P 18: Poster: Theorie/Modellierung

Zeit: Mittwoch 17:30–19:30 Raum: Foyer des IfP

P 18.1 Mi 17:30 Foyer des IfP

Dynamical collision frequency in warm dense matter — •Mathias Winkel, Heidi Reinholz, August Wierling, and Gerd Röpke — Institut für Physik, Universität Rostock

The dynamical collision frequency is the central quantity for calculating the dielectric function in warm dense matter. In particular, we are interested in static transport properties, e.g. dc-conductivity, and optical properties, e.g. reflectivity [1]. The description over a wide parameter region of the plasma's temperature, density, ionization degree and frequency is subject of current research.

Based on a generalized linear response theory, the dynamical collision frequency has been calculated in different approximations. Within the Gould-deWitt approach, dynamical screening and strong collisions have been taken into account [2, 3].

We discuss interpolational expressions for the dynamical collision frequency from its respective limiting cases over a wide parameter range and present exemplary results for optical frequencies.

Additionally, we compare the influence of these approximations on the dielectric function with expressions, that result from a treatment of collisions with the help of kinetic theory [4].

[1] T. Raitza *et al.* J. Phys. A: Math Gen. **39**, 4393 (2006)
[2] H. Reinholz *et al.*, Phys. Rev. E **62**, 5648 (2000)
[3] H. Reinholz, Annales de Physique Vol. 30, Issue 4-5 (2005)
[4] M. Veysman *et al.* Poster contribution to the ECLIM 2008 Conference

P 18.2 Mi 17:30 Foyer des IfP

Berezinskii-Kosterlitz-Thouless transition in two-dimensional dipole systems — •Alexey Filinov[1], Nikolay Prokof'ev[2], and Michael Bonitz[1] — [1]Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität, Leibnizstr. 15, D-24098 Kiel, Germany — [2]Department of Physics, University of Massacusetts, Amherst, Massachusetts 01003, USA

Dilute dipole gases of polar molecules and indirect excitons in quantum wells are of increasing interest in recent experimental realizations [1], since they allow to realize and control correlation and quantum degeneracy effects. Using path integral Monte Carlo we investigate the normal-superfluid transition in a system of 2D bosonic dipoles which models such experiments in the full temperature-density plane. The critical temperature, superfluid fraction, thermodynamic sound speed and compressibility have been evaluated for different dipole coupling strengths/densities. For indirect excitons at high densities the dipole approximation becomes invalid. We, therefore, take into account the internal exciton structure and derive new effective interaction which crucially effects the phase diagram at high densities.

[1] J.M. Sage *at al.*, Phys. Rev. **94**, 203001 (2005); D. Wang *at al.*, Phys. Rev. **93**, 243005 (2004). [2] Timofeev V *et al* 2007 *J. Phys: Cond. Matt.* **19** 295209.

P 18.3 Mi 17:30 Foyer des IfP

Quantum Potentials with Degeneracy — Sandipan Dutta[1], James Dufty[1], Alexei Filinov[2], and •Michael Bonitz[2] — [1]Department of Physics, University of Florida, Gainesville, FL 32611 — [2]Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universitat zu Kiel, D-24098 Kiel

An effective quantum potential can be defined by requiring that the ideal inhomogeneous electron gas have its simple classical form. Such quantum potentials are very useful for embedding essential quantum effects in semi-classical descriptions such as MD simulations and for implementation of PIMC and DFT calculations. If exchange effects are neglected the weak coupling form for the external potential is the familiar Kelbg result. Recently [1], it has been shown how to improve that result to include strong coupling. Here, those results are extended to include the effects of electron degeneracy. It is found that the weak coupling form with exchange is well-represented by the Kelbg result modified by a suitable coordinate scaling. This allows a phenomenological extension to include both degeneracy and strong coupling.

[1] A. Filinov, V. Golubnychiy, M. Bonitz, W. Ebeling, and J.W. Dufty, Phys. Rev. E 70, 046411 (2004).

P 18.4 Mi 17:30 Foyer des IfP

Effective quantum potentials for strongly correlated plasmas — •Torben Ott[1], Alexei Filinov[1], James W. Dufty[2], and Michael Bonitz[1] — [1]CAU zu Kiel, ITAP, Leibnizstraße 15, D-24098 Kiel — [2]Physics Department, University of Florida, Gainesville, FL

The idea of a semi-classical treatment of quantum effects via an effective pair potential $U^{\rm eff}$ goes back to Kelbg [1] and was further developed by many authors, e.g. [2].

