Modeling of evolution and nonelastic interaction of solitary NLS envelop pulses in complex media

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Abstract

Investigation of evolution and interaction of solitary waves and pulses (wave packets) is very actual problem in different fields of physics especially when the medium is non-uniform and its properties depend on time. In this case, as a model, we use the generalized nonlinear Schrödinger (GNLS) equation, which describes the waves in a plasma, fiber and planar optical waveguides, taking into account inhomogeneity and nonstationarity of a propagation medium. Earlier we have shoved analytically that the GNLS equation can have stable and quasi-stable solutions of the soliton and breather types and also unstable solutions which disperse with time. In this paper we study the evolution and interaction of the envelop solitons numerically. At simulation the Fourier splitting method for the GNLS equation was used, and the specially developed implicit scheme of finite-difference method was used for investigation of soliton-like structures propagation in non-uniform and nonstationary medium. Numerical modeling showed that inhomogeneity of medium changes the parameters of the envelop solitons such as their amplitudes, velocities and their quantity that is caused by their nonelastic interaction in inhomogeneous medium. Nonstationary medium changes a form of pulses and affects their spectral features. Changes of modulation of the parameters of medium make possible variation of character of nonelastic interaction at solitons attraction-repulsion. Obtained results can be useful in numerous applications in plasma physics, nonlinear optics and in many other fields of physics.

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Key words: Nonlinear Waves, Solitary Waves, Breathers, Interaction, NLS Equation, Complex Media, Modeling, Numerical Simulation

Image

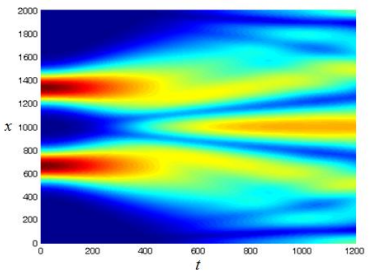

Figure 1: Evolution of double Gaussian envelop pulse in stationary medium with negative nonlinearity

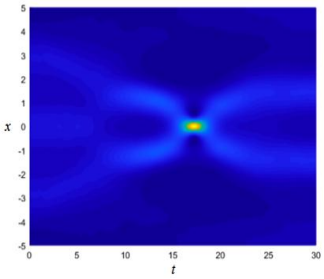

Figure 2: Interaction of three envelop pulses with formation of one strong pulse and its disintegration with time (negative nonlinearity)

Recent Publications

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4. Belashov V Yu, Kharshiladze O A, Rogava J (2018) Interaction of the multidimensional NLS solitons in non-uniform and nonstationary medium: modeling and stability problem. J. Astrophys. Aerospace Tech. 6:38.
5. Kharshiladze O A, Belashov V Yu, Rogava J, Chargazia Kh (2017) Modeling of nonelastic interactions of optical solitons. VIII Annual Meeting of the Georgian Mechanical Union. Tbilisi University Press, 2017. 31-32.

Biography

Prof. Oleg Kharshiladze is associated professor at physics department of Iv. Javakhishvili Tbilisi State University. He is involved in international scientific group, working on analytical and numerical analysis of ionospheric and magnetospheric processes (turbulence, shear flows, BBF and others).

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