HK 30: Schwerionenkollisionen und QCD Phasen

Zeit: Dienstag 14:00–16:15 Raum: HSZ-204

Gruppenbericht HK 30.1 Di 14:00 HSZ-204

How Neutron Stars Constrain the Nuclear Equation of State — •Thomas Hell[1,2], Norbert Kaiser[1], and Wolfram Weise[1,2] — [1]Physik-Department, Technische Universität München, D-85747 Garching, Germany — [2]ECT*, Strada delle Tabarelle 286, I-38123 Villazzano (Trento), Italy

Recently, the mass of the pulsar PSR J1614-2230 has been measured with high accuracy to be 1.97 ± 0.04 solar masses. This, in addition to statistical analyses of neutron-star radii, leads to tight constraints for the equation of state of dense baryonic matter inside neutron stars. We combine a realistic phenomenological equation of state at low densities with equations of state around nuclear density derived from chiral effective field theory, on one hand, and from the Polyakov-loop-extended Nambu–Jona-Lasinio model, on the other. In the latter case, we investigate also the particular role of a vector interaction for the chiral phase transition. Our analysis strongly supports a very stiff equation of state of ordinary nuclear matter, without the need of exotic-matter admixtures, in order to reproduce the empirical observations for neutron stars.

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HK 30.2 Di 14:30 HSZ-204

Shear Viscosity from the Nambu–Jona-Lasinio Model — •Robert Lang, Norbert Kaiser, and Wolfram Weise — Physik Department, Technische Universität München, D-85747 Garching, Germany

The Nambu–Jona-Lasinio (NJL) model provides a good description of strongly-interacting matter where confinement does not play the major role. In the vicinity of the chiral cross over we apply this model to calculate the T and μ dependence of the shear viscosity η. The theoretical foundations are a systematic large-N_c analysis of the NJL model and the Kubo formalism for the calculation of transport coefficients.

Work supported by BMBF, GSI and the Excellence Cluster "Origin and Structure of the Universe".

HK 30.3 Di 14:45 HSZ-204

Self-bound quark matter in the NJL model revisited: from schematic droplets to solitonic lasagne — •Michael Buballa and Stefano Carignano — TU Darmstadt

The existence and the properties of self-bound quark matter in the NJL model at zero temperature are investigated in mean-field approximation, focusing on inhomogeneous structures with one-dimensional spatial modulations. It is found that the most stable homogeneous solutions which have previously been interpreted as schematic quark droplets are unstable against formation of a one-dimensional soliton-antisoliton lattice. The solitons repel each other, so that the minimal energy per quark is realized in the single-soliton limit. The properties of the solitons and their interactions are discussed in detail, and the effect of vector interactions is estimated. The results may be relevant for the dynamics of expanding quark matter.

HK 30.4 Di 15:00 HSZ-204

Inhomogene Phasen stark wechselwirkender Materie mit Vektorwechselwirkung — •Marco Schramm, Daniel Nowakowski, Stefano Carignano und Michael Buballa — Institut für Kernphysik, Technische Universität Darmstadt

Im Rahmen eines Zwei-Flavor-Nambu–Jona-Lasinio-Modells untersuchen wir das Phasendiagramm stark wechselwirkender Materie. Für ein solches Modell wurde gezeigt, dass neben den bekannten homogenen Phasen auch inhomogene Phasen auftreten können, in denen der chirale Ordnungsparameter räumlich variiert. Wir betrachten in diesem Vortrag ein erweitertes Modell mit Vektorwechselwirkung und diskutieren die Auswirkungen auf das Phasendiagramm. Wir beschränken uns hierbei auf eindimensionale Modulationen für das chirale Kondensat. Dabei berücksichtigen wir im Gegensatz zu bisherigen Ansätzen die Rückwirkung der Dichtemodulation auf die Gapgleichung. Für realistische Parameter sind diese inhomogenen Phasen gegenüber homogenen, mit räumlich und zeitlich konstantem Ordnungsparameter und Dichte energetisch favorisiert.

