5 Plasma Physics

Wednesday, 26.03.2008, Room 2193 (2nd floor)

Time	ID	PLASMA PHYSICS 1 *Chair: S. Alberti, CRPP-EPFL*

08:30 | 501 | Overview of the ITER ECRH-ECCD system

Mark Henderson, CRPP-EPFL

An electron cyclotron heating (ECH) system is being planned for the ITER device, which will be supplied by in-kind procurements from the EU, Japan, US, Russia and India. This system will be comprised of up to 24 continuous wave (CW) gyrotrons providing ≥1 MW at 170 GHz and an additional 3 gyrotrons with 10sec pulse lengths and 1 MW at ~127 GHz for plasma break down assist. The RF power is transmitted to the ITER tokamak via a set of evacuated HE_{11} corrugated waveguide lines that are approximately 100 m in length. The overall transmission efficiency of the entire system is expected to deliver 20MW out of the installed 24 MW to the plasma. The power is injected into the plasma via two types of launching antennas (or launchers) that provide relatively narrow deposition to nearly any location in the plasma cross section. One launcher is placed in the equatorial mid plane and is optimized for central heating and plasma current profile tailoring, while the second is in the upper ports and used for stabilizing plasma instabilities such as the neoclassical tearing mode and the sawtooth oscillation. The aim of this paper is to review the present EC system design and discuss proposed modifications that improve the system functionality, while reducing the overall costs and complexity.

This work, supported by the Swiss National Science Foundation and the European Communities, was carried out within the framework of the European Fusion Development Agreement. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

09:00 | 502 | SOLPS5 simulations of Type I ELMing H-mode discharges on JET

Barbora Gulejova [1], Richard Pitts [1],David Coster [2], Xavier Bonnin [3],
Marc Beurskens [4], Stefan Jachmich [5], Arne Kallenbach [2], Janos Márki [1]
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Type I ELMing H-mode is baseline scenario for plasma operation on ITER. Maximum value of stored energy loss per ELM to avoid excessive damage of divertor is 1MJ. Such values are achievable on JET in discharges with I_p = 3.0 MA, PIN = 20 MW and zero gas fuelling. Such a discharge was simulated using SOLPS5 plasma fluid-neutral code package. Upstream, code is constrained by measurements from HRTS, Lithium beam, ECE, LIDAR and CXRS and at the targets by LP and IR profiles. Radial profiles of transport coefficients are

		adjusted until best agreement is found with experimental profiles. Simulations were also performed in similar way as a benchmarking exercise to compare SOLPS5 with the JET edge code package, EDGE2D-Nimbus. This is based on an earlier successful JET H-mode modelling exercise using the latter code for similar discharge[1]. [1] A. Kallenbach et al., Plasma Phys. Control. Fusion 46 (2004), 431
09:15	**503**	**ELM induced divertor heat loads on TCV** *János Márki [1], Richard Pitts [1], Jan Horacek [2], Gianpaolo Turri [1], David Tskhakaya [3]* *[1] CRPP-EPFL, Station 13, 1015 Lausanne* *[2] Institute of Plasma Physics AS CR, v.v.i., Association EURATOM-IPPCR, Za Slovankou 3, 18200 Prague, Czech Republic* *[3] Institut für Theoretische Physik, Association EURATOM-ÖAW, Technikerstraße 25/2, AT-6020 Innsbruck* The study and quantification of heat loads during Edge Localised Modes (ELMs) is of great importance to the target lifetime on ITER. This paper presents such observations using a newly installed CMT fast infrared camera system viewing the outer divertor area on the TCV tokamak. Measurements of characteristic quantities such as rise time to peak power, peak power, total deposited energy per ELM, deposition profile width have been made in both ohmic (Type III) ELMing H-mode and in X3 ECRH discharges with large, probably Type I ELMs. Recent publications present strong evidence that ELMs are composed of a number of plasma filaments expelled upstream from multiple toroidal locations. Such filaments are also clearly seen at TCV for the case of the large ECRH ELMs. Although not an ELM phenomena, an observation of strike point splitting in extremely low density L-mode plasmas will also be presented.
09:30	**504**	**ELM Filament Characteristics on TCV** *Robert Tye [1], Jan Horacek [2], Richard Pitts [1]* *[1] EPFL SB CRPP-GE, Station 13, 1015 Lausanne* *[2] Institute of Plasma Physics of the ASCR, Za Slovankou 3, CZ-18200 Praha 8* Edge Localised Modes (ELMs) are MHD instabilities associated with the steep pressure profiles present at the edge of tokamak plasmas in high confinement mode (H-mode). On fast timescales (100's microsec) they expel bursts of particles and energy into the scrape-off layer (SOL) where they are transported to solid surfaces both along and across the magnetic field. Using data from a fast reciprocating Langmuir probe, this contribution will show that on TCV (as elsewhere) these bursts have a rich filamentary structure in the SOL and propagate radially at speeds of ~0.5 km/s, which corresponds well with the range of radial ELM velocities seen on other devices. Within error bars, the radial velocity is constant through the main SOL but slows significantly as the filaments pass into the wall shadow. The filaments are seen also on fixed probes located on the outer vacuum vessel wall.

