Color-dependent $q\bar{q}$ potentials at finite temperature

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The color screened heavy $q\bar{q}$ potential at finite temperature plays an important role in the study of the J/ψ suppression in quark-gluon plasma (QGP), [1, 2] and was intensively investigated using lattice simulations for two-color [3] and three-color cases [4]. Quarkonium dissociation by color screening in a deconfining medium was studied by using the color singlet potential.[5] Finger-prints of QGP have been observed in CERN-SPS and RHIC, and one expects that J/ψ suppression or heavy hadron mass modification, which are produced at early stage of high energy heavy ion collisions, may be a definite evidence of the new form of matter, QGP. The heavy quark potentials in the QGP phase can be nonperturbatively determined through the Polyakov loop correlator (PLC). The color average potential has been extensively investigated, but detailed numerical calculation of singlet and adjoint channels, which give us more useful information on the dynamics, is just taking off; this is a much more cumbersome task since we require gauge fixing for the lattice calculation of the singlet and adjoint potentials. Recent progress of lattice QCD techniques and high-speed computers allow us to study the problem.

We report lattice QCD study of the temperature dependence for $q\bar{q}$ potentials in deconfinement phase in the quenched approximation [8]. A stochastic gauge-fixing quantization (SGFQ) with a Lorentz-type gauge-fixing term is employed.

In Fig. 1, we show typical behavior of three kinds of potentials at $T/T_c = 3.32$. As expected from the color exchange dynamics, $V_1^{q\bar{q}}$ yields the attractive force, while $V_8^{q\bar{q}}$ the repulsive force. This repulsive potential is weaker than the attractive potential, and correspondingly $V_c^{q\bar{q}}$ also results in the attractive force. At large R each potential becomes flat where the effective force due to the color screening becomes zero. $V_c^{q\bar{q}}$ reaches the flat region most rapidly and then next does the $V_8^{q\bar{q}}$ repulsive force, both of which vanish at $RT < 1$.

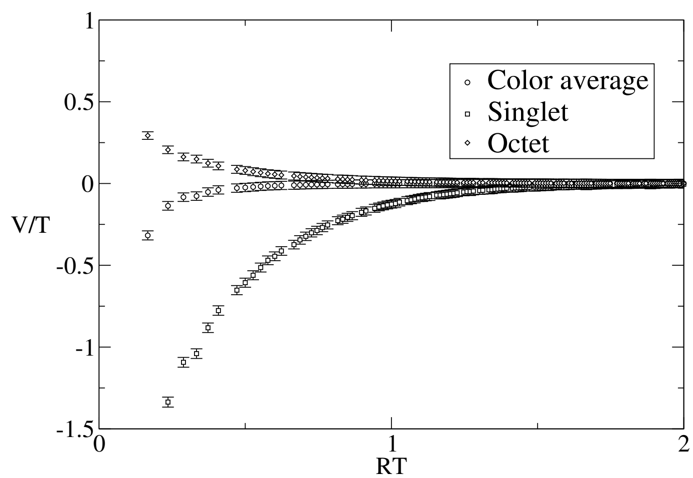

Figure 1:

The lattice calculations were carried out on SX-5 (NEC) vector-parallel computer at RCNP of Osaka University.

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