P 26: Poster Session-Plasma Diagnostics

Time: Thursday 16:30–19:00 Location: Empore Lichthof

P 26.1 Thu 16:30 Empore Lichthof

Improved Stereoscopy in Dusty Plasmas using Light-Field Cameras — Michael Himpel and •André Melzer — Universität Greifswald

Dusty plasmas are especially interesting for experimentalists due to the fact that the kinetic motion of the dust species is directly visible.

Thus, three-dimensional observation of the single-particle motion is desirable in most cases. Stereoscopy has already proven to be suitable for single-particle diagnostics in dusty plasmas.

In this presentation, the use of imaging by multiple light-field cameras will be discussed. The advantages and disadvantages will be shown together with preliminary results using light-field capturing.

P 26.2 Thu 16:30 Empore Lichthof

Enhanced setup facilitating emittance measurement for diagnosing ion thrusters — •Kristof Holste, Stefan Schippers, Alfred Müller, and Peter Klar — Justus-Liebig-Universität Gießen

Here we present an improved experimental setup for measuring the transverse emittance of low energy ion beams emerged, for instance, from gridded ion thrusters. Typically, the ion energy is in the order of 1 keV, the ion beams' divergence is in the order of 5-20°. The primary ion beam is decomposed into beamlets by an array of thin slits (0.2 mm slit width, 0.5 mm web thickness, 0.2 mm plate thickness). The spatial intensity distribution of the beamlets behind the slit array is measured with a wire scanner. The deviation of the beamlets' position relative to the corresponding slits corresponds to the transverse momentum distribution of the ions. Thus, the transverse phase-space area (emittance) occupied by the ions can be derived. The emittance is an important parameter for diagnosing the quality of the ion optics of an ion thruster and allows optimization of the extraction grids. Results from emittance measurements and comarisons with ions beam simulations will be presented.

P 26.3 Thu 16:30 Empore Lichthof

A New Algorithm to Determine the Total Radiated Power at ASDEX Upgrade — •Stephan Glöggler, Matthias Bernert, Thomas Eich, and The ASDEX Upgrade Team — Max Planck Institute for Plasma Physics, Boltzmannstr. 2, 85748 Garching, Germany

Radiation is an essential part of the power balance in a fusion plasma. In future fusion devices about 90% of the power will have to be dissipated, mainly by radiation. For the development of an appropriate operational scenario, information about the absolute level of plasma radiation ($P_{rad,tot}$) is crucial. Bolometers are used to measure the radiated power, however, an algorithm is required to derive the absolute power out of many line-integrated measurements.

The currently used algorithm (BPD) was developed for the main chamber radiation. It underestimates the divertor radiation as its basic assumptions are not satisfied in this region. Therefore, a new $P_{rad,tot}$ algorithm is presented. It applies an Abel inversion on the main chamber and uses empirically based assumptions for poloidal asymmetries and the divertor radiation. To benchmark the new algorithm, synthetic emissivity profiles are used. On average, the new Abel inversion based algorithm deviates by only 10% from the nominal synthetic value while BPD is about 25% too low. With both codes time traces of ASDEX Upgrade discharges are calculated. The analysis of these time traces shows that the underestimation of the divertor radiation can have significant consequences on the accuracy of BPD while the new algorithm is shown to be stable.

P 26.4 Thu 16:30 Empore Lichthof

Investigation of the influence of plasma temperature on Doppler reflectometry — •Vandana Revathi Venkateswaran, Carsten Lechte, and Thomas Hirth — IGVP, University of Stuttgart

Doppler reflectometry is a microwave scattering diagnostic technique which employs the scattering of waves near plasma cutoffs to get information on the electron density fluctuations and also poloidal flows in toroidal fusion experiments. The scattering process has to be investigated using simulation codes in order to interpret the diagnostic results. In this case, the influence of temperature on reflectometry is studied and discussed. IPFs Finite-Difference Time Domain method based code called IPF-FD3D is used to study the fluctuations. For the warm plasmas as opposed to cold plasmas,where the plasmas have values of electron temperature similar to those of existing tokamaks relativistic effects might also be important. A mass correction makes the cold-plasma approximation in agreement with that of the fully relativistic theory (for a range of values that is the only one of interest for X-mode reflectometry in tokamaks). This makes us modify the codes related to the cold plasma theory of wave propagations applicable to cases of plasmas with characteristics similar to those of existing tokamaks [1]. The method is incorporated to study its influence on cutoffs and scattering efficiency. Initial results will be presented.

