

Spatiotemporal pulse shaping in multimode nonlinear optical fibers

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Nonlinear multimode optical fibers (MMFs) have recently emerged as easily accessible platform to control complex spatiotemporal beam reshaping phenomena. Light intensity oscillations associated to the self-imaging effect in graded-index (GRIN) MMFs lead, via the Kerr effect, to a dynamic long-period index grating which may phase-match the generation of ultra-broadband sideband series. For relatively short, virtually lossless GRIN fibers, beam self-cleaning activated by the Kerr effect is observed, at lower power thresholds than the Raman beam cleanup. The output highly multimode speckled beam evolves, at high powers, into a high brightness bell-shaped beam sitting on a low-power background of high-order modes. This Kerr beam self-cleaning is shown to be even reinforced in the presence of strong loss or gain, e.g., in a passive or active ytterbium doped MMF, which leads to its possible exploitation in high power multimode fiber laser sources. We shall overview recent experiments, which demonstrate the spatiotemporal pulse break-up and significant temporal compression that accompany the self-cleaning process. At the same time, we shall describe experiments revealing the dependence of the output beam shape and the efficiency of the self-cleaning process on the input beam conditions, such as transverse dimension and incidence angle.

Presenter: Prof. WABNITZ, Stefan (Università degli Studi di Brescia)