HK 2: Schwerionenkollisionen und QCD Phasen I

Time: Monday 14:00–16:00 Location: HS AP

Group Report HK 2.1 Mon 14:00 HS AP

Influence of a finite volume on the QCD phase diagram — •Bertram Klein[1], Jens Braun[2], and Bernd-Jochen Schaefer[3] — [1]Technische Universität München — [2]Universität Jena — [3]Universität Graz

A very important method for studying QCD at finite temperature and density is the simulation on a discrete and finite space-time lattice. Both the discretization and the finite volume lead to errors in the results which need to be assessed carefully for extrapolations to the continuum theory in infinite volume.

With regard to the physics of phase transitions and critical phenomena, long-range fluctuations are of great importance, and a finite volume will affect these fluctuations. For small pion masses, such effects will be increasingly manifest in the finite-volume results. They may also affect the shape of the phase transition line at finite temperature and density.

We use a quark-meson model for the breaking of chiral symmetry to investigate effects of a finite volume on the phase diagram of QCD in the case of two quark flavors. We include the effects of long-range fluctuations by means of a non-perturbative renormalization group method. In particular, we discuss the curvature of the chiral phase transition line at finite temperature and density and how it is affected by a finite volume, depending on the spatial boundary conditions for the quark fields. We discuss implications for the QCD phase diagram.

Group Report HK 2.2 Mon 14:30 HS AP

Continuous Time Monte Carlo for QCD in the Strong Coupling Limit — •Wolfgang Unger and Philippe de Forcrand — ETH Zürich, Switzerland

We present results for QCD in the strong coupling limit, obtained from a worm-type algorithm on a discrete spatial lattice but with continuous Euclidean time. This is obtained by sending the anisotropy parameter $\gamma^2 = a/a_t$ to infinity. The gain is that no continuum extrapolation for $N_\tau \to \infty$ has to be carried out. We contrast these computations with those obtained on discrete lattices for large N_τ. As a first application we discuss the determination of the critical temperature for U(3) gauge group (purely mesonic system), and illustrate how the method can also be extended to SU(3) with finite baryon chemical potential.

HK 2.3 Mon 15:00 HS AP

Multiple Critical Points in Effective Quark Models — •Lorenzo Ferroni[1], Volker Koch[2], and Marcus Pinto[3] — [1]Institut für Theoretische Physik, Goethe-Universität, Frankfurt, Germany — [2]Lawrence Berkeley National Laboratory, Berkeley, CA (USA) — [3]Departamento de Fisica, Universidade Federal de Santa Catarina, Florianópolis, Santa Catarina, Brazil

We consider the two flavor version of the Linear Sigma Model as well as of the Nambu Jona-Lasinio model, at finite temperature and quark chemical potential, beyond the Mean Field Approximation. Using parameter values for the pion and quark current masses which weakly break chiral symmetry we show that both models can present more than one critical end point. In particular, we explicitly show that the appearance of a new critical point associated with a first order line at high temperature and low densities could help to conciliate some lattice results with model predictions. Using different techniques, we perform an extensive thermodynamical analysis to understand the physical nature of the different critical points. For both models, our results suggest that the new first order line which starts at vanishing chemical potential has a more chiral character than the usual line which displays a character more reminiscent of a liquid-gas phase transition.

HK 2.4 Mon 15:15 HS AP

The thermal transition of QCD with maximally twisted mass lattice fermions — •Lars Zeidlewicz — Goethe-Universität Frankfurt

I present the current results of the tmfT collaboration for the thermal crossover of QCD using two flavours of maximally twisted mass fermions. We have a set of different pion masses and observables from which we can obtain information about the thermal crossover. I will focus on the mass dependence of the (pseuod-)critical temperature, aimed at extracting the chiral limit. In this context also the nature of the transition in the two-flavour chiral limit can be addressed.

HK 2.5 Mon 15:30 HS AP

Inhomogeneous chiral symmetry breaking phases — •Stefano Carignano[1], Michael Buballa[1], and Dominik Nickel[2] — [1]Institut fuer Kernphysik, TU Darmstadt — [2]Institute for Nuclear Theory, Univ. Washington, Seattle, USA

We discuss the influence of spatially inhomogeneous chiral symmetry breaking phases within the framework of the NJL model and some of its most common extensions. While most of the discussion will be restricted to one-dimensional modulations, the procedure for tackling higher dimensional problems will also be outlined.

HK 2.6 Mon 15:45 HS AP

Resummation scheme for perturbative calculations of the magnetic QCD pressure — •Daniel Bieletzki — Uni Frankfurt

Perturbation theory for non-abelian gauge theories at finite temperature is plagued by infrared divergences which are caused by magnetic soft modes $\sim g^2T$, corresponding to gluon fields of a 3d Yang-Mills theory. While the divergences can be regulated by a dynamically generated magnetic mass on that scale, the gauge coupling drops out of the effective expansion parameter requiring summation of all loop orders for the calculation of observables. We use a scheme based on the non-linear sigma model to implement such infrared-safe resummations to estimate some of the contributions $\sim g^6$ of the soft magnetic modes to the QCD pressure through three loops.