In [2] it was shown that the potential $U^{\rm eff}$ can be successfully used in semi-classical MD simulations. Here we present two applications of this idea: 1) a realization of an external potential and 2) an effective potential for quantum particles in a Coulomb crystal.

[1] G. Kelbg, Ann. Phys. 12, 219 (1963); 13, 354 (1963); 14, 394 (1964).
[2] A. Filinov et al, PRE 70, 046411 (2004)

P 18.5 Mi 17:30 Foyer des IfP

Simulationen für die Entwicklung einer laserinduzierten, gepulsten Neutronenquelle — •Jörg Schütrumpf, Marc Günther und Markus Roth — Technische Universität Darmstadt, Darmstadt, Deutschland

In der Arbeitsgruppe Laser- und Plasmaphysik der Technischen Universität Darmstadt werden Untersuchungen zur Entwicklung einer laserinduzierten, gepulsten Neutronenquelle durchgeführt. Experimentell zugänglich sind bereits laserbeschleunigte Protonen über den Mechanismus der Target Normal Sheath Acceleration (TNSA). Damit ist es heutzutage möglich, 10^{13} Protonen auf eine Energie von über 60 MeV zu beschleunigen bei einer Pulslänge unter 1 ps. Mit einem solchen Teilchenstrahl kann auf diese Weise über ein Konvertertarget mit (p,xn) Reaktionen eine laserinduzierte Neutronenquelle aufgebaut werden.

Mit einer Monte-Carlo Simulation in GEANT4 wurden Rechnungen für die pn-Reaktionen angefertigt, die den Parameterraum für eine solche Neutronenquelle untersuchen sollen. Die Ergebnisse dieser Simulationen werden in diesem Beitrag vorgestellt. Zugrunde gelegt wurde hierbei ein Terawatt-Lasersystem mit einer Energie von $E_{laser} = 40$ J und einer Pulslänge von unter 1 ps, welches Protonen bis 25 MeV beschleunigen kann. Es wurden Rechnungen für verschiedene Zusammensetzungen des Konvertertargets durchgeführt, um die Effizienz zu optimieren. In einem Vanadiumtarget können so bis $7*10^9$ Neutronen mit einem einzigen Laserpuls erzeugt werden. Diese besitzen eine klare Vorzugsrichtung in Richtung des Protonenstrahls.

P 18.6 Mi 17:30 Foyer des IfP

Radiation Pressure Acceleration by Circularly Polarized Pulses: Three-Dimensional Dynamics and Angular Momentum Absorption — •Tatiana Liseykina[1,2], Dieter Bauer[1], Andrea Macchi[3,4], Francesco Pegoraro[3], and Sergei Popruzhenko[1,5] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]Institute of Computational Technologies SD RAS, Novosibirsk, Russia — [3]Physics Department, University of Pisa, Italy — [4]PolyLAB, Pisa, Italy — [5]Moscow Engineering Physics Institute, Russia

Radiation Pressure Acceleration of thin plasma targets by Circularly Polarized laser pulses is studied by three-dimensional particle-in-cell simulations. The use of flat-top intensity profiles is found to be important to avoid self-induced transparency and to reach high ion energies. A significant degree of absorption of the angular momentum of the laser pulse is observed, giving a signature of irreversible, non-adiabatic effects.

P 18.7 Mi 17:30 Foyer des IfP

Stoßabsorption intensiver Laserstrahlung in dichten Plasmen — •Max Moll[1], Paul Hilse[1], Manfred Schlanges[1] und Thomas Bornath[2] — [1]Ernst-Moritz-Arndt-Universität Greifswald — [2]Universität Rostock

Die Absorption von intensiver Laserstrahlung in Plasmen wird über inverse Bremsstrahlung maßgeblich von der Streuung der Elektronen an den Ionen bestimmt. Folglich ist die dynamische Elektron-Ion-Stoßfrequenz eine wesentliche Größe im Ausdruck für die Absorptionsrate.

In diesem Beitrag werden quantenstatistische Ausdrücke für den Real- und für den Imaginärteil der dynamischen Stossfrequenz diskutiert und mit Resultaten anderer Autoren verglichen. Insbesondere werden die Grenzfälle niedriger und hoher Laserintensitäten betrachtet.

Schließlich werden die Ausdrücke für die Stoßfrequenz zur Beschreibung der Dynamik der Laser-Cluster-Wechselwirkung im Rahmen des Nanoplasma-Modells benutzt. Die Resultate einer selbstkonsistenten Bestimmung von Strom, innerem Feld und Stoßfrequenz für den Fall hoher Feldstärken werden vorgestellt und diskutiert.

