Photonics and Ultrafast Laser Science

puls

Master thesis

Nonlinear self-compression of 2-µm ultrafast laser

Ultrafast 2-µm laser development is one of the main topics in PULS group. We have developed state-of-the-art solid-state bulk lasers at 2 µm wavelength based on Ho:CALGO crystals generating 100nJ to 100µJ fs/ps pulses [1,2]. Benefits from the nature of anomalous dispersion in the 2-µm wavelength region, it is convenient to use solid-core fibers to self-compress 2-µm pulses to few-optical cycle [3]. The current project aims to combine the self-compression technique with the 2-µm laser to achieve few-cycle pulses at 2 µm.

You will be part of the 2-µm laser-development team for the duration of your project. Your main tasks consist of the following parts:

- Simulating pulse compression in fiber with different parameters including input power/duration, fiber length/core size to give an instructive.
- Building and optimizing the fiber-compression stage to achieve sub-10 optical cycle pulses with high overall efficiency.
- Adapting current 1-µm FROG setup to 2-µm wavelength range and characterize the compressed pulse.
- Further extensions can be discussed depending on progress.

Successful completion of the project will give you skills besides a dissertation:

- Opto-mechanical design
- Knowledge of ultrafast pulse generation, compression and characterization
- Programming in Python

If you are interested in this topic, please contact Dr. Anna Ono for further discussion including the starting date via email: anna.ono@ruhr-uni-bochum.de

1. W. Yao, Y. Wang, S. Tomilov, M. Hoffmann, S. Ahmed, C. Liebald, D. Rytz, M. Peltz, V. Wesemann, and C. J. Saraceno, "8.7-W average power, in-band pumped femtosecond Ho:CALGO laser at 2.1 µm," Opt. Express **30**(23), 41075 (2022).
2. A. Suzuki, S. Ahmed, Y. Wang, and C. J. Saraceno, "Broadband Ho:CALGO regenerative amplifier at 2.1 µm," in *CLEO US* (Optica Publishing Group, 2024).
3. C. Gaida, M. Gebhardt, F. Stutzki, C. Jauregui, J. Limpert, and A. Tünnermann, "Self-compression in a solid fiber to 24 MW peak power with few-cycle pulses at 2 µm wavelength," Opt. Lett., OL **40**(22), 5160–5163 (2015).