[1] E. Mazzucato, Phys. Fluids B 4, 3460 (1992).

P 26.5 Thu 16:30 Empore Lichthof

Development and Verification of an Collisional Radiative Model for Argon — •Julian Kaupe and Slobodan Mitic — 1. Physikalisches Institut, Justus-Liebig-Universität Gießen

In order to establish a set of tools for diagnostics of cold plasmas in the newly formed working groups for plasma physics at JLU Gießen a Collisional Radiative Model for Optical Emission Spectroscopy (OES) of Argon plasmas was developed and tested. This model is the first result of the development of a generalized plasma diagnostics software toolbox whose projected use will also include OES diagnostics of other rare gases and molecular gases in laboratory process plasmas, ion thrusters and complex plasma experiments at JLU Gießen.

P 26.6 Thu 16:30 Empore Lichthof

Evidence of Secondary Electron Emission during PIII Pulses by Calorimetric Probe Measurements — •Fabian Haase[1], Darina Manova[2], Stephan Mändl[2], and Holger Kersten[1] — [1]Institute of Experimental and Applied Physics, Christian-Albrechts-University Kiel, Germany — [2]Leibniz Institute of Surface Modification, Leipzig, Germany

Plasma based coating processes are a widespread field in industrial surface modification. One of these methods is plasma immersion ion implantation (PIII), a pulsed technique to alter the substrate by implanting ions into the surface, which is commonly used in industry [1]. However, many accompanying processes during PIII have not yet been fully investigated but are crucial to the outcome of the coating procedure in terms of quality and properties of the deposited films. Secondary electrons are a major, undesired component of energetic particles present in PIII. However, a direct measurement using a Faraday cup is both complex and error prone. In this work an alternative method of measuring the thermal flux associated with energetic secondary electrons is presented using a calorimetric probe [2]. Angular variations have been performed to support the assumption of a directed flux. Further investigations include studies of parameter variation, such as pulse length, pulse voltage and pulse frequency using different substrate materials (Al, Cu, stainless steel). Additionally, the spatial effect has been investigated by changing the distance to the probe.

[1] J.R. Conrad et al., J. Appl. Phys. 62 4591, 1987
[2] S. Bornholdt and H. Kersten, Eur. Phys. J. D. 67(8):167 (2013)

P 26.7 Thu 16:30 Empore Lichthof

Diamantoide als alternative Treibstoffe für Ionentriebwerke — •Patrick Dietz[1], Kristof Holste[1], Waldemar Gärtner[1], Peter Köhler[1], Christine Hofmann[2], Peter Klar[1] und Peter Schreiner[2] — [1]I. Physikalisches Institut, Justus-Liebig-Universität Gießen — [2]Institut für Organische Chemie, Justus-Liebig-Universität Gießen

Ionentriebwerke basieren auf der Ionisation und nachfolgenden elektrostatischen Beschleunigung eines Treibstoffs. Als Treibstoff ist prinzipiell jedes Material geeignet, jedoch ist es aus energetischer und technischer Sicht vorteilhaft, Stoffe zu verwenden, die leicht zu verdampfen und mit geringem Energieaufwand effizient zu ionisieren sind. Als Stützmasse für Ionen-Triebwerke wird zurzeit hauptsächlich das Edelgas Xenon verwendet.

Eine Alternative könnten Diamantoide darstellen. Diamantoide, z. B. Adamantan $C_{10}H_{16}$, sind auf Grund ihrer hohen Sublimationsdampfdrücke bereits bei geringen Temperaturen leicht in die Gasphase zu bringen und haben eine deutlich niedrigere Ionisierungsschwelle als

Xenon (9.25 eV anstatt 12.1 eV). Auf Grund der diamantartigen Struktur der Moleküle wird von einer geringen Fragmentation der Moleküle im Triebwerksplasma ausgegangen.

Gezeigt werden Untersuchungen über das Fragmentationsverhaltens von Adamantan im Plasma eines Radiofrequenz-Ionentriebwerks mittels Massenspektrometrie des extrahierten Ionenstrahls sowie erste Ergebnisse eines experimentellen Aufbaus zur Bestimmung des Elektronenstoß-Ionisations-Wirkungsquerschnitts von Diamantoiden.

