P 7: Magnetic Confinement I

Time: Tuesday 11:00–12:55 Location: b305

Invited Talk P 7.1 Tue 11:00 b305

Erste Ergebnisse an Wendelstein 7-X — •Hans-Stephan Bosch und W7-X Team — Max-Planck-Institut für Plasmaphysik, Wendelsteinstr. 1, 17489 Greifswald

Seit April 2014 wurde der numerisch vollständig optimierte, supraleitende Stellarator Wendelstein 7-X im IPP Greifswald schrittweise für den Plasmebetrieb vorbereitet. Höhepunkte dieser Betriebsvorbereitung waren das Abkühlen des 235 t schweren Magnetsystems, die Erzeugung des Magnetfelds und die Bestätigung der Existenz der magnetischen Flußflächen.

Seit Dezember 2015 hat der Experimentbetrieb,zunächst mit Heliumplasmen, begonnen. Die Heizung der Plasmen erfolgt mit 140 GHz Mikrowellen (Elektronenzyklotronresinanzheizung) bei der 2. Harmonischen. Von Anfang an wurden an W7-X wichtige Diagnostiken betrieben, teilweise auch von anderen Deutschen und internationalen Institutionen.

Dieser Vortrag schildert die Betriebsvorbereitung und die ersten physikalen Ergebnisse aus der ersten Betriebsphase.

Fachvortrag P 7.2 Tue 11:30 b305

Magnetic Flux Surface Measurements at the Wendelstein 7-X Stellarator — •Matthias Otte[1], Tamara Andreeva[1], Christoph Biedermann[1], Sergey Bozhenkov[1], Joachim Geiger[1], Samuel Lazerson[2], and Thomas Sunn Pedersen[1] — [1]Max-Planck-Institut für Plasmaphysik, Greifswald, BRD — [2]Princeton Plasma Physics Laboratory, Princeton, USA

Recently the first plasma operation phase of the Wendelstein 7-X stellarator has been started at IPP Greifswald. Wendelstein 7-X is an optimized stellarator with a complex superconducting magnet system consisting of 50 non-planar and 20 planar field coils and further 10 normal conducting control and 5 trim coils. The magnetic confinement and hence the expected plasma performance are decisively determined by the properties of the magnet system, especially by the existence and quality of the magnetic flux surfaces. Even small error fields may result in significant changes of the flux surface topology. Therefore, measurements of the vacuum magnetic flux surfaces have been performed before plasma operation. The first experimental results confirm the existence and quality of the flux surfaces to the full extend from low field up to the nominal field strength of B=2.5T. This includes the dedicated magnetic limiter configuration that is exclusively used for the first plasma operation. Furthermore, the measurements are indicating that the intrinsic error fields are within the tolerable range and can be controlled utilizing the trim coils as expected.

P 7.3 Tue 11:55 b305

Poloidal asymmetric flow and current perturbations during I-phase in ASDEX Upgrade — •P. Manz[1,2], G. Birkenmeier[1,2], G. Fuchert[2], M. Cavedon[2], G.D. Conway[2], F. Mink[2], B.D Scott[2], U. Stroth[2,1], and the ASDEX Upgrade Team[2] — [1]Physik-Department E28, Technische Universität München, 85748 Garching, Germany — [2]Max-Planck-Institut für Plasmaphysik, 85748 Garching, Germany

At the transition from low confinement to high confinement regimes in magnetically confined plasmas regular pulsations occur, this regime is called the I-phase. During the I-phase in ASDEX Upgrade up-down asymmetric parallel current fluctuations are observed. A detailed investigation of the interplay of perturbations in different fields with different poloidal asymmetry reveals that the observed current fluctuations are not responses to the equilibrium, but can be interpreted as a response to strongly ballooned plasma transport. Furthermore they are also intrinsically coupled with the Stringer spin-up. A good agreement of the experimental measured limit-cycle frequencies during I-phase with the Stringer spin-up relaxation frequency is found.