09:45	**505**	**Intermittent transport events and blobs in a simple magnetized toroidal plasma** *Christian Theiler, EPFL-CRPP, Station 13, 1015 Lausanne* Intermittency in particle and heat transport across the magnetic field is reported from the plasma edge of virtually all laboratory devices. This transport is a crucial issue for magnetic fusion. It not only affects the confinement properties of the device, but also plays a significant role in the plasma-wall interaction. We present experimental results from the simple magnetized toroidal TORPEX plasma. Intermittent transport events are due to the radial elongation of an interchange wave. It is shown that this radial elongation occurs in response to a steepening of the density profile. Further away from the main plasma, localized filamentary structures (blobs) can be identified. We investigate the scaling of the cross-field blob velocity with blob size, connection length and neutral gas pressure. The results are compared with existing semi-analytical blob models.
10:00		***Coffee Break***
		Chair: R. Behn, CRPP-EPFL
10:30	**506**	**Soft X-ray emissivity profile inversion in quasi-axisymmetric equilibria** *Jonathan Rossel, CRPP - EPFL, PPB, Station 13, 1015 Lausanne* A complete method of tomographic inversion accounting for the presence of magnetic islands and based on the measurements of a single pin-hole soft X-ray camera is presented. The method divides the signals into a low frequency component used for the determination of the stationary emissivity, and a high frequency component used for the parametric determination of the magnetic island emissivity. The magnetic islands are simulated by a simple model based on the concentration of a current perturbation on a resonance surface. The inversion method results in a very accurate determination of the position of the resonance surface, as well as a precise estimation of the island width. Due to the high degree of automation of the method, only a minimal prior knowledge of the parameters of the magnetic islands is required. A possible application could be the assessment of models of the dynamics of the island growth.
10:45	**507**	**A new far-infrared polarimeter on the Tokamak à Configuration Variable.** *Alexandra Zhuchkova, Henri Weisen, EPFL/CRPP, Station 13, 1015 Lausanne* A new far-infrared polarimeter diagnostic is under installation on the TCV tokamak at CRPP. Its aim is to measure Faraday rotation angle of the beam polarisation along 10 different vertical lines. This angle is proportional to the product of plasma density and the vertical magnetic field, providing constraints for improving the reconstruction of the internal magnetic field distribution. The setup consists of two FIR lasers operating at a wavelength 432.5e-6 m, optically pumped by a 120 W continuous wave CO_2 laser. The diagnostic is based on a method proposed by Dodel and Kunz (Infrared Phys. 18, 773 1978). The FIR laser beams are detuned by 750kHz by adjusting the cavity lengths. They are relayed to the tokamak by separate dielectric waveguides and combined into a single

beam with a linear polarization rotating at the difference frequency. This probing beam is divided into five vertical beams across a poloidal section of the device. At the top of the tokamak each beam is equipped by 2 polarisation sensitive waveguide Schottky diode detectors. Measurements of Faraday rotation angles are obtained using a heterodyne detection scheme, with a reference signal from a line not passing through the plasma. The main aspects of the system and the use of the Faraday rotation measurements for the equilibrium reconstruction by the LIUQE equilibrium code will be presented.