P 26.8 Thu 16:30 Empore Lichthof

Charakterisierung des Aufbaus und der Emissionsdynamik eines Metallgitter-Mikroplasma-Arrays — •Sebastian Burhenn, Sebastian Dzikowski und Volker Schulz-von der Gathen — Lehrstuhl für Experimentalphysik II, Ruhr-Universität Bochum, Deutschland

Innerhalb der letzten Jahre wurde das Teilgebiet der Mikroplasmen intensiv untersucht. Mikroplasmen zeichnen sich durch ihre kleine räumliche Ausdehnung im Bereich von wenigen 100 μm bis zu einigen mm aus. Ein Vertreter sind die Metallgitter-Mikroplasma-Arrays. Sie sind Sandwich-artig aus einer geerdeten Gegenelektrode, einem Dielektrikum und einem Metallgitter aufgebaut und werden typischerweise in einer Edelgas-Atmosphäre betrieben. Beim Anlegen einer Wechselspannung an das Metallgitter zündet das Plasma in den Kavitäten des Gitters. Die Zündbedingungen des Plasmas werden maßgeblich durch die Wahl des Dielektrikums beeinflusst. Aufgrund der hohen Spannungen von bis zu 700 V_{pp}, die lediglich auf wenigen Mikrometern angelegt werden, kann es im schlimmsten Fall zur Zerstörung des Arrays kommen. Um dies zu vermeiden wurden verschiedene Dielektrika getestet und die Bauweise des Arrays modifiziert. Mit Hilfe von phasenaufgelöster Untersuchung der Emission des Arrays in Helium konnte dann gezeigt werden, dass sich Emissionswellen mit Geschwindigkeiten von einigen km/s über die Oberfläche der Plasmaquelle ausbreiten und sich ihre Ausbreitungsgeschwindigkeit mit dem Umgebungsdruck ändert. Gefördert durch die DFG in der Forschergruppe FOR1123 "Physics of Microplasmas"(SCHU 2353/2-2).

P 26.9 Thu 16:30 Empore Lichthof

In-situ real-time monitoring of spurious modes in high power millimeter wave transmission lines using multi-hole couplers in miter bends — •W. Alexander Zach[1], Walter Kasparek[1], Carsten Lechte[1], Burkhard Plaum[1], Jörg Stober[2], Francesco Monaco[2], Harald Schütz[2], Hiroshi Idei[3], and Thomas Hirth[1] — [1]Institut für Grenzflächenverfahrenstechnik und Plasmatechnologie IGVP, Univ. Stuttgart, Pfaffenwaldring 31, D-70569 Stuttgart, Germany — [2]Max-Planck-Institut für Plasmaphysik, EURATOM-IPP, D-85748 Garching, Germany — [3]Research Institute for Applied Mechanics, Kyushu Univ., Kasuga, 816-8560, Japan

For Electron Cyclotron Resonance Heating (ECRH) in fusion experiments, millimeter waves have to be transmitted over large distances from gyrotrons to the plasma. In the case of e.g. ASDEX Upgrade, millimeter waves with up to 1 MW of power at 140 GHz are transmitted via waveguides. Because of the high power, oversized corrugated circular waveguides are used. However, these are sensitive to alignment errors, which lead to the excitation of higher order spurious modes besides the favored hybrid mode HE_{11}. An alignment analysis would require a complete 2D field scan, which is not possible for high powers.

As an alternative, hole-array-couplers, placed in the cross section of the transmission line at a miter bend location, allow for an in-situ measurement of the power of modes, that are predominantly excited due to misalignment. Complex signals can either be processed independently or via a hard-wired interferometric setup. Simulations and experimental results are discussed.

P 26.10 Thu 16:30 Empore Lichthof

Preliminary study of ECE imaging concept for W7-X, using the Talbot effect in rectangular waguides — •Daniel Iglesias[1], Burkhard Plaum[1], Walter Kasparek[1], Matthias Hirsch[2], and Thomas Hirth[1] — [1]IGVP, Universität Stuttgart — [2]Max-Planck Institut für Plasmaphysik, Greifswald

For spatially resolved measurements of Electron Cyclotron Emission (ECE) in W7-X, an imaging antenna based on a corrugated rectangular waveguide can be used. The imaging characteristics of the antenna allow a simultaneous operation at multiple angles and frequencies. As a result it is possible to localize a set of points inside the plasma, where the ECE can be measured without the need of mobile components facing the plasma.

