P 20: Laser Plasmas III/Codes and Modeling III

Time: Thursday 17:30–18:45 Location: CHE/0091

Invited Talk P 20.1 Thu 17:30 CHE/0091

Laser-Induced Breakdown Spectroscopy (LIBS) for the detection of hydrogen isotopes stored in high-Z metals tungsten and tantalum — •Steffen Mittelmann[1], Kévin Touchet[3], Xianglei Mao[3], Minok Park[3], Vassilia Zorba[3], Sebastijan Brezinsek[2], and Georg Pretzler[1] — [1]Institut für Laser- und Plasmaphysik, Heinrich-Heine-Universität Düsseldorf — [2]Forschungszentrum Jülich GmbH, Institut für Energie- und Klimaforschung - Plasmaphysik — [3]Laser Technologies Group, Lawrence Berkeley National Laboratory, Berkeley

Laser-Induced Breakdown Spectroscopy (LIBS) is a promising technology for in-situ analysis of plasma facing components in confinement fusion experiments. It is of major interest to monitor the hydrogen isotope retention over many operation hours to guarantee the safety and lifetime of the facility. To be able to get full information of deuterium deposition in different surface layers, a LIBS setup with a high depth resolution is required. We present a comparison of such LIBS experiments with several laser systems of strongly differing parameters for optimizing the conditions. In our final study, ultra-short (ps- to fs-) UV-laser pulses were focused on tungsten and tantalum tiles that were exposed by a deuterium plasma in the linear plasma device PSI-2 at Forschungszentrum Jülich. We show that this concept can lead a Calibration-Free technique for quantitatively determining the amount of deuterium stored in the tiles under investigation without a-priori knowledge on the plasma.

P 20.2 Thu 18:00 CHE/0091

Acceptance Rates of Invertible Neural Networks on Electron Spectra from Near-Critical Laser-Plasmas: A Comparison — •Thomas Miethlinger[1,2], Nico Hoffmann[1], and Thomas Kluge[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Deutschland — [2]Technische Universitat Dresden, 01069 Dresden, Germany

While the interaction of ultra-intense ultra-short laser pulses with near- and overcritical plasmas cannot be directly observed, experimentally accessible quantities (observables) often only indirectly give information about the underlying plasma dynamics. Furthermore, the information provided by observables is incomplete, making the inverse problem highly ambiguous. Therefore, in order to infer plasma dynamics as well as experimental parameter, the full distribution over parameters given an observation needs to considered, requiring that models are flexible and account for the information lost in the forward process. Invertible Neural Networks (INNs) have been designed to efficiently model both the forward and inverse process, providing the full conditional posterior given a specific measurement. In this work, we benchmark INNs and standard statistical methods on synthetic electron spectra. First, we provide experimental results with respect to the acceptance rate, where our results show increases in acceptance rates up to a factor of 10. Additionally, we show that this increased acceptance rate also results in an increased speed-up for INNs to the same extent. Lastly, we propose a composite algorithm that utilizes INNs and promises low runtimes while preserving high accuracy.

P 20.3 Thu 18:15 CHE/0091

Magnetohydrodynamic Simulations of a Tapered Plasma Lens for Optical Matching at the ILC e^+ Source — •Manuel Formela[1], Gudrid Moortgat-Pick[1], Niclas Hamann[1], Gregor Loisch[2], Mathis Mewes[2], Maxence Thévenet[2], and Jens Osterhoff[2] — [1]University of Hamburg, Hamburg, Germany — [2]Deutsches Elektronen Synchrotron DESY, Hamburg, Germany

The International Linear Collider is a planned electron-positron linear collider with its positron source producing positrons by exposing a target to undulator radiation. The resulting, highly divergent positron beam requires optical matching to improve its luminosity and therefore the success of the collision experiments. Here, optical matching refers to capturing particles, i.e. making them available for downstream beamline elements. In the past, this has been done with sophisticated coils, but recently the usage of a current-carrying plasma, a plasma lens, has been proposed. For the International Linear Collider particle tracking simulations have already concluded with an optimal plasma lens design with respect to the captured positron yield. This design is characterized by a linearly widening radius in beam direction. Now further research and development is required, including both experiments with a prototype set-up as well as simulations modeling the hydrodynamics of the current-carrying plasma and the resulting magnetic field. The accuracy of the latter will benefit greatly from the former. First results of these magnetohydrodynamic simulations are discussed in this work.

P 20.4 Thu 18:30 CHE/0091

1D Vlasov simulations of the Windowless Gaseous Tritium source of the Karlsruhe Tritium Neutrino experiment — •Anna Josephine Schulze and Felix Spanier — University of Heidelberg

The aim of the Karlsruhe Tritium Neutrino (KATRIN) experiment is to precisely determine the neutrino mass by measuring the electron energy spectrum of the tritium-beta-decay. The high energy of this decay is also the reason for a plasma to develop inside the windowless gaseous tritium source (WGTS). Interactions between the plasma and metallic walls lead to the formation of a plasma sheath and with it an electrostatic potential arises. This can modify the resulting energy spectrum. Therefore, the behaviour of the plasma and especially its wall-interaction was estimated using a 1D simulation. It is based on solving the Vlasov-Poisson system with an Eulerian scheme to compute the electric potential along the middle axis of the tritium source. This technique allows for stronger density gradients as well as atomic processes to be considered. In general, however, it is more computationally expensive than a particle-in-cell method. Initial results yield a plasma potential of $\Delta\phi = 0.047$ V and show a backflow of electrons, leading to the development of a two-stream instability in the plasma. Currently, the code is further developed to simulate a larger area of the WGTS and to consider more effects, including recombination.