P 6: Grundlegende Probleme, Theorie

Zeit: Montag 14:35–16:00 Raum: 6F

Fachvortrag P 6.1 Mo 14:35 6F

Single particle spectral function and optical properties of dense plasmas — •Carsten Fortmann, Gerd Roepke, and August Wierling — Institut f. Physik, Universität Rostock, 18051 Rostock

Optical properties of plasmas are of great interest for plasma diagnostic purposes. A key quantity is the dielectric function which is determined by the spectral function of the charged particles in the plasma. The spectral function contains all correlations in the system.

In this work, we present a consistent scheme of approximations in order to calculate the electrons spectral function using thermodynamic Green's functions. By taking into account the dynamical self-energy of the electrons in a self-consistent way, we go beyond the quasiparticle picture and perturbative approaches such as Born approximation. We compare the widely used but inconsistent GW approximation to the $GW\Gamma$ approximation, in which correlations and exchange are accounted for in a way that sum rules (Ward identities) are fulfilled.

As an application, we present calculations of the inverse bremsstrahlung absorption of moderately coupled plasmas. The results are given in terms of the Gaunt factor, i.e. the correction of Kramer's result which is based on the quasiparticle approximation. We show in detail, how the account for medium effects via the self-energy modifies the absorption spectrum.

P 6.2 Mo 15:00 6F

Effective potentials and structure factors for partially ionized plasmas — •Wolf Dietrich Kraeft, Thomas Bornath, Volker Schwarz, and Ronald Redmer — Institut für Physik der Universität Rostock, D

Structure factors are needed in diagnostics for the interpretation of light and X-ray scattering plasma experiments. They can be determined via integral equations such as HNC schemes. Effective potentials are applied in order to extend the range of applicability to cover dense quantum plasmas.

Starting from the two-particle Slater sum, the Kelbg potential follows in first Born approximation. Here, we study the contribution of the second Born approximation. Comparison with other approaches to effective potentials, such as given by Gombert, PRE 66, 066407(2002) and by Filinov et al., PRE 70, 046411(2004), is performed. Finally, results for radial distribution functions and static structure factors are presented in an HNC scheme for a partially ionized plasma.

P 6.3 Mo 15:15 6F

Thermodynamic theory of a strongly correlated confined Yukawa plasma — •Christian Henning, Michael Bonitz, and Alexei Filinov — CAU zu Kiel, ITAP, D-24118 Kiel

The structure of "Yukawa balls", i.e. spherical 3D dust crystals, which recently have been produced at room temperature [1], is well explained by computer simulations of charged Yukawa interacting particles within an external parabolic confinement [2]. However, an analytical theory is still missing. Here we present first results of a systematic statistical theory of strongly correlated confined Yukawa plasmas based upon a continuum approach. In particular, mean-field and correlation contributions are analyzed. The results range from the ground state density profile [3, 4] to the equation of state and also allow to relate short range and long range interactions due to variation of the screening parameter. Furthermore, we compare the results to molecular dynamics simulations and to shell models as well showing that an excellent agreement to the crystalline structure is found. Finally the extension to finite temperature is presented.

[1] O. Arp, D. Block, A. Piel, and A. Melzer, Phys. Rev. Lett. 93, 165004 (2004)

[2] M. Bonitz, D. Block, O. Arp, V. Golubnychiy, H. Baumgartner, P. Ludwig, A. Piel, and A. Filinov, Phys. Rev. Lett. 96, 075001 (2006)

[3] C. Henning, H. Baumgartner, A. Piel, P. Ludwig, V. Golubnichiy, M. Bonitz, and D. Block, Phys. Rev. E 74, 056403 (2006)

[4] C. Henning, M. Bonitz, and A. Filinov, submitted for publication

P 6.4 Mo 15:30 6F

Z-Pinch-Plasmen als Absorptionsmedium für Laserstrahlung — •Stephan Brückner, Stephan Wieneke und Wolfgang Viöl — Hochschule für angewandte Wissenschaft und Kunst, Fakultät Naturwissenschaften und Technik, Von-Ossietzky-Str. 99, D-37085 Göttingen, Deutschland

Z-Pinche bieten eine sehr gute Möglichkeit räumlich begrenzte Plasmen hoher Dichte und hoher Temperatur zu erzeugen. Eine Alternative zu elektrisch erzeugten Plasmen stellen die laserinduzierten Plasmen dar. Beide Verfahren ermöglichen grundsätzlich Strahlungsquellen mit, je nach Anforderung, spezifischen Strahlungseigenschaften. Eine Kopplung dieser beiden Verfahren stellt eine mögliche Anordnung dar, Z-Pinche mit niedrigeren Strömen zu betreiben (einige kA). Entscheidend für eine effektive Einkopplung von Laserstrahlung in ein Z-Pinchplasma ist die Kenntnis der zeitlichen Entwicklung der Elektronendichte im Plasma. Das dynamische Verhalten von verschiedenen Z-Pinchplasmen wurde mit Hilfe eines 1-D-magnetohydrodynamischen Modells numerisch gelöst. Dieses simulierte Verhalten zusammen mit experimentell gewonnenen Daten wurde herangezogen um die Effizienz von Z-Pinchplasmen als Absorptionsmedium für Laserpulse abzuschätzen.

P 6.5 Mo 15:45 6F

Plasma instabilities in the quark gluon plasma — •Andreas Ipp[1], Anton Rebhan[2], Paul Romatschke[3], and Michael Strickland[4] — [1]Max-Planck-Institut für Kernphysik, Heidelberg — [2]Technische Universität Wien — [3]University of Washington, Seattle — [4]Frankfurt Institute for Advanced Studies

It has been pointed out a while ago that plasma instabilities, in particular the so-called Weibel or filamentary instabilities from ordinary electromagnetic plasmas, may play a role also in the quark-gluon plasma that is produced in relativistic heavy-ion collisions at CERN-SPS, RHIC, or soon the LHC. Only recently it has been proposed that the non-Abelian generalization of plasma instabilities to strong interactions may provide an explanation for the fast isotropization of the quark-gluon plasma and specifically an explanation for the recent puzzle of fast apparent thermalization that is observed in such experiments. There, the instabilities arise necessarily through the initial momentum anisotropy generated by the rapidly expanding plasma.

We treat the instabilities by gauge-covariant collisionless Boltzmann-Vlasov equations for an effective field theory for the soft momentum modes of the gauge fields. These soft modes pertain collective dynamics such as Debye screening, finite plasma frequency, and magnetic instabilities of anisotropic plasmas. In this work, we extend the previous work of Ref. [1] to treat full 3+1 dimensional SU(3) simulations. A new parallel implementation of the code allows to study larger lattices and therefore in more detail the late time behavior of the instabilities.

[1] A. Rebhan, P. Romatschke, M. Strickland, JHEP, 09:041, 2005.