P 26.11 Thu 16:30 Empore Lichthof

Untersuchung eines selbst-pulsenden Atmosphärendruck-Plasmajets mit propagierender kontrahierter Entladung — •Julian Held, Daniel Schröder und Volker Schulz-von der Gathen — Lehrstuhl für Experimentalphysik II, Ruhr-Universität Bochum

Bei Atmosphärendruck betriebene Niedertemperaturplasmen sind ein viel beachtetes Forschungsgebiet auf Grund des möglichen Einsatzes in der Biomedizin. Bei diesen Plasmaquellen können jedoch Instabilitäten auftreten, die zu einem Übergang der kalten, homogenen Entladung zu einer kontrahierten Entladung führen können. Diese Entladung zeichnet sich durch eine sehr hohe Leistungsdichte aus und führt zu einem starken Anstieg der Gastemperatur, was sowohl den Jet als auch das zu behandelnde Material beschädigen kann. Um die Prozesse, die zum Wechsel in den kontrahierten Modus führen, zu untersuchen benutzen wir einen kapazitiv gekoppelten, mit 13.56 MHz angeregten Jet mit einer keilförmigen Elektrodenkonfiguration. Die kontrahierte Entladung zündet an der Stelle des geringsten Elektrodenabstands, wird durch den Gasfluss an die Spitze des Jets getrieben und erlischt dort. Dieser Vorgang wiederholt sich mit einer Frequenz im kHz-Bereich. Dieses selbstpulsende Verhalten erlaubt die Untersuchung der kontrahierten Entladung über einen langen Zeitraum ohne den Jet zu beschädigen. Der Jet wurde mit verschiedenen optischen und elektrischen Diagnostiken mit hoher Zeitauflösung untersucht, um die Entstehung der Entladung besser zu verstehen. Gefördert durch die DFG in der Forschergruppe FOR1123 "Physics of Microplasmas" (SCHU 2353/2-2).

P 26.12 Thu 16:30 Empore Lichthof

Messung zweidimensionaler Dichte- und Potentialprofile in magnetisierten Hochfrequenzplasmen — •Jonathan Schilling, Franko Greiner und Alexander Piel — Christian-Albrechts-Universität, Kiel, Germany

Durch die Verwendung von Piezo-Aktuatoren für die Positionierung einer Langmuirsonde ist es möglich, auch in starken Magnetfeldern mit Flussdichten von bis zu 4 T raumaufgelöste Sondenmessungen durchzuführen. Eine für diesen Zweck konstruierte Verfahreinheit wird vorgestellt. Diese zeichnet sich dadurch aus, dass sie zusammen mit der Plasmakammer Suleika in der warmen Bohrung von 300 mm Durchmesser des supraleitenden Magneten Suleiman Platz findet. Somit ist es möglich, die Langmuirsonde im Plasma in einer 50 mm x 50 mm - Ebene senkrecht zu der Elektrodenoberfläche zu positionieren. 2D-Profile des Floatingpotentials und des Ionensättigungsstroms für verschiedene Leistungen der Hochfrequenzanregung und Flussdichten von 0 bis 4 T werden vorgestellt. Aus diesen Primärmessdaten werden weitere Messgrößen abgeleitet, u.a. das elektrische Feld im Plasma und hieraus die Ionendriftgeschwindigkeit. Diese Größen sind Schlüsselgrößen, um den Einschluss von Staub und das Entstehen von Voids in magnetisierten staubigen Plasmen zu verstehen.

