HK 34 Theorie

Zeit: Dienstag 16:30–19:00 Raum: TU MA042

HK 34.1 Di 16:30 TU MA042

Pentaquarks in Neutronensternen — •Mirjam Wietoska und Jürgen Schaffner-Bielich — Institut für theoretische Physik, Johann Wolfgang Goethe-Universität, Robert-Mayer-Str. 8-10, 60325 Frankfurt am Main

Es wurden Neutronensterne unter Verwendung von relativistischen Feldmodellen und verschiedenen Parametersätzen berechnet. Dabei wurde der Einfluss von Pentaquarks auf Neutronensterne und deren Masse-Radius-Beziehungen untersucht und mit astronomischen Beobachtungen verglichen. Anschließend wurden daraus Rückschlüsse auf die Eigenschaften von Pentaquarks in dichter Kernmaterie gezogen.

HK 34.2 Di 16:45 TU MA042

Color superconductivity in neutron and protoneutron stars — •Verena Werth and Michael Buballa — Institut für Kernphysik, TU Darmstadt

It is expected that quark matter at high densities and low temperatures is a color superconductor. Such conditions could be realized in the interior of neutron stars or protoneutron stars. In order to examine this possibility we employ a 3-flavor NJL model, which treats diquark condensates and quark-antiquark condensates on an equal footing. The latter lead to density dependent effective quark masses, which are known to have crucial influence on the phase structure. Special emphasis is put on the constraints imposed by electric and color neutrality which have to be obeyed in neutron stars. For protoneutron stars, where neutrinos are trapped, in addition lepton number conservation must be taken into account. The resulting phase structure and possible consequences for the structure of neutron and protoneutron stars are discussed.

HK 34.3 Di 17:00 TU MA042

Dynamical screening of non-Fermi-Liquid effect at finite temperature — •Kai Hebeler and Bengt Friman — GSI, 64291 Darmstadt, Planckstr. 1

We explore quark matter at high densities and low tempertaures in the Hard Dense Loop approximation. As is well known at zero temperture, due to the lack of screening for transverse gauge bosons, the quasiparticle strength vanishes for states at the Fermi surface. Consequently such a system is formally not a normal Fermi liquid. However, since the corresponding singularity is logarithmic, we show that the normal Fermi-liquid behaviour can be restored by taking finite temperature effects into account.

HK 34.4 Di 17:15 TU MA042

Correlations in many-body systems with two-time Green's functions — H.S. Köhler[1] und •K. Morawetz[2,3] — [1]Physics Department, University of Arizona, Tucson, Arizona 85721 — [2]Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — [3]Max-Planck-Institute for the Physics of Complex Systems, Nöthnitzer Str. 38, 01187 Dresden, Germany

The Kadanoff-Baym (KB) equations are solved numerically for infinite nuclear matter. In particular we calculate correlation energies and correlation times. Approximating the Green's functions in the KB collision kernel by the free Green's functions the Levinson equation is obtained. This approximation is valid for weak interactions and/or low densities. It relates to the extended quasi-classical approximation for the spectral function. Comparing the Levinson, Born and KB calculations allows for an estimate of higher order spectral corrections to the correlations. A decrease in binding energy is reported due to spectral correlations and off-shell parts in the reduced density matrix [1]. The possibility to reformulate these correlations in terms of nonlocal shifts is presented [2].

[1] H.S. Köhler, K. Morawetz; Phys. Rev. C 64 (2002) 024613
[2] K. Morawetz, P. Lipavsk'y, V. Spicka; Ann. Phys. 294 (2001) 135

HK 34.5 Di 17:30 TU MA042

Double pion production in nuclei — •Pascal Muehlich, Luis Alvarez-Ruso, Oliver Buss und Ulrich Mosel — Institut für Theoretische Physik, Universität Giessen, Germany

Double pion production in nuclei has been proposed to be a unique method the determine experimentally how the $\pi\pi$ interaction in the σ channel changes in the nuclear medium. Even at low energies, i. e. for average pion energies below the Δ resonance, the final $\pi\pi$ system underlies strong final state interactions due to πN collisions in the nuclear environment. We present a systematic analysis of double pion production in photon-, pion- and proton-induced reactions in nuclei, employing a semi-classical transport approach including the full coupled-channel dynamics of the πN final state interactions. We find a non-negligible effect of quasi-elastic and charge-exchange scattering, which in some cases appears to be sufficient to explain the experimental data without introducing further medium modifications. The aim of our work is to describe simultaneously photon- and hadron-induced reactions in nuclei with the very same physical input, providing a basis for the interpretation of results of ongoing experimental research.

Work supported by DFG.

HK 34.6 Di 17:45 TU MA042

Nuclear density functional constrained by low-energy QCD — •Paolo Finelli[1], Norbert Kaiser[1], Dario Vretenar[2], and Wolfram Weise[1] — [1]Physik Department, Technische Universität München, D-85747 Garching, Germany — [2]Physics Department, University of Zagreb, 10000 Zagreb, Croatia

We have developed a relativistic point-coupling model of nuclear many-body dynamics constrained by the low-energy sector of QCD. The effective Lagrangian is characterized by density-dependent coupling strengths determined by chiral one- and two-pion exchange (with single and double delta isobar excitation) and by large isoscalar background fields that arise through changes of the quark condensate and the quark density at finite baryon density. The model has been tested in the analysis of nuclear ground-state properties (binding energies, root mean square radii, single particle structure) along different isotope chains of medium and heavy nuclei. The agreement with experimental data is comparable with the best purely phenomenological descriptions. The built-in QCD constraints and the explicit treatment of pion exchange restrict the freedom in adjusting parameters and functional forms of density-dependent couplings. It is shown that chiral pionic fluctuations play a prominente role for nuclear binding and saturation machanism, whereas background fields of about equal magnitude and opposite sign generate effective spin-orbit potential in nuclei.

