Q 59: Ultrakurze Laserpulse

Time: Friday 10:30–12:00 Location: V38.04

Q 59.1 Fri 10:30 V38.04

Dependence of high-harmonic generation yield on driving-laser ellipticity — •Max Möller[1], Sabih Khan[2], Yan Cheng[2], Michael Chini[2], Zenghu Chang[2], and Gerhard G. Paulus[1] — [1]Institut für Optik und Quantenelektronik, Jena, Max-Wien-Platz 1, 07743 — [2]CREOL, University of Central Florida, Orlando

Elliptically polarized light fields are of interest in strong-field laser physics from a fundamental point of view as well as for many applications, e.g. polarization gating for the generation of isolated extreme ultra-violet attosecond pulses from multi-cycle lasers. Further, since high-harmonic generation is remarkable sensitive to the ellipticity of the driving pulse, it is central for the design and optimization of such schemes. We present an intuitive semi-classical model that predicts the dependence of high-harmonic generation on driving laser ellipticity. The analysis follows the three-step model of strong-field laser physics and is based on the transverse structure of the electron wave packet directly after the initial ionization step. This allows one to determine the ellipticity dependence as function of driving laser wavelength and intensity. Comparisons to a detailed experimental investigation performed with Ti:Sapphire and second harmonic, i.e. 810 nm and 405 nm, driving lasers as well as with existing time-dependent Schrödinger equation simulations show good agreement. Inversely, understanding the link between the electron wave packet directly after the ionization and ellipticity dependent yield in high-harmonic generation might provide a testing ground for strong-field ionization models.

Q 59.2 Fri 10:45 V38.04

Generation of intensive tunable femtosecond pulses in the vacuum-UV and observation of wave packet dynamics in high excited states of NO — Peter Trabs, •Masood Ghotbi, Andrea Lübcke, Arnaud Rouzée, Franziska Buchner, and Marc Vrakking — Max-Born-Institut, Berlin

We developed a tunable source in the vacuum-UV(VUV) spectral range generating femtosecond pulses between 147 nm and 151 nm at 1 kHz repetition rate. Across the whole tuning range we obtained pulse energies of about 100 nJ with sub-50 fs pulse durations. The VUV pulses were generated by a difference-frequency four-wave mixing process in argon or krypton between the third harmonic of an amplified Ti:spphire laser system and the signal output of an optical parametric amplifier.

This source was recently used to study wave packet dynamics in high excited states of NO molecules by time-resolved photoelectron imaging. We will briefly describe the results.

Q 59.3 Fri 11:00 V38.04

A Farewell to Laser Flash Photolysis: Transient Spectroscopy Covering Three Octaves and 11 Orders of Magnitude in Time — •Maxmimilian Bradler, Christoph Grill, Christian Sailer, Daniel Herrmann, Igor Pugliesi, and Eberhard Riedle — BioMolekulare Optik, LMU München

We present transient UV-visible-NIR spectroscopy that can be used for the everyday analysis of dynamical and kinetic processes over an unprecedented temporal and spectral range. We achieve a 50 fs temporal resolution covering 195 to 5000 nm excitation without gap and 245 to 1600 nm detection. The pump for fs to few ns measurements is based on a NOPA operated at kHz repetition rate and nonlinear optics for frequency conversion. As probe light fs continua generated in bulk materials are utilized. With 775 nm pumping from the Ti:Sa amplifier operated at 1 kHz a probe range from 285 to 730 nm is available. The range down to 245 nm can be accessed with SHG pumping. The range up to the cut-off of silicon based detectors is covered by a continuum pumped by 1250 nm pulses. For the longest wavelength range out to 1600 nm the continuum-pump is tuned to 1800 nm and a InGaAs array used for detection. To cover the time range beyond single nanoseconds we use a synchronized ns OPO (tunable from 210 to 2600 nm) for excitation. The jitter of this light source is less than 200 ps, and its pulses are about 2.7 ns long. Switching the pump pulse allows us to cover in total the temporal range from femtoseconds to about one millisecond. The probe wavelength is reproducible to about 0.1 nm and this allows even for the observation of extremely small spectral shifts.