11:00 **508**

Study of Suprathermal electron generation and dynamics in TCV

Silvano Gnesin, Stefano Coda, EPFL SB CRPP, Station 13, CH-1015 Lausanne

Electron cyclotron resonance heating (ECRH) and current drive (ECCD), disruptive instability events and sawtooth activity have been demonstrated to produce suprathermal electrons in fusion devices. The importance of these phenomena for fusion reactors renders suprathermal electron generation and dynamics a key topic in the physics of burning plasmas. The presentation briefly reviews some significant results from the TCV tokamak and focuses on diagnostic and simulation methods used in fast electron investigations. The development of a novel tomographic hard X-ray spectrometer proposed for TCV is also discussed.

11:15 **509**

Optimization of the TCV Thomson scattering system for high resolution measurements of transport barriers in Tokamak plasmas.

Andreas Pitzschke, Roland Behn, Yanis Andrebe
EPFL SB CRPP-GE, Station 13, 1015 Lausanne

The characterization of transport barriers in Tokamak plasmas requires high precision in the measurements of the spatial profiles of electron density and temperature. For this purpose the spatial resolution of the TCV Thomson scattering system has been increased and the parameter range extended to higher electron temperatures. The criteria of this optimization will be discussed and an adapted solution presented. During H-mode scenarios pressure profile measurements with high spatial resolution have permitted to quantify the bootstrap current contribution near the plasma edge. The importance of this non-inductive current component for the reconstruction of the plasma equilibrium will be evaluated.

11:30 **510**

Fast imaging of turbulent plasma in TORPEX

Davoud Iraji, Ivo Furno, Benoit Labit, Ambrogio Fasoli, Ahmed Diallo, Christian Theiler, Gennady Plyushchev, CRPP-EPFL, PPH, Station 13, 1015 Lausanne

A two dimensional and fast diagnostic system has been developed for studying the dynamic structure of plasma turbulence, so beside a hexagonal array of the Langmuir probes (HEXTIP), a fast camera has been acquired to study turbulent structures of the plasma in TORPEX with spatial resolution much higher than probe based diagnostics.
PHOTRON ULTIMA APX-RS consists of 1024·1024 CMOS diodes in dimension of 17μm·17μm. At maximum resolution, the frame rate can be increased up

		to 3,000 f/s. By choosing lower values of resolution, higher frame rates up to 250,000 f/s are available. The camera control and acquisition system has been fully integrated into the TORPEX cycle through a client-server technology which is based on the MDS+ database and TCL command language. For imaging of TORPEX plasmas, two different alignments of the camera looking tangentially and vertically with respect to the toroidal direction were tested. Using some objects inside the vessel of known dimension and comparing the Probability Density Function (PDF) of the camera with the HEXTIP data, calibration factor for each camera setting was found in the range of 0.25 - 0.40 (mm/pixel) as well as the resolution of the images which are limited by 9 pixel or equivalently 2.1mm. In the tangential view, almost 70 % of the plasma cross section is visible and radial and vertical movements of the plasma column as well as large scale structures in the case of high vertical magnetic field are observed. Also the frequency spectrum of visible light fluctuation shows the peak of the drift-interchange mode at 4 kHz as same as electron density fluctuation, which implies a proportionality of the light intensity to the electron density.
11:45		
12:00		***Postersession, Lunch***
12:45	***SPS General Assembly***	
		PLASMA PHYSICS 2 *Chair:* *B. Duval, CRPP-EPFL*
13:15	**511**	**Understanding turbulence in plasmas for fusion: the role of basic plasma physics experiments** *Benoit Labit, CRPP-EPFL* Magnetically confined plasmas are subject to gradient driven drift instabilities, causing anomalous transport. Progress towards a basic understanding of fluctuations and turbulent phenomena in magnetized plasmas is achieved in the TORPEX low density, low temperature device (R=1 m, a=0.2 m), allowing high resolution measurements of plasma parameters and wave fields throughout the plasma cross-section. The TORPEX discharges are produced with $n_e<10^{17}$ m^{-3} and T_e=5 eV by low field side injection of microwaves in the EC frequency range (P < 20 kW, f=2.45 GHz), and are confined by a toroidal magnetic field up to 0.1 T, and a smaller vertical component, < 50 mT. Such, configuration incorporates the main ingredients for drift wave instabilities, pressure gradients and field line curvature. A large probe set, covering the whole plasma cross-section, is used to characterize background plasma and fluctuations. A comparison between the global particle balance and the local measurements of the fluctuation induced particle flux is undertaken in different regimes, along with a characterization of the dynamical plasma response to microwave power modulation, and with a complete identification of the nature of the electrostatic instabilities, their dispersion relation and their driving mechanisms. Measurements of the fluctuation time series across the plasma cross-section in a variety of plasma conditions reveal universal aspects such as a precise quadratic relation between the fluctuation skewness and kurtosis, and a specific functional form for the probability density function, corresponding to the beta distribution. A full spatio-temporal imaging of the electrostatic fluctuations is undertaken, either directly

