Q 61: Ultrashort Laser Pulses II

Time: Thursday 14:30–16:30 Location: K/HS2

Q 61.1 Thu 14:30 K/HS2

Femtosecond laser writing of Type I and Type II waveguides in polymers — •Welm Pätzold[1], Carsten Reinhardt[2], Bernhard Kreipe[1], Boris Chichkov[2], and Uwe Morgner[1,2] — [1]Institut für Quantenoptik, Leibniz Universität Hannover, Welfengarten 1, 30167 Hannover — [2]Laserzentrum Hannover e.V., Hollerithallee 8, 30419 Hannover

The method of direct material modification through multi-photon absorption of tightly focused fs-laser radiation is already widely applied on glasses and laser crystals for micromachining purposes. The transfer of this technique to polymers offers the potential to create low cost, flexible foils with integrated photonic structures. Especially when the structural change manifests as a change in refractive indices, the fabrication of embedded 3-dimensional waveguides becomes feasible.

We investigate the formation of Type I (guiding in the modified region) and Type II (guiding in-between modified regions) waveguides in different polymer materials. We explore different writing parameters, the morphology of the resulting waveguides, and their longterm stability.

Q 61.2 Thu 14:45 K/HS2

High-sensitivity measurement of the nonlinear refractive index of noble gases — •Andreas Blumenstein[1], Milutin Kovacev[2], Uwe Morgner[2,3], Peter Simon[1], and Tamas Nagy[1,2] — [1]Laser-Laboratorium Göttingen e.V., Hans-Adolf-Krebs-Weg 1, Göttingen — [2]Leibniz Universität Hannover, Institut für Quantenoptik, Welfengarten 1, Hannover — [3]Laser Zentrum Hannover e.V., Hollerithallee 8, Hannover

The optical Kerr-effect which induces an intensity-dependent change in the refractive index $n = n_0 + n_2 I$ can lead to numerous spectacular effects (e.g. spectral broadening). However, the measurement of n_2 especially in gases is very difficult due to its low value. In most experiments the actually measured quantity is the accumulated nonlinear phase: $\Delta\Phi(x,y) = \frac{2\pi}{\lambda_0}\int_0^L n_2 I(x,y,z)dz$. In a usual geometry where a laser beam is focused into the nonlinear medium there are two basic problems: (i) the interaction length is severely limited to the order of the Rayleigh-length and (ii) it is difficult to precisely determine the 3D intensity distribution of the beam. The former problem limits the sensitivity, the latter the absolute precision of the measurement. In contrast to previous arrangements we use a hollow waveguide to host the nonlinear interaction allowing well-defined intensity distribution throughout a substantially larger interaction length. Our technique provides dramatically higher sensitivity and precision in the determination of nonlinear refraction in gases than former approaches.

Q 61.3 Thu 15:00 K/HS2

Controlling rogue waves in fiber-supercontinua — Ayhan Tajalli[1], •Alexander Pape[1], Carsten Brée[2], Shalva Amiranashvili[2], Günter Steinmeyer[3], Uwe Morgner[1], and Ayhan Demircan[1] — [1]Leibniz Universität Hannover, Institut für Quantenoptik, Welfengarten 1, Hannover — [2]Weierstraß-Institut für Angewandte Analysis und Stochastik, Mohrenstr. 39, 10117 Berlin — [3]Max-Born-Institut (MBI), Max-Born-Straße 2a, 12489 Berlin

The concept of rogue waves comes from the observation of isolated large amplitude waves in the deep ocean. These waves appear more often than expected for a normal Gaussian distribution of statistical events. The discovery of an analogy to extreme events in the supercontinuum of optical fibers was a turning point that inspired research in a large number of different physical wave systems. Various models have been derived to describe the generation mechanism, reaching from closed mathematical solutions of Akhmediev breathers or Peregrine solitons to complex soliton-soliton collision processes. Here, we present experimentally and numerically how to control the appearance of rogue waves in optical supercontinua by inducing a suitably designed enhanced interaction of solitons with background radiation. In this way, we can demonstrate how to create or suppress rogue events in a complete deterministic fashion. Moreover we show that a weak control wave may not only serve to thwart rogue wave generation in a single case, but may actually serve to modify the 'weather' in rogue wave dynamics by actively manipulating the global event statistics. This mechanism is universal and applies to many nonlinear systems.

Q 61.4 Thu 15:15 K/HS2

Highly compact, low noise, all-solid-state laser system for stimulated Raman scattering microscopy — •Tobias Steinle[1], Vikas Kumar[2], Andy Steinmann[1], Marco Marangoni[2], Giulio Cerullo[2], and Harald Giessen[1] — [1]4th Physics Institute and Research Center SCOPE, University of Stuttgart, Germany — [2]IFN-CNR, Dipartimento di Fisica, Politecnico di Milano, Italy

We present a highly stable and compact laser source for stimulated Raman scattering (SRS) microscopy. cw seeding of an Yb oscillator pumped OPA with a tunable external-cavity diode laser allows to cover the whole H-stretching vibrational region. In contrast to many other state of the art SRS sources, a single-channel silicon detector is employed. Despite the rather high noise level of the OPA, excellent signal-to-noise ratio is obtained by exploiting the performance of the solid-state Yb oscillator. Since very few optical components are required and a single-pass scheme can be used, the system is simple to set up, operate and maintain. As a further benefit, the simplicity comes along with low cost and robustness.