HK 30.5 Di 15:15 HSZ-204

Inhomogene Phasen in der QCD mit Dyson-Schwinger Gleichungen — •Daniel Müller, Michael Buballa und Jochen Wambach — Institut für Kernphysik, TU Darmstadt

Wir verwenden Dyson-Schwinger Gleichungen in Landau Eichung, um den chiralen QCD-Phasenübergang bei hohen Dichten zu beschreiben. Dabei erlauben wir räumlich inhomogene chirale Kondensate. Wir beschränken uns dabei auf eindimensionale Modulationen in Form einer ebenen Welle (chiral density wave). Dabei erhalten wir eine inhomogene Phase, welche den ursprünglichen Phasenübergang erster Ordnung komplett überdeckt.

HK 30.6 Di 15:30 HSZ-204

Temperature dependence of the quark propagator within a Dyson-Schwinger approach — •Marco Viebach, Thomas Hilger, and Burkhard Kämpfer — TU Dresden and Helmholtz-Zentrum Dresden-Rossendorf, D-01328 Dresden, Germany

We present calculations of the quark propagator within the Dyson-Schwinger equations (DSEs) at non-zero temperature for various quark masses. Using a phenomenological gluon propagator and the rainbow approximation to truncate the DSEs the analytical structure is examined for temperature effects. The loci of singularities in the complex momentum plane potentially characterize the phase state with respect to chiral symmetry and confinement.

The chiral condensate and the dual condensate offer measures of the chiral and the deconfinement transition, respectively. They are studied as a function of the temperature and compared with other quantities characterizing the quark propagator.

The results of the DSEs serve as input for the Bethe-Salpeter equation, which provides an access to the meson spectrum and temperature driven medium modifications.

The work is supported by BMBF.

HK 30.7 Di 15:45 HSZ-204

Phasendiagramm der Zwei-Farb-QCD mit Dyson-Schwinger-Gleichungen — •Pascal Buescher, Michael Buballa und Jochen Wambach — Institut für Kernphysik, TU Darmstadt

Wir untersuchen das Phasendiagramm der Zwei-Farb-QCD mithilfe von Dyson-Schwinger-Gleichungen (DSE) und vergleichen unsere Ergebnisse mit denen aus anderen Zugängen. Die DSEs werden hierzu geeignet trunkiert und in Landau-Eichung selbstkonsistent gelöst. Für das Quarkloopdiagramm in der DSE des Gluonpropagators vergleichen wir zwei verschiedene Trunkierungen: die selbstkonsistente Rückkopplung des vollen Quarkpropagators und der Verwendung des Quarkloops in Hard-Dense/Hard-Thermal-Loop-Näherung. Neben der Betrachtung des Phasendiagramms legen wir besonderes Augenmerk auf die Pauli-Gürsey-Symmetrie und die Silver-Blaze-Eigenschaft.

HK 30.8 Di 16:00 HSZ-204

Effective gluon potential and Yang-Mills thermodynamics — •Chihiro Sasaki[1] and Krzysztof Redlich[2] — [1]Frankfurt Institute for Advanced Studies (FIAS), Ruth-Moufang-Straße 1, D-60438 Frankfurt, Germany — [2]Institute of Theoretical Physics, University of Wroclaw,PL-50204 Wrocław,Poland

We show that the Polyakov-loop potential can be derived, using a field theoretical methods, directly from the SU(3) Yang-Mills theory. A class of the Polyakov-loop effective potentials used so far in literature appears as limiting cases of our potential. We deduce the correspondence of U(L) to the strong-coupling expansion, of which the relevant coefficients of the gluon energy distribution are specified solely by characters of the SU(3) group.

At high temperatures the derived gluon potential exhibits the correct asymptotic behavior, whereas at low temperatures, it disfavors gluons as appropriate dynamical degrees of freedom. To quantify the Yang-Mills thermodynamics in a confined phase, we propose a hybrid approach which matches the effective gluon potential to the one of glueballs constrained by the QCD trace anomaly in the context of dilaton fields.

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