Filamentation of phase-modulated pulse of femtosecond duration in fused silica

Annotation

Evolution of spatio-temporal intensity distribution of phase-modulated femtosecond laser pulses on different wavelengths observed upon the filamentation in fused silica is studied numerically.

Main attention was paid to investigation of evolution of spatio-temporal intensity distribution along the filament under invariable values of pulse energy, duration, peak power and beam radius. Such research definition allows us to investigate solely phase modulation influence in the process of femtosecond laser pulse propagation upon filamentation under the same conditions of Kerr self - focusing and defocusing of the pulse in filament plasma.

As a result of numerical analysis, it was ascertained, that phase modulation of light field allows us to control the speed of intensity growth in the process of self-focusing of femtosecond laser pulses thus controlling the distance to filament start and even preventing its formation in certain conditions. Phase modulation influence on pulse propagation is characterized by the medium material dispersion properties. In anomalous group velocity dispersion (GVD) zone negative chirping delays filament start and positive speeds it up. Likewise in normal GVD zone positive chirping augments dispersive spreading of the pulse and negative compensates for it. In zero GVD zone phase modulation influence is insignificant.

Application of initial pulse phase modulation doesn’t qualitatively change the form of its spatio-temporal intensity distribution in filament. In the region of anomalous GVD the intensity distribution takes form of the so-called light bullets – zones with high power density. In region of zero GVD temporal multi-peak mode takes place due to the effect of Kerr self-focusing on pulse tail that was defocused in plasma. In region of normal GVD pulse splitting happens due to dispersive effects under the phase-modulation conditions

.

A work by
Alexey I. Spirkov

Supervisor:
____
professor Kandidov V.P.