P 16: Poster Session - Helmholtz Graduate School for Plasma Physics

Zeit: Dienstag 16:30–18:30 Raum: Foyer Audimax

P 16.1 Di 16:30 Foyer Audimax

Comparison of the inter-ELM pedestal profile recovery in plasmas with different main ion species — •Florian M. Laggner[1], Gregor Birkenmeier[2], Mike G. Dunne[2], Rainer Fischer[2], Eleonora Viezzer[2], Matthias Willensdorfer[2], Elisabeth Wolfrum[2], Friedrich Aumayr[1], and the ASDEX Upgrade Team[2] — [1]Institute of Applied Physics, TU Wien, Fusion@ÖAW, Wiedner Hauptstr. 8-10, 1040 Vienna, Austria — [2]Max Planck Institute for Plasma Physics, Boltzmannstr. 2, 85748 Garching, Germany

Since edge localised modes (ELMs) strongly affect the performance of fusion plasmas a deeper understanding of the underlying physics is required to optimise future fusion devices. This contribution investigates the recovery of the edge electron density (n_e) and temperature (T_e) profiles in between ELMs. A comparison of a hydrogen (H) and a deuterium (D) plasma is presented. In the experiment a match of the collisionality (ν^*) and the normalised plasma pressure (β) was achieved at the pedestal top. For this, roughly a factor of 2 higher heating power as well as a factor of almost 10 higher fuelling rates were necessary in the H plasma. The measured n_e edge profiles are much steeper in D than in H, while the T_e gradients are similar. The recovery of the pedestal top n_e takes place at similar time scales in both plasma species. T_e recovers faster after the ELM in H, which is due to the higher heating power, although the energy loss per ELM is larger. The experimental results are presented together with ideal MHD stability analysis and the role of the ELM losses on the plasma stored energy is investigated.

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High Speed Gas Valve for Massive Gas Injection in Tokamaks — •Mathias Dibon[1,2], Albrecht Herrmann[1], Klaus Mank[1], Vitus Mertens[1], Rudolf Neu[1,2], Gabriella Pautasso[1], and Bernhard Ploeckl[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching, Germany — [2]Technische Universität München, Boltzmannstr. 15, 85748 Garching, Germany

For the purpose of mitigating the forces on the vessel during disruptions, a system for massive gas injection is used at the tokamak ASDEX Upgrade. Three gas valves are mounted inside the vacuum vessel with a distance of 10 cm between the nozzle exit (diameter 14 mm) and the plasma edge. This requires the valves to be insensitive to strong magnetic fields, especially on the magnetic high field side, to high temperatures and ionizing radiation. The new High Speed Gas Valve is meant to replace an old electromagnetic valve in order to increase the gas delivery efficiency and the operational reliability. The valve is closed by compressed air (20 bar) acting on through a piston on the stem and valve plate, pushing the seal onto the sealing edge and closing the gas chamber. Piezoelectric clamps secure the stem while the 80 cm^3 gas chamber is filled with neon or argon at a pressure of up to 50 bar. The valve opens up when the piezoelectric actuators release the stem and a stack of disk springs accelerates the valve plate until it reaches its maximum stroke of 4,5 mm after 4 ms. This allows a mass flow rate of the gas up to $10^5\ \frac{Pa*m^3}{s}$. A characterisation of the valve will be presented in the contribution.

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Neutral argon measurements in a high-power helicon discharge — •Nils Fahrenkamp, Birger Buttenschön, and Olaf Grulke — Max Planck Institute for Plasma Physics, 17491 Greifswald, Germany

The laser-induced-fluorescence (LIF) method is a widely used non-invasive technique to gain information about the velocity distribution, temperature and density of the plasma ions and the neutral gas. It has often been speculated that neutral gas pumping represents an important mechanism limiting the plasma density in high-power helicon discharges. Prometheus-A is an extremely high-power helicon discharge using multiple distributed helicon antennas to achieve rf power densities up to $P_{rf} \leq 100\,MW/m^{-3}$. The peak plasma density decreases in time with a typical timescale of $\approx 1\,ms$, which indicates the importance of the neutral gas inventory. LIF is used to measure the neutral gas density profile with high spatial resolution. The excitation vacuum-wavelength for the metastable argon atoms of $667.91nm$ is provided by a diode laser system and the fluorescence signal of $750.39nm$ is collected by an external pick-up optic, filtered and detected by a photomultiplier tube. Detailed measurements of the neutral pumping effect for various operation parameters are presented with special emphasis on its effect on the peak plasma density.

