

Nonlinear optics in the filamentation regime

Bree, Carsten, author

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Abstrak

This thesis provides deep insights into currently controversial questions in laser filamentation, a highly complex phenomenon involving nonlinear optical effects and plasma physics. First, based on the concrete picture of a femtosecond laser beam which self-pinches its radial intensity distribution, the thesis delivers a novel explanation for the remarkable and previously unexplained phenomenon of pulse self-compression in filaments. Moreover, the work addresses the impact of a non-adiabatic change of both nonlinearity and dispersion on such an intense femtosecond pulse transiting from a gaseous dielectric material to a solid one. Finally, and probably most importantly, the author presents a simple and highly practical theoretical approach for quantitatively estimating the influence of higher-order nonlinear optical effects in optics. These results shed new light on recent experimental observations, which are still hotly debated and may completely change our understanding of filamentation, causing a paradigm change concerning the role of higher-order nonlinearities in optics.