

Study of non-perturbative effects of gauge theories using numerical methods

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2006 Fiscal Year Final Research Report Summary

Study of non-perturbative effects of gauge theories using numerical methods

Research Project

Project/Area Number

13135210

Research Category

Grant-in-Aid for Scientific Research on Priority Areas

Allocation Type

Single-year Grants

Review Section

Science and Engineering

Research Institution

Kanazawa University

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Project Period (FY)

2001 - 2006

Keywords

monopole / QCD / Confinement / Extra dimension / flavor symmetry / The Kugo-Ojima condition / Landau gauge / The Kugo-Ojima parameter

Research Abstract

Abelian mechanism of color confinement is observed by Suzuki et al. in a gauge-independent way in SU (2) gluodynamics. A new noise-reduction method using random gauge transformations as well as the multi-level method are adopted. A static potential derived from Abelian Polyakov loop correlators gives us the correct string tension. Moreover only the monopole part in the Abelian Polyakov loop is responsible for the string tension. Abelian electric fields defined in an arbitrary color direction are squeezed and the corresponding monopole currents play the role of magnetic super currents. The penetration and the coherence lengths are consistent with those observed previously after Abelian projections. Since an Abelian neutral state in all color channels is restricted to a color-singlet state alone, the non-Abelian color confinement in SU (2) gluodynamics can be understood as the Abelian dual Meissner effect due to monopoles.

Kubo found that a certain flavor symmetry based on a non-abelian discrete group can be realized at low energies. Discrete flavor symmetries can originate from the geometry of compactified extra dimensions. They make predictions that can be tested by future experiments such as Large Hadron Collider experiments and Super B-Factory experiments at KEK.

The running coupling and the Kugo-Ojima confinement parameter were analyzed by Nakajima and his collaborator in lattice Landau gauge QCD with use of quenched and

unquenched gauge configurations. Although the running coupling measured by the ghost and gluon dressing function is infrared suppressed, the running coupling has a maximum of $\alpha_s \sim 2-2.5$ at around $q=0.5$ GeV irrespective of the fermion actions (Wilson fermions and Kogut-Susskind fermions). The Kugo-Ojima Parameter β which saturates to about 0.8 in quenched simulations becomes consistent with the expected value, 1, in the MILC configurations produced with the use of Asqtad action.

Research Products (17 results)

All	2007	2006	2005	2004	2003
All	Journal Article				

[Journal Article] Correlation of the ghost and the quark in the lattice Landau gauge QCD	2007	▼
[Journal Article] Unquenched Kogut-Susskind quark propagator in lattice Landau gauge QCD	2006	▼
[Journal Article] Effects of the quark field on the ghost propagator of lattice Landau gauge QCD	2006	▼
[Journal Article] NONABELIAN DISCRETE FAMILY SYMMETRY TO SOFTEN THE SUSY FLAVOR PROBLEM AND TO SUPPRESS PROTON DECAY	2006	▼
[Journal Article] $S(3)$ FLAVOR SYMMETRY AND LEPTOGENESIS	2006	▼
[Journal Article] Unquenched Kogut-Susskind quark propagator in lattice Landau gauge QCD	2006	▼
[Journal Article] Infrared features of unquenched lattice Landau gauge QCD	2006	▼
[Journal Article] Vacuum type of $SU(2)$ gluodynamics in maximally Abelian and Landau gauges	2005	▼
[Journal Article] Entropy of spatial monopole currents in pure $SU(2)$ QCD at finite temperature	2005	▼
[Journal Article] The dual Meissner effect and magnetic displacement currents	2005	▼
[Journal Article] Entropy of spatial monopole currents in pure $SU(2)$ QCD at finite temperature	2005	▼
[Journal Article] The dual Meissner effect and magnetic displacement currents	2005	▼
[Journal Article] Finite Temperature QCD with Two Flavors of Non-perturbatively Improved Wilson Fermions	2005	▼
[Journal Article] DIHEDRAL FAMILIES OF QUARKS, LEPTONS and HIGGSSES	2005	▼
[Journal Article] Profiles of the broken string in two-flavor QCD below and above the finite temperature transition	2004	▼
[Journal Article] Infrared Feature of the Landau Gauge QCD	2004	▼
[Journal Article] THE FLAVOR SYMMETRY	2003	▼

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