P 28: Laser Plasmas II

Zeit: Donnerstag 16:30–17:30 Raum: HZO 50

P 28.1 Do 16:30 HZO 50

Direct measurement of electron's dephasing in a laser-driven wakefield — •D. E. Cardenas[1,2], S. W. Chou[1,2], J. Xu[1,3], A. Buck[1,2], K. Schmid[1,2], C. M. S. Sears[1], B. Sheng[3], F. Krausz[1,2], and L. Veisz[1] — [1]Max-Planck-Institute für Quantenoptik, Hans-Kopfermann Strasse 1, 85748, Garching, Germany — [2]Ludwig-Maximilians-Universität, Am Couloumbwall 1, 85748, Garching, Germany — [3]State Key Laboratory of High Field Laser Physics, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, P. O. Box 800-211, Shanghai 201800, China

One of the most important effects limiting the maximal achievable energy of a laser-wakefield-accelerated electron [1] is dephasing. This process limits the acceleration length to a distance an electron must propagate in the lab system until it outruns the plasma wave by half of the plasma wavelength, i.e. the dephasing length $L_d \approx \lambda_p^3/\lambda_0^2$, where λ_p and λ_0 are the plasma and laser wavelength, respectively [2]. In resonant conditions, the laser pulse duration should match half of the plasma wavelength. Using the pulses delivered by the $<$ 5 fs Light Wave Synthesizer 20 (LWS-20) and the 8 fs LWS-10 [3], dephasing lengths in the order of 100 μm become measureable using shock-front injection [4]. These results match quite well the linear theory and give a solid basis to design higher energy accelerators using longer laser pulses. [1] T. Tajima and J.M. Dawson, Phys. Rev. Lett. 43. 267 (1979) [2] E. Esarey, C. B. Schroeder, and W. P. Leemans. Rev. Mod. Phys. 81, 1229. (2009). [3] K. Schmid et al., Phys. Rev. Lett. 102, 124801 (2009) [4] K. Schmid et al., Phys. Rev. ST Accel. Beams 13, 091301 (2010)

P 28.2 Do 16:45 HZO 50

Thomson Scattering from Warm Dense Matter — •Mohammed Shihab[1,2], Kai-Uwe Plagemann[1], Hannes R. Rüter[1], Thomas Bornath[1], Wolf-Dietrich Kraeft[1], Carsten Fortmann[3], Siegfried H. Glenzer[4], and Roland Redmer[1] — [1]Institut für Physik, Universität Rostock, Germany. — [2]Physics Department, Tanta University, Egypt. — [3]Quantumwise A/S, DK-2100 Copenhagen, Denmark. — [4]SLAC, Menlo Park, CA 94025, USA.

Thomson scattering is a promising tool to infer warm dense matter (WDM) properties [1]. WDM is characterized by densities near to solid-density up to compressed matter well above solid-density and electron temperatures of several electron volts. In this plasma region, the transition from ideal plasmas to degenerate and strongly coupled plasmas occurs. Accurate measurements of plasma temperature and densities and rigorous understanding of correlations and quantum effects are of great importance for modelling laser-shock and inertial confinement fusion experiments. Free electron lasers such as FLASH (Hamburg) or LCLS (Stanford) provide high-brilliance and coherent radiation sources that allow to resolve the ultra-short time kinetics of WDM in pump-probe experiments. For instance, collective x-ray Thomson scattering yields information on the density, temperature, and the ionization balance of WDM [2]. In this contribution we will highlight the theoretical basis of Thomson scattering and propose new experiments that can be performed at FLASH, LCLS or the future European XFEL in Hamburg. [1] Glenzer S.H. and Redmer R., *Rev. Mod. Phys.* **81** 1625(2009) [2] Glenzer et.al., *Phys. Rev. Lett.* **98** 065002(2007)

P 28.3 Do 17:00 HZO 50

Generation of ultra-short high-power laser pulses via strongly-coupled Brillouin amplification — •Friedrich Schluck, Götz Lehmann, and Karl-Heinz Spatschek — Institut für Theoretische Physik I, Heinrich-Heine Universität, 40225 Düsseldorf, Germany

Amplification of ultra-short laser pulses via strongly-coupled Brillouin scattering is a promising technique for the generation of multi-Petawatt to Exawatt laser pulses. Energy is transferred from a long pump pulse (ps to ns duration) to a short seed pulse (about 100fs duration) via a resonant interaction with an ion quasi-mode. We present an envelope model to investigate this process in multi-dimensional geometry. In particular we focus on the influence of a frequency chirp of the pump pulse. The chirp affects the resonance condition for frequency matching of pump, seed and plasma wave and thus the energy transfer from pump to seed. On the one hand a residual chirp will always be present in experiments, on the other hand, we find that artificially chirping the pump pulse may increase the amplification efficiency in the nonlinear phase of the amplification process.

P 28.4 Do 17:15 HZO 50

Towards Atomic Physics in PIConGPU — •Axel Huebl[1,2], Marco Garten[1], Rene Widera[1], Lingen Huan[1], Thomas Kluge[1], and Michael Bussmann[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf — [2]Technische Universität Dresden

Particle-in-Cell (PIC) codes are a ubiquitous tool to study laser-plasma physics in a fully relativistic environment. Theoretical models for plasma based accelerators and corresponding experiments, as planned by the HIBEF collaboration (XFEL), depend dramatically on the ability to precisely predict the complex processes inside of targets.

Unfortunately, basic atomic processes like the ionization dynamics of solid foil target in ultra-high fields of modern short-pulse laser systems in the PW class are not covered by the basic PIC algorithm. This poster shows ways to introduce the microscopic ionization dynamics inside the targets in a self-consistent and rigorous way. Combined with modern compute hardware such as GPUs and manycore systems in general, this paves the road to a new quality of multi-physics simulations with ab-initio modeling of atomic processes in strong laser fields.