P 2: Magnetic Confinement I

Zeit: Montag 10:30–12:25 Raum: HZO 30

Hauptvortrag P 2.1 Mo 10:30 HZO 30

Impact of magnetic perturbation fields on tokamak plasmas — •Sina Fietz[1], Ivo Classen[2], Marc Maraschek[1], Wolfgang Suttrop[1], Hartmut Zohm[1], and the ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Garching, Deutschland — [2]FOM-Institute DIFFER, Nieuwegein, The Netherlands

Non-axisymmetric external magnetic perturbation (MP) fields arise in every tokamak e.g. due to not perfectly positioned external coils. Additionally many tokamaks, like ASDEX Upgrade (AUG), are equipped with a set of external coils, which produce a 3D MP field in addition to the equilibrium field. This field is used to either compensate for the intrinsic MP field or to influence MHD instabilities such as Edge Localised Modes (ELMs) or Neoclassical Tearing Modes (NTMs).

But these MP fields can also give rise to a more global plasma response. The resonant components can penetrate the plasma and influence the stability of existing NTMs or even lead to their formation via magnetic reconnection. In addition they exert a local torque on the plasma. These effects are less pronounced at high plasma rotation where the resonant field components are screened. The non-resonant components do not influence NTMs directly but slow down the plasma rotation globally via the neoclassical toroidal viscous torque.

The island formation caused by the MP field as well as the interaction of pre-existing islands with the MP field at AUG is presented. It is shown that these effects can be modelled using a simple forced reconnection theory. Also the effect of resonant and non-resonant MPs on the plasma rotation at AUG is discussed.

Fachvortrag P 2.2 Mo 11:00 HZO 30

Progress on HELIAS Systems Studies — •Felix Warmer[1], Craig D. Beidler[1], Andreas Dinklage[1], Yuehe Feng[1], Joachim Geiger[1], Richard Kemp[2], Peter Knight[2], Felix Schauer[1], Yuriy Turkin[1], David Ward[2], Robert Wolf[1], and Pavlos Xanthopoulos[1] — [1]Max-Planck-Institut für Plasmaphysik, D-17491 Greifswald, Germany — [2]Culham Centre for Fusion Energy, Abingdon, Oxfordshire, OX14 3DB, United Kingdom

In order to study and design next-step fusion devices such as DEMO, comprehensive systems codes are commonly employed. For the HELIAS-line, stellarator-specific models have been developed, implemented, and verified within the systems code PROCESS. This systems code ansatz is complemented by self-consistent modeling of plasma scenarios employing a predictive 1-D neoclassical transport code which has been augmented with a model for the edge anomalous transport based on 3-D ITG turbulence simulations.

This approach is investigated to ultimately allow one to conduct stellarator system studies, develop design points of HELIAS burning plasma devices, and to facilitate a direct comparison between tokamak and stellarator DEMO and power plant designs. The work reports on the progress towards these goals.

P 2.3 Mo 11:25 HZO 30

Origin and turbulence spreading of plasma blobs — •Peter Manz[1,2], Tiago Ribeiro[2], Bruce Scott[2], Gregor Birkenmeier[1,2], Daniel Carralero[2], Golo Fuchert[3], Stefan Müller[2], Hans Werner Müller[2], Ulrich Stroth[2,1], Elisabeth Wolfrum[2], and the ASDEX Upgrade Team[2] — [1]Physik Department E28, Technische Universität München, Garching, Germany — [2]Max-Planck-Institut für Plasmaphysik, Garching, Germany — [3]IJL, Université de Lorraine, Vandoeuvre-lès-Nancy, France

The formation of plasma blobs is studied by analyzing their trajectories in a gyrofluid simulation in the vicinity of the separatrix. Most blobs arise at the maximum radial electric field outside the separatrix. In general, blob generation is not bound to one particular radial position or instability. The simulations show that the blob dynamics can be represented by turbulence spreading, which constitutes a substantial energy drive for far scrape-off layer turbulence and is a more suitable quantity to study blob generation compared to the skewness.