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Experimental study of the radial structure of turbulence with an ultra-fast swept reflectometer in ASDEX Upgrade — •Anna Medvedeva[1,2,3,4], Christine Bottereau[2], Frederic Clairet[2], Garrard D. Conway[1], Stephane Heureaux[3], Diego Molina[2], Ulrich Stroth[1,4], and AUG Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstraße 2, D-85748 Garching, Germany — [2]CEA, IRFM, F-13108 St-Paul-Lez-Durance, France — [3]Institut Jean Lamour UMR 7198 CNRS, Université de Lorraine, 34 cours Leopold, F-54000 Nancy, France — [4]Technische Universität München, James-Franck-Straße 1, D-85748, Garching, Germany

Confinement of fusion plasmas is restricted by anomalous transport where micro-turbulence is suspected to play a major role. Experimental documentation of this turbulence, its dependence on the plasma temperature, density, current will provide insights in the nature of this turbulence and the driving parameters. In this work advantage is taken of the ultra-fast sweep capabilities of the V and W band (50-110 GHz) reflectometers, developed by CEA, to record fast plasma turbulent events on ASDEX Upgrade. The X-mode polarization provides a rather large radial access to the plasma from the very edge to, under certain conditions, the center. The scope of the work is to exploit the specific strengths of the diagnostic in order to study the radial spectra of fluctuations, radial turbulence spreading and the fast dynamic profile evolution after confinement transitions or changes in the discharge control parameters. The latest experimental data obtained during the ASDEX Upgrade campaign 2014 will be presented.

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Hydrogen Diffusion in Tungsten near Room Temperature — •Stefan Kapser[1,2] and Armin Manhard[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching, Germany — [2]Physik-Department E28, Technische Universität München, 85748 Garching, Germany

Tungsten is a promising candidate for the use as plasma-facing material of a future nuclear fusion reactor, where it would be subjected to high fluxes of deuterium and tritium. It is crucial for safety considerations to estimate the uptake of the radioactive tritium by tungsten and its possible diffusion through it. Most investigations of hydrogen diffusion in tungsten have been performed only at very high temperatures. Thus measurements at lower temperatures are needed to verify or correct extrapolations from high temperature data.

A very direct method to study the diffusion of hydrogen in metals are permeation experiments. For hydrogen permeation measurements on tungsten, extremely thin samples are needed to achieve a measurable signal due to the very low solubility, and thus permeability, of hydrogen in tungsten. Such thin tungsten samples have been produced by electrochemical thinning of rolled foils. Hydrogen diffusion in these samples is studied using an electrochemical method. For comparison deuterium plasma implantation with subsequent diffusion is investigated in the same material. The dependence of the results on the tungsten microstructure is analyzed.

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Doppler coherence imaging of ion dynamics in the plasma experiment VINETA — •Dorothea Gradic, Oliver Ford, and Robert Wolf — Max-Planck-Institut für Plasmaphysik, Wendelsteinstraße 1, D-17491 Greifswald, Germany

Ion flows are investigated with the Doppler coherence imaging system (CIS) in the linear plasma experiment VINETA. The Doppler CIS is a passive optical diagnostic for the observation of plasma bulk ion dynamics. It enables line-integrated measurements to obtain 2D images of the ion flow and ion temperature. With a few birefringent plates, a narrow UV-VIS bandpass filter and a CCD camera a plasma image is acquired, modulated with an interference pattern induced by the plates. The fringe phase and contrast of the interference pattern encode the spectral information of the light. The spectral position and width are dependent on the Doppler shift and broadening induced by the movement of the light-emitting plasma particles.

The major objective of this study is the research of ion dynamics during a driven magnetic reconnection event in VINETA. Magnetic reconnection is of importance in space phenomenas, such as solar flares or in the Earth's magnetosphere, as well as in fusion experiments. It will be investigated whether magnetic reconnection has an influence on VINETA ion dynamics.

First studies have been made to analyse the dependence of the measured phase difference on spectral wavelength changes. Additionally, ion dynamics in VINETA without reconnection were investigated.

