P 19: Helmholtz Graduate School 4 and Magnetic confinement 4

Time: Thursday 11:00–13:10 Location: b305

P 19.1 Thu 11:00 b305

CO_2 Dissociation from low to high pressure in plasma torch and surfaguide — •Federico Antonio D'Isa, Clemént Brochet, Ante Hecimovic, Emile Carbone, and Ursel Fantz — Max-Planck-institut für Plasmaphysik, BoltzmannStr. 2, 85748 Garching

The power to gas technology aims to store excess energy into gas by conversion of CO_2 into chemical fuels to reduce the CO_2 produced from the transportation sector. One step of the green-fuels production process consists in the dissociation of CO_2 into CO. In this work the dissociation of CO_2 into CO is investigated in a 2.45 GHz microwave plasma torch and a 2.45 GHz surfaguide. The two plasma sources are studied in the pressure range from 5-1000 mbar (surfaguide 5-60 mbar, plasma torch 60-1000 mbar). The gas temperature is found to increase from 1400 K to 3000 K with pressure in the range between 5-60 mbar and no significand differences are found between the two setups. The CO_2 conversion is found to be comparable in the two setups when the same power, pressure and input flow are used. In the plasma torch, above circa 120 mbar, a sudden transition from a radially di*use to a contracted plasma regime is reported. The latter is accompanied by a sharp increase of gas temperature from 3000 K to 6000 K in the plasma core. The CO_2 dissociation is strongly influenced by the discharge parameters, exhibiting peak values in the 100-200 mbar range, and usually increase with power. The measured CO_2 conversion and energy efficiency are compared to the conversion expected for a hot CO_2 gas at thermal equilibrium.

P 19.2 Thu 11:25 b305

Influence of the magnetic filter field on the source and beam performance at the large negative ion source ELISE — •Isabella Mario, Dirk Wünderlich, Federica Bonomo, and Ursel Fantz — Max-Planck-Institut für Plasmaphysik, Garching, Germany

The neutral beam injection (NBI) system for ITER is based on RF sources for production of negative ions. The ELISE test facility (1/2 ITER source, 1m × 1m beam) plays a key role in demonstrating the scalability of the source performance between the prototype source (1/8 ITER source) to the full size ITER NBI source. Ion source requirements have to be combined with beam power uniformity ($> 90\%$ for ITER) to ensure an adequate beam transmission through the beamline. To minimize the destruction of negative ions by electron collisions in the plasma, the electron density and temperature close to the extraction area are reduced by a horizontal magnetic filter field. This, combined with electric fields and pressure gradients, gives rise to plasma drifts in the vertical direction, which affect the plasma properties and the beam profile. In this work the effect of the filter field on the plasma properties close to the extraction system and on the vertical beam profile at the ELISE test facility is presented. The aim is to study the global effect of the filter field on the source performance and beam uniformity. Plasma parameters such as positive and negative ion density and plasma potential are monitored 2 cm from the extraction apertures; several beam diagnostic tools provide accelerated beam current and divergences with a vertical spatial resolution of 4 to 5 cm.

P 19.3 Thu 11:50 b305

Hybrid driftkinetic-kinetic implementations and simulations for uniform magnetized space plasma. — •Karen Pommois[1], Simon Lautenbach[2], Florian Allmann-Rahn[2], Aleksandr Mustonen[1], Felippe Nathan De Oliveira[1], Rainer Grauer[2], and Daniel Told[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstrasse 2, 85748 Garching — [2]Ruhr-Universität Bochum, Universitätsstraße 150, 44801 Bochum

Kinetic numerical simulations, applied to study local heating in the solar wind, are computationally expensive due to the different evolution scales involved in the dynamics. Therefore, simplified models, such as hybrid fluid-kinetic and gyrokinetic, are widely employed. Gyrokinetics is missing waves with frequencies above the cyclotron frequencies of the species involved and can be applied only to cases of strong magnetization and where the magnetic moment is conserved. Instead, the hybrid-fluid model is missing electron kinetic effects, important even at ion scales. Consequently, we are working on a new computationally lighter hybrid model, composed of kinetic ions and driftkinetic electrons in an uniform magnetic field. The distribution functions are evolved through semilagrangian schemes separately for ions and electrons and coupled through the field, evolved using a domain decomposition method and an iterative scheduled relaxation method. In particular, we are interested in studying the stochastic heating at low beta, where the non conservation of the magnetic moment of ions breaks the gyrokinetic description for ions while electron landau damping do not ensure the validity of fluid description for electrons.

