Wavelength-Tunable μJ Few-fs VUV Pulses

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Practically all molecules display significant absorption bands at wavelengths below 200 nm, making short pulses in the vacuum-ultraviolet (VUV) spectral range particularly attractive for studies of molecular dynamics. In spite of their utility, tunable ultrashort VUV pulses have been difficult to generate. Strong VUV absorption limits frequency-mixing techniques in optical cyrstals to the UV range and low-order harmonic generation in gases, on the pother hand, suffers from low efficiency. Both techniques require a tunability of the driving laser to be transferred into the VUV range.

Here we report on the realization and characterization of an efficient source for ultrashort VUV pulses at wavelengths tunable from the UV deeply into the VUV range. Fixed-wavelength 800 nm Ti:S laser pulses are compressed to approx. 10 fs duration in a gas-filled hollow-core fiber (HCF) and are then focussed into a second gas-filled HCF, where the interplay between linear and non-linear dispersion gives rise to the formation of a soliton which – with a proper set of parameters – creates a resonant dispersive wave (RDW) [1] at a shorter wavelength that can be tuned with the gas pressure.

Results will be presented on the covered spectral range, the corresponding pulse energies as well as the achieved pulse durations. The latter were measured utilizing an all-reflective, thus dispersion-free, fringe-resolved autocorrelation technique [2], which has also shown its ability to disclose few-fs molecular dynamics [3,4]. The tunability of the new source will now allow more comprehensive studies with higher temporal resolution and an extended sampling of the molecules‘ potential energy surfaces.

References

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