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EMC3-Eirene simulations of gas puff effects on edge density and ICRF coupling in ASDEX Upgrade — •Wei Zhang[1,2], David Coster[1], Jean-Marie Noterdaeme[1,2], Tilmann Lunt[1], Volodymyr Bobkov[1], Yuehe Feng[1], and ASDEX Upgrade team[1] — [1]Max Planck Institute for Plasma physics, Garching, Germany — [2]University of Ghent, Ghent, Belgium

Ion cyclotron range of frequency (ICRF) heating relies on the Fast Wave (FW) to transport the power from the edge (the antenna) to the plasma center. Since the FW is evanescent below a critical density (typically in the 10^{18} m^{-3} range), the wave does not propagate in the region where the density is below this value in the very edge of the plasma. The coupling depends strongly on the width of this region. The distance between the ICRF antenna and the FW cut-off layer can be made smaller by increasing the edge density in front of the ICRF antenna.

Previous experiments in many tokamaks and preliminary simulation results for AUG and JET with EDGE2D-EIRENE show that the edge density could indeed be increased with gas puffing at the top of the vessel or in the midplane. But the 2D code cannot quantitatively reproduce the experimental results, mainly due to the assumptions of toroidal axisymmetry. EMC3-EIRENE is a 3D Edge Monte Carlo plasma fluid transport code. By including the toroidal nonaxisymmetric plasma facing components and 3D positions of gas valves in the code, the simulations can be made more realistic. We will show first simulation results of the code and a comparison to experiments.

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Vlasov-hybrid simulations of firehose-unstable plasmas — •Patrick Astfalk[1], Frank Jenko[1,3], Tobias Görler[1], and Francesco Califano[2] — [1]Max-Planck-Institut für Plasmaphysik, Garching, Germany — [2]Physics Department, University of Pisa, Pisa, Italy — [3]Department of Physics and Astronomy, University of California, Los Angeles, USA

The firehose instability is a kinetic instability which is driven by pressure anisotropies in high-beta space plasmas such as the solar wind. Since the occurence of the firehose is connected to a subsequent reduction of the pressure anisotropy, its instability threshold sets a limit to the observable anisotropies in firehose-unstable space plasmas. We carried out fully kinetic plasma simulations using the semi-Lagrange code VESPA (Mangeney et al. 2002, Valentini et al. 2007) to investigate the firehose instability in 1D3V and 2D3V setups. Starting from a successful benchmark with the PIC-code PEGASUS (Kunz et al., 2014), we revisited the linear and quasilinear theory of the firehose and checked the theoretical predictions for expected growth rates, frequencies and anisotropy reduction. Perhaps the most interesting topic in current research is the nonlinear evolution of firehose-unstable systems. Nonlinear wave-particle interactions lead to a dissipation of the injected magnetic and electric energy and a subsequent heating of the plasma particles. The detailed mechanisms in this regime are still not fully understood. However, they are the key to an explanation of turbulent heating processes in the solar wind, making this an active field of research.

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Poloidal asymmetries of the heavy ions in the ASDEX Upgrade tokamak — Tomáš Odstrčil[1,2], Thomas Pütterich[1], Didier Mazon[3], Clemente Angioni[1], Roberto Bilato[1], Anja Gude[1], Didier Vezinet[1], and •ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstraße 2, D-85748 Garching, Germany — [2]Physik-Department E28, Technische Universität München, 85747 Garching, Germany — [3]CEA, IRFM F-13108 Saint Paul-lez-Durance, France

Poloidal asymmetries of heavy ions in the tokamak plasma are caused by the presence of forces parallel with field-lines which have comparable magnitude to the thermal pressure. The most important examples are the centrifugal force (CF) and the electric force (EF). The CF is caused by fast toroidal rotation of the plasma column which is pushing impurity ions, that have a substantially higher mass than the main ions, on the outer-side of the plasma. And the EF can be produced by ion cyclotron heated fast particles with high pitch angle that are trapped by the mirror force on the low field side of the plasma. The excessive charge produced by these particles is affecting highly charged impurities and pushing them to the high field side of the plasma.