P 19.4 Thu 12:15 b305

Radiation cooling in strongly anisotropic electron-positron plasmas — •Daniel Kennedy and Per Helander — Max-Planck-Institut für plasmaphysik

Electron-positron plasmas have been found to possess “remarkable stability properties” [Helander, 2014] due to the mass symmetry of the two species. As such, it is thought that electron-positron plasmas confined in the magnetic field generated by a circular current- carrying coil ought to enjoy excellent confinement. In previous studies, it has been assumed that the equilibrium distribution function of such a plasma, ought to be an isotropic Maxwellian.

However, we have recently found that electron-positron plasmas under expected laboratory conditions are optically thin to cyclotron radiation. This radiative cooling is an extremely efficient way for the plasma to dissipate perpendicular energy on timescales which are typically much faster than the collision time. The presence of cyclotron cooling results in a strongly anisotropic equilibrium distribution function due to the different distributions of perpendicular and parallel velocities.

In this talk, I discuss these findings and show how cyclotron cooling can be incorporated into kinetic models for electron-positron plasmas. In particular I discuss how the presence of radiation cooling can impact the energy of the plasma and the ramifications this might have in terms of plasma stability.

P 19.5 Thu 12:40 b305

Development of a levitated dipole trap to study positron-electron plasma — •Matthew Stoneking[1,2], Juliane Horn-Stanja[1], Haruhiko Saitoh[3], Eve Stenson[1], Stefan Nissl[1,4], Thomas Sunn Pedersen[1,5], Alexander Card[1], Christoph Hugenschmidt[4], Markus Singer[4], James Danielson[6], Clifford Surko[6], and Uwe Hergenhahn[1] — [1]Max Planck Institute for Plasma Physics, Garching and Greifswald, Germany — [2]Lawrence University, Appleton, USA — [3]University of Tokyo, Japan — [4]Technische Universität München, Garching, Germany — [5]University of Greifswald, Germany — [6]University of California, San Diego, USA

A Positron-Electron eXperiment (APEX) is a project that aims to produce and study magnetically confined short Debye-length positron-electron plasma. We present design plans for a levitated dipole experiment to realize this goal. The design uses a floating coil constructed with high temperature superconducting tape (average radius 7.5 cm, current 30-50 kA-turns) to produce magnetic fields of order 0.1 - 1.0 T. Current is induced in the floating coil by inductive charging using a second superconducting coil (70-140 kA-turns). Two (~100 W) cryocoolers cool the superconducting coils (to 20K) and a copper radiation shield (to 80 K). Laser rangefinders provide position and attitude signals to feedback on the lifting coil (water-cooled, ~5 kA-turns) power supply. Positrons and electrons are injected into the dipole field using pulsed electric fields to produce ExB drifts that carry particles across the field. Scintillation detectors employed in pairwise coincident configurations detect annihilation gamma rays to diagnose positron losses.

P 19.6 Thu 12:55 b305

An Intense Pulsed Positron Source (IPPS) — •Stephan König[1], Martin Singer[2], Lutz Schweikhard[1], and Thomas Sunn Pedersen[2] — [1]Institut für Physik, Universität Greifswald — [2]Max-Planck-Institut für Plasma Physik

In a typical plasma the mass difference between the electrons and ions leads to instabilities and wave phenomena. It is predicted that in a positron-electron plasma due to the mass equality many of these phenomena will vanish. The APEX (A Positron Electron eXperiment) collaboration aims for the production of the first electron-positron plasma. One part of this collaboration is the Intense Pulsed Positron Source (IPPS), for the accumulation and storage of large numbers ($\sim 10^{11}$) of positrons in multiple Penning traps. From those devices the positrons will be guided to a levitated dipole for the intended electron-positron experiments. In this contribution first measurements with only one Penning trap in a 3.1T superconducting magnet are presented. This includes basic measurements like trap alignment, control of diocotron motion and plasma compression by rotating-wall application.