P 15: Poster Session - Magnetic Confinement

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

P 15.1 Di 16:30 Foyer Audimax

Experimental and numerical investigations of the energy confinement times in the stellarator TJ-K — •Ahmed Ali[1], Alf Köhn[1], Alejandro Muñoz[1], Eberhard Holzhauer[1], Gregor Birkenmeier[2], and Mirko Ramisch[1] — [1]Institute of Interfacial Process Engineering and Plasma Technology IGVP, Uni Stuttgart, Stuttgart, Germany — [2]Max-Planck Institute für Plasmaphysik, Garching, Germany

A particle and power balance model has been employed to numerically simulate and qualitatively understand transport processes, which determine equilibrium density and temperature profiles in the stellarator TJ-K. To quantify losses by these processes, the e-folding time of density and energy after switching off the heating source is used as a measure of the corresponding confinement times. For comparison with numerical simulation, both quantities are investigated experimentally in TJ-K. The particle confinement can be directly deduced from an interferometer or from Langmuir probes measuring the ion-saturation current. A commercial satellite receiver is used to measure the emitted radiation around 12 GHz, which is assumed to be dominated by Bremsstrahlung. In addition, the signal from a fast diode, which is sensitive in the visible range of light, is used. Results of the comparative numerical and experimental studies will be presented.

P 15.2 Di 16:30 Foyer Audimax

Effects of increased microwave heating power in the stellarator TJ-K — •Alejandro Muñoz, Alf Köhn, Ahmed Ali, and Mirko Ramisch — Institute of Interfacial Process Engineering and Plasma Technology, University of Stuttgart, Stuttgart, Germany

One of the microwave heating systems at the stellarator TJ-K has been recently upgraded: a third klystron has been installed, increasing the heating power from 4 kW to 6 kW operating at 14 GHz. A phased-array antenna is used which allows to vary the injection angle by sweeping the microwave frequency in order control the coupling mechanism of the microwave to the plasma. With the two klystrons already installed, ionization degrees of $\alpha \simeq 1$ have been reached. We expect that an increased heating power, by means of the third klystron put into operation, leads to an increase in the electron temperature T_e only, rather than in electron density n_e, and thus a decrease in the collision frequency $\nu_{ei} \propto n_e T_e^{-3/2}$ which has an impact on heating flow damping and neoclassical properties.

Parameter scans have been performed in order to characterize the new heating scenario. A radial movable Langmuir probe has been used to obtain radial profiles of the electron density and temperature. An arrangement of bolometers and an optical diode have been used to obtain the power losses by radiation. A particle and power balance model is used to obtain estimated densities and temperatures in order to compare with the experimental results.

P 15.3 Di 16:30 Foyer Audimax

Design of an novel antenna for EBW heating in FLIPS — •Lukas Rudischhauser, Kirill Rumiantcev, and Walter Kasparek — Institut für Grenzflächenverfahrenstechnik und Plasmatechnologie, Universität Stuttgart, Germany

Electron Bernstein waves (EBW) are electrostatic waves which do not have an O-wave cutoff. This enables them to penetrate into overdense plasmas and be absorbed at multiples of the electron cyclotron resonance frequency. These waves cannot propagate in free space, necessitating generation of EBW within the plasma volume through O-X-B or X-B conversion processes only possible for certain plasma parameters and injection angles. The aim of this work is to design a high directivity antenna which can excite EBW in FLIPS (Flexible Linear Plasma Experiment Stuttgart). We use commercial and scientific software such as CST MS and PROFUSION to produce two designs, a Vlasov-type cut waveguide and a circular slotted waveguide antenna. This second design is to line the inside of the vessel with rotational symmetry, simplifying comparison to numerical results. To find optimal injection angles and polarisations extensive use is made of simulations using a FD3D code and previous work on the plasma configuration in FLIPS. In a first step radiation pattern measurements outside of the plasma will be performed, the antenna will then be installed and generation of EBW indirectly shown by increased heating in the overdense plasma region.