From predictions based on neoclassical and turbulent theory, it follows that the radial flux of heavy ions will be significantly changed by the presence of these asymmetries. The purpose of this study is to investigate the presence of these asymmetries in ASDEX Upgrade and verify the predicted consequences on the particles flux.

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Change of the SOL power width with the toroidal B-field direction in ASDEX Upgrade — •Michael Faitsch, Thomas Eich, Bernhard Sieglin, Hong-Juan Sun, Albrecht Herrmann, and The Asdex Upgrade team — Max-Planck-Institute for Plasma Physics, Boltzmannstr. 2, D-85748 Garching, Germany

The change of the scrape-off layer power width in dependence on the toroidal magnetic field direction has been investigated in L-mode discharges in upper single null (USN) configuration in ASDEX Upgrade. The heat flux onto the outer and inner divertor plates was measured using a fast 2D infrared camera. The heat flux distribution is described by an exponential power fall-off length λ_q and a diffusive broadening in the divertor region S. The parameters, S and λ_q, for the inner and outer divertor target are compared for both toroidal magnetic field directions. For the divertor broadening S no dependence on the toroidal magnetic field direction is observed. The comparison between the near scrape-off layer electron temperature fall-off length λ_{T_e} and the power fall-off length λ_q are in agreement with the 2-point model. Therefore it is concluded that electron conduction is the main contribution for the scrape-off layer parallel transport in this discharges. The ratio between inner, λ_q^{inner}, and outer, λ_q^{outer}, power fall-off length λ_q is dependent on the toroidal magnetic field direction. The numerical values are $\lambda_q^{inner}/\lambda_q^{outer} = 0.44$ for favourable $\mathbf{B}\times\nabla B$ ion drift direction and $\lambda_q^{inner}/\lambda_q^{outer} = 0.85$ for non-favourable drift direction. The different ratios are explained assuming vertical drifts, which are dependent on the toroidal magnetic field direction.

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Measurements and Modelling of Hydrogen Dynamics in Tungsten — •Johannes Bauer[1,2], Thomas Schwarz-Selinger[1], Klaus Schmid[1], Udo von Toussaint[1], and Wolfgang Jacob[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, D-85748 Garching — [2]Technische Universität München, James-Franck-Str. 1, D-85748 Garching

Although hydrogen retention in defect free tungsten is low it can be significantly altered by plasma wetting. Thus understanding the interaction and dynamics of hydrogen in tungsten becomes an important issue. Present understanding distinguishes between solute and trapped hydrogen inventory. The solute hydrogen is located in the tetrahedral interstitial sites of bbc tungsten and can diffuse rapidly due to the low activation energy of 0.2-0.4 eV. The trapped hydrogen inventory resides at defects like vacancies, grain boundaries or dislocations, with de-trapping energies between 0.8-2.0 eV and is therefore less mobile. Common ex-situ experiments only allow the investigation of hydrogen retained in traps, while the solute is out of experimental reach due to its fast out-gassing at ambient temperatures. In this study the dynamics of the solute hydrogen in tungsten is measured in-situ for the first time. Diffusion/trapping simulations reveal that for low temperature e.g. 200 K, the solute hydrogen dominates the total inventory and its out-gassing after implantation is slowed down to the timescale of hours. Therefore in-situ hydrogen implantation and nuclear reaction analysis of tungsten samples are conducted at temperatures down to 140 K investigating experimentally the dynamics of solute hydrogen.

P 16.12 Di 16:30 Foyer Audimax

A new thermal He-beam diagnostic for electron density and temperature measurements in the scrape-off layer of ASDEX Upgrade — •Michael Griener[1], Elisabeth Wolfrum[1], Thomas Eich[1], Albrecht Herrmann[1], Volker Rohde[1], Oliver Schmitz[2], Ulrich Stroth[1,3], and the ASDEX Upgrade Team[1] — [1]Max Planck Institute for Plasma Physics, Boltzmannstr. 2, 85748 Garching, Germany — [2]Engineering Physics Department, University of Wisconsin-Madison, USA — [3]Physik Department E28, Technische Universität München, 85748 Garching, Germany

In a nuclear fusion device power is exhausted across the last closed flux surface into the so-called ‚scrape-off layer', SOL. In order to study the transport dynamics to (a) the divertor via parallel heat flux and (b) to the wall via filaments, a diagnostic for the determination of n_e and T_e with high spatial and temporal resolution is required. Although the diagnostic capabilities of the ASDEX Upgrade edge plasma are excellent, there is a lack of spatially and temporally highly resolved electron temperature measurements in the SOL.