P 26.13 Thu 16:30 Empore Lichthof

Ein System zur optischen Manipulation von Mikropartikeln im Plasma — •Viktor Schneider und Holger Kersten — Institut für Experimentelle und Angewandte Physik der Christian-Albrechts-Universität zu Kiel

Das Gebiet der Plasmen ist sowohl in der Grundlagenforschung als auch bei der technologischen Anwendung stets auf innovative Diagnostiken angewiesen. Insbesondere elektrostatische und kalorimetrische Sonden sind ein wichtiges Werkzeug in der Plasmaforschung und in der industriellen Anwendung [1].
Aufgrund ihrer Größe (nm bis μm) werden auch Mikropartikel zur Untersuchung von dynamischen Prozessen, aber auch als einzelne Sonden zur Randschichtdiagnostik eingesetzt. Nachteilig ist allerdings, dass sie sich in einem Plasma nicht beliebig manipulieren lassen.
In diesem Beitrag wird ein optisches System vorgestellt, welches den Einfang und die nichtinvasive Manipulation von Partikeln zur Plasmadiagnostik nach dem Prinzip der Laserpinzette ermöglicht. Dadurch lassen sich Mikropartikel sowohl in die Randschicht als auch in den Plasmabulk bewegen und aus der Positionsänderung in der Laserfalle Rückschlüsse auf die extern wirkenden Kräfte schließen. Weiterhin wird untersucht, ob mithilfe eines Plattenkondensators sowohl eine neue Kalibriermethode als auch eine Bestimmung der (Rest-)Partikelladung möglich ist.
[1] S. Bornholdt, et al., Complex Plasmas: Scientific Challenges and Technological Opportunities., Springer International Publishing, 2014, 197-234

P 26.14 Thu 16:30 Empore Lichthof

Thermal probe and VI-Probe measurements on a combination of HiPIMS and plasma based ion implantation — Sven Gauter[1], •Maik Fröhlich[2], Wagdi Garkas[2], Holger Kersten[1], and Martin Polak[2] — [1]Institute of Experimental and Applied Physics, Christian-Albrechts-University Kiel, Germany — [2]Leibniz Institute for Plasma Science and Technology, Greifswald, Germany

The combination of HiPIMS and plasma based ion implantation (PBII) offers new possibilities for surface modification taking advantage of the high density of target ions and application of a synchronized high voltage bias pulse onto the substrate. A very important parameter in this combined experiment is the delay between HiPIMS pulse and PBII pulse, according to the evolution of the HiPIMS pulse.

In the present study we investigate the influence of the delay time, PBII pulse length and distance between substrate and magnetron on the substrate current as well as on the energy flux towards the substrate, measured by a highly time resolved VI-probe and by means of a calometric probe as described in [1]. The results exhibit a remarkable influence especially of the delay time and give information about the transport of the ions from target to substrate in form of a localized ion bunch, as described in [2].

[1] S.Bornholdt et al., Complex Plasmas, M.Bonitz et al. (Eds.), 197-234, 2014.

[2] W.Breilmann et al., Journal of Physics D: Applied Physics, 46(48):485204, 2013

P 26.15 Thu 16:30 Empore Lichthof

Analytical Investigation of Surface Wave and Microwave Resonances of Curling Probe — •Ali Arshadi and Ralf Peter Brinkmann — Lehrstuhl für Theoretische Elektrotechnik, Bochum, Deutschland

The term "active plasma resonance spectroscopy" (APRS) denotes a related class of plasma diagnostic methods utilizing the natural ability of plasma to resonate on or near the plasma frequency: An electrical RF signal is coupled into the plasma via a probe, the response is recorded and a mathematical model is used to determine plasma parameters.

Curling probe (CP), recently invented by Liang et al. is a novel realization of APRS concept to measure the electron density. CP can be miniaturized and be flatly embedded into the chamber wall which prevents metal contamination release and electrical disturbance. Physically, CP can be understood as a "curled" form of the hairpin probe. FDTD simulation shows two kinds of resonance: Surface plasmon resonance which induces at frequencies smaller than plasma frequency and microwave resonance which is strongly dependent on the length of CP.

Assuming that the spiralization has little electrical effect, this manuscript investigates the characteristcs of a "straightened" CP by modeling it as a rectangular slot-type resonator which is in direct contact with the plasma. The diffraction of an incident plane wave at the slot is calculated by solving the cold plasma model and Maxwell's equations simultaneously. The resonances of the probe are obtained and good agreement with the numerical results of probe inventors is demonstrated.