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The structure and dynamics of blob filaments in the stellarator TJ-K — •Stephen Garland[1], Golo Fuchert[2], and Mirko Ramisch[1] — [1]Institut für Grenzflächenverfahrenstechnik und Plasmatechnologie, Universität Stuttgart — [2]Max-Planck-Institut für Plasmaphysik, Greifswald

Filamental structures with higher pressure than the background plasma are commonly observed in the scrape-off layer (SOL) of toroidal magnetic confinement devices. These structures, often referred to as blobs, propagate radially outwards and poloidally, contributing significantly to SOL transport. It is therefore important to study the properties of blobs in order to be able to predict heat loads on the plasma facing components of future reactors, as well as to better understand particle transport and plasma confinement.

Detailed experiments have been carried out into blob dynamics and structure using Langmuir probes at the stellarator TJ-K. By means of the conditional averaging technique, blob dynamics in a poloidal cross section have been studied, and the influence of geodesic curvature on poloidal blob drive will be shown. In addition, the result of simultaneous measurements at two toroidally separated locations will be presented, providing information on the 3D structure of blob filaments and their alignment to the magnetic field as they propagate through the SOL.

P 7.5 Tue 12:25 b305

Influence of the plasma pedestal parameters on ELM mitigation at low collisionality — •Nils Leuthold[1,2] and Wolfgang Suttrop[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching, Germany — [2]Universität Bayreuth, Universitätsstraße 30, 95440 Bayreuth, Germany

The control of Edge Localized Modes (ELMs) is of great importance for future fusion devices in order to provide longevity of the plasma facing components and a better overall plasma performance.

In recent magnetic perturbation ELM mitigation experiments in ASDEX Upgrade at low pedestal collisionality, the dependence of ELM losses on pedestal parameters is investigated. It is found that the reduction of the stored energy loss associated with ELMs occurs in correlation with a reduction of edge density and edge pedestal pressure induced by the applied magnetic perturbation ("pedestal pump-out"). Significant ELM mitigation occurs at lowest densities, in a region of pedestal n-T parameter space that has not been accessible in ASDEX Upgrade without magnetic perturbations, and which is occupied by type-IV ELMs in DIII-D. The role of magnetic perturbations for ELM mitigation will be discussed in this context and attempts to counteract the confinement loss by increasing neutral beam injection power or pellet injection increases the ELM energy losses.

P 7.6 Tue 12:40 b305

First on-line positron experiments en route to pair-plasma creation — •Juliane Stanja[1], Uwe Hergenhahn[1], Holger Niemann[1,2], Thomas Sunn Pedersen[1,2], Haruhiko Saitoh[1,3], Eve V. Stenson[1], Matthew R. Stoneking[4], Christoph Hugenschmidt[5], Christian Piochacz[5], and Lutz Schweikhard[2] — [1]Max-Planck-Institut für Plasmaphysik — [2]Ernst-Moritz-Arndt Universität Greifswald — [3]The University of Tokyo — [4]Lawrence University — [5]Technische Universität München

Electron-positron plasmas are predicted to show a fundamentally different behavior from traditional ion-electron plasmas, because of the equal masses of the two species. Using up to 10^9 positrons per second provided by the NEPOMUC (Neutron-Induced Positron Source Munich) facility, the APEX/PAX team aims to create the first such plasma confined in a toroidal magnetic trap. Positron beam parameters as well as efficient injection and confinement schemes for both species in toroidal geometries are fundamental to the project.

In this contribution we present results from first on-line positron experiments. Besides characterizing the NEPOMUC beam we conducted positron injection experiments into a dipole magnetic field configuration. Using static electric fields, a 5-eV positron beam was transported across magnetic field lines into the confinement region. With this method, up to 38% of the incoming particles reach the confinement region and make at least a 180° revolution around the magnet. Under dedicated experimental conditions confinement on the order of 1 ms was realized.