Therefore a piezo valve will be installed in ASDEX Upgrade in April 2015. It allows fast chopping of a thermal He-beam which is part of the new diagnostic. In the first campaign, existing lines of sight of the CXRS diagnostic will be used to measure various He I transitions to confirm the collisional radiative model for He.

The principle of the thermal He-diagnostic as well as calculations of the achievable spatial resolution of the initial set-up will be presented.

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Stromtrieb durch Neutralteilchen-Injektion an ASDEX Upgrade — •David Rittich, Ursel Fantz, Christian Hopf, Benedikt Geiger, Francois Ryter und das ASDEX Upgrade Team — Max-Planck-Institut fuer Plasmaphysik, Garching

Um einen Tokamak stationär zu betreiben oder zumindest dessen Pulsdauer zu verlängern, muss der Plasmastrom oder zumindest ein Teil davon nicht-induktiv erzeugt werden. Zudem sind für Szenarien mit verbessertem Plasmaeinschluss maßgeschneiderte Stromprofile nötig. Zum nicht-induktiven Stromtrieb und zu gezielten Modifikationen des Stromprofils eignen sich sämtliche Zusatzheizungen, die entweder auf der Einstrahlung von elektromagnetischen Wellen oder der Injektion von neutralen Wasserstoffatomen (NBI) beruhen. Am Tokamak ASDEX Upgrade erlaubt die große Flexibilität der installierten NBI, während einer Entladung radiale Quellen, welche nahe der magnetischen Achse einen geringen Strom treiben, durch tangentiale Quellen, die etwas abseits der magnetischen Achse einen höheren Strom treiben, zu ersetzen. Untersucht werden die dadurch auftretenden räumlichen und zeitlichen Veränderungen des Stromprofils, sowie dessen Zusammensetzung. Gezeigt werden Messergebnisse der Motional-Stark-Effect-Diagnostik (MSE), der Fast-Ion-D-Alpha-Spektroskopie (FIDA) und der Faraday-Rotations-Polarimetrie in Endladungen in denen etwa 20% des Stroms durch NBI getrieben werden. Die Messergebnisse dieser Diagnostiken werden mit Vorwärtsrechnungen verglichen, welche unter Zuhilfenahme des Transportcodes TRANSP [1] erzeugt werden. [1] TRANSP home page, http://w3.pppl.gov/transp

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Non-linear simulations of ELMs in ASDEX Upgrade including diamagnetic drift effects — •Alexander Lessig[1], Matthias Hoelzl[1], Isabel Krebs[1], Emmanuel Franck[1], Sibylle Guenter[1], Francois Orain[2], Jorge Morales[2], Marina Becoulet[2], and Guido Huysmans[3] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstrasse 2, 85748 Garching, Germany — [2]CEA-IRFM, Cadarache, 13108 Saint-Paul-Lez-Durance, France — [3]ITER Organization, 13067 Saint-Paul-Lez-Durance, France

Large edge localized modes (ELMs) are a severe concern for ITER due to high transient heat loads on divertor targets and wall structures. Using the non-linear MHD code JOREK, we have performed ELM simulations for ASDEX Upgrade (AUG) including diamagnetic drift effects. The influence of diamagnetic terms onto the evolution of the toroidal mode spectrum for different AUG equilibria and the non-linear interaction of the toroidal harmonics are investigated. In particular, we confirm the diamagnetic stabilization of high mode numbers and present new features of a previously introduced quadratic mode coupling model for the early non-linear evolution of the mode structure. Preliminary comparisons of full ELM crashes with experimental observations are shown aiming at code validation and the understanding of different ELM types. Work is ongoing to include toroidal and neoclassical poloidal rotation in our simulations.