Work supported in part by BMBF and GSI.

HK 34.7 Di 18:00 TU MA042

Chiral SU(3) dynamics, QCD sum rules and Λ-hyperons in the nuclear medium — •Norbert Kaiser, Bernhard Langwallner, and Wolfram Weise — Physik-Department, TU München, D-85747 Garching, Germany

We present a novel approach to the density dependent mean field and the spin-orbit interaction of a Λ-hyperon in nuclear many-body systems, based on flavor-SU(3) in-medium chiral perturbation theory. The leading long-range ΛN-interaction arises from kaon exchange and from two-pion exchange with a Σ-hyperon in the intermediate state. The empirical Λ-nucleus potential depth of about $-28\,\mathrm{MeV}$ is well reproduced with a single cutoff scale, $\bar{\Lambda} = 0.7\,\mathrm{GeV}$, effectively representing all short-distance (high-momentum) dynamics not resolved at scales characteristic of the nuclear Fermi momentum. The smallness of the Λ-nuclear spin-orbit interaction finds a natural (yet novel) explanation in terms of an almost complete cancellation between short-range contributions (properly rescaled from the known nucleonic spin-orbit coupling strength) and long-range terms generated by iterated one-pion exchange with intermediate Σ-hyperons. The small $\Sigma\Lambda$-mass difference figures prominently in this context. We perfom a similar calculation for the complex-valued Σ-nuclear mean field $U_\Sigma(k_f) + i\,W_\Sigma(k_f)$. At saturation density two-pion exchange with Λ-hyperons in the intermediate state gives rise to an imaginary part of $W_\Sigma(k_{f0}) = -21.5\,\mathrm{MeV}$ in good agreement with the value extracted from the width of Σ^- atom states. We also examine connections with in-medium QCD sum rules for hyperons.

HK 34.8 Di 18:15 TU MA042

Low-energy pions in nuclear matter — •Oliver Buss[1], Luis Alvarez-Ruso[1], Ulrich Mosel[1] und Radhey Shyam[2] — [1]Institut für Theoretische Physik, Universität Giessen, Germany — [2]Saha Inst. Nuclear Phys., Calcutta, India

We use the the *Boltzmann-Uehling-Uhlenbeck (BUU)* transport model to describe low energy scattering events of pions and nuclei [1]. Our interest in such low energy events has been triggered by recent photoproduction experiments of the TAPS collaboration [2] and π-induced experiments of the CHAOS collaboration[3]. In these experiments the σ-resonance is excited inside different nuclei and it decays already inside the nuclear medium into a two-pion final-state.
We have shown that also in a regime of large wave length the semiclassical BUU model still gives reasonable results for π-nucleus scattering. Hence it is a suitable tool to describe the final state effects of the latter experiments. In addition we exploited the Δ-hole model to investigate the influence of a mean field potential for the pion on parameters like the mean free path and the velocity of the pion inside the medium and observables like π- and γ-induced [4] scattering events. We also compared our results to fully quantum mechanical calculations.
Work supported by DFG.
[1] Oliver Buss, diploma thesis at JLU Giessen, April 2004.
[2] J. G. Messchendorp et al.,*Phys. Rev. Lett.* 89, 222302 (2002).
[3] F. Bonutti et al.,*Nucl. Phys.* A677, 213 (2000).
[4] P. Mühlich,L. Alvarez-Ruso,O. Buss and U. Mosel, *Phys.Lett.* B595, 216-222 (2004)

HK 34.9 Di 18:30 TU MA042

Nambu Goldstone modes in a modified Hartree Approximation to the O(N) Model — •Felix Riek[1], Yuri Ivanov[1,2], and Jörn Knoll[1] — [1]GSI, 64291 Darmstadt, Planckstr. 1 — [2]Kurchatov Institute, Kurchatov sq. 1, Moscow 123182

We present a modified selfconsistent Hartree approximation at the example of the ϕ^4 $O(N)$-model. The modification complies a) with all the desireable features of selfconsistent Dyson resummation schemes base on the 2PI functional formalism (Φ-derivable approximation) like conservation laws and thermodynamical consistency, while b) it simultaneously respects the Nambu-Goldstone theorem in the chirally broken phase. Because of these features our approach allows a scale independent renormalization of the self consistent treatment in the vacuum. However the scale dependence still persists at finite temperature leading to ambiguous results.
In this talk the temperature dependence of the masses of the pion and sigma meson will be presented together with a discussion of the resulting phase structure of the system. The results will be compared to the standard Hartree approximation.

HK 34.10 Di 18:45 TU MA042

Non-linear QCD evolution at fixed and running coupling — •Dennis Dean Dietrich — The Niels Bohr Institute, Copenhagen, Denmark

A relation is presented, which connects results obtained from the Balitsky-Kovchegov equation at fixed and running QCD coupling, respectively. Its implications are discussed.