P 19: Poster Session- Laser Plasmas

Time: Wednesday 16:30–19:00 Location: Empore Lichthof

P 19.1 Wed 16:30 Empore Lichthof

Collisionless Shocks in laboratory plasmas — •shikha bhadoria, naveen kumar, and christoph h. keitel — Max Planck Institute for nuclear physics, Heidelberg, Germany

Collisionless shocks are formed when two counter-propagating streams of plasmas are collided. This situation occurs quite often in astrophysical environments e.g when the supernova remnant blast shell hits the interstellar medium etc. This can be envisaged in a laboratory easily by irradiating two energetic laser pulses on thin-foil targets placed opposite to each other. These collisionless shocks are responsible for extreme acceleration of charged particles (e.g. cosmic rays) by Fermi acceleration mechanism, however little is known about their formation process. We present results of collisionless shock formation in such a situation and discuss their implications for the astrophysical scenario.

P 19.2 Wed 16:30 Empore Lichthof

Kinetic effects in strongly coupled Brillouin laser seed pulse amplification — •Götz Lehmann and Karl-Heinz Spatschek — HHU Düsseldorf, 40255 Düsseldorf

Today laser intensities on the order of 10^{22} W/cm^2 can be achieved via chirped pulse amplification. Due to the damage thresholds of amplifier crystals and compressor gratings, laser systems which offer intensities magnitudes larger are either extremely costly or unrealistic. Plasma-based concepts such as Brillouin amplification offer a potential route towards lasers on the scale of 100 PW or even beyond.

In Brillouin amplification a long and energetic pump pulse is backscattered into a short seed pulse off an ion oscillation [1,2]. For sufficiently strong pump pulses, the beat of pump and seed drives a strongly-coupled ion oscillation, which acts as a Bragg grating, backscattering the pump into the seed.

The amplification dynamics is often modeled by envelope models. With the help of Maxwell-Vlasov simulations we explore the validity of these models and establish the role of kinetic effects on the grating. We find that strong electron trapping determines the late time dynamics of the Bragg grating, however the amplification process is not significantly affected by this.

[1] G. Lehmann and K.H. Spatschek, Phys. Plasmas 20, 073112 (2013) [2] F. Schluck, G. Lehmann and K.H. Spatschek, Phys. Plasmas 22, 043105 (2015)

P 19.3 Wed 16:30 Empore Lichthof

Time-Resolved In-Line-Holography for Observing Laser Plasmas — •Hannes Bassen[1], Neeke Rothe[1], Christoph Merschjann[2], Franziska Fennel[1], and Stefan Lochbrunner[1] — [1]Universität Rostock, D-18059 Rostock, Germany — [2]Freie Universität Berlin, D-14195 Berlin, Germany

Dense laser-induced plasmas attract strong scientific interest. They are crucial in understanding the interaction between condensed matter and intense laser radiation as well as in providing an elegant and powerful approach to study warm dense matter. Here we focus on the experimental setup to detect diffraction patterns created by dense plasmas with a radius of about 30 μm in a thin gold foil. This results from the interaction of the foil with an intense, ultrashort pump laser pulse, which creates a dense plasma and finally leaves a hole. Using a temporally shifted and frequency doubled probe pulse we are able to gather the caused diffraction pattern with a CCD camera. Afterwards we can obtain information about structure, transmittance and phase at a certain delay by using an iterative algorithm based on the angular spectrum method: We implemented the phase retrieval algorithm and additionally use a hybrid-input-output algorithm, which keeps feedback information from previous iterations. To ensure convergence and fewer artifacts in the reconstruction we also restrict the plasma area regularly by applying a shrink-wrap mask. Comparison of images reconstructed from diffraction patterns of holes in the gold foil with REM images shows perfect match. The method allows to reconstruct the spatially resolved plasma dynamics.

P 19.4 Wed 16:30 Empore Lichthof

Dynamics of spatially overlapping flat top electromagnetic solitons in plasmas — •Sita Sundar — Christian-Albrechts-Universität Kiel

Interaction of ultra-intense laser with plasma exhibits a rich variety of interesting nonlinear phenomena. Numerical and asymptotic solutions describing the interactions of relativistically intense plane electromagnetic waves and cold plasmas are of fundamental importance for nonlinear science and are considered to be a basic component of turbulence in plasmas. The numerical identification of solitons stimulated a renewed interest in developing an analytical model and in envisaging ways of detecting solitons experimentally. The inclusion of ion response in the relativistically intense electromagnetic laser pulse propagation in plasma yields certain distinct varieties of single peak solitonic structures. A falt-top slow moving structure is one such solution. Here, detailed characterization and numerical investigations on mutual interactions between two spatially overlapping electromagnetic flat-top solitons in plasma will be presented.

P 19.5 Wed 16:30 Empore Lichthof

Elektronenbeschleunigung in relativistischen Gauß-Laguerre Laserpulsen — •Camilla Willim, Götz Lehmann und Carsten Müller — Theoretische Physik I, Heinrich-Heine Universität, 40225 Düsseldorf, Germany

In Laserfeldern mit Intensitäten oberhalb von 10^{18} W/cm^2 wird die Bewegung von Elektronen relativistisch. Freie Elektronen werden von Laserpulsen ponderomotorisch gestreut und können so relativistische Energien erhalten. Wir untersuchen die Dynamik von Elektronen welche an ultrakurzen relativistischen Gauß-Laguerre Laserpulsen gestreut werden.

Gauß-Laguerre Strahlen sind Lösung höherer Ordnung der paraxialen Wellengleichung. Im Vergleich zur Grundmode, den Gauß Strahlen, besitzen diese Lösungen einen Drehimpuls und haben eine deutlich komplexeres transversales Intensitätsprofil. Von speziellem Interesse sind Moden deren Intensitätsprofil im Zentrum ein Minimum aufweist.

Wir untersuchen sowohl die Beschleunigung von anfänglich ruhenden Teilchen, als auch die Nachbeschleunigung von injizierten Teilchen. Es zeigt sich, dass neben der gewöhnlichen ponderomotorischen Beschleunigung ein zweiter Mechanismus hohe Energien produzieren kann. Elektronen können vorübergehend in einer bestimmten Phase des Feldes gefangen werden und so in einem quasi-statischen Feld beschleunigt werden. Anhand von Vergleichen mit Gauß Strahlen zeigt sich, dass Gauß-Laguerre Strahlen potentiell zu deutlich höhere Elektronenenergien führen können.

P 19.6 Wed 16:30 Empore Lichthof

Raman amplification in the coherent wavebreaking regime — •John Farmer and Alexander Pukhov — Heinrich-Heine-Universität Düsseldorf, 40225 Düsseldorf

Raman amplification in plasma is a potential method for the creation of ultra-short, ultra-intense laser pulses. We show that in regimes far beyond the wavebreaking threshold of Raman amplification, significant amplification can occur after the onset of wavebreaking, before phase mixing destroys the coherent coupling between pump, probe and plasma wave. Amplification in this regime is therefore a transient effect, with the higher-efficiency “coherent wavebreaking” regime accessed by using a short, intense probe.

Parameter scans illustrate the marked difference in behaviour between below wavebreaking, in which the energy-transfer efficiency is high but total energy transfer is low, wavebreaking, in which efficiency is low, and coherent wavebreaking, in which moderate efficiencies allow the highest total energy transfer.