhancement of elliptic flow.

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