P 26.16 Thu 16:30 Empore Lichthof

Bestimmung der Ionenzusammensetzung in einem Niederdruck-Niedertemperatur H_2-Plasma — •Dominikus Zielke[1], Stefan Briefi[1] und Ursel Fantz[1,2] — [1]AG Experimentelle Plasmaphysik, Universität Augsburg, 86135 Augsburg — [2]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching

Ein wesentlicher Aspekt bei der Charakterisierung von Molekülplasmen ist die Kenntnis der quantitativen Ionenzusammensetzung. In H_2-Niederdruck-Niedertemperaturplasmen treten die positiven Ionenspezies H^+, H_2^+ und H_3^+ auf. An einem induktiv gekoppelten HF-Plasma (Frequenz 2 MHz, maximale HF-Leistung 2 kW) mit planarer Spule werden mittels eines energieauflösenden Ionenmassenspektrometers die absoluten Dichten der jeweiligen Ionenspezies in Abhängigkeit von Druck (1 bis 10 Pa) und HF-Leistung gemessen. Die aus der relativen Zusammensetzung der Ionenspezies bestimmte effektive Ionenmasse wird als Eingangsparameter für die Auswertung von Langmuirsondenkennlinien mit den gängigen Ionentheorien verwendet. Anschließend werden die aus den verschiedenen Ionentheorien berechneten effektiven Ionendichten mit den Ergebnissen der massenspektrometrischen Messungen und mit der mittels Langmuirsonde bestimmten Elektronendichte verglichen.

P 26.17 Thu 16:30 Empore Lichthof

Diurnal dependence of foF2 variations connected with earthquakes — Elena V. Liperovskaya[1], •Claudia-Veronika Meister[2], Dieter H.H. Hoffmann[2], and Alexandra S. Silina[1] — [1]Institute of Physics of the Earth, Bol'shaya Gruzinskaya 10, 123995 Moscow — [2]Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstr. 9, 64289 Darmstadt, and Graduate School of Excellence Energy Science and Engineering, Jovanka-Bontschits-Str. 2, 64287 Darmstadt

The diurnal variation of the characteristic frequency foF2 of the ionosphere is studied with regard to earthquakes. Used are observations of the vertical ionospheric sounding station "Tokyo" registered in the years 1957-1990. Analysed are the normalized parameter $\Delta foF2_{\mathrm{norm}} = (foF2 - \mathrm{medium}(foF2))/\mathrm{medium}(foF2)$ obtained for every hour of the day, and $\mathrm{abs}(\Delta foF2_{\mathrm{norm}})$. It is found, that about one-and-a-half months before earthquakes with magnitudes $M > 5.5$, at distances $R > R_D + 100$ km, $\mathrm{abs}(\Delta foF2_{\mathrm{norm}})$ increases in the evening, where $R_D = \exp(M)$ designates the dimension of the earthquake preparation region. The increase depends on M. Studying seismo-ionospheric effects two-three days before earthquakes, it is obtained that at night about two days before the seismic shocks $\Delta foF2_{\mathrm{norm}}$ increases with a reliability of 95 % in case of earthquakes with magnitudes $M > 5.5$ at distances $R > R_D + 100$ km. Further, a decrease of $\Delta foF2_{\mathrm{norm}}$ is observed on the day of the earthquake at daytime, for $M > 6.0$ and $R < 1000$ km.

P 26.18 Thu 16:30 Empore Lichthof

Anomalous behavior of ionospheric parameters on Kamchatka before and during seismic activities — Vadim V. Bogdanov[1], Alexander V. Kaisin[1], Aleksey V. Pavlov[1], Anastasia L. Polyukhova[1], and •Claudia-Veronika Meister[2] — [1]Institute of Cosmophysical Research and Radio Wave Propagation FEB RAS, 684034 Paratunka, Mirnaya 7, Russia, vbogd@ikir.ru — [2]Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstr. 9, 64289 Darmstadt and Graduate School of Excellence Energy Science and Engineering, Jovanka-Bontschits-Str. 2, 64287 Darmstadt, Germany, c.v.meister@skmail.ikp.physik.tu-darmstadt.de

In the present report, the variations of ionospheric parameters and ionospheric turbulence before and during seismic events are studied applying complex radiophysical methods and using a theoretical probability approach, suggested by the authors. The probability approach allowed to detect the growth of seismic activity in the Kamchatka region in 2013. It is found that characteristic ionospheric features as K-layer (corpuscular layer due to precipitation of particles from the radiation belts) formation, increase of the critical f_oF2-frequency and formation of F-spread as well as E_s-spread occur about one day before some seismic events on February-March (28.02.–02.03.) 2013