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Indirect measurement of the poloidal velocity using charge exchange recombination spectroscopy — •Alexander Lebschy[1,2], Benedikt Geiger[1], Rachael McDermott[1], Marco Cavedon[1], Mike G. Dunne[1], Rainer Fischer[1], Eleonora Viezzer[1], and the ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, D-85748 Garching, Germany — [2]Physik-Department E28, Technische Universität München, D-85748 Garching, Germany

Plasma rotation has a strong influence on plasma transport by the stabilization of modes and the suppression of plasma turbulence, which affects the transport of heat, particles, and momentum. In tokamaks, the toroidal rotation is essentially a free parameter that is usually dominated by the external momentum input from neutral beams used to heat the plasma. The poloidal rotation, on the other hand, is strongly damped and is expected to remain at neoclassical levels. A commonly used diagnostic to measure impurity ion rotation as well as temperature and density is charge exchange recombination spectroscopy. Measuring the inboard-outboard asymmetry of the toroidal rotation enables an indirect measurement of the poloidal rotation so that both, poloidal and toroidal rotation, can be measured with toroidal viewing chords. Additional benefits of this technique are that poloidal velocities are amplified with the safety factor and that the technique is less sensitive to atomic physics effects like the gyro motion. In this poster, first reconstructions of the poloidal rotation are shown and compared to neoclassical theory and to other direct measurements.

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Study of Turbulence Structures using Poloidal Correlation Reflectometry at AUG — •Dmitrii Prisiazhniuk[1,2], Andreas Krämer-Flecken[3], Garrard Conway[1], Ulrich Stroth[1,2], and The ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstrasse 2, 85748 Garching, Germany — [2]Physik-Department E28, Technische Universität München, 85748 Garching,Germany — [3]Institut für Energieforschung - Plasmaphysik, Forschungszentrum Jülich, Association EURATOM-FZJ, 52425 Jülich, Germany

A poloidal correlation reflectometer (PCR) system has been installed on AUG, which is able to measure key properties of turbulence such as correlation length, decorrelation time, inclination of eddies and propagation velocity. Additionally, these measurements provide information on global plasma properties such as the velocity of plasma rotation and the shear of the magnetic field (q-profile). After a first campaing of operation of the PCR at AUG, preliminary results for pitch angle and velocity measurements have been obtained. Initial cross-comparison of the measured velocity with the Doppler reflectometry system are presented. The measured pitch angles are compared with magnetic equilibrium reconstruction from the Cliste code. This comparison showed similar trends and values of measured angle for L-mode confinement, but some deviations from Cliste results have been found.

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Computational Grids Adapted to the Background Distribution Function for Eulerian Gyrokinetic Simulations — Hans-Joachim Bungartz[2], Tobias Görler[1], •Denis Jarema[2], Frank Jenko[1], Tobias Neckel[2], and Daniel Told[1] — [1]Max-Planck-Institut für Plasmaphysik, EURATOM-Assoziation, Boltzmannstraße 2, 85748 Garching — [2]Scientific Computing in Computer Science, Technische Universität München, Boltzmannstraße 3, 85748 Garching

Gyrokinetics has been shown to be an appropriate model to simulate microturbulence in fusion plasma. The dimensionality of the phase-space grids, however, makes gyrokinetics computationally expensive already for the local flux-tube plasma simulations, where the radial direction range is small compared to the machine size and the plasma temperature radial variation can be neglected. In global simulations, nevertheless, the radial range has to be extended to the full machine size in order to capture global effects. The corresponding computational domain spans now over areas with significantly different temperatures. This leads to different plasma properties in different radial positions and, thus, other computational grids in the velocity directions are required. The temperature variations are reflected in the background distribution function, which appears in the numerically-solved gyrokinetic equations. We develop computational grids adjusted to the background distribution function, thus enabling faster and more stable gyrokinetic plasma simulations on massively parallel machines.

P 16.18 Di 16:30 Foyer Audimax

Application of Radial Correlation Doppler Reflectometry on the ASDEX Upgrade tokamak — •J.R. Pinzón[1,2], T. Happel[1], P. Hennequin[3], U. Stroth[1,2], and The ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, D-85748 Garching — [2]Physik-Department E28, TUM, D-85748 Garching — [3]Laboratoire de Physique des Plasmas, Ecole Polytechnique, France

Doppler Reflectometry (DR) is a diagnostic used for the characterization of plasma density turbulence in magnetic confinement devices. It allows to measure the perpendicular propagation velocity of density fluctuations and their perpendicular wavenumber spectrum with good spatial resolution. By studying the correlation between signals of two reflectometers probing at different radial positions (Radial Correlation DR), it is possible to evaluate the radial correlation length L_r of the plasma turbulence by scanning the radial separation Δr.

