HK 65: Heavy Ion Collisions and QCD Phases 9

Time: Thursday 17:00–19:00 Location: T/SR14

HK 65.1 Thu 17:00 T/SR14

Graphene as a lattice field theory — •Dominik Smith[1], Lorenz von Smekal[1,2], and Michael Körner[1] — [1]Technische Universität Darmstadt, Deutschland — [2]Justus Liebig Universität Gießen, Deutschland

We report on the status of ongoing ab-initio simulations of the electronic properties of mono-layer graphene within the tight-binding description. Hereby we employ standard methods of lattice field theory, similar to those used in simulations of Quantumchromodynamics. We present results concerning the semimetal-insulator phase-transition, which is analogous to chiral symmetry-breaking in strongly interacting field theories, and concerning the topological neck-disrupting Lifshitz transition, which occurs at finite electron number-density.

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HK 65.2 Thu 17:15 T/SR14

Generalizations of the excluded-volume mechanism — •Stefan Typel — GSI, Darmstadt, Germany

The excluded-volume mechanism is a simple approach in order to take the finite size of particles and their short-range repulsive interaction into account in models for the nuclear matter equation of state. It can also be used to simulate the suppression of cluster formation with increasing density that is caused by the action of the Pauli principle. The excluded-volume mechanism can be seen more generally as a means to describe a change in the number of effective degrees of freedom. Thermodynamic consistency requires the occurrence of particular rearrangement contributions in a generalized formulation. Examples for the application of this extended approach to hadron and quark matter are discussed.

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HK 65.3 Thu 17:30 T/SR14

Phasespace dynamics of strongly interacting bose systems — •Eduard Seifert — Institut für Theoretische Physik, Gießen, Deutschland

The equilibration of many-body systems far out-off equilibrium has always been a major topic of research. With increasing calculational power more complicated systems can be studied numerically in acceptable time. A complete off-shell transport approach based on the detailed balance relation is used to simulate a spatially homogeneous system of scalar bosons in the ϕ^4-theory in two spatial dimensions including bose-enhancement factors. The scalar ϕ^4-theory is chosen as the interacting theory because of its simplicity and comparability to known solutions of the Kadanoff-Baym equations (KBE) for spatially homogenous systems. The transport equation is solved within a finite box with periodic boundary conditions employing an off-shell test particle ansatz with relativistic Breit-Wigner spectral functions. Three stages of equilibration (kinetic, spectral and chemical equilibration) are studied for different initial momentum distributions, particle densities and coupling strengths. The transport approach propagates the system for moderate coupling strengths comparably to the KBE solutions but deviates for strong coupling strengths.

HK 65.4 Thu 17:45 T/SR14

Baryon-Meson Model with Mirror Assignment beyond Mean-Field — •Johannes Weyrich[1], Nils Strodthoff[2], and Lorenz von Smekal[1,3] — [1]TU Darmstadt — [2]Universität Heidelberg — [3]Justus-Liebig-Universität Gießen

Nuclear matter has been studied intensively making use of the Walecka model and the chiral Walecka model since the 1970s. It was noted early on, however, that the chiral model (on mean-field level) leads to massless Lee-Wick nuclear matter in the chirally restored phase.

A promising candidate to describe nuclear matter and chiral symmetry restoration consitently is the parity doublet model (or mirror model). It has already been treated in a mean-field (MF) approach and showed promising results.

We studied the parity doublet model in an extended mean-field (eMF) approach as well as with full mesonic fluctuations, using a functional renormalization group (FRG) framework.

