## **BPU11 CONGRESS**



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

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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.

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