Q 59.4 Fri 11:15 V38.04

2D-UV Spectroscopy in the Pump-Probe Geometry: First Resolution of Cross-Peaks — •Igor Pugliesi, Nils Krebs, and Eberhard Riedle — BioMolekulare Optik, LMU München

Pulses with a spectral width large enough to cover the absorption bands and compressible to the Fourier limit are the major challenge for any realization of coherent two dimensional spectroscopy. While in the IR and VIS spectral range established techniques for the generation of ultrabroad pulses are available, in the UV the methods are still in their early stages and quite demanding. We now show that spectral broadening by self-phase modulation in bulk materials offers a simple and reliable option to generate UV pulses with a spectral width of 50 THz. 20 fs UV pulses between 295 and 370 nm are generated from a NOPA and spectrally broadened by focusing the beam into a few mm thin CaF_2 crystal. They are compressed to sub-16 fs by an acousto-optic pulse shaper. In the 2D-UV setup the broadened pulse is split into a pump and a probe beam and the acousto-optic pulse shaper is then used to compress and generate the phase locked double pulses. Building on this strategy we were able to record 2D-UV spectra of the vibrational progression of the first electronic absorption band of pyrene centered at 310 nm and we resolve vibrational wavepackets as cross-peak. This result is the doorway to the direct investigation of the energy and electron transfer dynamics in DNA.

Q 59.5 Fri 11:30 V38.04

Saturation of the all-optical Kerr effect in solids — •Bastian Borchers[1], Carsten Brée[2], Simon Birkholz[1], and Günter Steinmeyer[1] — [1]Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Max-Born-Straße 2a, 12489 Berlin, Germany — [2]Weierstraß Institute for Applied Analysis and Stochastics, Mohrenstraße 39, 10117 Berlin, Germany

Nonlinear Optics is based on a perturbative expansion of the relation between the polarization and the electric field: $P = \epsilon_0(\chi^{(1)}E + \chi^{(2)}E^2 + \chi^{(3)}E^3 + \dots)$. Normally it is sufficient to consider terms up to third order in this expansion. Recently, a controversial debate started whether or not higher order terms contribute to the formation of filaments in gases. Little is known, however, on the appearance of similar effects in solid dielectrica. In fact, their appearance would have severe consequences for our understanding of, e.g., Kerr lens mode-locking or supercontinuum generation in photonic crystal fibers.

We used multiphoton absorption rates provided by different theoretical models to compute a) the nonlinear refractive index via Kramers-Kronig transform and b) the plasma contribution predicted by the Drude model. Within this theoretical framework we observe the onset of the two different effects at nearly the same intensity, indicating that Kerr-saturation must not be neglected at intensities where plasma formation comes into play. These theoretical findings are discussed for the scenarios mentioned above along with the result of a four-wave mixing experiment in BaF_2 supporting the appearance of HOKE.

Q 59.6 Fri 11:45 V38.04

Rogue waves in the transverse domain of multifilaments — •Simon Birkholz[1], Carsten Brée[1,2], Goery Genty[3], Erik Nibbering[1], and Günter Steinmeyer[1,3] — [1]Max Born Institute, Berlin, Germany — [2]Weierstrass-Institut für Angewandte Analysis und Stochastik, Berlin, Germany — [3]Tampere University of Technology, Finland

We experimentally demonstrate rogue waves in multiple filamentation of pulsed laser beams. Other than previous demonstrations in optics, we observe rogue waves in a two-dimensional system analogous to deep water waves. The much stronger modulational instability in our system makes the appearance of rare events a ubiquitous phenomenon at the onset of multiple filamentation. We provide a careful statistical analysis of the L-shaped intensity distributions measured with a kHz line scan camera. In addition to the experimental observations, numerical simulations of multifilament formation are conducted. The numerical analysis indicates interaction between individual filament strings behind the appearance of rogue waves, widely confirming similar observations in the one-dimensional optical system and oceanic scenarios. We therefore believe that our experimental and theoretical analysis brings us closer to a unifying theory about the general appearance of extreme events in physics.