# HK 74: Schwerionenkollisionen und QCD Phasen

Zeit: Donnerstag 16:45–19:00 Raum: HSZ-201

**Gruppenbericht** HK 74.1 Do 16:45 HSZ-201

**Thermalization through Hagedorn-States** — •Maxim Beitel, Kai Gallmeister, and Carsten Greiner — Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt, Germany

We examine the evolution of a heavy ion collision starting from non-equilibrium to an equilibrium state by looking at the corresponding thermalization times. Therefore we use the hadronic transport model "UrQMD" as microscopic model for high-energetic heavy ion collisions. Unfortunately these times are too long at present because detailed balance is not realized for all collisions which may occur. In order to get rid of this drawback we deploy Hagedorn-States proposed by the "Statistical Bootstrap Model". We study the question, whether creation of these states in binary collisions and their decay into two particles only will lower the thermalization times in UrQMD.
Supported by the Hessian LOEWE initiative through the Helmholtz International Center for FAIR (HIC for FAIR), GSI and HGS-HIRe.

HK 74.2 Do 17:15 HSZ-201

**Thermalization of weakly coupled non-abelian plasmas** — •Soeren Schlichting — Universität Heidelberg

The question how thermalization is achieved in relativistic heavy-ion collision provides one of the biggest theoretical challenges in our current understanding of the experiments performed at RHIC and the LHC. In this talk I will address the problem of thermalization of weakly coupled non-abelian plasmas from a more general point, by considering a class of systems which share important features with the one created in relativistic heavy-ion collisions. In the first part of this talk, I will discuss the occurrence of Kolmogorov wave turbulence in non-abelian gauge theories which drives the thermalization process in non-expanding plasmas [1,2]. In the second part of this talk I will present preliminary results on the properties of longitudinally expanding plasmas, which are phenomenologically relevant for relativistic heavy-ion collisions. In both cases numerical and analytical considerations will be presented.

[1] J. Berges, S. Schlichting, D. Sexty, Phys.Rev. **D** 86, 074006
[2] S.Schlichting, Phys. Rev. **D** 86, 065008

HK 74.3 Do 17:30 HSZ-201

**Hydrodynamics on graphic cards** — •Jochen Gerhard[1,2], Volker Lindenstruth[1,2], and Marcus Bleicher[1,3] — [1]Frankfurt Institute for Advanced Studies (FIAS), Ruth-Moufang-Str. 1, D-60438 Frankfurt — [2]Institut für Informatik, Goethe-Universität Frankfurt, Robert-Meyer-Straße 11-15, D-60054 Frankfurt — [3]Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt

In the field of high-energetic nucleus-nucleus collisions at RHIC and LHC ideal and dissipative relativistic hydrodynamics is used to calculate the evolution of hot and dense QCD matter. A large body of current numerical tools employs relativistic hydrodynamics in various facets. The acceleration of relativistic hydrodynamics using graphic cards (GPUs) is therefore of highest relevance to this fields. The results reported here are based on the Sharp And Smooth Transport Algorithm SHASTA, which is employed in many hydrodynamical models and hybrid simulation packages, e.g. the Ultrarelativistic Quantum Molecular Dynamics model (UrQMD). We have redesigned the SHASTA using the OpenCL computing framework to work on accelerators like graphic processing units (GPUs) as well as on multi-core processors. With the redesign of the algorithm the hydrodynamic calculations have been accelerated by a factor 160 allowing for event-by-event calculations and better statistics in hybrid calculations.
Supported by the Hessian LOEWE initiative through the Helmholtz International Center for FAIR (HIC for FAIR).

HK 74.4 Do 17:45 HSZ-201

**Der chirale Phasenübergang - dynamische Transport-Simulation eineslinearen Sigma Models** — •Christian Wesp und Carsten Greiner — Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt, Germany

Ziel dieser Studie ist die Suche nach Signaturen des chiralen Phasenübergangs. Um den Einfluss des Überganges oder eines kritischen Punktes auf Fluktuationen in z.B. der Baryonenzahl zu untersuchen, behandeln wir das lineare Sigma Model in einer dynamischen 3+1D numerischen Simulation. Die chiralen Felder werden als klassische Felder genähert, während die Quarks durch Quasiteilchen in einer Vlasov-Gleichung beschrieben werden. Zusätzliche Systemdynamik wird mit einer Quark-Quark und Quark-Feld Interaktion erziehlt. Als modellhafte Nichtgleichgewichtsbehandlung einer Scherionenkollision wird die Expansion eines Feuerballs simuliert.
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HK 74.5 Do 18:00 HSZ-201

