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Hamiltonian analysis of stability and classification of multidimensional nonlinear wave structures of soliton type in space plasma

The stability of the multidimensional nonlinear waves and solitons forming on the low-frequency branch of oscillations in space plasma is studied analytically on the basis of the Belashov-Karpman (BK) system which includes the Kadomtsev Petviashvili and derivative nonlinear Schrodinger classes of equations and takes into account the generalizations relevant to various complex physical media including space plasma, associated with the effects of high-order dispersion corrections, influence of dissipation and instabilities. This is a consistent representation of the both early known and new original results obtained by author and also some generalizations in theory of the nonlinear waves and solitons in complex dispersive media. The analysis of stability of solutions is based on a study of transformational properties of the Hamiltonian of the system. The structure of possible multidimensional solutions is investigated using the methods of qualitative analysis of proper dynamical systems and analysis of the solutions asymptotics. As a result, we have constructed a classification of possible solutions for the BK system and have obtained the conditions of existence of the 2D and 3D soliton solutions in this system. Some applications of obtained results in plasmas (for the FMS and Alfven waves and for the internal gravity waves at heights of the F-layer of the ionosphere) are considered.

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 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.

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