Annotation of 6th course student A. D. Bessonov's graduate work

Soliton phenomena and evolution of high-power ultrashort pulses in air-core photonic bandgap fibers

This work is devoted to numeric simulations of high-power ultrashort pulse propagation in some existing models of air-core photonic bandgap fibers (PBG). Simulations base on measured characteristics of the fibers. We have modeled propagation with core filled by air under normal conditions and by argon with pressure of 3 atmospheres. Theoretical basis of the work consists of a model of powerful ultrashort pulse propagation in PBG fiber, incorporating the effect of stimulated raman scattering (SRS).

It was shown that pulses with energy above that of an equivalent fundamental soliton have two possible types of evolution: quasi-periodic like high-order ideal solitions and stable like a fundamental soliton or a group of them. When the pulse spectrum exceeds the fiber transmission band, pulse evolution becomes unpredictable and has nothing in common with high-order soliton dynamics.

Aperiodicity of pulse envelope evolution underwent thorough analysis. Aperiodicity proved to account mainly for fiber attenuation. Some rules of this phenomenon have been revealed.

The effect of SRS in core gas and high-order fiber dispersion on dynamics of soliton-like formations has been analyzed. Stabilization of pulse envelope form and fission into solitons is depicted. Finally, a special regime of propagation has been observed. This regime constitutes in pulse propagation without changing its form with energy below the energy of the fundamental soliton due to third-order dispersion and a special self-formed profile of chirp.