SFB1242

SFB 1242 Nichtgleichgewichtsdynamik kondensierter Materie in der Zeitdomäne

UNIVERSITÄT DUISBURG ESSEN

Open-Minded

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Terahertz strong-field control of solid-state excitations with subcycle precision

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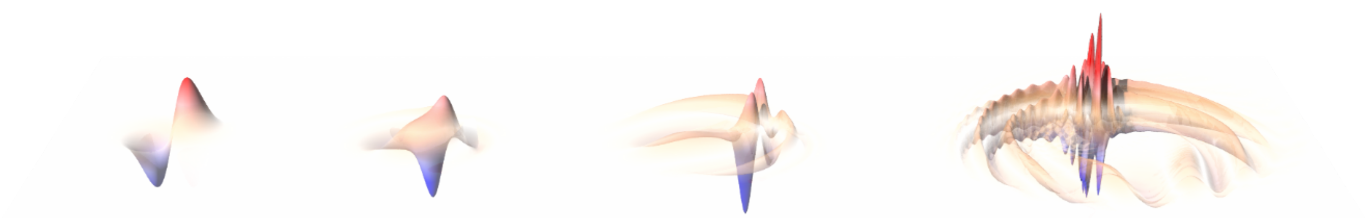
Terahertz spectroscopy has opened up exciting new chapters in ultrafast condensed-matter physics. Phase-locked THz waveforms are uniquely suited to control the quantum motion of electrons, while the resulting field dynamics can be traced on subcycle time scales. A particularly powerful strategy to disentangle individual nonlinear interactions employs two-dimensional, phase and amplitude resolved THz strong-field spectroscopy and Liouville path decomposition in two-dimensional frequency space.

Here, we discuss a wide range of nonlinearities in solid-state structures investigated by two-dimensional THz spectroscopy, including elementary excitations as well as custom-tailored, light-matter hybrid modes. First, we investigate strong-field excitation of Landau-quantized electrons of semiconductor quantum well heterostructures. Here, strong THz waveforms drive Landau ladder climbing by up to six rungs within a half-cycle of the incident field. This non-perturbative excitation gives rise to dynamical Coulomb correlations between electrons and ions, leading to strong nonlinearities such as four and six-wave mixing in a setting beyond Kohn's theorem. We then investigate intersubband transitions, where the strong-field dynamics are characterized by carrier-wave Rabi flopping and include saturation of absorption on subcycle time scales. Finally, we turn to ultrastrongly coupled THz cavity quantum electrodynamical systems, where even the faint fields of quantum vacuum fluctuations drive subcycle polarization dynamics. Here, applying a strong coherent THz field leads to high-order multi-wave mixing and inter-polariton correlations beyond the normal-mode approximation, which highlights a path towards the generation of novel quantum states by nonlinear interactions.



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

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