P 19: Magnetic Confinement V/HEPP VIII

Time: Thursday 17:30–18:40 Location: CHE/0089

Invited Talk P 19.1 Thu 17:30 CHE/0089

Numerical and experimental investigations of a linear microwave plasma source for metal foil pumps for DEMO — •Stefan Merli[1], Andreas Schulz[1], Matthias Walker[1], Yannick Kathage[2], Stefan Hanke[2], Christian Day[2], and Günter Tovar[1] — [1]IGVP, University of Stuttgart, Stuttgart, Germany — [2]Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

In future fusion power plants like DEMO, minimizing the tritium fuel inventory is a critical design issue. Hydrogen isotopes have to be separated from the exhaust gas close to the diverter so that they can be immediately recirculated. At KIT a direct internal recycling system is being developed using a metal foil pump (MFP) which can selectively separate hydrogen isotopes by superpermeation even against a pressure gradient. For this process to work, the hydrogen must be in the form of atoms or ions, which is achieved with a linear microwave plasma source, the Duo-Plasmaline.

Since the Duo-Plasmaline is an integral part of the MFP, hydrogen plasmas from the Duo-Plasmaline are being investigated numerically and experimentally at the University of Stuttgart. In the numerical model the transport of electrons and heavy species are calculated self-consistently with the microwave el. field and a reduced set of plasma chemical reactions. Since the MFP will be in close proximity to the torus, the influence of strong magnetic fields up to 1 T is investigated. The results are compared to investigations in the experiment FLIPS with up to 250 mT. Results of the performance of the Duo-Plasmaline and the MFP from the HERMESplus experiment are presented as well.

P 19.2 Thu 18:00 CHE/0089

Physics-informed machine learning to approximate the ideal-MHD solution operator in Wendelstein 7-X configurations — •Andrea Merlo, Daniel Böckenhoff, Jonathan Schilling, Samuel Aaron Lazerson, Thomas Sunn Pedersen, and the W7-X Team — Max-Planck-Institute for Plasma Physics, 17491 Greifswald, Germany

The stellarator is a promising concept to produce energy from nuclear fusion by magnetically confining a high-pressure plasma. Magnetohydrodynamics (MHD) describes how plasma pressure, current density and magnetic field interact. In a stellarator, the confining field is three-dimensional, and the computational cost of solving the 3D MHD equations currently limits stellarator research and design. In this work, we present data-driven approaches to provide fast 3D MHD equilibria: we describe an artificial neural network (NN) that quickly approximates the ideal-MHD solution operator in W7X configurations. The model fulfils equilibrium symmetries by construction and the MHD force residual regularizes the solution of the NN to satisfy the ideal-MHD equations. The model predicts the equilibrium solution with high accuracy, and it faithfully reconstructs global equilibrium properties (e.g., magnetic well depth). We also optimize W7X magnetic configurations, where desiderable configurations can be found in terms of fast particle confinement. Moreover, preliminary results from solving the ideal-MHD equations for a generic stellarator geometry with a physics-informed model without any ground-truth data will be presented.

P 19.3 Thu 18:25 CHE/0089

Structure splitting at the transition to self-sustained turbulence in a magnetized cylindrical plasma — •Peter Manz[1], Stefan Knauer[1], Chanho Moon[2], Nils Fahrenkamp[1], and Akihide Fujisawa[2] — [1]Institut für Physik, Universität Greifswald, Greifswald — [2]Research Institution for Applied Mechanics, Kyushu University, Kasuga

When turbulent structures split more frequently before they decay, persistent turbulence forms in neutral fluid shear flows. Whether such behavior also occurs in magnetized plasmas is investigated in the experiment PANTA. With increasing control parameter the dynamics in the magnetized plasmas is known to undergo several changes from a quasiperiodic to a phase locked to a weakly turbulent regime. When the phase-locked regime breaks down, the splitting time approaches the decreasing lifetime reflecting self-sustained turbulence, as known from the pipe flow.