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Spatio-temporal reshaping in multimode fibers

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Multimode fibers received recently a renewed interest because of the ability to control the multimode propagation and to select, at the output, a quasi-single mode supporting the main part of the energy. In this paper we present results on spatial Kerr-beam self-cleaning in multimode optical fiber. We show how a speckled beam obtained because of multimode propagation can be transformed into a quasi-single-mode emission under the effect of the peak power increase [1]. A theoretical approach developed to explain that intriguing and surprising spontaneous effect is proposed with a possible connection with the condensation of optical waves. Beam self-cleaning can be observed both in passive [1] and in active [2] fibers with parabolic or quasi-step refractive index core profiles. Such spatial reshaping is also accompanied by significant spectral and temporal [3] evolutions of the initial beam, leading to pulse temporal narrowing at the pump wavelength and new frequency conversions in visible and infrared domain. The input conditions required for the experimental observation as well as the coherence of such nonlinear evolution will be discussed. Finally, we will demonstrate the potential of beam self-cleaning in the domain of nonlinear imaging for the analysis of biological samples, as well as for high power fiber lasers.

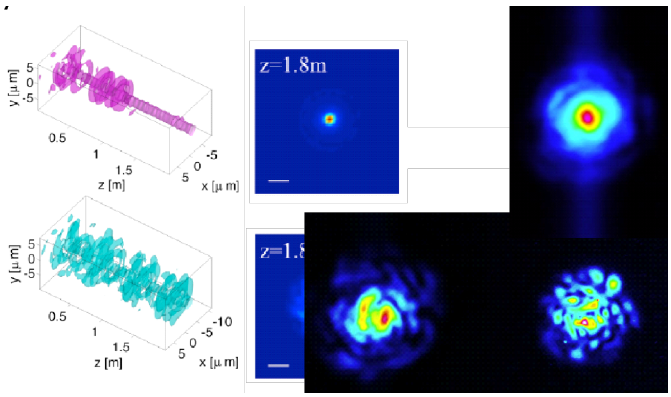

Fig. 1: spatial self-cleaning in multimode parabolic fiber (Left: simulation, right: experiment)

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