Influence of turbulent fluctuations in atmosphere on femtosecond laser pulse filamentation and interaction of coherent filaments

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Numerical simulation of influence of atmospheric turbulence on femtosecond laser pulse filamentation was conducted. Parallel algorithms were developed for this purpose. Calculations were done with the usage of modern computer clusters.

It was found that average nonlinear focus distance changes nonmonotonically with the grow in magnitude of atmospheric turbulence for beams on the order of several critical powers. In the case of large powers of the beam average distance declines monotonically. It was shown that turbulent influence on wider beams is stronger than on beams of small diameter. Estimations of spatial scales of fluctuations that are most favorable to cause multiple filamentation were done.

Periodization of boundary conditions for investigation of wide beams filamentation were proposed. This made possible to obtain qualitative pattern of small-scale structures dynamics and interaction of filaments. Interaction between two coherent uncollimated filaments with different phase relationships was studied. It was shown that a thin channel with high energy density is formed along the propagation axis in the case of in-phase pulses. In antiphased case the length of high energy density region and pick values of energy density are much lower.

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