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Modification of intense light by propagating in air[1]

LADAN ARISSIAN, University of New Mexico

In thriving to reach higher intensities, amplified light pulses are compressed in time and space. Although rigorous methods are used to characterize the spatio-temporal properties of a pulse at the output of a laser system, the fields at the focal point cannot be directly measured. We show in this paper the nonlinear effect on intense laser pulses propagating in air, prior to reaching a focus or forming a filament, a state of light where nonlinear Kerr focusing balances a plasma induced defocusing. It is accepted that in laser filaments the peak intensity of light is determined by intensity clamping. In order to understand the microscopic interaction of light and matter in the propagation of ultrashort pulses in air, we monitor the fluorescence of nitrogen at 337 and analyze the state of polarization for various pulse energies and pulse widths. In order to separate the effect of light preparation (the focusing phase) from the interaction at focus, for all cases of study we compare the measurements of preparation in air with focusing in vacuum. A long tube (3 meters) is maintained at 1 torr pressure and connected to atmospheric air with an aerodynamic window. We show that elliptical polarization is not preserved in filament formation. The molecular orientation induces cross-phase modulation resulting in stronger self-focusing of the weaker polarization.

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