K 7: Laserstrahlwechselwirkungen

Zeit: Dienstag 15:15–16:00 Raum: 6E

K 7.1 Di 15:15 6E

FDTD simulations of ultrashort laser pulse propagation — •Karsten Köhler, Dennis Kröninger, and Thomas Kurz — Drittes Physikalisches Institut, Univ. Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

The propagation and interaction of picosecond to femtosecond laser pulses is usually calculated by employing first-order wave equations based on the slowly varying envelope approximation. While this approximation has been shown to be valid even for very short (few-cycle) pulses (Brabec & Krausz) the proper description of linear and nonlinear dispersion (e.g. Raman term) in such cases becomes more difficult when the pulse spectrum covers resonances of the medium. Then direct finite-difference time-domain simulations of Maxwell's equations provide the most accurate description of pulse dynamics. In this work we describe an implementation of this method for pulse propagation in a Kerr medium with linear and nonlinear dispersion. We present numerical results on propagation and interaction of pulses having different durations and peak intensities, and compare them with the corresponding solutions of nonlinear-Schrödinger-type envelope equations.

K 7.2 Di 15:30 6E

High harmonics and attosecond pulses in the relativistic regime — •Teodora Baeva[1], Sergey Gordienko[2], and Alexander Pukhov[1] — [1]Institut für theoretische Physik I, Düsseldorf, Germany — [2]L. D. Landau Institute for Theoretical Physics, Moscow, Russia

The theory of relativistic spikes explaining the high harmonics generation due to the interaction of a short ultra-relativistic laser pulse with overdense plasma in the relativistic regime is presented [1]. The main analytical results based on microscopic analysis of the plasma as well as PIC simulations are discussed. This theory predicts universal spectrum of the high harmonics, which includes a power-law part, followed by exponential decay. The high harmonic roll-over at γ_{max}^3 is parametrically larger than the $4\gamma_{max}^2$ predicted by the oscillating mirror model based on the Doppler effect. These predictions of the relativistic spikes were confirmed experimentally [2].

The spikes lead to a train of attosecond pulses in the reflected radiation and propose a way to extract a single attosecond pulse out of the pulse train generated by a multi-cycle driver by means of the mechanism of Relativistic Plasma Control (RPC) [3]. RPC is based on the observation that dynamics of the relativistic spikes is strongly affected by the laser pulse polarization. One can manage the laser polarization in order to control the relativistic spikes and the generation of attosecond pulses. RPC is demonstrated numerically by PIC simulations.

Literature 1. T. Baeva, S. Gordienko, A. Pukhov, PRE 74, 065401(R) (2006). 2. B. Dromey, M. Zepf, A. Gopal et. al., Nature Physics 2, 456 (2006). 3. T. Baeva, S. Gordienko, A. Pukhov, PRE 74, 046404(2006).

K 7.3 Di 15:45 6E

X-ray study of acoustic transients in laser-excited Germanium — •Uladzimir Shymanovich, Matthieu Nicoul, Klaus Sokolowski-Tinten, Stephan Kähle, Alexander Tarasevitch, and Dietrich von der Linde — University Duisburg-Essen, Institut für experimentelle Physik, Lotharstr. 1, 47048 Duisburg

X-ray diffraction with femtosecond time-resolution allows to directly follow ultrafast structural changes in solids. Using femtosecond Titanium Kα X-ray pulses from a laser-driven plasma X-ray source, we have measured the transient acoustic lattice response of single crystalline, (111)-oriented, thin Germanium films after femtosecond optical excitation. An acoustic model which includes time-dependent thermal and electronic contributions to the laser-generated stress was combined with dynamical diffraction theory to calculate the transient changes in X-ray diffraction. Comparison of these calculations with the measured data allowed in particular to estimate the relative strength of electronic and thermal stress contributions.