P 22: Poster: Theory/Modelling II

Time: Thursday 16:00–18:00 Location: Lichthof

P 22.1 Th 16:00 Lichthof

Beschleunigungsprozesse in Laserplasmen - kinetische Simulationen — •Patrick Kilian, Urs Ganse, Thomas Burkart und Felix Spanier — Astronomie Uni Würzburg

Wir haben Particle-in-Cell-Simulationen durchgeführt, sowohl für Laser Wakefield Beschleunigung als auch für Surfatron-Beschleunigung und stellen die Ergebnisse für Teilchenbeschleunidung und Felderzeugung hier vor.

P 22.2 Th 16:00 Lichthof

Simulation and analytical analysis of 3D plasma edge region regarding toroidal symmetry breaking block limiters — •Felix Hasenbeck[1,2], Heinke Frerichs[3], Detlev Reiter[2], and Yühe Feng[4] — [1]RWTH Aachen University, Aachen — [2]Institut für Energieforschung 4 - Plasmaphysik, Forschungszentrum Jülich — [3]German Research School for Simulation Sciences, Jülich — [4]Max-Planck-Institut für Plasmaphysik, Greifswald

It is foreseen that ITER will employ a number of block limiters during start-up and ramp-down phases. Due to the loss of toroidal symmetry fully 3D transport simulations have been done to determine plasma characteristics in the edge region. It was shown [1] that calculations of heat loads and surface temperatures based on an approximate analytical plasma description mostly complied with simulation results.

In order to capture all physical details of these 3D configurations the Monte Carlo code EMC3-EIRENE has been extended to enable flexible treatment of block limiters. A connection length atlas for 3D limiters is being set up and the effects of different forms and positions on the field line structure and the plasma transport have been studied. Based on this work a comparison of the simulation results with predictions of semi-analytical models will be presented as well as corrections to increase the accuracy of these reduced models. In this context the magnetic topology presented in [1] for a particular ITER reference case could be confirmed.

[1] Kobayashi, M. et al, *Nucl. Fusion*, **47** (2007), 61-73

P 22.3 Th 16:00 Lichthof

Thermodynamic Theory of Spherically Trapped Coulomb Clusters — Jeffrey Wrighton[1], James Dufty[1], •Henning Bruhn[2], Hanno Kählert[2], and Michael Bonitz[2] — [1]Department of Physics, University of Florida, Gainesville, FL 32611 — [2]ITAP, Christian-Albrechts Universität zu Kiel, 24098 Kiel

The radial density profile of a finite number of identical charged particles confined in a harmonic trap is computed over a wide ranges of temperatures (Coulomb coupling) and particle numbers. At low temperatures these systems form a Coulomb crystal with spherical shell structure which has been observed in ultracold trapped ions and in dusty plasmas. The shell structure is readily reproduced in simulations. However, analytical theories which used a mean field approach [1] or a local density approximation [2] have, so far, only been able to reproduce the average density profile. Here we present an approach to Coulomb correlations based on the hypernetted chain approximation with additional bridge diagrams. It is demonstrated that this model reproduces the correct shell structure within a few percent and provides the basis for a thermodynamic theory of Coulomb clusters in the strongly coupled fluid state [3,4].

[1] C. Henning *et al.*, Phys. Rev. E **74**, 056403 (2006)
[2] C. Henning *et al.*, Phys. Rev. E **76**, 036404 (2007)
[3] J. Wrighton, J. W. Dufty, H. Kählert, and M. Bonitz, accepted for publication in Phys. Rev. E, arXiv:0909.0775
[4] J. Wrighton, J. W. Dufty, M. Bonitz, and H. Kählert, Contrib. Plasma Phys. (2009)

P 22.4 Th 16:00 Lichthof

Modeling of massive gas injection in tokamaks — •Mikhail Koltunov, Mikhail Tokar, and Michael Lehnen — Institut für Energieforschung – Plasmaphysik, Forschungszentrum Jülich GmbH, Association FZJ–Euratom, Trilateral Euregio Cluster, Germany

Heat losses and energetic runaway electrons generated by plasma disruptions can lead in future fusion reactors to intolerable wall erosion and mechanical forces on the vessel. In order to soften consequences of disruptions, provide a controllable and safe ending of discharges, and prevent machine damage massive injection of different neutral gases is used.