		using a multiple probe array or via conditional average sampling of high spatial resolution data obtained from movable probes. The resulting images are used to construct observables and characterize statistically the measured structures, for example in terms of size and velocity distributions, and the macroscopic transport events that they generate. A regime is identified, in which a core plasma is produced and confined on the device high field side, separated from an SOL-like region on the low-field-side. Structures or blobs are observed in this regime to carry plasma from the core to the SOL region. The mechanism behind the generation and ejection of plasma blobs from the core is investigated by reconstructing simultaneously two-dimensional structures of plasma density, temperature and potential. The data indicates that the blobs originate from the breaking up of radially extended structures associated with the drift-interchange instability due to the action of the ExB shear flow, in the presence of a critical radial density gradient.
13:45	**512**	**Parametric Trade-Offs in Laser Plasma Sources for Extreme Ultraviolet Lithography** *Davide Bleiner, Bob Rollinger, Martin Haag, Reza S. Abhari* *Institute for Energy Technology, ETH Zürich, Sonneggstrasse 3, 8092 Zürich* The remarkable development in semiconductor performance ("Moore's law") was grounded on advances in manufacturing technology. The radiation source is critical for the throughput, resolution, and cost of ownership. Extreme UV sources are the anticipated enabling technology for high volume manufacturing of nano-scale processors performing at > 20 GHz, integrating billions of transistors per IC. The use of laser plasma EUV radiation combines scalable output power (>50W), <50 nm resolution, and accessible cost of ownership. The main challenge for the delivery of the laser plasma-based EUV lithography tool is, besides the conversion efficiency (CE), the source cleanliness, since plasma-related debris is potentially harmful for the collection optics. To-date, the laser plasma sources developed obeyed a number of parametric trade-offs, such as CE vs. debris load, CE vs. duty cycle, plug-energy vs. pulse-energy CE, debris load vs bandwidth emission. A solution to overcome these limitations is discussed as enabling strategy.
14:00	**513**	**Microring Resonators in F-Implanted Lithium Niobate** *Aleksej Majkic, Manuel Koechlin, Gorazd Poberaj, Peter Günter* *Nonlinear Optics Lab., Inst. of Quantum Electronics, ETH Zürich, 8093 Zürich* Optical microring resonators have recently attracted a growing research interest as they can be used in a variety of integrated-optics applications, such as wavelength add-drop filters, on-chip sensors and laser cavity resonators. We present a new, combined fabrication technique that yields low-loss single-mode channel waveguides and microring resonators in lithium niobate ($LiNbO_3$). Planar waveguides are produced by implantation of fluorine ions with high energy into the material. The corresponding electronic excitation induces a lower-index optical barrier in a controlled depth, whose thickness is tuned by the implantation fluence. The surface layer remains largely unaffected and constitutes the core of the waveguide. Subsequently, a two-step photolithographic patterning and ion sputtering are used for the surface structuring. The resulting microring