Q 61.5 Thu 15:30 K/HS2

Strong quantum interferences in frequency conversion towards short vacuum-ultraviolet radiation pulses — •Patric Ackermann. and Thomas Halfmann — TU-Darmstadt, Institut für Angewandte Physik, Darmstadt, Deutschland

We present experimental data on quantum interferences in resonantly enhanced frequency up-conversion towards the vacuum-ultraviolet spectral regime. The process is driven in xenon atoms by ultrashort laser pulses. We use two simultaneous frequency conversion pathways via an excited intermediate state, i.e., fifth harmonic generation of the fundamental wavelength and four-wave mixing of the fundamental and two photons of its second harmonic wavelength. Both conversion pathways yield radiation at 102 nm. The two pathways interfere, depending on the relative phase of the fundamental and second harmonic. By appropriate choice of the phase we get constructive interference (increased conversion efficiency) or destructive interference (reduced conversion efficiency). The total conversion yield shows very pronounced constructive and destructive quantum interference with a visibility of roughly 90%. A stable and highly accurate phase control setup enables such strong quantum interferences for more than 260 oscillation cycles. In an extension of the experiment, simultaneously we also monitor laser-induced fluorescence as a measure for the excitation probability to the excited intermediate state. A small phase lag occurs between the quantum interference patterns of frequency conversion and population transfer. This is due to an additional atomic phase acquired during frequency conversion.

Q 61.6 Thu 15:45 K/HS2

Time-resolved two-color laser-induced photoemission from a metal nanotip in the infrared — •Timo Paschen, Michael Förster, Michael Krüger, Sebastian Thomas, and Peter Hommelhoff — Lehrstuhl für Laserphysik, Department Physik, Friedrich-Alexander Universität Erlangen-Nürnberg, Staudtstr. 1, 91058 Erlangen

By focusing femtosecond laser pulses on an ultrasharp metal tip it is possible to trigger laser-induced electron emission in the strong-field regime [1] due to field enhancement in the vicinity of the tip apex. Since the emission dynamics are highly dependent on the temporal form of the laser field [2] we investigate electron emission from a single crystal tungsten tip using an asymmetrically synthesized waveform consisting of two different laserfields. For our experiments a spectrally broadened erbium-doped fiber laser system [3] is used. We show time-resolved dynamics of laser-induced photoemission dependent on the relative phase between ultrashort infrared laserpulses and their second harmonic.

[1] M. Schenk et al., Phys. Rev. Lett., 105, 257601 (2010).
[2] M. Krüger et al., Nature 475, 78 (2011).
[3] S. Thomas et al., Optics Express 20, 13663 (2012).

Q 61.7 Thu 16:00 K/HS2

Dielectric Laser Acceleration of Subrelativistic Electrons in the Vicinity of a Fused Silica Grating: Recent Results and Future Directions — •Joshua McNeur[1], John Breuer[2], Jonas Hammer[1], Ang Li[1], Norbert Schönenberger[1], Alexander Tafel[1], and Peter Hommelhoff[1,2] — [1]Department of Physics, Friedrich-Alexander-Universität Erlangen Nürnberg, Staudtstr. 1, D-91058 Erlangen, Germany — [2]Max Planck Institute of Quantum Optics, Hans-Kopfermann-Str. 1, D-85748 Garching, Germany

Within the last year, Dielectric Laser Acceleration has been demonstrated on multiple fronts (at different electron energies, laser wavelengths and laser pulse energies) [1,2]. The theory [3] and recent demonstration of Dielectric Laser Acceleration of subrelativistic electrons is reviewed. In this experiment, a Ti:Sapphire laser is incident upon a fused silica grating, exciting fields that accelerated 28 keV thermally emitted electrons with a 25 MeV/m acceleration gradient, detected via a retarding field spectrometer and micro channel plate. Upgrades and future directions of this DLA project taking place at Friedrich-Alexander-Universität, including proton acceleration, use of a 2 micron Thulium laser, testing of deflecting and focusing geometries and a laser-triggered electron source, are discussed.

1. Peralta et al., 2013 Nature 503 91
2. Breuer and Hommelhoff, 2013 Phys. Rev. Lett. 111 134803
3. Breuer, McNeur and Hommelhoff, 2014 J. Phys. B: At. Mol. Opt. Phys. 47 234004

Q 61.8 Thu 16:15 K/HS2

Erzeugung spinpolarisierter Elektronen mit variabler Repetitionsrate durch Hochfrequenz-modulierte Laserdioden

— •Martin Espig, Joachim Enders, Yuliya Fritzsche, Andreas Kaiser, Neeraj Kurichiyanil und Markus Wagner — TU Darmstadt, Institut für Kernphysik

Zur Erhöhung der Verfügbarkeit der Quelle polarisierter Elektronen am supraleitenden Darmstädter Elektronenbeschleuniger S-DALINAC wird zur Zeit ein Kathoden-Reinigungs- und -Testsystem aufgebaut ("Photo-CATCH", photo cathode activation, test and cleaning with atomic hydrogen), welches polarisierte Elektronen aus Strained-Superlattice-GaAs- und bulk-GaAs-Photokathoden erzeugt.
Es werden die Arbeitsweise sowie die simulierten Ergebnisse von hochfrequent modulierten Laserdioden und darauf basierende Messungen vorgestellt. Ziel ist die Erzeugung von Laserpulsen mit Halbwertsbreiten <50 ps bei variablen Repetitionsraten von 3 GHz und Subharmonischen bis 1 MHz. Photo-CATCH wird so in Zukunft Elektronenstrahlen für Polarisations-, Hochstrom- und Laufzeitexperimente zur Verfügung stellen können.

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