Contribution ID: **87** Contribution code: **S07-OP-208** Type: **Poster presentation**

Experimental demonstration of coherent beam recombination after controllable beam break-up and filamentation by using optical vortex lattices

Monday, 29 August 2022 18:00 (1h 30m)

Coherent beam combining (CBC) is denoting a group of methods developed for achieving higher power/energy and for enhancing the spectral brightness of laser emission at preserved beam quality by combining several high-power laser beams (or sub-beams) [1]. On the other hand, the spectral broadening of coherent optical pulses is inevitably necessary for their compression in time. The beam filamentation is a complex nonlinear process (see e.g. [2]), potentially promising for the subsequent pulse compression. This makes sense only if there is a reliable way to coherently recombine the sub-beams after their spectral broadening for following pulse compression prior entering the interaction zone in the experiment.

The controllable (and reversible) beam break-up of optical vortex lattices in the focal plane of a lens (i.e. in the artificial far field) to an ordered structure of well-formed peaks, has been demonstrated with square-shaped [3] and with hexagonal OV lattices [4], as well as after mixing such OV lattices (formally - using the Convolution theorem for the Fourier-transformation) [5]. These beam reshaping techniques along with their reliability to controllably split the beam into sub-beams and later to recombine them is the key component of the present work.

Here, we essentially exploit this technique in order to coherently recombine the peaks from the focal region after a nonlinear process of filamentation in its vicinity, resulting in a spectral broadening of the involved femtosecond laser pulses. Results for the experimental realization of controllable beam break-up into six peaks, filamentation and coherent beam recombination using specific optical vortex lattices in ambient air and in a glass substrate (as nonlinear media) will be presented and discussed.

We acknowledge funding of the DFG (project PA 730/7). This work was also supported by the Bulgarian Ministry of Education and Science as a part of National Roadmap for Research Infrastructure, grant number D01-401/18.12.2020 (ELI ERIC BG). L.S. gratefully acknowledges the research scholarship granted by the Alexander von Humboldt Foundation.

References

1. Z. Liu, P. Zhou, X. Xu, et al. Sci. China Technol. Sci. 56, 1597–1606 (2013).
2. A. Braun, G. Korn, X. Liu, D. Du, J. Squier, and G. Mourou, Opt. Lett. 20, 73-75 (1995).
3. L. Stoyanov, G. Maleshkov, M. Zhekova, et al., J. Opt. Soc. Am. B 35, 402-409 (2018).
4. L. Stoyanov, G. Maleshkov, M. Zhekova, I. Stefanov, et al., J. of Optics 20, 095601 (2018).
5. L. Stoyanov, G. Maleshkov, I. Stefanov, et al., Opt. Quant. Electron. 54, 34 (2022).

Primary authors: Dr STOYANOV, Lyubomir (Institute of Optics and Quantum Electronics, Friedrich Schiller University, Germany & Department of Quantum Electronics, Faculty of Physics, Sofia University "St. Kliment Ohridski", Bulgaria); Prof. DREISCHUH, Alexander (Department of Quantum Electronics, Faculty of Physics, Sofia University "St. Kliment Ohridski", Bulgaria); Prof. PAULUS, Gerhard G. (Institute of Optics and Quantum Electronics, Friedrich Schiller University, Germany & Helmholtz Institute Jena, Germany)

Presenter: Dr STOYANOV, Lyubomir (Institute of Optics and Quantum Electronics, Friedrich Schiller University, Germany & Department of Quantum Electronics, Faculty of Physics, Sofia University "St. Kliment Ohridski", Bulgaria)

Session Classification: Poster session

Track Classification: Scientific Sections: S07 Optics and Photonics