III International Workshop "Lattice and Functional Techniques for QCD"

Report of Contributions

https://indico.jinr.ru/e/LFTQCD2022

Contribution ID: **4** Type: **not specified**

Casimir effect in 3+1 dimentional lattice Abelian and non-Abelian gauge theories

Wednesday 12 October 2022 11:20 (20 minutes)

Compact U(1) gauge theory in 3+1 dimensions possesses the confining phase which is characterized by a linear raise of the potential between particles with opposite electric charges at sufficiently large inter-particle separation. This phenomenon is closely related to the color confinement in non-Abelian gauge theories such as QCD. In QED the condensation of Abelian monopoles at strong gauge coupling leads to confinement of electric charges because monopole condensate squeezes the electric flux into a thin electric tube which plays the role of confining string. We investigate how the vacuum structure of the theory is influenced by adding ideally conducting parallel plates associated with Casimir effect which predicts that the energy of vacuum fluctuations is modified by the presence of physical bodies. Using first-principal numerical simulations in compact U(1) lattice gauge theory we have found that as the distance between the plates diminishes, the vacuum between the plates undergoes a deconfining transition and the phase transition point shifts towards weaker gauge coupling. The phase diagram in the space of the lattice gauge coupling and the inter-plate distance is obtained. We also discuss our new results on the non-Abelian Casimir effect in SU(3) gauge theory.

Authors: TANASHKIN, Aleksei (Pacific Quantum Center, Far Eastern Federal University); Dr MOLOCHKOV, Alexander (Pacific Quantum Center, Far Eastern Federal University); CHERNODUB, Maxim (Institut Denis Poisson, University of Tours, France); Mr GOY, Vladimir (Pacific Quantum Center, Far Eastern Federal University)

Presenter: TANASHKIN, Aleksei (Pacific Quantum Center, Far Eastern Federal University)

Session Classification: LFTQCD Session

Contribution ID: **5** Type: **not specified**

Analytic Properties of the Quark Density in QC_2D and the Sign Problem

Wednesday 12 October 2022 10:40 (20 minutes)

Analytic dependence of the quark density on the quark chemical potential is extracted from the data simulated in lattice rergularization of QC_2D. It is shown that the cluster expansion model provides the best parametrization for analytic continuation of the quark density from imaginary to real values of the chemical potential. The problem of calculation of canonical partition functions and partial probabilities at high quark densities is discussed.

Author: ROGALYOV, Roman (NRC "Kurchatov Insitute" - IHEP)

Co-authors: BEGUN, Aleksandr (Pacific Quantum Center, Far Eastern Federal University); NAKAMURA, Atsushi (RCNP, Osaka University); GERASIMENIUK, Nikolay (Pacific Quantum Center, Far Eastern Federal University); BORNYAKOV, Vitaly (NRC "Kurchatov Institute" - IHEP, NRC "Kurchatov Institute" - ITEP); GOY, Vladimir (Pacific Quantum Center, Far Eastern Federal University); VOVCHENKO , Volodymyr (Nuclear Science Division, Lawrence Berkeley National Laboratory)

Presenter: ROGALYOV, Roman (NRC "Kurchatov Insitute" - IHEP)

Session Classification: LFTQCD Session

Contribution ID: **6** Type: **not specified**

Spectral functions of the O(N) model from the functional renormalization group approach

Thursday 13 October 2022 11:35 (20 minutes)

Due to the substantial progress in the development of functional approaches for the computation real-time correlation functions, new prospects have arisen to investigate diverse collective physical phenomena in the systems in a strong coupling regime. At the same time, the main problem with computations directly in Minkowski space is a complex analytical structure of correlation functions.
We will discuss the computation of spectral functions of bound states using the real-time formulation of a functional renormalization group (FRG) approach on the example of the O(4)-symmetric model. The computation is based on the Kallen-Lehmann spectral representation of dressed propagators used in the Wetterich equation – the flow equation of the effective action. As a first approximation, we solely consider momentum-independent vertices, the so called propagator approximation. Such an approach gives analytic access to the emergent singularities and brunch cuts, which opens the way for the numerical solution of a system of the FRG equations for the spectral functions corresponding to dressed retarded propagators.

Authors: LEBEDEV, Nikita (N.N. Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research); KALAGOV, Georgii (BLTP JINR); PAWLOWSKI, Jan M. (University of Heidelberg)

Presenter: LEBEDEV, Nikita (N.N. Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research)

Session Classification: LFTQCD Session

Contribution ID: **7** Type: **not specified**

Monopole and monopoleless components of the lattice gauge field in the maximal Abelian gauge

Wednesday 12 October 2022 10:20 (20 minutes)

The lattice gauge field is decomposed into the monopole and monopoleless components after the Maximal Abelian gauge is fixed. The interaction potential between static charges is calculated for each component and their sum is compared with the full non-Abelian static potential. A good agreement is found in both SU(2) and SU(3) gluodynamics and in two-color QCD. Implications of this result are discussed.

Authors: BORNYAKOV, Vitaly (IHEP, Protvino); Mr KUDROV, Ilya (NRC "Kurchatov Institute"-KKTEP, Moscow, Russia); ROGALYOV, Roman (IHEP)

Presenter: BORNYAKOV, Vitaly (IHEP, Protvino)

Session Classification: LFTQCD Session

Contribution ID: **8** Type: **not specified**

Influence of relativistic rotation on the equation of state of gluodynamics

Thursday 13 October 2022 12:15 (20 minutes)

Relativistic rotation may have some impact on various properties of quark-gluon plasma. For example, lattice simulations show an increase in critical temperature of both QCD and gluodynamics due to rotation. In this report the first lattice study of an effect that rotation has on gluodynamics' equation of state will be presented. In particular, it will be shown that rotation's impact on free energy density changes sign with temperature increase.

