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ЛАБОРАТОРИЯ ТЕОРЕТИЧЕСКОЙ ФИЗИКИ
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Семинар
"ТЕОРИЯ АДРОННОГО ВЕЩЕСТВА ПРИ ЭКСТРЕМАЛЬНЫХ УСЛОВИЯХ"

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A DOMAIN WALL NETWORK AS QCD VACUUM: CONFINEMENT, CHIRAL SYMMETRY, HADRONIZATION

An overall task pursued by most of the approaches to QCD vacuum structure is an identification of the properties of nonperturbative gauge field configurations able to provide a coherent resolution of the confinement, the chiral symmetry breaking, the $U_{\rm A}(1)$ anomaly and the strong CP problems, both in terms of color-charged fields and colorless hadrons.

The central subject of the talk is an ensemble of almost everywhere homogeneous, Abelian and (anti-)self-dual gluon field configurations. These configurations are represented by a network of domain wall defects in an initially homogeneous background. A single domain wall is given by the sine-Gordon kink configuration for the angle between the chromomagnetic and chromoelectric components of the gauge field. The kink arises as a solution of the effective equations of motion within the Ginzburg-Landau approach to the effective quantum action of QCD. The effective action takes into account the existence of a non-vanishing gluon condensate $\langle g^2F^2\rangle$ and the symmetries of QCD. The network of domain walls is introduced by a combination of multiplicative and additive superpositions of kinks. The spectrum and eigenmodes of color charged field fluctuations are calculated for the case of an infinitely thin planar Bloch domain wall. The character of the spectrum and eigenmodes of field fluctuations in the presence of the network of domain walls characterizes the QCD vacuum as the heterophase mixed state. The concept of the confinement-deconfinement transition in terms of the ensemble of domain wall networks is outlined. The role of a strong electromagnetic field as a trigger of deconfinement is discussed.

This ensemble of gluon fields provides a setup for description of the main nonperturbative features of QCD. The phenomenological results obtained previously in the context of domain model are reviewed: confinement of static and dynamical quarks, chiral symmetry realization, the $U_A(1)$ anomaly and the strong CP problem, as well as the mechanism of hadronization. In particular, with a minimal set of parameters (characteristic for QCD) the model describes the properties of mesons from qualitatively different parts of the spectrum: light mesons (including the Regge spectrum), heavy quarkonia, heavy-light mesons, electromagnetic form factors and decay constants.