P 15.4 Di 16:30 Foyer Audimax

Curvature dependence of blob dynamics in TJ-K — •Stephen Garland, Mirko Ramisch, and Thomas Hirth — Institut für Grenzflächenverfahrenstechnik und Plasmatechnologie, Universität Stuttgart

Turbulent transport in the scrape-off layer (SOL) is an important area of investigation in magnetic confinement fusion research. Relatively dense and hot, field-aligned, filament-like structures (blobs) have been observed to propagate radially through the SOL in many fusion devices, and contribute significantly to SOL transport. The torsatron TJ-K is well suited to turbulence studies since it operates with a low-temperature plasma, allowing Langmuir probe measurements in the entire plasma volume. Despite the low temperature, investigations are relevant to fusion research due to dimensionless plasma parameters similar to those in the edge region of fusion plasmas.

Blob dynamics have been studied in the SOL of TJ-K using a 2D movable probe and the conditional averaging technique. In addition, emissive probes have been used to determine equilibrium electric fields, allowing the calculation of background ExB flows. Experimentally deduced centre of mass radial and poloidal blob velocity components have been compared to an analytical blob model, which has been simplified to express blob velocity in terms of the magnetic field curvature vector. Experimental radial blob velocity components compare well to the model, confirming the normal curvature drive of blob polarisation. On the other hand, poloidal velocity components are comparable to the model only when background ExB flow is also taken into account.

P 15.5 Di 16:30 Foyer Audimax

Propagation and absorption of electron Bernstein waves in the linear device FLiPS — •Kirill Rumiantcev, Alf Köhn, Carsten Lechte, and Walter Kasparek — IGVP, Universität Stuttgart, Pfaffenwaldring 31, 70569, Stuttgart

In overdense plasmas the O-mode encounters a O-cutoff before being able to deposit its energy at ω_{ce}. In order to overcome this issue heating of the plasma by Bernstein waves is proposed. These electrostatic waves have no density cutoff and are strongly absorbed on harmonics of ω_{ce}. Their electrostatic nature leads to the fact that they cannot propagate in the vacuum and have to be created by a conversion process.

A linear device FLiPS is now equipped with an R-wave axial heating system and basic plasma diagnostics. The O-X-B process is experimentally studied using an oblique injection of the O-mode.

In this work we will present results of a numerical investigation of the O-X conversion process by using a full-wave time domain code and the first measurements of plasma parameters of FLiPS.

P 15.6 Di 16:30 Foyer Audimax

High-speed lithium pellet injector commissioning in ASDEX Upgrade to investigate impact of Li in an all-metal wall tokamak — •Rodrigo Arredondo Parra[1], Antonino Cardella[2,3], Peter Thomas Lang[1], Rafael Macian Juan[2], Rudolf Neu[1,2], and Bernhard Ploeckl[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching, Deutschland — [2]Technische Universität München, Boltzmannstr. 15, 85748 Garching, Deutschland — [3]Fusion for Energy; Boltzmannstr. 2, 85748 Garching, Deutschland

Encouraging results with respect to plasma performance have been observed in several tokamak devices (TFTR, NSTX, etc) when injecting Lithium. Recently, a pedestal broadening resulting in an enhanced energy content during transient ELM-free H-mode phases was achieved in DIII-D. Experiments are planned at ASDEX Upgrade, aiming to investigate the impact of Li in an all-metal wall tokamak and to enhance the pedestal operational space. For this purpose, a Lithium pellet injector has been developed, capable of injecting pellets with a particle content up to $1.64 * 10^{20}$ atoms (1.89 mg) at a foreseen maximum repetition rate of 3 Hz. Free flight launch from the torus outboard side without a guiding tube is envisaged. A transfer efficiency exceeding 90 % was achieved in the test bed. Pellets will be accelerated in a gas gun; hence special care must be taken to avoid deleterious effects by the propellant gas pulse, this being the main plasma gas, leading to speeds ranging from 500 $\frac{m}{s}$ to 800 $\frac{m}{s}$. Additionally, a large expansion volume equipped with a cryopump is added in to the flight path. The injector is expected to commence operation by May 2015

