Q 49: Ultrashort laser pulses: Generation II

Time: Thursday 11:00–12:30 Location: F 142

Group Report Q 49.1 Thu 11:00 F 142

Novel opportunities with intense mid-IR pulses: Self-compression to the 3-cycle regime and broadest coherent supercontinuum source — Matthias Baudisch[1], •Michael Hemmer[1], Alexandre Thai[1], Francisco Silva[1], Dane Austin[1], Arnaud Couairon[2], Daniele Faccio[3], and Jens Biegert[1,4] — [1]ICFO Institut de Ciencies Fotoniques, 08860 Castelldefels, Barcelona, Spain — [2]Centre de Physique Theorique, Ecole Polytechnique, CNRS UMR 7644, F-91128 Palaiseau Cedex, France — [3]Heriot-Watt University, Edinburgh Campus, Edinburgh EH14 4AS, United Kingdom — [4]ICREA Institucio Catalana de Recerca i Estudis Avançats, 08010 Barcelona, Spain

Availability of intense few-cycle pulses in the mid-IR allows scrutinizing strong field and attoscience phenomena in the deep tunneling regime. We present first results from anomalous nonlinear propagation and filamentation in solid state media. We observe coherent supercontinuum generation from filamentary propagation in YAG avoiding the ubiquitous chaotic pulse breakup and loss of coherence. The resulting 3.3 octave-spanning spectrum is the broadest demonstrated, and coherent, supercontinuum generated in bulk [1]. Furthermore, the intricate pulse propagation dynamics results in stable temporal self-compression from 70 fs at 3100 nm to 32 fs which correspond to the sub-3-optical-cycle regime. The self-compression is surprisingly efficient (80%) and extremely stable; we observe a pulse-to-pulse stability of 0.8% rms. Numerical simulations and experimental results show excellent agreement.

Q 49.2 Thu 11:30 F 142

Beating the astigmatism in laser focusing and collimation with off-axis spherical mirrors — •Emanuel Wittmann, Niko Heinrichs, Elias Eckert, and Eberhard Riedle — LS für BioMolekulare Optik, LMU München

A central issue in ultrafast optics is the need to focus and collimate pulses with a very wide spectrum without diffractive elements. Diffractive lenses introduce an unacceptable chirp and also chromatic aberrations. Theoretically parabolic mirrors would be ideal. However, their optical quality is far inferior to spherical mirrors and the off-axis parabolics are only useful in the IR. We show that a combination of a concave and a convex spherical mirror with suitable ratio of radii of curvature can focus and collimate ultrafast pulses without any detectable astigmatism. This is found at angles where a single spherical mirror already introduces a large aberration. The new possibility is highly interesting for the collimation of NOPA seed continua generated in bulk materials and the beam management in 2D-UV spectroscopy. It renders for the first time undistorted short wavelength and duration pulses in the interaction region. In the talk the theoretical background, the implementations as well as the characterization of the spatial beam evolution are discussed. Ongoing measurements on the quality of the resulting phasefronts will conclude the presentation.

Q 49.3 Thu 11:45 F 142

High-order harmonic generation in laser-induced plasma plumes at 1 kHz repetition rate — •Jiaan Zheng[1], Michael Wöstmann[1], Henrik Witte[1], Helmut Zacharias[1], and Rashid A. Ganeev[2] — [1]Physikalisches Institut, Westfälische Wilhelms-Universität, Wilhelm-Klemm-Str.10, 48149 Münster, Germany — [2]Institute of Ion, Plasma, and Laser Technologies, Academy of Sciences of Uzbekistan, Akademgorodok 33, Dormon Yoli Street, Tashkent 100125, Uzbekistan

High-order harmonic generation (HHG) of ultra-short laser pulses in laser-induced plasmas for generation of extreme ultraviolet radiation is reported. Laser-generated silver and tin plasma plumes are produced by an amplified Ti:sapphire laser system, which provides pulse energies up to 5 mJ at a duration of 35fs and 1 kHz repetition rate. The HHG output is characterized with regard to the target design, the pre-pulse energy and pre-pulse duration. The time delay between the pre-pulse for plasma generation and the main pulse for efficient HHG was optimized. Influences of a main pulse chirp and an additional second harmonic field in the main pulse on the HHG spectra are studied.