**Off-equilibrium photon production during the chiral phase transition** — •Frank Michler[1], Hendrik van Hees[1,2], Dennis Dean Dietrich[1], Stefan Leupold[3], and Carsten Greiner[1] — [1]Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt, Germany — [2]Frankfurt Institute for Advanced Studies (FIAS), Ruth-Moufang-Straße 1, D-60438 Frankfurt, Germany — [3]Institutionen för fysik och astronomi, Uppsala Universitet, Box 516, 75120 Uppsala, Sweden

We investigate the photon emission arising from the chiral mass shift during the chiral phase transition in the early stage of ultrarelativistic heavy-ion collisions. As this mass shift leads the spontaneous creation of quark-antiquark pairs and thus contributes to the formation of the quark-gluon plasma, our investigations are relevant in the context of finite lifetime effects on the photon emission from the latter. Earlier investigations on this topic were accompanied by a divergent vacuum contribution and a non-integrability of the remaining contributions in the ultraviolet domain. In contrast to these investigations, we do not consider the photon numbers at finite times but for free asymptotic states obtained by an adiabatic switching of the electromagnetic interaction according to the Gell-Mann and Low theorem. This approach eliminates possible unphysical vacuum contributions and leads to photon spectra integrable in the UV domain. It is emphasized that the consideration of free asymptotic states is indeed crucial to obtain such physically reasonable results.
Supported by Land Hessen and HGS-HIRe.

HK 74.6 Do 18:15 HSZ-201

**Direct Photons at FAIR** — •Bjørn Baeuchle[1], Marcus Bleicher[1,2], and Andreas Grimm[1,2] — [1]Frankfurt Institute for Advanced Studies (FIAS), Ruth-Moufang-Str. 1, D-60438 Frankfurt — [2]Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt

Photons, as all electromagnetic probes, can give direct access to the hot and dense phase of a heavy-ion reaction. We show calculations of direct photon emission at SiS100- and SiS-300 energies with the UrQMD-hybrid model. UrQMD is a full microscopic+macroscopic transport/fluiddynamics hybrid model with hadron- and string-driven equilibration phase, a full (3+1)-dimensional fluiddynamic hot and dense phase and a hadronic after-burner. Unequilibrated matter at high rapidity is preserved during the fluid phase. A strong emphasis is set on the impact of viscosity and Equation of State at zero and non-zero baryon density to the spectra and flow patterns of thermal and non-thermal photons in A+A-collisions at the colliding systems relevant for FAIR.
Supported by the Hessian LOEWE initiative through the Helmholtz International Center for FAIR (HIC for FAIR) and BMBF.

HK 74.7 Do 18:30 HSZ-201

**Real and virtual photon emission of strongly interacting matter** — •Falk Wunderlich and Burkhard Kämpfer — Helmholtz-Zentrum Dresden-Rossendorf, D-01328 Dresden, Germany

We present calculations of the photon emissivity of strongly interacting matter. Within the HTL approximation the resulting spectral function is analyzed to find suitable cuts on the real and virtual photon spectrum in order to obtain a clear signal from the deconfined phase. Emphasis is put on imprints of Van Hove singularities. The analysis is extended to effective theories which describe the chiral or deconfinement phase transition. Here, we search for signals of soft modes nearby

a critical point.The work was funded by BMBF.

HK 74.8 Do 18:45 HSZ-201

**Holographic reconstruction of the dilaton potential in a gravity dual of the pure gluon plasma** — •Roman Yaresko[1,2] and Burkhard Kampfer[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, POB 51 01 19, 01314 Dresden, Germany — [2]TU Dresden, Institut für Theoretische Physik, 01062 Dresden, Germany

Employing new precision data of the $SU(3)$ Yang-Mills theory (gluon plasma) the potential of the gravity dual with a dilaton field is reconstructed in a wide temperature range above the deconfinement temperature $T_c$. The compact form of the potential employed recently by Gubser is shown to reproduce the lattice data with suitable parameter adjustments. The ratio of bulk-to-shear viscosity exhibits within such a setting a pronounced increase when approaching $T_c^+$.