P 2.4 Mo 11:40 HZO 30

Zonalströmungen im Stellarator TJ-K — •Bernhard Schmid[1], Mirko Ramisch[1] und Ulrich Stroth[2,3] — [1]Institut für Grenzflächenverfahrenstechnik und Plasmatechnologie, Universität Stuttgart — [2]Max-Planck-Institut für Plasmaphysik, Garching — [3]Physik-Department E28, Technische Universität München

Der Einschluss in Fusionsplasmen wird maßgeblich durch radialen turbulenten Transport von Dichte und Energie limitiert. Zonalströmungen tragen auf Grund ihrer Symmetrie nicht zum Transport bei. Außerdem können sie den radialen Transport durch Verscherung von Driftwellen verringern. Die Zonalströmungen werden dabei als sekundäre Instabilität von der umgebenden Turbulenz selbst generiert. Wirbelstrukturen werden verkippt und treiben die Scherströmung an, was zu einer Selbstverstärkung der Zonalströmung führt. Ein Maß für die Verkippung ist der sogenannte Reynolds-Stress. Für den Antrieb der Zonalströmung muss der radiale Gradient des flussflächengemittelten Reynolds-Stress ungleich Null sein. Zur Untersuchung dieses Antriebsmechanismus wurden Messungen mit einem poloidalen Sondenkranz, bestehend aus 128 Langmuir-Sonden, im Stellarator TJ-K durchgeführt. Anhand benachbarter Sonden lassen sich die E×B-Geschwindigkeitskomponenten in radiale und poloidale Richtung messen. Somit ist es möglich den für den Antrieb wichtigen Reynolds-Stress auf zwei Flussflächen und gleichzeitig das poloidale Modenspektrum zu bestimmen. Mit konditionellem Mitteln wird der Reynolds-Stress-Antrieb gezeigt und seine Skalierung untersucht.

P 2.5 Mo 11:55 HZO 30

Perturbations of a microwave beam by plasma density fluctuations — Alf Köhn[1], Eberhard Holzhauer[1], Mirko Ramisch[1], Matthew Thomas[2], Roddy Vann[2], and •Jarrod Leddy[2] — [1]Institut für Grenzflächenverfahrenstechnik und Plasmatechnologie, Universität Stuttgart — [2]York Plasma Institute, Department of Physics, York, U.K.

Microwave heating is a widespread tool in both high- and low-temperature plasmas. While high-temperature fusion plasmas are usually below cut-off density, allowing the microwave to propagate to the centre, this is different in low-temperature plasmas: the electromagnetic wave needs to couple to electrostatic waves at the plasma boundary if central heating is considered. The microwave beam is in either case interacting with the plasma boundary, by traversing it or by triggering mode conversion processes there. Due to the strong gradients of the density at the plasma boundary, the turbulence is largest there. In this work, we investigate the perturbation of a microwave beam by these density fluctuations. The fluctuations are created by a Hasegawa-Wakatani drift-wave turbulence model within the BOUT++ framework. The microwave simulations are performed with the full-wave code IPF-FDMC.

P 2.6 Mo 12:10 HZO 30

Experimental investigation of a rapidly moving arch-shaped plasma — •Sascha Ridder, Felix Mackel, Jan Tenfelde, and Henning Soltwisch — Ruhr-Universität Bochum

In the FlareLab experiment, rapidly evolving magnetic flux tubes are generated by igniting a pulsed-power discharge along an external circular magnetic field, producing an initially arch-shaped plasma, which expands into the vessel on a microsecond time scale. The plasma has its footpoints on the electrode surfaces where instability phenomena appear in the course of the discharge evolution. Eventually, the plasma arch loses its visible connection to the electrode surface, while the discharge current continues to rise. Interferometric and Rogowski coil measurements in different locations along the plasma arch revealed a different arch morphology than initially suspected based on CCD camera images. Interferometric data obtained in the footpoint region of the arch show high density gradients either in radial or in axial direction and link the dark regions above the electrodes to electron density depletion after the arch has lost its connection to the footpoints. Those measurements are accompanied by CCD camera images which in comparison with numerical simulations indicate a kink instability in the footpoint region of the plasma arch.