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Vasily Yu Belashov

Kazan Federal University, Russia

Interaction of the multidimensional NLS solitons in non-uniform and non stationary medium: Modeling and stability problem

Investigation of propagation and interaction of multidimensional electromagnetic (EM) waves in a plasma, such as 2D and 3D envelop solitons, is a very actual problem. The interaction sufficiently changes the characteristics of the waves and background EM field in the region of interaction. The problem of the dynamics and stability of the solitons becomes more complicated if it is necessary to take into account an influence of different dispersive and nonlinear inhomogeneities and nonstationary parameters of the medium on the soliton structure and evolution. In this case, the problem reduces to the generalized nonlinear Schrodinger (GNLS) equation for the amplitude of the EM field with coefficient functions having spatial and temporal inhomogeneities. The analysis of stability of the multidimensional GNLS solitons was based on the method of study of transformational properties of the Hamiltonian of the system developed by authors earlier for the BK class of the equations which includes the GKP and 3-DNLS equations. As a result, we have found the conditions of existence of the 2D and 3D stable soliton solutions of the GNLS equation. At numerical modeling, the Fourier splitting method for the GNLS equation was used taking into account the inhomogeneities of coefficient functions of the equation. The GNLS equation was divided into linear and nonlinear parts, dispersive and nonlinear effects were considered separately, corresponding operators were assumed commutative. Implicit scheme of the finite-difference method was used for the investigation of soliton propagation in the non-uniform and nonstationary medium. Numerical modeling showed that inhomogeneity of medium changes the amplitudes of solitons and nonlinear EM waves, their velocities of propagation, their quantity that is caused by their nonelastic interaction in an inhomogeneous medium. Nonstationary medium changes a form of impulse and affects its spectral features. Changes of modulation of the parameters of medium make a possible variation of the character of nonelastic interaction at solitons attraction-repulsion.

Biography

Vasily Yu Belashov, PhD (Radiophysics), DSci (Physics and Mathematics). Main fields: Theory and numerical simulation of the dynamics of multidimensional nonlinear waves, solitons and vortex structures in plasmas and other dispersive media. Presently, he is Chief Scientist and Professor at the Kazan Federal University. He was Coordinator of studies on the International Program "Solar Terminator" (1987-1992) and took part in the International Programs WITS/WAGS and STEP. He is the author of 320 publications including 7 monographs. Main books: Solitary Waves in Dispersive Complex Media. Theory, Simulation, Applications. Springer-Verlag GmbH, 2005; Solitons: Theory, Simulation, Applications. Kazan, Kazan Federal University, 2016.

vybelashov@yahoo.com

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