		resonators have low radiation losses due to efficient lateral optical confinement. The performance characteristics of the first microrings in $LiNbO_3$ produced by this method will be presented and discussed.
14:15	**514**	**Properties and sensitivity of electrode-arc interface models for vacuum-breakers** *Oliver Fritz, Thierry Delachaux, Kai Hencken, ABB Switzerland Ltd., Corporate Research, Segelhofstrasse 1K, Postfach, 5405 Baden-Dättwil* The authors present structural properties and numerical results of their coupled model for the arc-electrode interfaces in high-current vacuum-breaker configurations. The model is based on detailed balances of electromagnetic quantities, and particle and energy flows; it assumes the existence of one extended area on both electrodes each, from which the necessary electrical current, electrons and atoms for sustaining the plasma arc are injected. Ranges of validity, sensitivity to material property parameters, and representative numerical results of the model are discussed and compared with experimentally observed phenomena. The authors highlight the particular usefulness of the models for predicting the spatial and temporal heat distribution and estimates on material losses in the electrode systems.
14:30	**515** (&) cancelled	~~**Temperature resistant diffusion barrier coatings on polypropylene**~~ ~~*Lutz Körner, Axel Sonnenfeld, Philipp Rudolf von Rohr*~~ ~~*Institute of Process Engineering, ETH Zürich, Sonneggstrasse 3, 8092 Zürich*~~
14:45	**516**	**Chemical features in amorphous TiO_x films obtained by PECVD and their absorption in the UV range** *Axel Sonnenfeld [1], Roland Hauert [2], Ulrich Müller [2], Philipp Rudolf von Rohr [1]* *[1] Institute of Process Engineering, ETH Zürich, Sonneggstrasse 3, 8092 Zürich* *[2] EMPA, Materials Science and Technology, Überlandstrasse 129, 8600 Dübendorf* Crystalline titanium dioxide (TiO_2) films exert effective UV absorption. This is of special interest for the protection of polymers, which suffer photodegradation. As we've shown earlier, also amorphous thin films obtained by plasma enhanced chemical vapour deposition at low temperature and mainly consisting of TiO_2

		(95 % atomic concentration) absorb effectively light below a wavelength of 310 nm. In opposition to crystalline TiO_2, however, the spectral transmission of the amorphous films shows a simple "step-like" behaviour. Furthermore, we've found that the transition region of the spectral transmission (from effective uv absorption to transmission of visible light), i.e. the cut-off wavelength of the films varies in dependence on the amount of inertial gases admixed to the discharge gas mixture. Beside the influence of the film thickness, here, the role of chemical features analyzed by FTIR as well as by XPS is investigated, while comparing three different types of discharge gas mixtures.
15:00	**517**	**Thermal Characterization of a Plasma Down Stream Reactor for Particle Surface Modification** *Christian Roth, Adrian Spillmann, Axel Sonnenfeld, Philipp Rudolf von Rohr, Institute of Process Engineering, ETH Zürich, Sonneggstrasse 3, 8092 Zürich* The flowability and wettability of particles in micron-size range is improved by plasma-induced surface modifications. For this, the powders are treated in a rf-plasma down stream reactor which provides a fast and homogeneous treatment of the particle surface. To improve the flow behavior of dry cohesive powders, the surface topography of the substrate particles is modified by plasma enhanced chemical vapor deposition. On the other hand, the wettability of polymer powders can be increased by a plasma-assisted surface activation. Although the application of low temperature plasmas provides the opportunity to treat temperature sensitive materials the reactor wall temperatures have been determined to be the most critical process parameter. Therefore, the temperature profiles in the gas phase and on the walls of the plasma down stream reactor were determined by a fiber optical temperature measurement system. The effect of rf-power, gas composition and process pressure on the temperature evolutions was investigated.
15:15		
15:30		***Coffee Break***
		Chair: H. Weisen, CRPP-EPFL
16:00	**518**	**Micro-plasmas in industry** *Christoph Hollenstein, CRPP-EPFL* Micro-plasmas are plasma existing in very small electrode gaps, typical in the (sub) micron range. Micro-plasmas are mostly metallic plasmas with very high electron density and low electron temperature. These micro-plasmas are strongly coupled (the Coulomb energy dominates the thermal energy) and their properties deviate considerably from the usual plasmas found in fusion and industry. Micro-plasma formation during opening of electrical contacts and electrical discharge machining (EDM) are typical examples of this interesting class of plasmas. Plasma diagnostics for these plasmas is challenging due to the small plasma size (micrometer or even smaller), the different physics and the short duration of the discharges, typically bellow the microsecond range. First results from detailed investigations of EDM discharges using emission spectroscopy are presented and discussed. Furthermore, the behaviour of nanosecond discharges

appearing during low current contact opening is discussed. These two examples of micro-plasmas give an impression of the importance of strongly coupled plasmas in daily life.

