K 1: Laser Systems

Time: Tuesday 10:30–12:00 Location: K-H4

K 1.1 Tue 10:30 K-H4

High-power, ultra-broadband, femtosecond non-collinear optical parametric oscillator in the visible spectral range (VISNOPO) — •Robin Mevert[1,2], Yuliya Binhammer[1,2], Christian M. Dietrich[1,2], Luise Beichert[1,2], José R. Cardoso de Andrade[3], Thomas Binhammer[4], Jintao Fan[1,2], and Uwe Morgner[1,2] — [1]Institute of Quantum Optics, Leibniz University Hannover, Welfengarten 1, D-30167 Hannover, Germany — [2]Cluster of Excellence PhoenixD, Welfengarten 1, D-30167 Hannover, Germany — [3]Max-Born-Institute, Max-Born-Straße 2A, D-12489 Berlin — [4]neoLASE GmbH, Hollerithallee 17, D-30419 Hannover, Germany

Ultrafast visible radiation is of great importance for many applications ranging from spectroscopy to metrology. Unfortunately, most of the visible range is not covered by laser gain media, hence optical parametric oscillators offer a solution. Besides a high-power broadband laser source, the rapid frequency tunability of pulses with high-power spectral densities is a clear advantage for experiments such as multicolor spectroscopy or imaging. Here, we demonstrate a high-power, ultrabroadband, rapidly tunable femtosecond non-collinear optical parametric oscillator with a signal tuning range of 440-720 nm. The VISNOPO is pumped by the third harmonic of an Yb-fiber laser at 345 nm. Moreover, the signal wavelength is tuned by changing the cavity length only. Output powers up to 452 mW and pulse duration down to 268 fs with a repetition rate of 50.2 MHz are achieved. To the best of our knowledge, this is the first demonstration of a quickly tunable femtosecond NOPO that covers nearly the entire visible spectral range.

K 1.2 Tue 10:45 K-H4

1 MHz - CEP stable, few-cycle OPCPA with dual channel output at 800nm and 2μm wavelength — Thomas Braatz, Ekaterina Zapolnova, Sebastian Starosielec, Torsten Golz, •Kolja Kolata, Mark Prandolini, Jan Heye Buss, Michael Schulz, and Robert Riedel — Class 5 Photonics GmbH, Research Campus Hamburg Bahrenfeld, Luruper Hauptstrasse 1, 22547 Hamburg, Germany

Active carrier envelope phase (CEP) stabilization in the few-cycle regime is essential for most attosecond experiments, e.g. studying the coherent evolution of electronic structure and dynamics in solids or complex many body phenomena crystals, require active carrier envelope phase stabilization in the few-cycle regime. We present an optical parametric chirped-pulse amplifier (OPCPA) design providing CEP stable, sub 9 fs pulses with a dual channel output around 800 nm center wavelength and 2 *m as a high-harmonic driver for attosecond experiments. Two CEP stable OPCPA designs (a) high repetition rate and (b) a high pulse-energy system will be demonstrated.

K 1.3 Tue 11:00 K-H4

a stabilized doubly resonant optical parametric oscillator for strong-field applications — •han rao[1,2], christian markus dietrich[1,2], josé ricardo cardoso de andrade[3], ayhan Demircan[1,2], ihar babushkin[1,2,3], and uwe morgner[1,2] — [1]Leibniz University Hannover, Institute of Quantum Optics, Hannover, Germany — [2]Cluster of Excellence PhoenixD, Hannover, Germany — [3]Max Born Institute, Berlin, Germany

Strong tailored two-and three-color optical waveshapes can be especially useful for effective generation of light at very high (XUV) and very low (THz) frequencies via the photoionization dynamics. In particular, for generation of THz radiation, strong and stable asymmetric time-waveshapes are needed. Phase locked doubly resonant optical parametric oscillators (DROPO) can provide, via strong intracavity enhancement, high enough intensities needed for this goal. DROPO can work in a self-locking regime, where the relative phases between the signal, idler and pump waves are locked. The region of cavity lengths (detuning) where DROPO is locked, is however typically small, and even if self-locking is achieved, the dynamics is destabilized on the long run. In this work, we stabilize our degenerate DROPO by using a locking scheme which utilizes monitoring of a "parasitic" sum-frequency generation (SFG) of the signal and pump-a method proposed very recently.

