K 2: Laser Systems and their Applications II

Time: Monday 17:00–17:45 Location: HS 20

K 2.1 Mon 17:00 HS 20

Diode-Pumped and Helium-Gas-Cooled Yb:YAG Multi-Slab Amplifier with > 10 J Pulse Energy and > 1 Hz Repetition Rate — •Katrin Schulz[1,2], Klaus Ertel[1], Markus Graf[1], Harald Rapp[1], Aleksander Budnicki[1], Klaus Albers[1], Thomas Dekorsy[2,3], and Bernd Metzger[1] — [1]Trumpf Laser SE, 78713 Schramberg, Germany — [2]University of Stuttgart, 70569 Stuttgart, Germany — [3]German Aerospace Center (DLR), 70569 Stuttgart, Germany

We report on a high-energy, diode-pumped solid-state laser employing a multi-slab multi-pass Yb:YAG amplifier operating with helium gas cooling at room temperature. So far, the highest measured parameters with this setup are 10.4 J pulse energy at 20 ns pulse duration, an optical-to-optical efficiency of 23 %, and a repetition rate of 10 Hz. Furthermore, an output energy stability of 0.17 % (std. dev.) was demonstrated over 20 minutes. The current results demonstrate the potential to increase the output energy and repetition rate to approximately 20 J and 100 Hz, respectively, within a reasonable timescale. This demonstration of room temperature operation brings industrial application of high-energy and high-average power laser systems closer to reality.

K 2.2 Mon 17:15 HS 20

Compact Shot-Noise Limited Multipass OPO providing Watt-Scale, Femtosecond Pulses — •Johann Thannheimer[1], Florent Kadriu[1,2], Philipp Flad[1], Tobias Steinle[1,2], and Harald Giessen[1] — [1]4th Physics Institute and Research Center SCoPE, University of Stuttgart, Stuttgart, Germany — [2]SI Stuttgart Instruments GmbH, Stuttgart, Germany

We present an efficient, high power, tunable, shot-noise limited, truly single-stage, ultrashort pulse source with an excellent spatial profile. High power ultrafast lasers are essential light sources for a many applications such as ultrafast spectroscopy, bioimaging and medical ablation. The limited number of laser gain media that simultaneously provide a large gain bandwidth and high gain limits ultrafast lasers to only a few central wavelengths. Optical parametric oscillators (OPO) are inherently broadly tunable, but limited to either a high gain or a broad bandwidth. The traditional solution to this are cascading amplification stages, increasing system footprint and cost. Our novel multipass parametric amplifier (MPA) [Nägele et al. Nature 647, 74 (2025)] combines multiple passes through a single nonlinear crystal with dispersion engineered coatings to reset the dispersion and drop the idler, simultaneously achieving a broad bandwidth and high gain. In this work the MPA is implemented in a fiber-feedback cavity as an oscillator (FFMOPO). This allows us to forgo a seed OPO, decreasing the system footprint and cost. Signal powers over one Watt at pulse durations around 100 fs are achieved with a system conversion efficiency of around 40 % and a tuning range of over 400 nm.

K 2.3 Mon 17:30 HS 20

Continuous-wave injection-seeded multipass OPA for direct 1 W, 76 MHz, sub-50 fs pulse generation at 1.5*1.7 *m — •Florent Kadriu, Johann Thannheimer, Philipp Flad, Tobias Steinle, and Harald Giessen — University of Stuttgart 4th Physics Institute

Generating sub-50 fs laser pulses in the near-infrared via nonlinear down-conversion is fundamentally limited by the trade-off between amplification bandwidth and achievable gain. Conventional approaches based on OPOs or OPO/OPA combinations often require several amplification stages, adding significant complexity. A cw-seeded OPA can eliminate the need for an additional OPO, but such setups typically remain elaborate multi-stage systems. Here, we present a cw-seeded, extremely compact, and low-noise OPA based on our recently introduced multipass-OPA technology (Nägele et al.,*Dispersion-engineered multipass optical parametric amplification,* Nature 647, 74*79 (2025)). The system delivers Watt-scale average power in sub-50 fs pulses and is continuously tunable from 1.5 to 1.7 *m, offering a simple and efficient alternative to conventional multi-stage near-IR ultrafast sources.