Объединенный институт ядерных исследований
ЛАБОРАТОРИЯ ТЕОРЕТИЧЕСКОЙ ФИЗИКИ
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Семинар
"ТЕОРИЯ АДРОННОГО ВЕЩЕСТВА ПРИ ЭКСТРЕМАЛЬНЫХ УСЛОВИЯХ"

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Семинар состоится
в среду 17 августа в 16.00
в конференц-зале (2 этаж)

Ernst-Michael Ilgenfritz
(BLTP JINR)

How can lattice QCD describe non-zero baryonic density? Continuation.

The region of large baryonic density is *terra incognita* in the QCD phase diagram, at least for *ab initio* theoretical investigations usually offered by lattice QCD.

Quenched lattice studies are obviously misleading, and this is known for 20 years when lattice studies with dynamical fermions were turning to the phase structure of QCD. Dynamical studies are possible, however only with decreasing reliability, over a region of limited chemical potential. They give knowledge with controllable precision up to $\mu/T \approx 1$, in other words, they are practically impossible for cold dense matter and matter becoming accessible in heavy ion collisions in the energy range with $\sqrt{s_{NN}}$ between 4 and 10 GeV (so far explored only in the BES extension program at RHIC down to 7.7 GeV). The region of medium temperatures and $\mu/T >> 1$ and $\mu_B = 3\mu_q \sim 0.8$ GeV (according to Cleymans et al. 2006) will become the object of much more dedicated interest in heavy ion collisions planned at facilities like NICA (MPD) and FAIR (CBM). This can be considered as their *brand mark*.

In relatively simple terms, I will give an explanation for the unpleasant situation in lattice theory, which has its roots in the complex phase problem (a.k.a. "sign problem"), which has prevented a broad activity and rapid growth of knowledge (as we were to used to get it for zero baryonic density with $\mu = 0$) over the last 10 years.

An intensive search for possibilities to overcome this "technical barrier" has attracted human and machine resources to these methodical questions (detracted away from "number crunching"). This initiative is bearing fruit now and has revealed a number of promising potential escapes. They are all related either to "dualization" (choosing a conjugated configuration space for simulations) or "complexification" (choosing a slightly extended configuration space).

The conference "Lattice 2016" was dominated in a remarkable manner by this development.