In this contribution the first modeling results of gas injection impacts on the local plasma behavior are presented. For this purpose a quasi 2-D fluid model is developed to describe the transport of both, very locally injected impurity neutrals and impurity ions generated by ionization, and their effects on the background plasma. The model allows to analyze the main impacts of the injected particles on the plasma caused by the production of electrons by impurity ionization, generation of intensive electric fields, cooling of electrons by radiation losses, friction forces on main ions by coulomb collisions, etc. The modification of the plasma state affects the impurity penetration process itself and this is taken self-consistently into account. One of the important problems discussed in the contribution is the selection of proper boundary conditions for the parallel momentum equations for the main and impurity ions both in the scrape-off layer, where the plasma is bounded by the limiter, and in the confined volume.

P 22.5 Th 16:00 Lichthof

Stability of relativistic superluminal solitons — •Götz Alexander Lehmann and Karl-Heinz Spatschek — Heinrich Heine Universität, Düsseldorf, Germany

The nonlinear interaction of a relativistically intense linearly polarized laser beam with a cold plasma can give rise to superluminal solitons. Within a one-dimensional description the superluminal solitons with phase velocity $\beta > c$ are solutions to the famous Akhiezer-Polovin equations.

The model starts with the Maxwell-fluid equations describing the interaction of relativistic electromagnetic fields with the cold plasma fluid. Assuming a constant phase velocity, they reduce to coupled nonlinear oscillator equations in the co-moving frame. These equations are of Hamiltonian form. Possible solutions to the oscillators can be discussed with the help of Poincaré plots. Different kinds of solutions can be classified, e.g. periodic, quasiperiodic, chaotic or solitonic structures. The superluminal solitons are represented by the separatrix and consist of relativistic longitudinal and transversal oscillations.

We discuss the linear stability of superluminal solitons with respect to perturbed inital conditions for a broad range of parameters. Since the solitons are not available in analytic form, we use a numerical scheme to perform the stability analysis. It is found that the solutions are always unstable. The possible implications of the linear instability for the nonlinear regime are outlined.

P 22.6 Th 16:00 Lichthof

Dynamics of strongly correlated ions in a partially ionized quantum plasma — •Patrick Ludwig[1], Michael Bonitz[1], Hanno Kählert[1], and James W. Dufty[2] — [1]Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität Kiel — [2]Department of Physics, University of Florida, Gainesville (USA)

A scheme which allows to compute the dynamics of strongly correlated classical ions embedded into a partially ionized quantum plasma by first principles molecular dynamics is presented. The dynamically screened dust approach of Joyce and Lampe [Phys. Rev. Lett. 88, 095006 (2002] is generalized to quantum systems. The electrons are treated fully quantum-mechanically taking into account their dynamical screening of the ion-ion interaction in linear response on the basis of an extended Mermin formula. The scheme allows to include the effect of the electron dynamics, electron streaming, wake effects and electron magnetization.

P 22.7 Th 16:00 Lichthof

Static and Dynamic Structure Factors with Account of the Ion Structure for High-temperature Alkali and Earth-alkali Plasmas — •Saltanat Polatovna Sadykova[1], Werner Ebeling[1], and Igor Mijail Tkachenko[2] — [1]Institut für Physik, Humboldt Universitat zu Berlin, Newtonstr. 15, 12489 Berlin, Germany — [2]Department of Applied Mathematics, Polytechnic University of Valencia, 46022 Valencia, Spain

The structure factors (SF) are the fundamental quantities that describes the X-ray scattering cross-section in a plasma. The recent work (G. Gregori et al. Phys. Rev. E **74**, 026402 (2006)) has shown that the technique, developed in the classical work of Bogoljubow for determination of the screened Deutsch potential for point-like charges, provides good expressions of SF even for moderately coupled plasmas. However, it is of high interest to take into account the ion shell structure. We calculate the $e-e$, $e-i$, $i-i$ and charge-charge static structure factors for Alkali (Li^+, Na^+, K^+, Rb^+, Cs^+) at $T \geq 30000K$ and Be^{2+} at $T \geq 100000K$ plasmas using the method described by G. Gregori et al. We also study the dynamic structure factors for Alkali plasmas using the Adamjans' et al method (S. V. Adamjan et al., Phys. Rev. E **48**, 2067 (1993)). For determination of the static and dynamic structure factors we use the screened Hellmann-Gurskii-Krasko potential which takes into an account not only the quantum-mechanical effects but also the ion shell structure (S. Sadykova, Contr.Plasma Phys. **49**, 76 (2009)). The results show that at high coupling the ion structure plays significant role and must be taken into account.