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Multidimensional solitons in plasmas and fluids: Theory, simulation, applications

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The theory, results of numerical simulation and applications for the multidimensional nonlinear waves and solitons forming on the low-frequency branch of oscillations in complex continuous media with dispersion, including plasmas and fluids, are presented on the basis of the Belashov-Karpman (BK) system which includes the generalized Kadomtsev Petviashvili and derivative nonlinear Schrodinger classes of equa¬tions in cases when and respectively, and takes into account the generalizations relevant to various complex physical media, associated with the effects of high-order dispersion corrections, influence of dissipation and instabilities. This is 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 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 Alfvén waves, and for the internal gravity waves at heights of the F-layer of the ionosphere) and fluids (including nonlinear waves and solitons on shallow water) are considered.

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