P 18.8 Mi 17:30 Foyer des IfP

Laser-Cluster-Wechselwirkung in einem modifizierten Nanoplasma-Modell mit effektiven Ionisierungsenergien — •Thomas Bornath[1], Paul Hilse[2], Max Moll[2] und Manfred Schlanges[2] — [1]Institut für Physik, Universität Rostock — [2]Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald

Ein interessantes Problem ist der Einfluss des dichten Cluster-Mediums auf die Prozesse der inneren Ionisation. Wir haben einfache Modifikationen der Ratenkoeffizienten benutzt, die es gestatten, den Einfluss der Erniedrigung der Ionisierungsenergien zu berücksichtigen. Die Ionisationspotentiale wurden dabei im Stewart-Pyatt-Modell betrachtet, das zwischen Debye-Modell und Ion-Sphären-Modell interpoliert. Ionisationspotentiale für verschiedene Ladungsstufen von Argon und Silber als Funktion von Dichte und Temperatur werden diskutiert.

In einem kinetischen Zugang zur Absorption wird die Bedeutung der kollektiven Resonanzabsorption gezeigt. Inneres Feld und dynamische Stoßfrequenz sind prinzipiell selbstkonsistent zu bestimmen. Betrachtet man lediglich Elektron-Ion-Stöße, so erhält man in der Nähe der Mie-Resonanz eine unphysikalische Überhöhung des inneren Feldes. Als zusätzlicher Dämpfungsmechanismus werden Stöße der Elektronen mit der Clusteroberfläche betrachtet. Resultate werden für die Wechselwirkung von Silberclustern und von Argonclustern mit Laserpulsen der Wellenlänge 825nm vorgestellt.

[1] P. Hilse, M. Moll, M. Schlanges, Th. Bornath, Laser-Cluster Interaction in a Nanoplasma-Model with Inclusion of Lowered Ionization Energies, Laser Physics, accepted (2009); arXiv: 0809.3058v1

P 18.9 Mi 17:30 Foyer des IfP

Pressure broadening of Lyman-Lines in Dense Li^{2+} Plasmas — •Sonja Lorenzen[1], August Wierling[1], Heidi Reinholz[1,2], and Gerd Röpke[1] — [1]Institut für Physik, Universität Rostock, 18051 Rostock, Germany — [2]University of Western Australia, Nedlands, WA 6009, Australia

Pressure broadening of Lyman-lines of hydrogen-like lithium is studied using a quantum statistical approach to the line shape in dense plasmas. We report line widths (FWHM) and shifts for Lyman-α, -β, and -γ in a wide range of densities ($n_e = 10^{24} - 10^{28}$ m^{-3}) at temperatures relevant for laser-produced lithium plasmas ($T = 10^5$ K). We discuss the effect of different ionic microfield distributions and estimate the influence of ion dynamics. Special care is taken to account for strong collisions. The results are applied to measured spectra of lithium irradiated by a nanosecond laser pulse of moderate intensities ($I \approx 10^{11} - 10^{13}$ W/cm^2), see G. Schriever et al. [Applied Optics **37**, 1243 (1998), J. Appl. Phys. **83**, 4566 (1998)]. By matching synthetic spectra to the experimental ones, density and temperature conditions are inferred assuming the model of a one-dimensional uniform plasma slab. Self-absorption is accounted for and found to be important for Lyman-α. In this way, experimental spectra are overall reproduced. To describe remaining deviations in the line wings, it is essential to use a multilayer model adapted to density and temperature profiles from hydrodynamic expansion codes.

P 18.10 Mi 17:30 Foyer des IfP

Radiation Hydrodynamics of Laser-induced Plasmas using dynamic collision frequencies — •Philipp Sperling, August Wierling, Gerd Roepke, and Mathias Winkel — Universitaet Rostock, Institut fuer Physik

Radiation Hydrodynamics of laser-induced Plasmas is usually treated by well-established hydrodynamic codes such as MEDUSA or MULTI. These codes require transport coefficients, e.g. the absorption coefficients or thermal conductivity, as inputs. Typically, Spitzer-Haerm-like expressions are used. However for high densities these expressions can not be applied and have to be replaced by more advanced expressions. In particular quantum effects and dynamical screening have to be accounted for in a systematic manner, see Reinholz et al. PRE 62, 5648 (2000). Here, we present results for a hydrodynamical calculation including these advanced collision frequencies. We also compare to earlier calculations with Spitzer-Haerm-like expressions.