Authors: Prof. BRAGUTA, Victor (BLTP JINR); Dr KOTOV, Andrey (JINR); Dr ROENKO, Artem (BLTP JINR); SYCHEV, Dmitrii (BLTP JINR, MIPT)

Presenter: SYCHEV, Dmitrii (BLTP JINR, MIPT)

Session Classification: LFTQCD Session

Contribution ID: **9** Type: **not specified**

Monopoles, instantons, and eta-prime meson in external magnetic fields

Wednesday 12 October 2022 10:00 (20 minutes)

Magnetic monopoles are essential ingredients for explaining the color confinement mechanism, and instantons induce chiral symmetry breaking. The magnetic monopoles and instantons are closely tied to one another in the QCD vacuum. Furthermore, the eta-prime meson is closely related to the topology of the QCD vacuum. However, it is difficult to demonstrate the relations among them by perturbative calculations because of the strong interaction in the low-energy region of the QCD. Therefore, we perform simulations of lattice gauge theory and reveal the relations.

In this research, the Pisa group generates gauge field configurations with $N_f = 2 + 1$ dynamical fermions at the physical pion mass under the Pisa-Dubna collaboration. The standard configurations and the configurations to which uniform magnetic fields are applied are prepared at low and finite temperatures. The intensity of the uniform magnetic fields varies from $e|B| = 0.7$ to 1.1 [GeV^2]. We calculate the eigenvalues and eigenvectors of the overlap Dirac operator that holds the exact chiral symmetry using these configurations.

First, we compute the monopole density. Second, we compute the topological charges and the number of instantons and anti-instantons and compare the distributions of the eigenvalues of the overlap Dirac operator with the predictions of random matrix theory. Third, we estimate the eta-prime meson mass from the disconnected contribution of the quark bilinear operator for the pseudoscalar density. Finally, we demonstrate the impact of the external magnetic fields on the monopoles, instantons, spectrum of the overlap Dirac operator, and eta-prime meson mass.

In my talk, I will present the preliminary results obtained using the small lattice volumes.

Author: HASEGAWA, Masayasu (JINR, BLTP)

Presenter: HASEGAWA, Masayasu (JINR, BLTP)

Session Classification: LFTQCD Session

Contribution ID: **10** Type: **not specified**

Phase diagram of rotating QCD with Nf = 2 clover-improved Wilson fermions

Thursday 13 October 2022 11:55 (20 minutes)

The relativistic rotation causes a change in QCD critical temperature. Various phenomenological and effective models predict a decrease in the critical temperature in rotating QCD. Nevertheless, it follows from lattice simulations that the critical temperature in gluodynamics increases due to rotation. But in QCD the rotation acts on both gluons and fermions, and combination of these effects may lead to unexpected results. In this report the lattice results for a rotating QCD with dynamical Nf=2 clover-improved Wilson quarks will be presented. It is shown that the rotation of gluons and fermions has an opposite effect on the critical temperature. Dependence of the results on the pion mass is also discussed.

Authors: Prof. BRAGUTA, Victor (BLTP JINR); Dr KOTOV, Andrey (JINR); SYCHEV, Dmitrii (BLTP JINR, MIPT); Dr ROENKO, Artem (JINR, BLTP)

Presenter: Dr ROENKO, Artem (JINR, BLTP)

Session Classification: LFTQCD Session

Contribution ID: **11** Type: **not specified**

Phase diagram of QCD in a magnetic background

I will review recent results regarding the phase structure of QCD in the presence of a magnetic background, proving in particular the presence of a first order transition for large enough fields.

Author: D'ELIA, Massimo (University of Pisa and INFN)

Presenter: D'ELIA, Massimo (University of Pisa and INFN)

Session Classification: LFTQCD Session

Contribution ID: **12** Type: **not specified**

Various corners of QCD and 2 color QCD phase diagrams

Thursday 13 October 2022 11:15 (20 minutes)

Phase structure of dense quark matter with chiral and isospin imbalance is considered in the framework of effective models. There has been considered as two color as well as three color QCD. It was shown that chiral imbalance has several rather peculiar properties such as being universal catalyzer,
i. e. it catalyzes all the considered symmetry breaking patterns in the system, including the diquark condensation phenomenon (color superconductivity). Duality properties found earlier have been considered in both case.

Author: Dr ZHOKHOV, Roman

Presenter: Dr ZHOKHOV, Roman

Session Classification: LFTQCD Session

Contribution ID: **13** Type: **not specified**

Electromagnetic conductivity of dense quark-gluon plasma

Thursday 13 October 2022 12:35 (20 minutes)

In this report we present the results on the study of the electromagnetic conductivity in dense quark-gluon
plasma obtained within lattice simulations with Nf=2+1 dynamical quarks. We employ stout improved
rooted staggered quarks at the physical point and the tree-level Symanzik improved gauge action. The simulations are performed at imaginary baryon chemical potential, and the Tikhonov regularisation
method is used to extract the conductivity from current-current correlators. Our results indicate an increase of QGP electromagnetic conductivity with real baryon density, and this dependence is quite strong.

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Contribution ID: **14** Type: **not specified**

TBA

Wednesday 12 October 2022 11:00 (20 minutes)

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