HK 14: Theorie

Zeit: Dienstag 14:15–16:30 Raum: C

HK 14.1 Di 14:15 C

Eigenschaften des Nukleons in heisser und dichter Quarkmaterie auf dem Lichtkegel — •Stefano Mattiello[1], Michael Beyer[2], Stefan Strauss[2], Tobias Frederico[3] und Hans-Jürgen Weber[4] — [1]Institut für Theoretische Physik, Universität Giessen, Germany — [2]Institut für Physik, Universität Rostock, 18051 Rostock — [3]Dep. de Física, Instituto Tecnológico de Aeronáutica, Centro Técnico Aeroespacial, 12.228-900 Sao José dos Campos, Sao Paulo, Brazil — [4]Dept. of Physics, University of Virginia, Charlottesville, VA 22904, U.S.A.

Die Lichtkegelquantisierung einer Feldtheorie erlaubt eine relativistische Untersuchung der Korrelationen in Quarkmaterie endlicher Temperatur und Dichte. Besonders interessiert dabei der Übergang von korrelierten Dreiquarkzuständen zu rein hadronischer Materie aus Nukleonen. Zur mikroskopischen Behandlung des Übergangs haben wir eine relativistische in-medium Faddeev-artige Gleichung abgeleitet. Ein bekanntes Problem ist dabei die Behandlung der Spinfreiheitsgrade auf dem Lichtkegel, die bisher in der Gleichung nur additiv berücksichtigt wurden. In neueren Rechungen wurde der Spin der Konsitutenten für verschiedene Kontaktwechselwirkungen voll berücksichtigt und ein entsprechendes System von Fadeevgleichungen gelöst. In dem Beitrag werden die ersten Resultate gezeigt.

Unterstützt durch die DFG.

HK 14.2 Di 14:30 C

QCD quasi-particle model with widths and Landau damping — •Robert Schulze[1], Marcus Bluhm[2], and Burkhard Kämpfer[1,2] — [1]Institut für Theoretische Physik, TU Dresden, 01062 Dresden, Germany — [2]Forschungszentrum Dresden-Rossendorf, PF 510119, 01314 Dresden, Germany

The equation of state is a central issue for describing the hydrodynamical expansion of strongly interacting matter in relativistic heavy-ion collisions, say at RHIC or LHC energies. Lattice QCD provides important information on the equation of state. We show how a chain of systematic approximations carries us from QCD to a quasi-particle model which accommodates lattice QCD results, e.g. the entropy, on a quantitative level. This approach allows for extrapolation into a region of finite baryon density not yet accessible to lattice calculations. The importance of finite width effects and the Landau damping is centralized.

We also discuss a family of equations of state suitable for RHIC and LHC energies and test the sensitivity of transversal momentum spectra and differential elliptic flow.

HK 14.3 Di 14:45 C

Energy Loss of Charm Quarks Passing Hot Deconfined Matter — •Henry Schade[1], Ronny Thomas[2], and Burkhard Kämpfer[2] — [1]Institut für Theoretische Physik, TU Dresden, 01062 Dresden, Germany — [2]Forschungszentrum Dresden-Rossendorf, PF 510119, 01314 Dresden, Germany

Recent results from RHIC for the nuclear modification factor R_{AA} for charmed hadrons seem to challenge the previous paradigm: Collisional energy loss of charm (and bottom) quarks needs to supplement the celebrated radiative energy loss when passing a deconfined medium. We present results of numerical evaluations of these processes in leading tree-level order of opacity, where finite quark masses and finite energies are exactly accounted for. Dynamical quark-quark scattering is compared with the often employed potential scattering model. Collinear divergences are screened by effective gluon masses, representing the QCD analog of the Ter-Mikaelian (longitudinal density) effect in QED. This modifies also the dead cone suppression. In such a way, an important piece of a complete formalism for jet quenching in relativistic heavy ions is provided.

HK 14.4 Di 15:00 C

Susceptibilites and the Phasestructure of a Chiral Model with Polyakov loops — •Chihiro Sasaki[1], Bengt Friman[1], and Krzysztof Redlich[1,2] — [1]GSI, Planckstr. 1, 64291 Darmstadt — [2]Institute of Theoretical Physics, University of Wroclaw, PL-50204 Wroclaw, Poland

We explore the relation between the deconfinement and chiral phase transitions in an extension of the Nambu-Jona-Lasinio model, where the quarks interact with the temporal gluon field, represented by the Polyakov loop. The effect of Polyakov loop dynamics on thermodynamic quantities, on the phase structure at finite temperature and baryon density and on various susceptibilities is presented. Particular emphasis is put on the behavior and properties of the fluctuations of the (approximate) order parameters and their dependence on temperature and net–quark number density. We also discuss how the phase structure of the model is influenced by the coupling of the quarks to the Polyakov loop.