P 18.11 Mi 17:30 Foyer des IfP

Collisions in EUTERPE code — •Karla Kauffmann and Ralf Kleiber — Max-Planck-Institut für Plasmaphysik, Teilinstitut Greifswald

In stellarators, neoclassical transport is dominant in the core, therefore collisions are important. EUTERPE is a 3-D δf gyrokinetic PIC code which is currently collisionless. It is necessary, then, to add collisional effects to the δf method and to test its applicability. Some basic tests were performed, such as the Spitzer problem in a tokamak and radial neoclassical transport.

P 18.12 Mi 17:30 Foyer des IfP

Numerical study of the interaction between Alfvén waves and fast particles — •Tamás Béla Fehér, Axel Könies, Ralf Kleiber, and Roman Hatzky — Max-Planck-Institut für Plasmaphysik, Greifswald, Germany

Alfvén waves are commonly observed in tokamak and stellarator plasmas. There are weakly damped Alfén eigenmodes which can become unstable by interaction with fast particles.

A hybrid approach i.e. a model combining fluid and kinetic parts is used to describe the wave-particle interaction in stellarator plasmas. Linearized reduced MHD equations with kinetic effects are used to describe the wave field. The particles are followed with the gyrokinetic PIC code EUTERPE. This approach aims at calculating the growth rate of the instability from the energy transfer between the particles and the wave, avoiding any approximations of the guiding center orbits.

P 18.13 Mi 17:30 Foyer des IfP

Time Series Analysis of Gyrokinetic Turbulence Data — •Holger Angenent[1], Frank Jenko[2], and Rudolf Friedrich[1] — [1]Institut für Theoretische Physik, WWU Münster, Germany — [2]Max-Planck-Institut für Plasmaphysik, D-85748 Garching, Germany

Time series of gyrokinetic computations near critical ion temperature gradients show heavy fluctuations. A characterization of such data - in particular with respect to stationarity - under these circumstances is non-trivial. These parameter regimes are of significant relevance for tokamaks, however, whose gradients are close to the threshold of ion temperature gradient (ITG) modes. The time series, which are generated with the GENE code (www.ipp.mpg.de/∼fsj/gene), are analyzed with respect to a criterion for stationarity and a basic mechanism describing a bifurcation related to the so-called Dimits upshift.
As a more simple model, a two dimensional fluid model is used. It shows the basic patterns in plasma turbulence. Theses are zonal flows for the case of ion temperature gradient driven turbulence (ITG), respectively streamers for electron temperature gradient driven turbulence (ETG). The influence of the patterns regarding the transport properties of massless tracer particles is investigated and compared with the GENE data.

P 18.14 Mi 17:30 Foyer des IfP

Towards a Better Understanding of Critical Ion Temperature Gradients in Tokamaks — •Julian Hüser[1], Frank Jenko[2], and Rudolf Friedrich[1] — [1]Institut für Theoretische Physik, WWU Münster — [2]Max-Planck-Institut für Plasmaphysik, D-85748 Garching, Germany

It is well known that tokamaks often exhibit ion temperature profiles whose gradients are close to the threshold of ion temperature gradient (ITG) modes. Thus, the ratio of the core to edge ion temperature is directly linked to the radial profile of this critical value. Since about 2000, it is also known that nonlinear effects can lead to a significant upshift of the threshold, an effect called Dimits shift. However, to date, the physics underlying this phenomenon is not well understood. The present work attempts to shed new light on the Dimits shift effect by means of nonlinear gyrokinetic simulations with the GENE code (www.ipp.mpg.de/∼fsj/gene) along with dynamical systems analyses of the simulation data.

P 18.15 Mi 17:30 Foyer des IfP

Zonal flow generation in quasi 2D turbulence in magnetised plasmas and rapidly rotating planetary atmospheres — •Andreas Kammel and Klaus Hallatschek — IPP-Garching, Boltzmannstr. 2, 85748 Garching

The interaction between drift waves and zonal flows in plasmas through Reynolds stresses is being examined in great detail using the two-fluid code NLET, thereby studying the structure of the flows, the median zonal flow width, possible stable states and the influence of the geometry of the magnetic field in fusion devices.

In a later stage, the development of a new numerical code for simulating the atmospheres of gas giants is being projected, with the aim of expanding the analysis above to include the hydrodynamic, planetary case, where the geostrophic modes act as the analogon to the drift waves, thereby allowing for a comparison between the two systems.

