Tuesday, 01.09.2015, Room El 3

Time	ID	PLASMA PHYSICS *Chair: Stephan Brunner, EPFL*
16:00	651	**Experimental and numerical study of Niobium coating by DC-magnetron and bias diode sputtering** *Thibaut Richard, CERN - EPFL/CRPP, CH-1015 Lausanne* Niobium thin-films deposition on copper is used at CERN for manufacturing superconducting radio-frequency accelerating cavities of different complex geometries. We adopt an experimental and numerical approach to advance the understanding of DC bias diode and DC magnetron sputtering. Experimental measurements in a cylindrical test bench are used to benchmark simulations performed with a Particle In Cell (PIC) numerical code. We present here the first measurements on plasma ignition and steady-state discharges together with preliminary comparisons with simulations of sputtered niobium transport in such configurations. Reference: S. Calatroni, 20 Years of experience with the Nb/Cu technology for superconducting cavities and perspectives for future developments, Physica C 441 (2006) 95-101
16:15	652	**Influence of high magnetic field on plasma sputtering of ITER First Mirrors** *Lucas Moser [1], Roland Steiner [1], Laurent Marot [1], Ernst Meyer [1], Roger Reichle [2], Frank Leipold [2], Stefano Alberti [3], Ivo Furno [3]* *[1] University of Basel, Klingelbergstrasse 82, CH-4056 Basel* *[2] ITER Organization, Route de Vinon-sur-Verdon, FR-13115 St Paul-lez-Durance* *[3] EPFL-CRPP, Association Euratom-Confédération Suisse, CH-1015 Lausanne* Due to their proximity with the plasma in the fusion reactor ITER, metallic first mirrors used in optical diagnostic systems will be subject to erosion but mostly to deposition. The most promising insitu technique to remove these deposits is plasma sputtering. This work presents the results of plasma cleaning tests in magnetic field with aluminium deposits on molybdenum mirrors. Using argon 13.56 MHz radio frequency plasma, the removal of a 25 nm film was demonstrated in a 3.5 T magnetic field with various angles between the field lines and the mirrors surface. The cleaning efficiency was evaluated by performing reflectivity measurements, SEM and XPS.
16:30	653	**Morphological Changes of Tungsten Surfaces by Low-Flux Helium Plasma Treatment and Helium Incorporation via Magnetron Sputtering** *Laurent Marot [1], Santhosh Iyyakkunnel [1], Baran Eren [2], Roland Steiner [1], Lucas Moser [1], Daniel Mathys [3], Marcel Düggelin [3], Patrick Chapon [4], Ernst Meyer [1]* *[1] Department of Physics, University of Basel, Klingelbergstrasse 82, CH-4056 Basel* *[2] Material Sciences Division, Lawrence Berkeley National Laboratory, Cyclotron Road, 94720 Berkeley, USA* *[3] Centre of Microscopy, University of Basel, Klingelbergstrasse 50/70, CH-4056 Basel* *[4] Horiba Jobin Yvon, 16-18, rue du Canal, FR-91165 Longjumeau* Tungsten will be used for plasma-facing materials in the reactor in the International Thermonuclear Experimental Reactor (ITER). Helium (He) will be produced, along with a neutron, as a by-product of the fusion reaction. At temperatures above 1000 K, He is known to form bubbles in W and, thereby, cause blistering and holes on its surface. W was exposed to a low flux He plasma and the surface was observed SEM, FIB and He incorporation by GDOES [1]. [1] S. Iyyakkunnel et al, ACS applied materials & interfaces 6 (2014), 11609-11616

