Gauge Problem of Monopole Dynamics in SU(2) LGT

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It is known that many low energy physical properties of QCD are reproduced from the monopole degree of freedom alone ("monopole dominance"). This fact suggests that monopoles play an important role for the confinement mechanism. On the other hand, we have infinite degrees of freedom when we extract monopoles from gauge fields after an abelian projection [1]. That is to say, which gauge should be chosen? Monopole dominance has been observed from lattice QCD simulations only in some special gauges like the Maximal Abelian (MA) gauge and the Laplacian Abelian (LA) gauge. However, these observations should not depend on the choice of gauge essentially, if the dual superconductor scenario based on the abelian projection is physical.
We determined the effective monopole action in six gauges (i.e., MA, LA, Maximal Abelian Wilson Loop (MAWL), Polyakov, F_{12} and no gauge fixing) from monopole vacua using the inverse M-C method [2]. The form of action adopted here is 27 quadratic interactions and 4-point and 6-point interactions. These effective monopole actions except in MA gauge are determined for the first time in this study. Moreover, these effective actions were determined on the blocked monopole vacua, too. In these effective actions, 4-point and 6-point effective couplings are negligibly small at IR regions. RG flows for each gauge seem to converge on the identical line as repeating the blocking (Fig. 1), and distances of RG flows between MA gauge and other gauges tend to zero (Fig. 2). In the case of the MA, LA and MAWL gauge, the behavior of their RG flows are very close to each other, although these gauges have a completely different form in the continuum limit. In the case of other gauges, the convergence property of RG flows is not seen so definitely, but they seem to converge to the same line at larger b. Energy-entropy balance of the system is also remarkable. The condition $g_1 < \ln 7$ holds for all gauges at IR regions. It tells us the monopole condensation is occurred in IR regions for all gauges. These results support the gauge independence of monopole dynamics in IR regions.

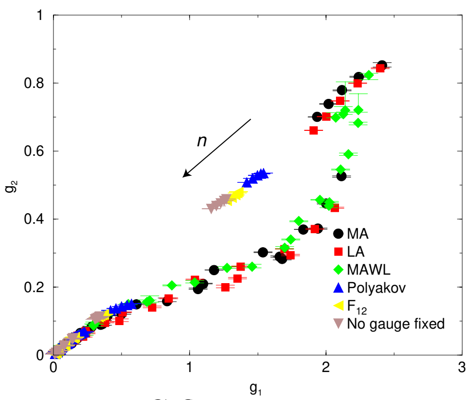

Fig. 1: RG flows in various gauges projected onto the g_1-g_2 coupling plane.

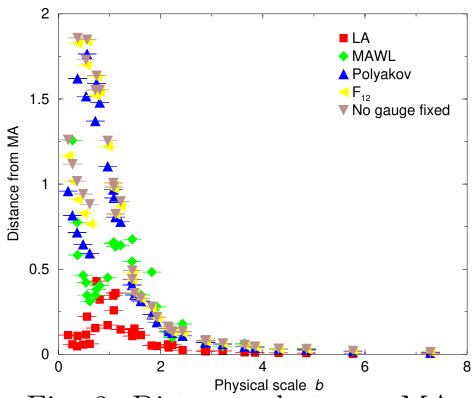

Fig. 2: Distances between MA gauge and other gauges vs. physical scale b.

References

[1] G. 't Hooft, Nucl. Phys. **B190** (1981) 455.
[2] H. Shiba and T. Suzuki, Phys. Lett. **B343** (1995) 315