P 18.16 Mi 17:30 Foyer des IfP

Modeling Lagrangian MHD fluctuations — •Thorsten Hater, Holger Homann, Martin Rieke, and Rainer Grauer — Theoretische Physik I, Ruhr-Universität Bochum

Understanding and modeling magnetic field fluctuations in turbulent flows like the solar wind is of fundamental importance. Modeling magnetic field fluctuations such that the higher order statistical features are correclty captured opens a way to efficiently study questions like cosmic ray transport properties. Here, we present a model based on the Recent Fluid Deformation closure (RFD) introduced by Chevillard and Meneveau (2006, 2007) for the incompressible Navier-Stokes equations. We extend this theory to include kinematic magnetic field fluctuations and fluctuations of the gradient of passively transported quantities. Comparison of the PDFs of these fluctuations gives insight into the influence of the relevant stretching processes. PDFs of the modeling are also compared with PDFs obtained from high-resolution direct spectral simulations of Lagrangian turbulence. The agreement between modeling and direct simulations exceeded our expectations.

In addition, we started using graphics cards for spectral simulations. As a first example, long time Lagrangian statistics of the 2D inverse cascade are simulated. Speed-ups of a factor 30 have been achieved compared to CPU computing.

P 18.17 Mi 17:30 Foyer des IfP

Multi-Ion kinetic model for coronal Loop — •Sofiane Bourouaine[1], Christian Vocks[2], and Eckart Marsch[1] — [1]Max-Planck-Institut für Sonnensystemforschung, 37191 Katlenburg-Lindau, Germany — [2]Astrophysikalisches Institut Potsdam, 14482 Potsdam, Germany

A multi-ion kinetic model for a coronal loop is presented, whereby ion heating in the magnetically confined plasma is achieved by absorption of ion-cyclotron waves. We assume that linear Alfvén/cyclotron waves penetrate the loop from its footpoint and directly heat the ions. Then due to electron-ion collisions the electrons can also be heated. Depending on the spatial variation of the mean magnetic field, the model is able to produce warm and hot model loops having features similar to the ones observed in extreme-ultraviolet and soft X-ray emissions in real coronal loops. Furthermore, it is found that a loop with high expansion factor is far from local thermal equilibrium (LTE) and shows remarkable temperature differences between electrons and ions. Also in such a case, the heavy ions (minor ions) are via resonant wave absorption heated more than the protons and helium ions (major background ions), whereby the cyclotron-resonance effect leads to a temperature anisotropy with $T_\perp > T_\parallel$. However, if the flux tube cross section is nearly homogeneous, temperature isotropy of the ions is maintained in most parts of the loop, and the plasma is nearly in LTE.

P 18.18 Mi 17:30 Foyer des IfP

Influence of reabsorption and trapping of radiation on the population of excited states in low-temperature plasma — •Sergey Gorchakov[1], Dmitry Demchuk[2], Yuri Golubovskii[2], Detlef Loffhagen[1], Alexander Timofeev[2], and Dirk Uhrlandt[1] — [1]INP Greifswald, Felix-Hausdorff-Str. 2, D-17489 Greifswald, Germany — [2]Saint-Petersburg State University, Ulyanovskaya 1, 198504 St. Petersburg, Russia

Reabsorption and trapping of radiation play an important role in gas discharge plasmas. The description of corresponding phenomena in numerical models follows from the solution of the radiation transport equation (Holstein-Biberman equation) [1]. The most promising solution method of this equation is the matrix method which is based on the transformation of the integral radiation transport operator into a system of linear algebraic equations. This contribution presents the further development of the matrix method. In particular, two situations have been considered: (i) the case of an inhomogeneous density distribution of absorbing atoms due to the gas heating, when the absorption coefficients which are dependent on the density of the ground state atoms and the width of the spectral line profile vary in space, and (ii) the case when the absorption coefficient is of the order of unity, i.e. the line profiles according to the relevant broadening mechanism have to be taken into account. First results are discussed and compared with those of conventional methods.