Q 49.4 Thu 12:00 F 142

A broadband milliwatt-level mid-infrared source for near-field microscopy applications — •Robin Hegenbarth[1], Andy Steinmann[1], Sergey Sarkisov[2], Stefan Mastel[3], Sergiu Amarie[3], Andreas Huber[3], and Harald Giessen[1] — [1]4th Physics Institute and Research Center SCoPE, University of Stuttgart, Stuttgart, Germany — [2]Siberian Physical and Technical Institute of Tomsk State University, Tomsk, Russia — [3]Neaspec GmbH, Planegg, Germany

We demonstrate the generation of broadband mid-infrared radiation by difference-frequency mixing of two signal wavelengths of a femtosecond dual-signal-wavelength optical parametric oscillator (OPO). The OPO is pumped by a mode-locked Yb:KGW laser with 530 fs pulse duration and 7.4 W average output power and employs a 1 mm long MgO:PPLN crystal with 31 μm poling period. With a total intracavity group delay dispersion equal to zero at 1740 nm wavelength the OPO generates two different signal wavelengths that are mixed in an extracavity GaSe or $AgGaSe_2$ crystal. The polarizations of the OPO signals were adjusted to enable a type-II phase-matching process. This system generates up to 4.3 mW average mid-infrared power. Its spectra can be tuned between 10.5 μm and 16.5 μm (952 cm^{-1} - 606 cm^{-1}) with more than 50 cm^{-1} spectral bandwidth. We combined this system with a scattering-type SNOM and show near-field spectra on gold and near-field scans of Si-doped GaN nanowires.

Q 49.5 Thu 12:15 F 142

Rauscharmes, CEP stabilisiertes OPCPA System — •Jan Matyschok[1], Thomas Binhammer[2], Oliver Prochnow[2], Stefan Rausch[1,2], Piotr Rudawski[3], Cord L. Arnold[3], Anne L'Huillier[3] und Uwe Morgner[1,4,5] — [1]Institut für Quantenoptik, Leibniz Universität Hannover, D-30167 Hannover — [2]Venteon Laser Technologies GmbH, D-30827 Garbsen — [3]Department of Physics, Lund University, SE-221 00 Lund — [4]Quest: Center for Quantum Engineering and Space-Time Research, D-30167 Hannover — [5]Laser Zentrum Hannover e.V., D-30419 Hannover

Wir präsentieren ein zweistufiges, nichtkollineares OPCPA System bei einer Repetitionsrate von 200 kHz. Als Seedquelle kommt ein CEP stabilisierter Titan:Saphir-Oszillator (VENTEON | PULSE : ONE OPCPA SEED) zum Einsatz. Dieser liefert neben dem breitbandigen Spektrum, das Pulsdauern $<$ 6 fs unterstützt, gleichzeitig und ohne zusätzliche externe Verbreiterung hinreichend Leistung bei 1030 nm, um damit einen Faserverstärker zu seeden. Mit den frequenzverdoppelten Ausgangspulsen wird ein zweistufiger parametrischer Verstärker gepumpt, um die ursprüngliche Pulsenergie von 2 nJ auf mehr als 10 μJ zu verstärken. Die Ausgangsleistung von mehr als 2 Watt, bei einer Pulsdauer von 6,3 fs, weist ohne zusätzliche Stabilisierung ein rms Rauschen von 0,35 % über 100 Minuten auf. Langsame CEP-Drifts können durch eine zweite Regelschleife ausgeglichen werden. Durch das geringe Amplitudenrauschen, sowie der stabilen CE-Phase bei einer Pulsspitzenleistung von 800 MW, eignet sich dieses OPCPA-System hervorragend für die Erzeugung von hoher harmonischer Strahlung.