HK 65.5 Thu 18:00 T/SR14

The magnetic equation of state in effective chiral models — •Gabor Almasi[1], Wojciech Tarnowski[1,4], Bengt Friman[1], and Krzysztof Redlich[2,3] — [1]Helmholtzzentrum für Schwerionenforschung (GSI), 64291 Darmstadt, Germany — [2]University of Wrocław - Faculty of Physics and Astronomy, PL-50-204 Wroclaw, Poland — [3]Helmholtzzentrum für Schwerionenforschung (GSI) - ExtreMe Matter Institute (EMMI), 64291 Darmstadt, Germany — [4]Jagiellonian University, PL-30-059 Cracow, Poland

The chiral properties of QCD are often studied using effective models like the Quark-Meson model. In these models the gauge sector of QCD is integrated out and the models do not show confinement, but they are significantly easier to deal with. Concerning chiral properties they are constructed to be in the same universality class as QCD, so sufficiently close to the chiral phase transition they have the same universal properties (e.g. critical exponents). A finite current quark mass however breaks chiral symmetry explicitly rendering it an approximate symmetry both in QCD and in effective models. This causes violation of the scaling laws at the chiral phase transition. The measure of the violation in QCD and the effective model is in general different. However the better the model is, the closer the deviations from the scaling should be to the deviations in QCD. In this talk the scaling violations in effective models of QCD will be discussed and the results will be compared with lattice data on the magnetic equation of state.

HK 65.6 Thu 18:15 T/SR14

Quark number susceptibilities within the dynamical quasiparticle model — •Thorsten Steinert and Wolfgang Cassing — Institut für Theoretische Physik, Universität Giessen, 35392 Giessen, Germany

QCD thermodynamics can be well described with effective quasiparticle models. We present such a model that treats quarks and gluons as fully dressed particles with effective masses and widths. This dynamical quasiparticle model (DQPM) is tuned to reproduce the equation of state from recent lattice QCD calculations at vanishing quark chemical potential as well as different correlators describing e.g. the shear and bulk viscosities, the electric and heat conductivities. We discuss various methods to extend the model to finite chemical potential and check their validity by calculating the quark number susceptibilities and compare them with recent lattice QCD results.

HK 65.7 Thu 18:30 T/SR14

Chiral symmetry breaking in continuum QCD — •Mario Mitter, Jan M. Pawlowski, and Nils Strodthoff — Universität Heidelberg - Institut für Theoretische Physik, Deutschland, Heidelberg

We present a quantitative analysis of chiral symmetry breaking in two-flavour continuum QCD in the quenched limit. The theory is set-up at perturbative momenta, where asymptotic freedom leads to precise results. The evolution of QCD towards the hadronic phase is by means of dynamical hadronisation in the non-perturbative functional renormalisation group approach. We use a vertex expansion scheme based on gauge-invariant operators and discuss its convergence properties and the remaining systematic errors. In particular we present results for the quark propagator, the full tensor structure and momentum dependence of the quark-gluon vertex, and the four-fermi scatterings.

HK 65.8 Thu 18:45 T/SR14

Gluonic Vertices of Landau Gauge Yang-Mills Theory in the Dyson-Schwinger Approach — •Anton Konrad Cyrol[1], Markus Huber[2], and Lorenz von Smekal[1,3] — [1]Technische Universität Darmstadt, Institut für Kernphysik, Theoriezentrum, 64289 Darmstadt, Germany — [2]University of Graz, Institute of Physics, 8010 Graz, Austria — [3]Justus-Liebig-Universität Gießen, Institut für Theoretische Physik, 35392 Gießen, Germany

We report on a self-consistent solution of the Landau gauge four-gluon vertex DSE. Our calculation includes all perturbatively leading one-loop diagrams, which constitutes the state-of-the-art truncation. As only input we use results for lower Green functions from previous Dyson-Schwinger studies that are in good agreement with lattice results. Within the truncation, no higher Green functions enter. Hence, the results depend only indirectly on models of Green functions. Our self-consistent solution resolves the full momentum dependence of the four-gluon vertex but is limited to the tree-level tensor structure. We

calculate a few exemplary dressings of other tensor structures and find that they are suppressed compared to the tree-level structure except for the deep infrared where they diverge logarithmically. We employ the results to derive a running coupling. Furthermore, we study the coupled system of the three- and the four-gluon vertices to reduce the model dependence and to explore the convergence of the system of DSEs within the truncation scheme employed. For the scaling solution we establish a solution of the coupled system of vertices which provides promising evidence for the convergence.