16:30 | **519**

Electron Bernstein Wave Core Deposition via O-X-B double mode conversion in the TCV tokamak

Loïc Curchod [1], Antoine Pochelon [1], Stefano Coda [1], Joan Decker [2], Timothy Goodman [1], Heinrich Laqua [3], Laurie Porte [1], Victor Udintsev [1]
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In the first results of electron Bernstein wave heating (EBWH) via O-X-B double mode conversion in a medium aspect ratio tokamak performed in TCV, the total power absorption efficiency was typically 60% and the deposition was made off-axis to avoid the central sawteeth perturbation that would prevent a clear detection of the deposition location [1-2]. Central power deposition is however needed to maximize the global EBWH effects. Therefore, initial experiments have been started to optimize central deposition using an equatorial rather than poloidally oblique launch. A toroidal field scan provided promising central deposition results within a small database, in preparation for dedicated central high power deposition [3]. The deposition location in presence of strong sawteeth could be determined from the slope break of soft X-ray traces at the EC power switch-ON times, in conditions where usual methods failed. Further analysis of these discharges will be presented. In particular, the difference between the experimental results and the non-relativistic calculations of deposition locations appears more significant than in the earlier off-axis deposition experiments, which provides a good opportunity for the simulation of relativistic ray propagation effects.

[1] A. Mück, L. Curchod et al., Phys. Rev. Lett. 98, 175004 (2007).
[2] A. Pochelon et al., Nucl. Fusion 47, 1552 (2007).
[3] L. Curchod et al., in Proceedings of the 34th EPS Conference on Controlled Fusion and Plasma Physics, Warsaw, 2007, ECA Vol. 31F, P-5.52

16:45 | **520**

Safety factor profile influence on tearing mode stability in TCV

Federico Felici, Tim Goodman, Costanza Zucca, Olivier Sauter
CRPP-EPFL, Station 13, 1015 Lausanne

Neoclassical Tearing Modes (NTMs) are expected to significantly degrade energy confinement, and therefore fusion efficiency, of next-step Tokamak devices such as ITER. The study of the creation and suppression mechanisms for these modes is therefore essential. Tearing Modes and their Neoclassical variants are generally described in terms of the so-called Modified Rutherford Equation (MRE), which contains stabilizing and destabilizing terms due to several effects in the plasma. These terms depend on diverse plasma features such as the local safety factor (q) profile and its derivatives, local current drive, bootstrap current effects, resistive wall effects and others. The systematic study of these effects and their relative importance requires flexibility in exploring the relevant parameter space. TCV, with its ability to apply Electron Cyclotron Resonance Heating (ECRH) and Current Drive (ECCD) locally at different points in the plasma offers the opportunity to study these effects. In past shots, the appearance and disappearance of the modes have been observed under varying heating and current drive situations. Using knowledge of the q-profile obtained from ASTRA/CQL3D calculations, the corresponding driving terms in the MRE can be calculated in the cylindrical tokamak limit and their effect on the tearing mode stability can be compared to experimental data. This analysis is performed in view of more detailed parameter scans of the effect of localized co-counter current drive on mode stabilization and destabilization which will be carried out during the coming TCV experimental campaign.

17:00 **521**

Electrical model of the Alfvén eigenmode exciter on JET

Theodoros Panis [1], Duccio Testa [1], Ambrogio Fasoli [1], Alex Klein [2]
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The TAE antenna system on JET is used to drive intermediate and high n Alfvén Eigenmodes (AEs) into the plasma so as to study their properties and estimate their stability by measuring their damping rates as a function of the various plasma parameters. In order to bring the system to full and optimized operation in terms of driving higher current into the antennas and hence higher magnetic perturbations into the plasma, the design of a matching unit was considered. The latter required a complete and accurate electrical circuit representation of the system. The construction of such an electrical model of the system involved the development of equivalent transformer circuits in the frequency range of interest and the use of impedance measurements as a benchmark in order to test its validity. The potential of the possible matching solutions was assessed and the effects of the inductive coupling between the antennas were investigated.