P 26.19 Thu 16:30 Empore Lichthof

Acceleration of Bayesian Model Based Data Analysis through Software/Hardware — Humberto Trimino Mora[1], Robert Wolf[1], •Dirk Timmermann[2], Andreas Werner[1], and Jakob Svensson[1] — [1]Max-Planck-Institut für Plasmaphysik, Greifswald, Germany — [2]Universität Rostock, Rostock, Germany

Today's leading fusion experiments set new requirements for control systems as well as data analysis to achieve the desired results. Often the performance of state of the art control systems is limited, thus better solutions for the data analysis and the control of complex systems are needed. Typically, control and data analysis use straightforward processing of signals to derive the parameter of interest. Significant improvement can be reached by incorporating knowledge of the system, or the lack of it, into data analysis. Bayesian analysis provides this by empowering the analysis with a rigorous estimation of the uncertainty while introducing previous knowledge with a prior. However, this analysis currently takes long processing times which makes real time analysis and control feedback infeasible. This project attempts to accelerate this analysis towards a real time solution and presents a first proposal solution designed with highly parallelized reconfigurable hardware. The W7-X Dispersion Interferometer diagnostic model was used to implement a single free parameter hardware analysis. The trade-off between arithmetic precision and parallelization area revealed limitations and showed alternate ways to deal with this analysis. The implementation results posed the question of how to deal with the arithmetic error in the forward modeling using this analysis.

P 26.20 Thu 16:30 Empore Lichthof

A phased array antenna for Doppler reflectometry in ASDEX Upgrade — •Stefan Wolf[1], Carsten Lechte[1], Walter Kasparek[1], Pascale Hennequin[2], Garrard Conway[3], Tim

Happel[3], and ASDEX Upgrade Team[3] — [1]IGVP, Universität Stuttgart, D-70569 Stuttgart, Germany — [2]Laboratoire de Physique des Plasmas, CNRS, Ecole Polytech., F-91128 Palaiseau, France — [3]Max-Planck-Institut für Plasmaphysik, D-85748 Garching, Germany

In a toroidal plasma, Doppler reflectometry (DR) allows investigating electron density fluctuations with finite $k_\perp$. The injected microwave beam's frequency determines the radial position of the probed region, its tilt angle selects the wavenumber satisfying the Bragg condition for backscattering. The rotation velocity can be calculated from the Doppler shift of the backscattered signal's frequency. By varying the injected frequency, radial profiles can be reconstructed. Varying the tilt angle resolves the $k_\perp$-spectrum of the fluctuations. For DR, a pair of phased array antennas (PAAs) has been designed, built, and installed in the ASDEX Upgrade tokamak. Beam steering is done by slightly changing the injected frequency, thus, the PAAs do not need any movable parts or electronics inside the vacuum vessel. From 75 to 105 GHz, the PAAs feature 13 frequency bands, each with an angular scan range of -20 to $+20°$. So, for each angle, there are 13 radial positions to be probed. The results from PAA characterisation, commissioning, and first DR measurements will be presented. This work was performed in the framework of the Helmholtz Virtual Institute on plasma dynamical processes and turbulence using advanced microwave diagnostics.

P 26.21 Thu 16:30 Empore Lichthof

Phase Contrast Imaging Diagnostic for the Wendelstein 7-X Stellarator — •Lukas-Georg Böttger and Olaf Grulke — Max Planck Institute for Plasma Physics, 17491 Greifswald, Germany

The phase contrast imaging (PCI) diagnostic allows for non-invasive measurements of density fluctuations in high temperature plasmas. Since the index of refraction in a plasma is a function of the electron density, an incoming laser beam experiences a phase shift, which can be converted to intensity variations via interference after passing a phase plate. Generally speaking, the signal contains only the line-integrated information along the beam path. This limitation can be circumvented by using the fact that the density fluctuations form filamentary structures that are well aligned with the local magnetic field. If the magnetic field direction significantly varies along the beam path, optical filtering allows for localization of the density fluctuations.

In order to identify the best diagnostic position regarding localization performance three figures of merit are introduced. They allow for quantitative comparison of different lines of sight and different magnetic field configurations. The results of the optimization process and a comparison with other fusion experiments are shown in this contribution.