Non-perturbative study of gluon screening masses

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One of the most interesting features of QCD (quantum chromodynamics) is the transition from the confinement to the deconfinement phase. In this new state of QCD, quarks and gluons confined in the hadron at zero temperature move freely when the system reaches a sufficiently high temperature. QGP (quark gluon plasma) was realized at high temperature in the early universe, and is expected to be produced in heavy-ion collision experiments at SPS, RHIC and LHC [1, 2]. Thus it is an urgent task to accumulate theoretical knowledge about QGP.

The massless gluon in QGP medium is changed into a dressed massive gluon after quantum corrections. The screening effect is characterized by a mass pole of the propagator and is closely related to thermal QCD phenomenology. One example is a screened heavy quark potential, which is frequently discussed with the relation of J/ψ or Υ suppression. For calculations of jet quenching, which might be a finger print of QGP, a model including the electric and magnetic masses has been proposed [**?**]. The nonperturbative quantitative study in the vicinity of T_c and up to several times T_c, is of great importance for understanding QGP physics.

We study the temperature dependence of the screening mass in the range, $T/T_c = 1 \sim 6$ which would be realized in high-energy heavy ion collision experiments such as RHIC or LHC [3]. Fig. 1 shows electric and magnetic masses as a function of the temperature [4, 5]. The magnetic part definitely has nonzero mass in this temperature region. As T increases, both $m_{e(m)}/T$ decrease monotonically, and at almost all temperatures, the magnetic mass is less than the electric one, except very near T_c where the electric mass decreases very quickly as T approaches T_c.

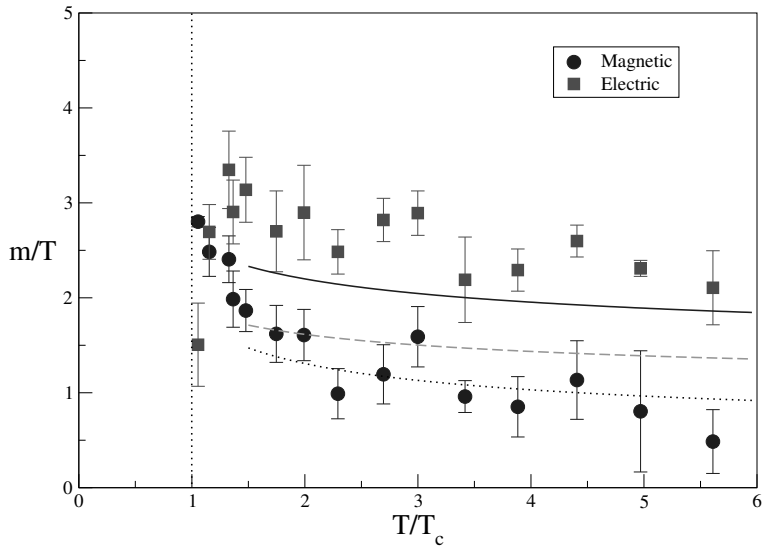

Figure 1: Temperature dependence of electric and magnetic screening masses. The dotted line is fitted by the assumption, $m_g \sim g^2 T$. For the electric mass, the dashed and solid lines represent LOP and HTL resummation results, respectively.

The calculations were performed on SX-5(NEC) vector-parallel computer at the RCNP of Osaka University.

References

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