17:15 **522**

Gyrokinetic simulations of shaping effects on turbulent heat and particle transport

Xavier Lapillonne [1], Tilman Dannert [1], Olivier Sauter [1], Alessandro Marinoni [1], Yann Camenen [2], Antoine Pochelon [1], Laurent Villard [1], Jonathan Graves [1], Stephan Brunner [1]
[1] EPFL CRPP, Station 13, 1015 Lausanne
[2] Warwick University CFSA, Physics Department, CV47AL, Warwick, UK

Using an interface with the equilibrium code CHEASE, numerical simulations are performed in realisitic Tokamak geometry with the gyrokinetic flux tube code GENE. The effects of geometry on turbulent transport are investigated through a systematic scan over two key parameters, the elongation and the triangularity of the last closed flux surface. When changing these two parameters, other local values, such as the effective aspect ratio or the spacial gradients, are modified as well. A detailed study of their influence on microinstabilies is shown. Both linear and non-linear simulations are caried out, and in particular the question of the influence of geometry on the Dimits shift is presented.
In order to address the issue of non-local effects in turbulent transport, some of the standard flux tube assumptions are released and the code GENE is extended to allow for radial variations of the equilibrium profiles. Preliminary results of this work are presented.

17:30	**523**	**Impact of ICRH heating on particle motion in anisotropic toroidal magnetic confinement systems** *Martin Jucker [1], Jonathan P. Graves [1], Guy A. Cooper [2], W. Anthony Cooper [1]* *[1] EPFL SB CRPP, Association EURATOM-Confédération Suisse, 1015 Lausanne* *[2] Department of Physics, University of the South, Sewanee, Tennessee 37383, USA* Using a generalised anisotropic tokamak equilibrium and an exact guiding centre drift formulation, the effect of ion cyclotron resonant heating (ICRH) on single particle orbits including parallel and perpendicular anisotropy is investigated. The numerical model consists of an equilibrium code, encompassing full shaping and anisotropic pressure, and a Hamiltonian single particle code. An interface with a full-wave code for realistic ICRH wave fields is under way. Both Coulomb pitch angle and energy collisions of fast ions with background plasma are introduced via Monte-Carlo scattering operators, and a third Monte-Carlo operator simulates perpendicular velocity kicks received by the fast ions due to resonance of the gyromotion of the particle with the ICRH wave field.
17:45	**524**	**Laser-driven particle acceleration at the Lund Laser Centre, Sweden** *Guillaume Genoud* *Atomic Physics, Lund Institute of Technology, P.O. Box 118, S-22100 Lund* The intensity achievable in a focused multi-terawatt laser beam can be as high as 10^{20} W/cm^2, corresponding to a peak transverse electric field exceeding 10^{13} V/m. This extremely high field will accelerate any charged particle in the focus, but because of the oscillating nature of the field, it is not suited for direct acceleration. However, by transferring the laser energy to a plasma, the energy density of this field can create extremely strong and quasistationary longitudinal electrostatic fields that can be used to accelerate electrons, protons and heavier ions. In Lund, electrons are routinely accelerated to hundreds of MeV and protons to several MeV. Conventional accelerators are limited by the accelerating gradient that can be sustained in resonant radio-frequency cavities without electrical breakdown. This limitation leads to large-scale structures and high costs. On the other hand a plasma can support much stronger electric fields, allowing more compact accelerators.

18:00	**525**	**The PSI X-Ray Free Electron Laser Project: Fundamentals, Implementation and Possible Applications** *Bruce Patterson, Paul Scherrer Institut, WSLA 116, 5232 Villigen PSI* Third generation synchrotrons provide an average X-ray brightness 10^9 times that of a laboratory source, making trivial many experiments which were formerly impossible. But standard short-wavelength synchrotron light is also incoherent and is limited to pulse lengths in excess of 100 ps. A hard X-ray free electron laser (XFEL) will produce a peak brightness 10^{10} times that of a synchrotron, with full lateral coherence and sub-ps pulse lengths. I briefly present the operating principle of an XFEL and technical innovations proposed by PSI for a national XFEL facility [1]. Possible coherent scattering and / or time-resolved applications of the XFEL are discussed which span the range over chemistry, condensed matter physics, materials science and biology. [1] http://fel.web.psi.ch
18:15		***END / Conference Dinner***

