P 12: Astrophysical Plasmas & Laser Plasmas II

Time: Thursday 11:00–12:15 Location: H5

Invited Talk P 12.1 Thu 11:00 H5

Planetary and astrophysical high Mach-number shocks: kinetic simulations vs in-situ measurements — •Artem Bohdan[1], Martin Pohl[1,2], and Paul Morris[1] — [1]DESY, DE-15738 Zeuthen, Germany — [2]Institute of Physics and Astronomy, University of Potsdam, DE-14476 Potsdam, Germany

High-Mach-number collisionless shocks are found in planetary systems and supernova remnants (SNRs). Electrons are heated at these shocks to temperatures well above the Rankine-Hugoniot prediction. However, the processes responsible for causing the electron heating are still not well understood. We use a set of large-scale particle-in-cell simulations of nonrelativistic shocks in the high-Mach-number regime to clarify the electron heating processes. The physical behavior of these shocks is defined by ion reflection at the shock ramp. Further interactions between the reflected ions and the upstream plasma excites electrostatic Buneman and two-stream ion-ion Weibel instabilities. Electrons are heated via shock surfing acceleration, the shock potential, magnetic reconnection, stochastic Fermi scattering, and shock compression. The main contributor is the shock potential. The magnetic field lines become tangled due to the Weibel instability, which allows for parallel electron heating by the shock potential. The constrained model of electron heating predicts an ion-to-electron temperature ratio within observed values at SNR shocks and in Saturn's bow shock. We also present evidence for field amplification by the Weibel instability. The normalized magnetic field strength strongly correlates with the Alfvenic Mach number, as is in-situ observed at Saturn's bow shock.

P 12.2 Thu 11:30 H5

Detector characterisation for grating-based X-ray phase-contrast imaging — •Constantin Rauch, Bernhard Akstaller, Lisa Dietrich, Dennis Haag, Veronika Ludwig, Stephan Schreiner, Max Schuster, Andreas Wolf, Thilo Michel, Gisela Anton, and Stefan Funk — Ecap - Erlangen Centre for Astroparticle Physics, University Erlangen-Nürnberg, Erwin-Rommel-Str. 1, 91058 Erlangen

Imaging at X-ray backlighter allow to capture fast dynamic processes due to extremely short exposure times. Grating-based X-ray phase-contrast imaging is expected to observe plasma shocks with higher contrast than absorption-based imaging due to its sensitivity to the differential phase-shift caused by local electron density variation present in plasma shocks. These rapid processes place special demands on the imaging system consisting of two gratings and a detector. Optimising the setup promises improvements in photon noise and sensitivity. This can be achieved by optimising the gratings, their positions and the detector. In this contribution, a methodology for characterising X-ray detectors according to their resolution, sensitivity and noise in phase-contrast imaging is introduced.

P 12.3 Thu 11:45 H5

X-ray phase contrast imaging as a plasma diagnostics technique — •Lisa Dietrich, Bernhard Akstaller, Stephan Schreiner, Veronika Ludwig, Max Schuster, Gisela Anton, and Stefan Funk — ECAP - Erlanger Centre for Astroparticle Physics, Universität Erlangen-Nürnberg, Erwin-Rommel-Str. 1, 91058 Erlangen, Germany

A single-shot x-ray phase-contrast imaging technique with short exposure time allows to capture sharp images of fast dynamic processes, like laser-produced plasma shock-waves in high-energy density pump-prope experiments. Using grating-based x-ray phase-contrast imaging as a measurement technique, allows to determine the projected electron density distribution of a sample with a single acquisition. In this talk the methodology of grating-based phase-contrast imaging and its ability to retrieve electron density distribution is introduced. Further, the concept of a portable grating-based phase-contrast imaging setup is explained, which allows to adjust the interferometer at low repetion rate backlighter sources within a reasonable time using a fast-alignment method.

P 12.4 Thu 12:00 H5

Noise reduction for single-shot grating-based phase-contrast imaging at an x-ray backlighter — •Stephan Schreiner[1], Bernhard Akstaller[1], Lisa Dietrich[1], Paul Neumayer[2], Max Schuster[1], Andreas Wolf[1], Veronika Ludwig[1], Thilo Michel[1], Gisela Anton[1], and Stefan Funk[1] — [1]Friedrich-Alexander Universität Erlangen-Nürnberg, Erwin-Rommel-Straße 1, 91058 Erlangen, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt, Germany

X-ray backlighters allow to capture sharp images of fast dynamic processes , like laser-produced plasma shock-waves in high-energy density experiments, due to extremely short exposure times. Moiré imaging using a two-grating imaging setup enables to measure the absorption and differential phase-contrast (DPC) of these processes simultaneously, allowing to retrieve the electron-density distributions of the imaged object. However, acquiring images with one single-shot limits the x-ray photon flux, which can result in noisy images. In this contribution an implementation of a laser-driven x-ray backlighter experiment is presented and two noise reduction methods for single-shot images are evaluated.