K 1.4 Tue 11:15 K-H4

InP-based Semiconductor Saturable Absorber Mirror (SESAM) for ultrashort laser pulse generation at 1560 nm — •Alexander Dohms[1], Steffen Breuer[1], Christoph Skrobol[2], Robert B. Kohlhaas[1], Lars Liebermeister[1], Martin Schell[1,3], and Björn Globisch[1,3] — [1]Fraunhofer HHI, Einsteinufer 37, 10587 Berlin, Germany — [2]TOPTICA Photonics AG, Lochhamer Schlag 19, 82166 Gräfelfing, Germany — [3]TU Berlin, Festkörperphysik, Hardenbergstraße 36, 10623 Berlin, Germany

Semiconductor Saturable Absorber Mirrors (SESAMs) are key to ultrafast lasers, as they allow for simple and self-starting passive modelocking and pulse stabilization. However, SESAMs based on the standard AlAs/GaAs material system require highly strained InGaAs absorber layers, which may reduce the device efficiency and operational lifetime. Here, we report on an entirely strain-free SESAM based on InP/InGaAlAs, designed for 1560 nm operation with an Erbium-doped fiber laser. The SESAM is composed of a highly reflective InGaAlAs/InAlAs Bragg mirror and an InGaAs absorber, which provides ultrafast SESAM response ($\tau < 1$ ps), low non-saturable losses and high modulation depth (ΔR = 8 %) at the same time. The near anti-resonant SESAM design results in very high saturation fluence (25 μJ/cm2) and roll-over fluence (33 mJ/cm2), and is demonstrated to enable successful laser self-start and stable modelocking of 330 fs pulses at 80 MHz repetition rate and 17.5 mW average power. This illustrates the excellent optical performance of InP-based SESAMs, which will enable more reliable and efficient ultrafast laser systems.

K 1.5 Tue 11:30 K-H4

Compact Few-Cycle Source in the Mid-Infrared by Adiabatic Difference Frequency Generation — •Engjell Bebeti[1], Felix Ritzkowsky[1,2], Giulio M. Rossi[1,2], Nicholas H. Matlis[1,2], Haim Suchowski[3], Huseyin Cankaya[1,2], and Franz X. Kärtner[1,2] — [1]Center for Free-Electron Laser Science CFEL, Deutsches Elektronen-Synchrotron DESY, Germany — [2]Department of Physics and The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Germany — [3]Department of Condensed Matter Physics, Tel-Aviv University, Israel

Ultrafast electron emission in nano plasmonic structures is driven by the electric field of few-cycle infrared pulses. Shaping of the optical pulse waveform allows for controlling of the emitted electrons. We present a compact few-cycle source in the mid-infrared with a controllable center wavelength in the range of 2 and 3.5 microns, generating pulses with 60 nJ of energy at a repetition rate of 50 kHz, serving as an ideal driver for such experiments. Our setup is driven by a commercial regenerative Yb:KYW amplifier delivering 420 fs pulses at a wavelength of 1.03 microns. The nonlinear conversion scheme consists of an adiabatic difference frequency generation (ADFG) crystal subsequent to an optical parametric amplifier stage. The ADFG allows for a broadband and linear one-to-one conversion in spectral amplitude and phase of the incident pulse producing octave-spanning mid-infrared pulses with a pulse duration down to 13 fs. The tunability of the center wavelength will enable tailoring of the few-cycle waveform to tightly control ultrafast electron emission.

K 1.6 Tue 11:45 K-H4

Laser frequency stabilization using quasi-monolithic unequal-arm interferometers — •Miguel Dovale Alvarez, Victor Huarcaya, Juan Jose Esteban Delgado, and Gerhard Heinzel — Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Callinstrasse 38, 30167 Hannover, Germany

Lasers with high and ultra-high frequency stability are a key resource in many areas of science and technology, such as high-precision time and frequency metrology, inertial sensing, and the search for gravitational waves. Typically the required stability is achieved by locking the laser to the narrow resonance of a structurally stable optical cavity, or to the narrow absolute reference frequency provided by atomic or molecular transitions. These frequency stabilization schemes usually involve many optical components, modulators, and complex electronics. Here we describe the advances in laser frequency stabilization via quasi-monolithic unequal-arm interferometers with DC balanced readout. In this scheme the setup consists of only a handful of optical components, as well as an analog circuit to perform the balanced readout and the feedback to the laser. The structural stability of the interferometer is transferred to the frequency stability of the laser, and hence a big effort is directed towards isolating the interferometer from external perturbations. Preliminary measurements show a stability of $100\,\mathrm{Hz}/\sqrt{\mathrm{Hz}}$ at $1\,\mathrm{Hz}$, worsening with $1/f$ at lower frequencies. In the next iteration of this experiment, we aim to reduce the noise floor at low frequency by enhancing several aspects of the setup. $\pm 1^\circ$