ID	**PLASMA PHYSICS POSTER**
531	**Electron energy distributions in associative detachment reactions of O^- with H_2 and NO** *Juraj Fedor, Olivier May, Michael Allan, Department of Chemistry, University of Fribourg, Chemin du Musee 9, 1700 Fribourg* We have measured electron energy distributions of the electrons detached in low-energy collisions $O^- + H_2 \rightarrow H_2O + e$ (1) $O^- + NO \rightarrow NO_2 + e$ (2) The reactant O^- ions have been created via dissociative electron attachment to N_2O in the vicinity of a heated filament, focused by an ion lens system and crossed at 90° with the neutral H_2 or NO beam. The electron kinetic energy distributions have been measured using a magnetically collimated electron spectrometer. A distinctly different behavior has been found for each of the reactions (1) and (2). In the first case, the electrons carry away only a minor amount of the available energy and the product H_2O molecule is left in highly excited vibrational states. In the O^-/ NO collisions, the electron energies extend up to the allowed limit given by the reaction exothermicity. The observed behavior is explained on the basis of the widths of the involved resonances. In addition, we observed weak structures in the electron energy spectra, which we correlate with the vibrational levels of the product molecules.

532	**Absolute cross sections for the dissociative electron attachment to HCl, HBr and their deuterated analogs**

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Dissociative electron attachment cross-section measurements for HX and DX (X= Cl and Br) have been performed. We have utilized a trochoidal electron monochromator with a recently constructed total ion collection collision chamber. The chamber can be used in two independent modes of measurement - in the "no ion extraction" mode, the created ions hit the collection sheets due to their large gyroradii; in the "active ion extraction" mode a small electrostatic voltage is applied across the chamber and ions are collected due to the electric field.
Electron attachment to both hydrogen halides lead to the production of X^- at low electron energies, below 1 eV, and to the production of H^- (D^-) at higher energies, around 7 eV. The experimental cross section for the X^- production was compared with the predictions of the nonlocal resonance theory [1]. Whereas the theoretical results agree with our measurements in case of Br^-/HBr, the model seems to overestimate the cross section for Cl-/HCl by approximately a factor of 3. Both HBr and HCl cross sections show a strong isotope effect, however, this effect is much weaker for the H^- (D^-) production than for the X^- production.

[1] J. Horácek, M. Cížek, P. Kolorenc and W. Domcke, Eur. Phys. J. D, 35, 225, 2005

533	**Dissociative electron attachment to some molecules of astrophysical relevance**

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The number of molecules detected in the interstellar space has increased dramatically in the last years. Although more than 100 neutral molecules and 14 molecular cations have been identified in space, until recently polyatomic anions have eluded detection. The first anion to be detected was C_6H^- [1], followed by C_8H^- [2]. Laboratory spectra will be necessary for identification of other expected anions (CN^-, OH^-, CH_2CN^-, C_2H^-).
The most probable process for anion formation, at least for the laboratory measurements, is dissociative electron attachment (DEA). It is consequently very important to know the absolute cross-sections and the main pathways of dissociation.
The first part of this work presents mass-resolved (but relative) DEA measurements of 1,3-butadiyne (diacetylene) C_4H_2 and acetylene C_2H_2 (the latter in extension of our previous work [3]). In the second part we present the absolute (but not mass-resoved) cross sections, measured with a newly constructed instrument.
The main dissociation channel for both molecules is the loss of a hydrogen atom. In the case of C_4H_2, the DEA spectrum shows two bands, at 2.5 eV and 5 eV, assigned to the $^2\Pi_u$ and $^2\Pi_g$ shape resonances. The shape of the first band is asymmetric, indicating signal onset at the thermodynamical threshold (calculated to be at 2.07 eV).

[1] M. C. McCarthy et al., Astrophys. J., 652, L141 (2006).
[2] S. Brünken, H. Gupta, C. A. Gottlieb, M. C. McCarthy and P. Thaddeus, Astrophys. J., 664, L43-46 (2007),.
[3] R. Dressler and M. Allan, J. Chem. Phys. 87, 4510 (1987).