Institute of Optics & Quantum Electronics JENA
Friedrich Schiller University

Abbe School of Photonics JENA
Friedrich-Schiller-Universität

Internship / Research Lab Work / Master Thesis open positions

Topic: Supercontinuum generation in Antiresonant Hollow Core Fibers

The interaction of intense laser pulses with matter is a vivid research area as it not only aims at investigating fundamental physical questions but also offers a variety of applications. The interaction of atomic and molecular gases with ultrashort infrared laser pulses generates new frequencies due to nonlinear effects. The central idea of this project is to study supercontinuum generation in gas filled novel antiresonant hollow-core fiber (ARHF), which enables efficient guiding of intense light. This fiber features transmission windows between deep ultraviolet and the near infrared for single mode operation.

The experiment uses a femtosecond laser system producing pulses with sub-35 fs duration at 800 nm wavelength and energies up to 2 mJ at a repetition rate of 1kHz. The laser pulses are coupled into 25 cm long gas-filled ARHF [ref Fig. 1]. The supercontinuum generation involves different nonlinear processes like self-phase modulation, self-steepening, dispersive wave generation, soliton fission, etc. This broadband supercontinuum from ultraviolet to infrared is characterized using autocorrelator/FROG and spectrometers.

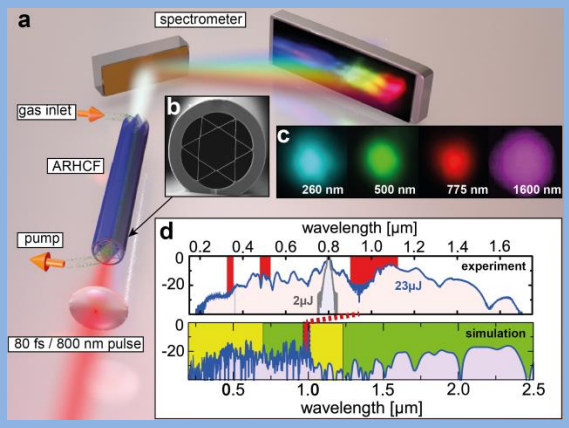

Fig. 1. Supercontinuum generation in an ARHCF. (a) Experimental scheme. (b) SEM image of the ARHCF (I.D. ~50 µm). (c) Far-field beam profiles for selected wavelengths show a fundamental mode. In the experiment (d) at low energy (gray line, top panel) only weak SPM-related broadening is observed. As the broadening extents to the resonances along the propagation (indicated by the red bars), soliton explosion suddenly generates a broad continuum (blue line, top panel). The simulation confirms broadband supercontinuum generation for a strand resonance with changing GVD sign. The green and yellow bar correspond to negative and positive GVD, respectively [1].

This project offers hands on experience in nonlinear ultrafast fiber optics. You will be introduced to handling of speciality fibers, dispersion measurement, supercontinuum generation and pulse characterization. Programming skills in Matlab / LabView will be an advantage if you are interested to write short scripts to integrate the opto-electronic devices into computer control. Additionally, you will also be exposed to working with vacuum and pressure systems.

Contact person for student

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References:

[1] R. Sollapur et. Al., Light: Science and Applications, doi: 10.1038/lsa.2017.124