[1] T.Holstein, Phys. Rev. 72,1212 (1947); L. M. Biberman, Zh. Exp. Teor. Phys. 17, 416 (1947)

P 18.19 Mi 17:30 Foyer des IfP

Modellierung des Anodengebietes von freibrennenden Lichtbögen — •Sergey Gorchakov[1], Alexander Timofeev[2] und Dirk Uhrlandt[1] — [1]INP Greifswald, Felix-Hausdorff-Str. 2, 17489 Greifswald, Germany — [2]Saint-Petersburg State University, Ulyanovskaya 1, 198504 St. Petersburg, Russia

Freibrennende Lichtbögen finden zahlreiche industrielle Anwendungen, wie z.B. Schweißen, Plasmaspritzen und Abfallbearbeitung. Für eine Optimierung der Anlagen und der technologischen Prozesse ist ein Verständnis der physikalischen Vorgängen in den Randbereichen, u.a. in der Nähe von Elektroden notwendig. Eigenschaften des Plasmas in diesen Entladungsgebieten sind stark durch die Verdampfung des Elektrodenmaterials und deutliche Abweichungen vom lokalen thermischen Gleichgewicht charakterisiert. Für die Untersuchungen wurde ein Zweitemperatur-Mehrflüssigkeitsmodell des Anodengebietes von freibrennenden Lichtbögen entwickelt. Das Modell berücksichtigt die vom Gleichgewicht abweichende Gemischzusammensetzung, sowie die thermodynamischen und Transportkoeffizienten als Funktionen von der Elektronen- und Schwerteilchentemperatur sowie des Metalldampfanteils im Gemisch. Die Energiebilanz der Anode wurde unter Berücksichtigung der Beiträge des Wärmeflusses aus dem Plasma, der Verdampfung des Elektrodenmaterials und der Ohmschen Heizung evaluiert. Die Ergebnisse für ein Argonplasma und die Elektrodenmaterialien Kupfer und Eisen werden präsentiert und diskutiert.

P 18.20 Mi 17:30 Foyer des IfP

Analytische und numerische Untersuchungen zur Stabilität einer DC-Sauerstoffglimmentladung — •Benjamin May, Johannes Marbach, Berndt Bruhn und Andreas Richter — Institut für Physik, Ernst-Moritz-Arndt Universität Greifswald

In elektronegativen Plasmen des Sauerstoffs im Gleichstrombetrieb wird ein Übergang zwischen einem Entladungsmodus mit hohem axialen elektrischen Feld (H-Mode) zu einem mit geringem, zeitlich variierenden Feld (T-Mode) beobachtet. Bei diesem Übergang handelt es sich um eine attachment induzierte Instabilität, die wesentlich von den negativen Ionen verursacht wird.

Ausgehend von einem hydrodynamischen Modell [Paper zur Stabilität linear] werden nichtlineare Phänomene dieser Instabilität untersucht. Hierzu werden analytische Rechnungen zur Untersuchung der auftretenden Hopf-Verzweigung durchgeführt, wodurch die im Experiment beobachtete Hysterese zwischen dem Übergang von H- nach T-Mode erklärt werden könnte. Zusätzlich finden numerische Simulationen der Dynamik der nichtlinearen Wellen statt.

Die analytischen und numerischen Ergebnisse werden mit experimentellen Resultaten auch quantitativ verglichen.

P 18.21 Mi 17:30 Foyer des IfP

Einfluss elastischer Stöße auf die räumliche Dämpfung von elektrostatischen Elektronenwellen in Niederdruckplasmen — •Jens Oberrath und Ralf Peter Brinkmann — Lehrstuhl für Theoretische Elektrotechnik, Ruhr-Universität Bochum

In technischen Niederdruckplasmen gibt es eine Vielzahl möglicher Wellen. Eine spezielle ist die elektrostatische Elektronenwelle, die beispielsweise durch einen Resonanzeffekt auftreten kann, wenn die Anregungsfrequenz in der Nähe der Elektronenplasmafrequenz liegt. Ein Phänomen, das diesem Resonanzeffekt zugrunde liegt, ist in der Literatur als Herlofson-Paradoxon [1] bekannt und ist bei Simulationen der Plasmaabsorptionssonde erkennbar [2].

Zur Untersuchung dieser Wellen setzen wir einen isotropisierenden Stoßterm für elastische Elektronen-Neutralteilchen-Stöße an. Dies erlaubt die Herleitung einer Dispersionsrelation für homogene longitudinale Wellen aus dem linearisierten Gleichungsystem von Boltzmann- und Poisson-Gleichung. Diese Relation beschreibt im stoßfreien Fall die räumlich Landau-Dämpfung und bietet die Möglichkeit den Einfluss der elastischen Elektronen-Neutralteilchen-Stöße auf die räumliche Dämpfung zu untersuchen.

