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. Recently we have developed a state-of-the-art solid-state bulk oscillator in the 2-3 µm wavelength region with record-high pulse energy of 100 nJ and pulse duration of 300 fs [1]. 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-cycle [2]. Current project aims to combine the self-compression technique with the 2-µm oscillator to achieve few-cycle pulses in 2 µm.

You will be part of the laser-development sub-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 extension can be discussed depends on progress.

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

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

If you are interested in this topic, please contact Dr. Yicheng Wang for further discussion via email: yicheng.wang@ruhr-uni-bochum.de

[1] W. Yao, et al. "8.7-W average power, in-band pumped femtosecond Ho:CALGO laser at 2.1 µm." arXiv preprint arXiv:2207.11516 (2022).
[2] C. Gaida, et al. "Self-compression in a solid fiber to 24 MW peak power with few-cycle pulses at 2 µm wavelength," Opt. Lett. 40, 5160-5163 (2015)