HK 14.5 Di 15:15 C

Modeling the QCD-phase diagram in and beyond mean field theory — •Simon Rössner[1], Thomas Hell[1], Claudia Ratti[2], and Wolfram Weise[1] — [1]Physik Department, TU München, 85747 Garching, Germany — [2]ECT*, I-38050 Villazzano (Trento), Italy

The two most prominent non-perturbative effects in QCD, spontaneous chiral symmetry breaking and confinement, are the major driving forces of QCD dynamics at energies below 1 GeV. The PNJL model incorporating these features [1,2] shows astonishingly good agreement with full QCD calculations [3]. We present predictions on the QCD phase diagram derived within the framework of this model. The critical point with its current quark mass dependence will be studied as well as the speed of sound [4].

So far the calculation in the PNJL-model have been performed using a mean field approximation. This approach does not allow for a proper treatment of fermion sign problem, which appears on equal footing in QCD. The ansatz we would like to present provides systematic corrections to the mean field approximation. The lowest order corrections lead to a split of the thermal expectation value of Polyakov loop and its complex conjugate. It can be seen from this ansatz that this split is caused by fluctuations and is not part of the mean field result.

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[1] C. Ratti, M. A. Thaler, W. Weise, Phys. Rev. D**73**, 014019 (2006).
[2] C. Ratti et al., to appear in Eur. Phys. J. C [arXiv:hep-ph/0609218].
[3] C. R. Allton *et al.*, Phys. Rev. D**71**, 054508 (2005).
[4] S. Rößner, C. Ratti and W. Weise, [arXiv:hep-ph/0609281].

HK 14.6 Di 15:30 C

Chiral pion-nucleon dynamics in finite nuclei — •paolo finelli[1], norbert kaiser[2], dario vretenar[3], and wolfram weise[2] — [1]Physics Department, University of Bologna, Italy — [2]Institute for Theoretical Physics (T39), TU Muenchen, Germany — [3]Physics Department, University of Zagreb, Croatia

A relativistic nuclear energy density functional, based on chiral dynamics and the symmetry breaking pattern of low-energy QCD, is presented and applied to the description of ground-state properties and collective excitations, in particular Gamow-Teller and IAS resonances. The results are at the same level of quantitative comparison with data as the best phenomenological relativistic mean-field models.

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HK 14.7 Di 15:45 C

Memory effects in the Bremsstrahlung emission from a fermion jet in a non equilibrated hot plasma — •Frank Michler, Björn Schenke, and Carsten Greiner — Institut für theoretische Physik, Johann Wolfgang Goethe Universität Frankfurt am Main, Max von Laue Straße 1, 60438 Frankfurt am Main, Germany

Radiative processes have been found to be the main source for energy loss of high pT partons in a quark gluon plasma. Since the quark gluon plasma produced in heavy ion collisions expands and cools down before it hadronizes, the density of scattering centers is decreasing in time, which makes the radiative behavior of the jet time dependent. We use the Schwinger Keldysh formalism to describe such a non equilibrium process including the Laundau Pomeranschuk Migdal effect. As a first step we restrict our calculations to QED-like interactions, i.e., to ordinary photon emission. A comparision of our results to a quasistatic calculation shows that the radiative behavior follows the changes in the medium almost instantaneously.

HK 14.8 Di 16:00 C

Lattice simulations of a SU(N) matrix model — •Dominik Smith and Adrian Dumitru — Institut für theoretische Physik, Jo-

hann Wolfgang Goethe-Universität, Max-von-Laue-Straße 1, 60438 Frankfurt

We perform lattice simulations of a SU(N) matrix model in three spatial dimensions. Using metropolis updating, we investigate autocorrelation times, expectation values of Polyakov loops in various representations and of their two-point correlation functions. The results give insight into properties of the deconfining phase transition in high temperature SU(N) gauge theories.

HK 14.9 Di 16:15 C

Critical exponents and finite size scaling from non-perturbative Renormalization Group methods — •Bertram Klein[1] and Jens Braun[2] — [1]Physik Department, Technische Universität München, 85747 Garching — [2]Institut für Theoretische Physik, Universität Heidelberg, 69120 Heidelberg

Continuous phase transitions and critical behavior are characterized by the appearance of long-range fluctuations. These critical fluctuations give rise to universal behavior that is independent of the dynamics of the underlying system and can be studied in much simpler model systems in the same universality class.

For the investigation of the phase transition in Quantum Chromodynamics, lattice simulations are indispensable. However, they are still restricted to relatively large quark masses and small volumes. To determine the order of the phase transition, a scaling analysis is an important tool. It requires reliable knowledge of critical exponents, scaling functions and finite size scaling effects. Renormalization Group (RG) methods have been very successful in providing this knowledge.

We apply non-perturbative RG methods to an O(N)-model in a finite 3-dimensional volume and consider explicit breaking of the symmetry. Our goal is to obtain critical exponents and to investigate the effects of the finite volume, which acts as an infrared-cutoff for the long-range fluctuations and affects the critical behavior. We obtain results for critical exponents and the deviation of the scaling from the infinite volume behavior.