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Diploma thesis abstract

Generation, characterization and nonlinear transformations of mid-infrared ultra-short laser pulses.

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In this work different methods of generation, characterization and compression of mid-infrared ultra-short pulses are investigated. Generation of tunable few-cycle pulses in the wavelength range from 4 to 8.5 μm is demonstrated through self-focusing-assisted spectral broadening in a highly nonlinear semiconductor material in the regime of normal and anomalous group velocity dispersion. Pulses with widths as short as 2-3 field cycles and energies above 2 μJ are achieved in the whole investigated wavelength range. Self-focusing-assisted self-phase modulation is determined to be responsible for generation of multi-octave supercontinuum, spanning the range of wavelengths from 3 to 18 μm. High-peak-power compressed output of a multistage mid-infrared OPCPA system is employed in our experiments to enable the generation of mid-infrared laser filaments in the atmosphere. Our studies reveal unique properties of mid-infrared filaments, where the generation of powerful mid-infrared supercontinuum is accompanied by unusual scenarios of optical harmonic generation, giving rise to remarkably broad radiation spectra, stretching from the visible to the mid-infrared. Theoretical analysis shows, that such a supercontinuum can be compressed to a waveform with a pulse width close to 2 fs.