Properties of monopoles in hot lattice gluodynamics

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We investigate non–perturbative effects associated with Abelian monopole dynamics in lattice gluodynamics. At the phase transition the monopoles may lead to a non–perturbative short ranged interaction between quarks and anti–quarks. The cluster analysis of the monopole trajectories shows that the motion of the monopoles in small clusters is Brownian.

One of the most popular approaches to the problem of confinement of quarks in QCD is the so–called dual superconductor mechanism [1]. The key role in this approach is played by Abelian monopoles identified by the Abelian projection [2]. The Abelian monopoles are considered as effective degrees of freedom responsible for confinement of quarks.

The monopoles are condensed in the low temperature (confinement) phase. The condensation of the monopoles leads to formation of the chromoelectric string due to the dual Meissner effect. As a result the fundamental sources of chromoelectric field, quarks, are confined by the string. In the confinement phase the QCD vacuum is filled by a large (infrared) monopole cluster. This cluster warrants the confinement of quarks.

In the deconfinement phase (high temperatures) the monopoles are not condensed and the quarks are liberated. The deconfinement transition is associated with breaking of the infrared monopole cluster into many clusters of finite sizes [3].

We investigate non-perturbative effects caused by the monopoles at high temperatures. The distribution number of the monopole trajectories with a fixed length L is investigated. We show that the ultraviolet piece of the distribution is consistent with the Brownian nature of the ultraviolet clusters. The finite–volume dependence of the distribution may provide an information on the mean free path of such monopoles.
At the phase transition, $T = T_c$, the breaking of the infrared monopoles cluster into small *but finite sized* clusters may modify the inter–quark potential at short distances. We discuss the short distance physics using analytical methods.

References

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