P 15.7 Di 16:30 Foyer Audimax

Capabilities of nitrogen admixed cryogenic deuterium pellets — •Igor Sharov[1], Peter Lang[2], Bernhard Ploeckl[2], Marco Cavedon[2], Gabor Kocsis[3], Tamas Szepesi[3], Vladimir Sergeev[1], and ASDEX Upgrade Team[2] — [1]SPU, Saint-Petersburg, Russia — [2]Max-Planck-Institut für Plasmaphysik, Garching, Germany — [3]Wigner RCP RMI, Budapest, Hungary

Operation at high core density with high energy confinement - as foreseen in a future fusion reactor like DEMO - is being investigated at ASDEX Upgrade tokamak. The efficiency of pellet fuelling from the high-field side usually increases with increasing injection speed. Due to the fragile nature of the deuterium ice, however, the increment of pellet mass losses and subsequent pellet fragmentations take place when the speed is increased. Studies show, that admixing of a small amount of nitrogen (N2) into D2 gas can be favorable for the mechanical stability of pellets. This might be helpful for deeper pellet penetration. Besides, seeding by N2 can enhance plasma performance due to both increasing the energy confinement time and reducing the divertor heat load in the envisaged ELMy H-mode plasma scenario. Fuelling efficiency of N2-admixed solid D2 pellets and their nitrogen seeding capabilities were investigated. It was found that both the overall plasma density increase and the measured averaged pellet penetration depth were smaller in case of the admixed (1% mol. in the gas resulting in about 0.8% in the ice) pellet fuelling. Possibility of the N2-seeding by admixed pellets was confirmed by CXRS measurements of N7+ content in plasma.

P 15.8 Di 16:30 Foyer Audimax

Phase Contrast Imaging diagnostic for Wendelstein 7-X — •Lukas-Georg Böttger[1] and Olaf Grulke[2] — [1]Ernst-Moritz-Arndt-Universität Greifswald — [2]Max Planck Institute for Plasma Physics, 17491 Greifswald, Germany

The Phase Contrast Imaging (PCI) diagnostic allows non-invasive measurements of density fluctuations in high temperature plasmas.

The index of refraction in a plasma depends approximately linearly on its density. Therefore an incoming probing laser beam is shifted in phase by the density fluctuations. This phase shift information can be translated into intensity variations by interference after a phase plate.

In general the signal contains only the line-integrated information along the beam path. This limitation can be overcome by the fact that the density fluctuations form filament structures well aligned with the local magnetic field. If the pitch angle of the magnetic field varies significantly along the beam path, optical filtering allows for localization of the density fluctuations. First estimates show that a resolution of about 15 cm in W7-X can be achieved, which will allow for a clear separation of edge and core fluctuations.

The process of integration starts with the development of a virtual diagnostic revealing the specific behaviour of the PCI diagnostic at W7-X for standard operation scenarios. In this contribution first results of these investigations are presented.

P 15.9 Di 16:30 Foyer Audimax

Blob dynamics simulations for the TJ-K plasma — •Allah Rakha[1], Stephen Garland[1], Mirko Ramisch[1], and Bruce Scott[2] — [1]Institut für Grenzflächenverfahrenstechnik und Plasmatechnologie, Universität Stuttgart, Germany — [2]Max-Planck-Institut für Plasmaphysik, Euratom Association, D-85748 Garching, Germany

Radially propagating filaments elongated along magnetic field lines, known as blobs, are responsible for a major part of particle density and energy cross-field transport in the scrape-off layer (SOL) of fusion devices. Blobs, which are born in the vicinity of the last closed flux surface, are denser and hotter than the background SOL plasma, and can cause damage to plasma facing components. A good understanding of their trajectories is therefore important for the design of future fusion reactors.

As the dynamics of blobs in the SOL is governed by nonlinear phenomena, and analytical models are insufficient for their detailed study, nonlinear simulations are necessary to gain a better understanding. First simulations of plasmas with TJ-K equivalent parameters have been carried out using the GEMR gyrofluid code (an energy conserving electromagnetic six field gyrofluid model with radially dependent geometry). The simulation results are compared with experimental data from the TJ-K Stellarator in order to improve the understanding of SOL transport.