Designer Photons for Tailored Ultrafast Laser Control of Matter

Prof. Dr. Thomas Baumert / Universität Kassel, Deutschland
www.uni-kassel.de/go/femto

Abstract

How do the building blocks of matter move after irradiation with very short and intense laser pulses and can this movement be controlled and made use of?

To address these questions, we illuminate matter with extremely short laser pulses in the femtosecond regime and watch the ultrafast dynamics with stroboscopic methods in slow motion (femtosecond spectroscopy). Using optical synthesizers, we shape the laser light in time and can thus control the ultrafast dynamics (ultra-fast laser control) by customizing the energy transfer.

The span of our investigation ranges from free electrons, atoms and molecules in the gas phase to dye molecules and colloidal quantum dots in solution, as well as excitation and removal (ablation) mechanisms in solids and organic tissue.

In this talk - after an introduction to femtosecond spectroscopy and ultrafast laser control - I will concentrate on our current experiments devoted to tailored laser control of matter: material processing on the nanometer scale, the creation and tomographic reconstruction of 3D designer electron wave packets in the continuum, chiral recognition in the gas phase and charge oscillation controlled molecular excitation serve as illustrative examples.