K 3: Laser Systems I

Zeit: Dienstag 14:00–16:00 Raum: HS 3

K 3.1 Di 14:00 HS 3

Build-up dynamics in an optical parametric oscillator with synchronized pump modulation — •Moritz Floess[1], Tobias Steinle[1,2], Florian Moerz[1], Heiko Linnenbank[1], Andy Steinmann[1], and Harald Giessen[1] — [1]4th Physics Institute and Research Center Scope, University of Stuttgart, D-70569 Stuttgart — [2]ICFO - Institut de Ciencies Fotoniques, The Barcelona Institute of Science and Technology, 08860 Castelldefels, Barcelona, Spain

We investigate the build-up dynamics in an optical parametric oscillator (OPO) by synchronously modulating the intensity of the pump beam. An 8-W, 1032-nm, 450-fs Yb:KGW oscillator with 41 MHz repetition rate serves as the OPO pump source. The intensity modulation is realized with an acousto-optical modulator (AOM), which is electronically locked to the repetition rate of the pump laser. The AOM bandwidth of 200 MHz enables shutter times of only ~7 ns. Therefore, the full pump power is available within one laser cycle. This allows to investigate the temporal build-up process of the signal pulses in the OPO cavity. Furthermore, we also have access to the dynamics in the spectral domain by using a dispersive Fourier transformation (DFT) scope, which allows to measure spectra of individual, isolated pulses.

K 3.2 Di 14:20 HS 3

Dispersion management in a fs Fiber-Feedback Optical Parametric Oscillator — •Matthäus Jäckle[1], Heiko Linnenbank[1], Tobias Steinle[2], Florian Mörz[1], Andy Steinmann[1], and Harald Giessen[1] — [1]University of Stuttgart, Pfaffenwaldring 57, 70569, Germany — [2]ICFO Institute of Photonic Sciences, Av. Carl Friedrich Gauss 3, 08860 Barcelona, Spain

Fiber-Feedback optical parametric oscillators (ff-OPO) are tunable, coherent light sources which are used in a wide range of spectroscopic applications like FTIR, sSNOM and SRS. They rely on a fiber-based cavity and large nonlinear gain, which is usually achieved by pump pulses in the picosecond and several hundred femtoseconds regime. This combination leads to a remarkable temporal power stability and ultralow noise characteristics.

The investigated ff-OPO is pumped by a near-infrared solid-state laser with a pulse duration close to 100 fs. Light between 1400 nm and 1900 nm with 120 fs pulse durations and nJ pulse energies is generated. In our experiments the feedback-fiber of the cavity introduces not only pulse broadening caused by linear dispersion, but also nonlinear fiber effects such as Kelly sidebands and self-phase modulation. These effects lead to broader pulses as well as disturbances in the spectrum. Here we show how these effects can be compensated, reduced or even exploited by carefully controlling the intra-and extra-cavity dispersion.

K 3.3 Di 14:40 HS 3

Towards a Joule-Class Ultrafast Thin-Disk Based Amplifier at Kilohertz Repetition Rate — •Clemens Herkommer[1,2], Peter Krötz[1], Sandro Klingebiel[1], Christoph Wandt[1], Dominik Bauer[3], Knut Michel[1], Reinhard Kienberger[2], and Thomas Metzger[1] — [1]TRUMPF Scientific Lasers GmbH & Co. KG, Feringastr. 10a, 85774 Unterföhring — [2]Techn. Universität München, Physik-Department, James-Franck-Str. 1, 85748 Garching — [3]TRUMPF Laser GmbH, Aichhalder Str. 39, 78713 Schramberg

In the recent years, thin-disk based regenerative amplifiers (RAs) have enabled the generation of sub-picosecond laser pulses with energies exceeding 200 mJ. Applications such as the pumping of OPCPAs and the generation of high-harmonics and x-rays are currently addressed. Nevertheless, there is a desire for even higher peak powers, realized by higher pulse energies along with shorter pulse durations. Scaling the pulse energy within a RA requires adapting the cavity mode size, however, the limited aperture of currently available Pockels cells remains the bottleneck for the achievable output energy.