16:45	**654**	**Feasibility study for a density-profile reflectometer diagnostic for TCV** *Pedro Molina, Laurie Porte, Stefano Coda* *Centre de Recherches en Physique des Plasmas, EPFL, CH-1015 Lausanne* Microwave reflectometry is a RADAR technique used to obtain electron density profiles at high spatial (few mm) and temporal resolution (sub MHz). A new reflectometer diagnostic is being considered for TCV in order to increase the electron density temporal and spatial resolutions available from the Thomson scattering diagnostic (60 Hz, d_R=12 mm). A technological review is underway to explore how advances in digital electronics and solid-state microwave circuits could result in improved performance of pulsed-RADAR systems or whether continuous-wave frequency-modulation remains the most adept technique. Several preliminary designs of both (US)PR and CWFM systems will be presented.
17:00	**655**	**Scattering of radio frequency waves by turbulent structures in fusion plasmas** *Oulfa Chellaï [1], Stefano Alberti [1], Ivo Furno [1], Timothy P. Goodman [1], Daria Ricci [2], Fabio Avino [1]* *[1] Centre de Recherche en Physique des Plasma, EPFL, Station 13, CH-1015 Lausanne* *[2] IFP-CNR, Via R. Cozzi, 53, IT-20125 Milano* In fusion devices, Radio Frequency (RF) waves at the electron cyclotron frequency are used to perform localised heating and current drive. Before reaching the target region, the RF waves must propagate through the turbulent Scrape-off Layer (SOL) where filamentary structures, such as blobs and ELM's, may scatter the RF waves, resulting in less precise targeting or broadening of the absorption and driven current. Progress in understanding the interactions between blobs and RF waves is achieved in the TORPEX device, a simple magnetised torus. We will detail measurements planned on TCV to investigate the effect of the SOL turbulent structures on a gaussian beam.
17:15	**656**	**Novel self-consistent linear theory for a gyrotron oscillator based on a spectral approach.** *Jérémy Genoud, Stefano Alberti, Trach-Minh Tran, Falk Braunmüller* *Centre de Recherches en Physique des Plasmas (CRPP), EPFL, Station 13, CH-1015 Lausanne* With the aim of getting a better understanding of new operational regimes in gyrotrons, a new model was developed. This model is based on a spectral approach for solving the linearized system of equations describing the self-consistent wave-particle interaction in the cavity of a gyrotron oscillator. This model gives informations on both stable and unstable modes and permits to reveal the existence of a new set of linearly stable eigenmodes. This presentation will include a description of the model, its numerical implementation, as well as a discussion on real-cavity simulation results and comparisons with experiments.
17:30	**657**	**Towards porting a gyrokinetic PIC code on coprocessor-equipped supercomputers** *Emmanuel Lanti [1], Trach-Minh Tran [1], Farah Hariri [1], Andreas Jocksch [2], Stephan Brunner [1], Claudio Gheller [2], Laurent Villard [1]* *[1] EPFL SB CRPP-TH, Station 13, CH-1015 Lausanne* *[2] CSCS, Via Trevano 131, CH-6900 Lugano* Particle-in-cell (PIC) codes are widely used to cary out gyrokinetic simulations of turbulence in magnetic fusion relevant plasmas. With the aim of exploiting modern parallel computer architectures equipped with coprocessors, we have designed a testbed called PIC_ENGINE retaining the key elements of the PIC algorithm. Hybrid MPI/OpenACC and MPI/OpenMP implementations are used to explore potential gains in performance on GPUs, and on MICs and multicore CPUs, respectively. Finally, to approach a gyrokinetic description, Larmor rings are included and a bucket-sort algorithm is used showing improved overall performance. Results of our benchmarks on different architectures will be discussed in this work.

