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Noncollinear UV Pulse Generation

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Pulses with durations short enough to probe the electronic timescale can be generated in the XUV and in the IR-VIS regime. At photon energies around 4-20 eV, pulses with such extremely short durations have not yet been demonstrated. Frequency conversion in a gas cell or filamentation yields comparatively short pulses, but the complex interplay of nonlinear light-matter interaction and significant linear dispersion has prevented to approach the femtosecond barrier, even when extremely short (<4 fs) driving pulses are used. For spectroscopic applications such as transient absorption spectroscopy, broadband and sub-femtosecond pulses in the deep-UV would be very useful, because they allow the direct probing of the bandgap in many materials. Laser pulses (centre wavelength 700 nm, pulse duration 5 fs) are focused into a generation medium (sapphire, MgO, fused silica, BK7 glass) with a beam waist of 85 µm and a crossing angle $2\alpha = 1°$. A spectrometer has been constructed with resolution in the emission angle φ behind the generation medium. Data stacks dependent on 3 parameters (wavelength λ, pulse delay τ, emission angle φ) are recorded.
The cascaded processes of third harmonic generation (THG) and self-diffraction yield a multifaceted emission pattern in the deep-UV with pulse durations < 3 fs at selected emission angles. Hence it is demonstrated that the generation of short deep-UV pulses by THG can be improved by using a noncollinear geometry.

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