SFB1242

SFB 1242 Nichtgleichgewichtsdynamik kondensierter Materie in der Zeitdomäne

UNIVERSITÄT DUISBURG ESSEN

Open-Minded

05.11.2019 / 10 Uhr c.t., Raum MG 272
Campus Duisburg

Subcycle THz control of electronic charges, spins, and photons

PD Dr. habil. Christoph Lange

Universität Regensburg

Phase-locked THz waveforms are uniquely suited to control the quantum motion of electrons in solid-state systems since their photon energies lie far below typical interband electronic excitations, while the resulting nonlinear field dynamics can be traced on subcycle time scales. Here, we review distinct non-perturbative THz dynamics observed over many orders of magnitude of the field amplitude: From atomically strong THz fields to quantum vacuum fluctuations.

We first show how atomically strong multi-THz pulses drive all-coherent charge dynamics including dynamical Bloch oscillations and quasiparticle recollisions in both bulk and monolayer-thin semiconductors. This subcycle electron motion leads to the generation of high optical harmonics and high-order harmonic sidebands covering up to 13 optical octaves in the THz-to-UV spectral range. At center frequencies of 1 THz, we exploit a novel electric-dipole mediated mechanism to induce unprecedentedly large spin oscillations in the antiferromagnet $TmFeO_3$ by resonant single-cycle THz pulses of up to 1 MV/cm of amplitude, enhanced by a custom-tailored, micrometer-sized metallic antenna. The resulting dynamics include a characteristic phase flip, an asymmetric spectral splitting of the magnon resonance, and a long-lived offset of the transient polarization rotation signal, representing a novel fingerprint of all-coherent spin switching with minimal energy dissipation. Finally, even the faint fields of quantum vacuum fluctuations may drive non-perturbative, subcycle polarization dynamics. In our ultrastrongly light-matter coupled structures, the vacuum Rabi frequency exceeds the carrier frequency of light, leading to a record population of the ground state with 0.37 virtual photon pairs, which theory predicts to be released upon non-adiabatic modulation of the coupling strength, in analogy to Unruh-Hawking radiation of black holes.

Für diese Zeit steht eine Kinderbetreuung nach vorheriger Anmeldung zur Verfügung.

Contact: Prof. Dr. Björn Sothmann, Faculty of Physics
Phone: +49 (203) 37-91578 / Mail: bjoerns@thp.uni-due.de