[1] Barston E. M., Annals of Physics, Vol. 29, 282 (1964)
[2] Lapke M., et al., Appl. Phys. Lett. 90, 121502 (2007)

P 18.22 Mi 17:30 Foyer des IfP

Electric Microfield Distributions in Nonideal Two-Component Electron-Ion Plasmas with account of the ion structure — •Saltanat Polatovna Sadykova[1], Werner

Ebeling[1], Ilya Valuev[2], and Igor Sokolov[1] — [1]Humboldt-Universität zu Berlin, Newtonstraße 15, 12489 Berlin — [2]Joint Institute for High Temperatures of RAS, 125412 Moscow

The electric microfields distribution (EMD) influences many elementary processes in plasma and its optic spectra (OS). In EMD calculations pseudopotentials play a crucial role (S. Sadykova et al.. Contr. Plasma Phys. (CPP) 47, No. 10, 659 (2007)). There is a high interest in the inclusion of ion structure (shell) into the pseudopotential model (PM). One of the successful PMs of electron-ion-core interaction, pioneered by H. Hellmann (J. Chem. Phys 1935), V. Heine *"Pseudopotential Theory"* 1973, is the unscreened Hellmann-Gurskii-Krasko (HGK) PM (JETP 10, 363 (1969)). We calculate EMD acting on ions, electrons using Ortner's et al.(CPP. 40 (2000)), Iglesias's methods (Phys. Rev. A 27, 2705 (1983)) and Molecular Dynamics tool for the nonideal two-component H^+, Li^{1+}, Li^{2+} plasmas in a frame of corrected Kelbg (W. Ebeling CPP 39, 61 (1999)), HGK and screened HGK PMs at different plasma parameters (PP) and pay special attention to the behaviour of EMD tails. On a base of work (Yu. Arkhipov Eur. Phys. J. D 2000), we derive the analytical expressions for Fourier transform of the screened HGK which allow to calculate EMD in a wide range of PP. The results of calculations are found in a good agreement with the earlier published theoretical as well as experimental results of OS.

P 18.23 Mi 17:30 Foyer des IfP

Stability and dynamics of relativistic solitons — •Götz Alexander Lehmann, Ernst Wolfgang Laedke, and Karl-Heinz Spatschek — Institut für Theoretische Physik I, 40225 Düsseldorf, Germany

The creation of slow moving relativistic solitary structures from high intensity laser radiation interacting with plasma has been demonstrated in various experiments and simulations. Considerable amounts of the laser radiation, up to 40%, are predicted to become trapped in these cavities. We discuss the stability of solitons by numerical simulations. The solitons are stationary solutions of the Maxwell-fluid equations and model trapped high intensity radiation. The structure of the most unstable mode and its growth rate are determined by our stability analysis technique. Within a one-dimensional (1D) model the stability of circular and linear polarized solitons is investigated. Different types of instabilities are found and quantified. Nonlinear 1D simulations of unstable solitons show excitation of a wake-field and subsequent wavebreaking as part of the unstable dynamics. In order to explain the instability of the excited electrostatic wave, we refine existing wavebreaking criteria. To allow for transversal perturbations we discuss the stability of circular polarized solitons in 2D geometry. All studied solitons turn out to suffer from transversal instability. It is demonstrated that the transversal instability dominates the longitudinal instability.

P 18.24 Mi 17:30 Foyer des IfP

Density profile of confined charged particles — Jeffry Wrighton[1], James Dufty[1], Christian Henning[2], •Michael Bonitz[2], and Hanno Kählert[2] — [1]Department of Physics, University of Florida, Gainesville, FL 32611 — [2]Institut für Theoretische Physik und Astrophysik, Christian-Albrechts Universiät zu Kiel, 24098 Kiel

The density profile of a finite number of identical classical charged particles confined in a trapping potential is computed analytically and numerically. The results bridge the gap between the temperature limit given by the Boltzmann factor and the ground state result [1,2] given by a step profile. Preliminary results in mean-field approximation [3] are discussed further, and then extended to include strong correlations in the framework of the hypernetted chain approximation.

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

[2] C. Henning, P. Ludwig, A. Filinov, A. Piel, and M. Bonitz, Phys. Rev. E 76, 036404 (2007)

[3] J. Wrighton, J.W. Dufty, C. Henning, and M. Bonitz, J. Phys. A (in press); arXiv:0809.3071.

