SYRL 1: Relativistische Laserplasmen

Zeit: Freitag 10:30–12:30 Raum: 6C

Hauptvortrag SYRL 1.1 Fr 10:30 6C

Relativistic mirrors with two colliding laser pulses — •Sergei Bulanov — Advanced Photon Research Centre, Japan Atomic Energy Agency, 8-1 Umemidai, Kizu, Souraku, Kyoto, 619-0215 Japan

In a plasma wake wave generated by a relativistically intense ultrashort laser pulse, modulations of the electron density naturally and robustly take the shape of paraboloidal dense shells, separated by evacuated regions, moving almost at the speed of light. When another counter-propagating laser pulse is injected, it is partially reflected from the shells, which act as relativistic flying semi-transparent mirrors. This process produces an extremely time-compressed frequency-multiplied electromagnetic pulse which may be focused tightly to the diffraction limit [1]. Recently the frequency multiplication was detected in the APRC-JAEA experiments on the reflection of a weak laser pulse in the region of the wake wave generated by the driver laser pulse in an underdense plasma [2]. This mechanism represents a new kind of short-pulse, tunable frequency source leading to the possibility of very strong pulse compression and extreme light intensification.

[1] S. V. Bulanov, T. Zh. Esirkepov, T. Tajima, Phys. Rev. Lett. 91, (2003).

[2] M. Kando, et al., (2007)

Hauptvortrag SYRL 1.2 Fr 11:00 6C

Lösung eines 20 Jahre alten Problems: Zur Physik der stoßfreien Absorption ultrakurzer Laserpulse — •Peter Mulser[1], Dieter Bauer[2] und Hartmut Ruhl[3] — [1]Theoretische Quantenelektronik (TQE), TU Darmstadt, Hochschulstr. 3, 64289 Darmstadt — [2]Max-Planck-Institut für Kernphysik, Postfach 103980, 69029 Heidelberg — [3]Institut für Theoretische Physik I, Ruhr-Universität Bochum, 44797 Bochum

Particle-in-Cell (PIC)-, Vlasov- und molekulardynamische Simulationen zeigen, dass intensive fs-Laserpulse in idealen stoßfreien Plasmen sehr gut absorbiert werden (über 50% Absorption). Seit zwanzig Jahren werden immer wieder neue Absorptionsmodelle vorgestellt, die aber nicht überzeugend sind. Eine Ausnahme mit Einschränkungen bildet das Modell von Brunel. Durch die Formulierung eines NO-GO-Theorems kann gezeigt werden, dass ein ideales stoßfreies Plasma in beliebiger nichtlinearer, aber regulärer Dynamik nicht absorbieren kann, wohl aber, wenn die Bewegung singulär wird. Dies legt den Schluss nahe, dass es Plasmaresonanzen sind, die die Adiabasie brechen. Eine eingehende Untersuchung zeigt in der Tat, dass anharmonische Resonanz vorliegt und dass diese die hohe stoßfreie Absorption in den Simulationen auf zwangslose Art erklären kann. Überdies gibt das Resonanzmodell Hinweise auf Beeinflussung und Steuerung von Absorption und Spektren der heißen Elektronen.

Hauptvortrag SYRL 1.3 Fr 11:30 6C

The new world of relativistic laser plasmas and applications — •Juergen Meyer-ter-Vehn — Max-Planck-Institute for Quantum Optics, Garching, Germany

Ultra-short high-power laser pulses with intensities beyond 10^{18} W/cm^2 now drive target electrons to the velocity of light and create dense relativistic plasmas in table-top experiments. The relativistic interaction with gas and solid targets leads to a number of surprising new phenomena, which were first predicted by numerical simulation and have now been impressively confirmed in experiments. Well collimated, ultra-bright electron (up to GeV energy) and ion beams have been observed. They are accelerated over hundreds of micrometer rather than hundreds of meter as in conventional accelerators. High laser harmonics up to keV energies involving ultra-bright attosecond pulses have been created at plasma surfaces acting as relativistic mirrors. Physics and applications are discussed in this talk.

Hauptvortrag SYRL 1.4 Fr 12:00 6C

Relativistic laser-plasmas: novel sources of x-rays and particle beams — •Alexander Pukhov — Institute for Theoretical Physics I, Uni-Duesseldorf

Laser plasma becomes relativistic at intensities I well above 10ˆ18 W/cmˆ2. One of the main applications for relativistic laser plasmas is the high-gradient particle acceleration and new table-top sources of short wavelength radiation. The main breakthrough happened in the last two years as a number of experimental groups reported monoenergetic electron beams from laser plasmas reaching GeV energies. These beams have been accelerated in the Bubble regime [Pukhov, Meyer-ter-Vehn, Applied Phys. B74, p.355 (2002)]. The main numerical tool to study the relativistic laser plasmas are particle-in-cell simulations. In the ultra-relativistic regime, I>>10ˆ18 W/cm2, the S-similarity theory [Pukhov, Gordienko, Phil. Trans. R. Soc. A364, p. 623 (2006)] helps to scale experimental results.