Flux Tubes of Two and Three Quark System in Full QCD

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The chromoelectric flux tube (color flux tube) between static color electric charges forms an interface between the superconducting (confining) phase and the conducting phase, and in this capacity bears valuable information about the properties of the QCD vacuum. We study the color flux tube in full QCD in the maximally abelian gauge to find further evidence for the dual superconducting picture of QCD vacuum. In this picture, the color electric fields are squeezed as the result of the dual Meissner effect by monopole condensation. Because we are interested in the confinement mechanism related to monopole dynamics, we restrict ourselves to abelian flux tubes being excited by abelian Wilson loops. Our simulations are at $\beta = 5.29$, $\kappa = 0.1355$ and with $N_f = 2$ nonperturbatively $O(a)$ improved Wilson fermions for full QCD and at $\beta = 6.0$ in quenched QCD.

We find that abelian flux tube in full QCD is very much the same as in quenched QCD up to the quark separation $R \sim$ 2fm. Although the monopole density of full QCD is two times larger than that in quenched QCD, the dual Ampère's law is obeyed also in full QCD. The abelian flux tube does not show any broadening towards larger distances from the static charges(see Figure 1), which could mean that the abelian string is described by the Ramond string rather than the Nambu-Goto string. We do not find any signals of the string breaking in full QCD. Further, we extend our study to the three quark (baryonic) system. We find that the shape of the three quark system seems to be of "Y-type", which is interpreted as the result of the pressure from the QCD vacuum in the confined phase.

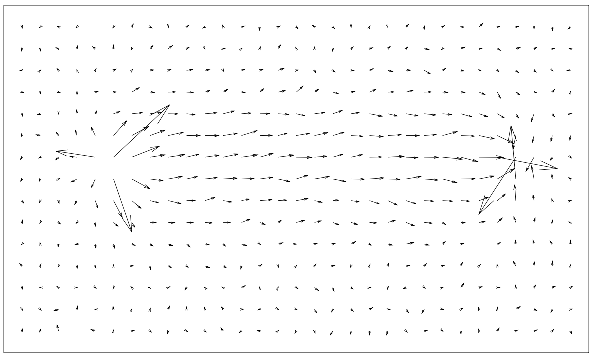

Figure 1: Distribution of the color electric field of the abelian flux for the quark distance $R = 22$ ($\sim$ 2fm) on the 24^3 48 lattice in full QCD.

References

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