In this contribution we report on the development of a thin-disk based high-energy multipass amplifier operating at 1 kHz, circumventing the current energy limitation of RAs. The chirped pulse amplifier consists of a fiber oscillator delivering chirped seed pulses, a RA preamplifying the pulses to 200 mJ, and the multipass amplifier, consisting of two thin-disk laser heads, boosting the pulse energy to 600 mJ. Currently, by using further amplifier stages, a laser source with sub-ps pulse durations and pulse energies of >1 Joule is under construction.

K 3.4 Di 15:00 HS 3

Diode-pumped Tb^{3+}-doped laser with direct emission in the visible range — •Elena Castellano-Hernández and Christian Kränkel — Zentrum für Lasermaterialien, Leibniz-Institut für Kristallzüchtung (IKZ), Berlin, Germany

We present, to the best of our knowledge, the first diode pumped laser operation of Tb^{3+}-doped materials. Under pumping with an InGaN diode laser and without any nonlinear conversion steps, a $Tb^{3+} : LiLuF_4$ laser operates at a wavelength of 542.5 nm in the green. Under 200 mW of diode pumping at 488.3 nm, we obtained 44 mW of green output with a slope efficiency with respect to the absorbed pump power of 52 %. Initial results were also obtained at 587.5 nm in the yellow.

K 3.5 Di 15:20 HS 3

Growth and characterization of Er^{3+}-doped sesquioxide crystals for 3 μm lasers — •Anastasia Uvarova, Christo Guguschev, and Christian Kränkel — Zentrum für Lasermaterialien, Leibniz-Institut für Kristallzüchtung, Berlin, Germany

Lasers in the wavelength range of 3 μm are attractive in fields like laser surgery or atmospheric detection. Er^{3+}-doped sesquioxide crystals have been shown to be very suitable laser materials for this purpose. However, the melting points of these materials in excess of $2400°C$ make the growth of these materials very challenging. Here, we report on our recent efforts to utilize the optical floating zone method (OFZ) for the growth of sesquioxide crystals to avoid the use of expensive and sensitive crucible materials. Undoped and Er^{3+}-sesquioxide crystals with diameters up to 5 mm and cm-lengths were grown in a high temperature OFZ furnace under Ar-atmosphere at elevated pressure.

K 3.6 Di 15:40 HS 3

Long-term stability of the 200 TW ANGUS laser system — •Timo Eichner[1], Cora Braun[1], Björn Hubert[1], Lars Hübner[1,2], Sören Jalas[1], Manuel Kirchen[1], Vincent Leroux[1], Phuoc-Thien Le[1], Philipp Messner[1], Jannis Neuhauss-Steinmetz[1], Max Trunk[1], Christian Werle[1], Paul Winkler[1,2], and Andreas R. Maier[1] — [1]Center for Free-Electron Laser Science and Department of Physics, University of Hamburg, Hamburg — [2]Deutsches Elektronen-Synchrotron (DESY), Hamburg

Laser-plasma acceleration has developed into a technique providing high-energy electron beams as a driver for undulator-based X-ray sources. The LUX beamline, built in close collaboration of the University of Hamburg and DESY, is designed to be such a light source. The plasma acceleration stage is driven by the ANGUS laser, a Ti:Sapphire based system capable of producing 5J, 25fs pulses at a repetition rate of up to 5Hz. After significant in-house development, the laser has reached an operational stability, that enables us to repeatedly demonstrate 24-hour operation of the laser-plasma accelerator with several 10k consecutive electron beams and high availability. The electron beam quality is sufficient to drive a miniature undulator, generating undulator radiation at wavelengths below 4nm.

Integrating the laser into an accelerator-grade controls system, with several hundred online diagnostic channels, was a crucial step to achieve operational stability and day-to-day reproducibility. Here, we discuss the stability and control of spectral and temporal pulse properties in the context of 24-hour long experimental runs.