P 18.25 Mi 17:30 Foyer des IfP

Quantum breathing mode of charged fermions and bosons at arbitrary coupling — Sebastian Bauch, Karsten Balzer, Christian Henning, David Hochstuhl, and •Michael Bonitz — Christian-Albrechts-Universität Kiel, Institut für Theoretische Physik und Astrophysik, Leibnizstraße 15, 24098 Kiel, Germany

We present a detailed analysis of the quantum breathing behavior of few-particle Coulomb systems in one- and two-dimensional harmonic traps. While the behavior in limiting cases, the *classical* limit and the *ideal* quantum limit, are well-known [e.g. 1, 2], we report a smooth transition behavior in between by variation of the relative interaction strength. We further show, that spin-statistic effects, i.e. the symmetry of the wave function, play an important role. We solve the many particle Schrödinger equation and compare with mean-field Hartree Fock calculations. The numerically obtained results may serve as an experimental tool to probe small interacting quantum systems.

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P 18.26 Mi 17:30 Foyer des IfP

Few-electron quantum dots within a nonequilibrium Green's functions study — Karsten Balzer, David Hochstuhl, and •Michael Bonitz — Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität Kiel, Leibnizstrasse 15, 24098 Kiel, Germany

Carrier-carrier correlations in few-electron quantum dots (QDs)—artificial atoms [1] with parabolic confinement— are studied by means of nonequilibrium Green's functions (NEGF) theory. Starting from an (un)restricted Hartree-Fock reference state, the Dyson equation is solved in the time domain [2] at zero and finite temperatures including 2nd Born and *GW* interaction kernels. We focus on strongly correlated QDs, the electron density in which is tunable by the strength of the confining potential. Considering system sizes with up to 12 electrons in one- and two-dimensional confinements, the computed ground state and equilibrium properties incorporate the self-consistent total energies, the single-carrier densities, the orbital-resolved distribution functions as well as the one-electron spectral functions [2]. The comparison of the results with Configuration Interaction [3,4] and path integral Monte Carlo [4,5] comprises the crossover from Fermi liquid to Wigner molecule or crystal behavior [5] and reveals good agreement with the NEGF approach.

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P 18.27 Mi 17:30 Foyer des IfP

Kinetic Modelling of PECVD of Boron Nitride Films — Ya Ting Wu[1], Jens Matheis[2], and •Achim Lunk[2] — [1]Shanghai Jiaotong University, PR China — [2]Institut für Plasmaforschung, Universität Stuttgart

Using PECVD for BN deposition more than hundred reaction equations must be taken into account and the reaction paths are very complex in a system with the educts B/H/X/N/Ar (X=F, Cl, Br, I). Therefore it takes advantage if modelling of the processes can be performed parallel to experimental investigations. In the paper following reactions are considered: neutral-neutral-, electron-neutral- and ion-neutral-processes in the volume as well as on the surface. Modelling was performed with the Plasma-PSR-module of the software Chemkin-Pro. It allows the introduction of different temperatures for the species in the description of plasma initiated reactions. For comparison of data resulting from our own experiments and from kinetic modelling we started with the simple system B/N/Ar at different plasma conditions. While at equilibrium conditions the influence of plasma can be neglected up to temperatures of 2500 K in kinetic modelling dissociation, ionisation and excitation play an important role. From analysis of results of kinetic modelling, the main process in BN deposition in the system B/N/Ar seems to be the dissociation of nitrogen molecules by electron impact and the reaction of atomic nitrogen with boron on the surface.

P 18.28 Mi 17:30 Foyer des IfP

Weibel instability of a relativistic electron beam in quasineutral plasma — •Anupam Karmakar[1], Naveen Kumar[2], Alexander Pukhov[2], Oleg Polomarov[3], and Gennady Shvets[3] — [1]Institute for Advanced Simulation, Jülich Supercomputing Centre, Forschungszentrum Jülich GmbH, D-52425, Germany — [2]Institut für Theoretische Physik I, Heinrich-Heine-Universität, Düsseldorf, D-40225, Germany — [3]Institute for Fusion Studies, University of Texas at Austin, One University Station, Austin, TX 78712, USA

A new model describing the Weibel instability of a relativistic electron beam propagating through a resistive plasma is developed. For finite-temperature beams, a new class of negative energy magneto-sound

waves is identified, whose growth due to collisional dissipation destabilizes the beam-plasma system even for high beam temperatures. We perform 2D and 3D particle-in-cell (PIC) simulations to study the filamentary structures and associated electromagnetic fields and show that in 3D geometry, the Weibel instability persists even for collisionless background plasma. The effects of beam temperature and collisions on the filamentary structures generated in 3D simulations have distinctly been examined. The anomalous plasma resistivity in 3D is caused by the two-stream instability.