However, results from analytical calculations and two-dimensional full-wave simulations indicate that the L_r measurement by RCDR is not straightforward and might depend on factors such as plasma velocity, fluctuation amplitudes and probing beam angle. Experimental data from the ASDEX Upgrade tokamak are studied. An assessment of the viability of the use of different signals and analysis methods, including an evaluation of potential caveats, is given.

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Optimization of Caesium Dynamics in Large and Powerful RF Sources for Negative Hydrogen Ions — •Alessandro Mimo, Christian Wimmer, Dirk Wünderlich, and Ursel Fantz — Max-Planck-Institut für Plasmaphysik, 85748 Garching

The development of large and powerful RF sources for negative hydrogen and deuterium ions is mandatory for the realization of the Neutral Beam Injection system at ITER. Caesium seeding into negative ion sources is necessary to obtain the required ion current with a tolerable level of co-extracted electrons. The caesium dynamics, during both plasma and vacuum phases, was investigated by means of the Monte Carlo transport code CsFlow3D, which is used to simulate the time evolution of the distribution of neutral and ionic caesium in the IPP prototype RF ion source. Simulations were performed for different durations of plasma-on and plasma-off phases, with the purpose of understanding how the duty cycle influences the caesium distribution and hence the source performance. In order to investigate asymmetry effects in the caesium distribution, caused by the positioning of caesium evaporator, the caesium coverage on the top and on the bottom part of the plasma grid was simulated and data were compared to the caesium density measured by laser absorption in the prototype source. The next step will be to introduce in the code the simulation of diagnostics such as laser absorption spectroscopy and optical emission spectroscopy, in order to achieve a direct benchmark of the code with experimental data.

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Investigation of momentum loss mechanisms in the divertor region of ASDEX Upgrade with EMC3-Eirene — •Dominik Brida[1,2], Tilmann Lunt[1], Marco Wischmeier[1], and the ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching, Germany — [2]Physik-Department E28, Technische Universität München, 85747 Garching, Germany

In future fusion devices, such as ITER and DEMO, it will be necessary to prevent direct contact between the hot confined plasma and the vessel wall. This will be achieved by employing divertors, which offer a number of desirable advantages, such as screening of impurities from the core plasma, improved energy confinement (H-mode) and effective pumping of helium ash and hydrogen. However, due to material limits, the power and particle flux as well as the temperature at the target must be reduced to acceptable levels. This can be attained by operating the divertor in a (partially) detached regime, which requires considerable volumetric energy and momentum losses in the divertor region. Previous studies identified ion-neutral friction as the principal momentum loss factor. For this contribution the fluid code EMC3-Eirene was applied to simulate ASDEX Upgrade discharges with increasing plasma densities and investigate the role of different momentum loss mechanisms by switching on and off respective terms in the simulation. Interestingly, even without the charge-exchange collisions a strong momentum loss is observed in the simulation.

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Experimental investigation of specific heat in finite 3D Yukawa-balls — •Matthias Mulsow[1], André Schella[2], and André Melzer[1] — [1]Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald, 17487 Greifswald — [2]Max-Planck-Institut für Dynamik und Selbstorganisation, 37077 Göttingen

In low-temperature plasmas micrometer-sized particles are able to form highly ordered structures. Using a harmonic three-dimensional trapping potential strongly coupled finite systems can be created, the Yukawa-balls. The characteristic crystal-like structure and its phase transitions during heating can be quantified by the center-two-particle correlation function (C2P) and the triple correlation function (TCF). While the C2P takes all particles of the spherical cluster into account, the TCF is computed for each shell individually.

Recently it was shown by Thomsen and Bonitz [1] that reduced Shannon entropies and reduced specific heats can be derived from these distribution functions. The authors used the latter to identify the onset of the well known radial melting on the one hand but also discovered new intrashell structural transitions in the specific heats associated with the C2P.

To investigate these predictions experimentally, spherical Yukawa-balls are observed at different temperatures to which they are tuned by heating lasers. This poster presents the current status and results of these observations in order to verify the new structural transitions.

[1] H. Thomsen and M. Bonitz, arXiv:1410.2393v1 (2014)