17:45	**658**	**Emissive probe of carbon fibres for laboratory plasmas** *Codrina Ionita, Bernd S. Schneider, Paul Jäger, Stefan Costea, Roman Schrittwieser* *Institute for Ion Physics and Applied Physics, University of Innsbruck, Technikerstr. 25, AT-6020 Innsbruck* Electron emissive probes are well established plasma diagnostic tools when direct measurements of the plasma potential are required. For high-temperature plasmas carbon is a favourable material for probes due to its high temperature resistance. We have designed and investigated an emissive probe consisting of a 12 mm long bundle of carbon fibres consisting of about 5000 single fibres of 7 μm thickness. At both ends the fibres are spliced on a length of about 4 mm with thin copper wires which provide the connection to the electric heating circuit. The carbon fibre bundle is bent and pulled into a two-bore alumina tube of 5 mm outer diameter.
18:00		***END; Postersession and Aperitif***
19:45		***Public Lecture***

ID	**Plasma Physics Poster**
671	**A flexible numerical scheme for simulating plasma turbulence in the tokamak scrape-off layer** *Paola Paruta, Paolo Ricci, CRPP, EPFL, PPB, Station 13, CH-1015 Lausanne* Simulating the most external plasma region of a tokamak, the scrape-off layer (SOL), is of crucial importance in the way toward a fusion reactor as heat load on the vessel wall, impurity generation, overall plasma confinement, all depend on the plasma dynamics in this region. In the last few years a numerical code, GBS, has been developed for solving the drift-reduced Braginskii equations (DRBE), which describe turbulence in the tokamak SOL. In the present work, we re-formulate the DRBE in a general form that enables to treat diverted configuration with X-point. We check their validity, as well as their numerical implementation in GBS, in the limited configuration.
672	**Simulation of the plasma profiles evolution for a tokamak discharge including time varying geometry** *Anna Teplukhina [1], Olivier Sauter [1], Federico Felici [2]* *[1] Center de Recherches en Physique des plasmas, EPFL, Station 13, CH-1015 Lausanne* *[2] Eindhoven University of Technology, Faculty of Mechanical Engineering, P.O. Box 513, NL-5600 Eindhoven* Applications of the RApid Plasma Transport simulatOR (RAPTOR) [1] for the simulation of the plasma tokamak parameters evolution are presented. The RAPTOR transport model has been extended by time varying terms and verified via comparisons with ASTRA [2] simulation results. The possibilities for plasma trajectories optimization with the RAPTOR code [3] are demonstrated in case of the time varying geometry of the plasma discharges including current ramp phases. [1] F. Felici et al, Nucl. Fusion 51 (2011) 083052. [2] A. G. V. Pereverzev, P. N. Yushmanov, IPP-Report 5/98 (2002). [3] F. Felici, O. Sauter, PPCF 54 (2012) 025002.
673	**Al/ZrO$_2$ optical coating for ITER First Mirror** *Zakaria Azdad, Ernst Meyer, Laurent Marot, Lucas Moser, Roland Steiner* *Department of Physics University of Basel, Klingelbergstrasse 82, CH-4056 Basel* Due to their proximity with the plasma in the fusion reactor ITER, metallic first mirrors used in optical diagnostic systems will be subject to erosion but mostly to deposition. This work presents the results of plasma cleaning performed on different films (Al_2O_3, AlW) and the properties of Al/ZrO$_2$ thin films. Using 13.56 MHz radio frequency plasma, the removal of a 25 nm films was demonstrated in various conditions. The results are compared to the different potential mirror for ITER [1]. The cleaning efficiency was evaluated by reflectivity measurements,SEM and XPS. [1] L. Moser et al . 2015 Nucl. Fusion 55

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Magnetron-Like Discharges with Permanent Magnet as Cathode

Roman Schrittwieser [1], Reiner Stenzel [2], J. Manuel Urrutia [2], Codrina Ionita [1], Claudia-Teodora Teodorescu-Soare [3]

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A magnetic field transverse to the electric field between cathode and anode of a discharge confines electrons increasing ionization. This is the principle of a magnetron. The present work describes a simple cross-field discharge: a permanent magnet as cold cathode and the chamber wall as anode. The magnet's equator is biased strongly negative producing secondary electrons due to impact of energetic ions. The emitted electrons are confined by dipolar magnetic field and the negative potential in the equatorial plane of the magnet.These electrons ionize near the sheath producing further electrons, which drift across field lines to the anode while the nearly unmagnetized ions are accelerated back to the magnet.