Heavy quark potential in $N_f = 2$ lattice QCD with nonperturbatively improved Wilson fermions below and above the finite temperature phase transition

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We study heavy quark potential at finite temperature in full QCD at $\frac{m_\pi}{m_\rho} \approx 0.8$ on $16^3 \cdot 8$ lattice. The fermionic action is of the form $S_F = S_F^{(0)} - \frac{\mathrm{i}}{2}\kappa\, g\, c_{sw} a^5 \sum_x \bar{\psi}(x)\sigma_{\mu\nu}F_{\mu\nu}\psi(x)$, where $S_F^{(0)}$ is the original Wilson action, c_{sw} is determined nonperturbatively. We use Wilson gauge field action. The abelian projection is employed to obtain better signal for Polyakov loop correlator. It is found that our data for the Polyakov loop correlator in the low temperature phase can be fitted by two exponent function

$$G(r) \equiv < L_{\vec{x}} L_{\vec{y}}^{\dagger} > = C_v(r) e^{-V(r,T)/T} + e^{-2m(T)/T} + ... \tag{1}$$

where $V(r,T)$ is Coulomb + linear potential and exponent $m(T)$ has divergent selfenergy contribution $V_0/2$ as well as physical part $E(T)$ called string breaking energy. Fig.1 shows potential from the monopole Polyakov loop correlator computed at $T/T_c \approx 0.8$. The fit curve is two exponent fit eq.(1). Good agreement with lattice data is found. We obtain for the first time dependence of the string tension on the temperature in full QCD. The temperature dependence for the string breaking energy $E(T)$ is also determined.

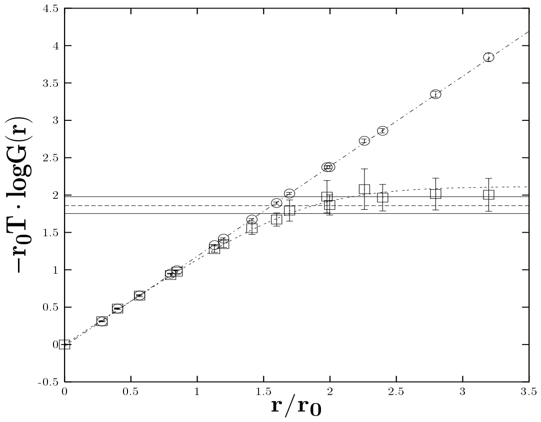

Figure 1: Heavy quark potential from the monopole Polyakov loop correlator (squares). Dotted line is the fit eq.(1). Horizontal lines show $-2r_0T \cdot \log < L >$ with error bars. The potential obtained from the monopole Wilson loop $W_{\mathrm{mon}}(r, t = 4a)$ (circles) is shown for comparison.