

Pre Conference Workshop

## Nonlinear wave structures in complex continuous media including atmosphere, hydrosphere and space plasma

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#### Nonlinear dynamics of the 3D solitary Alfvén waves in the ionospheric and magnetospheric plasma

The nonlinear dynamics of the 3D solitary Alfvén waves propagating nearly parallel to the external magnetic field in plasma of ionosphere and magnetosphere, which are described by the model of the 3-DNLS equation, is studied analytically and numerically. Under the assumption of negligible dissipative effects, the analytical estimates and the sufficient conditions for the stability of 3D solutions of the 3-DNLS equation are obtained, based on the transformational properties of the system's Hamiltonian for the whole range of the equation coefficients. On the basis of asymptotic analysis the solutions asymptotics are presented. To study the evolution of the 3D Alfvén solitary waves including propagation of the Alfvén waves' beams in magnetized plasma, the equation are integrated numerically using the simulation codes specially developed. The results show that the 3-DNLS equation in non-dissipative case can have the stable 3D solutions in form of the 3D Alfvén Solitons (Fig.1), and also on a level with them the 3D solutions collapsing (Fig. 2) or dispersing with time. In terms of the self-focusing phenomenon, the results obtained can be interpreted as the formation of the stationary Alfvén wave beam propagating nearly parallel to magnetic field, or Alfvén wave beam spreading, or the self-focusing of the Alfvén wave beam. The influence of the dissipation in the medium on structure and character of evolution of 3D Alfvén waves is studied.

#### Biography

Prof. Vasily Yu. Belashov, PhD (Radiophysics), DSc (Physics and Mathematics). Main fields: theory and numerical simulation of the dynamics of multi-dimensional nonlinear waves, solitons and vortex structures in plasmas and other dispersive media. Presently, he is Chief Scientist at the Kazan Federal University. He is author of 288 publications including 6 monographs. Main books: *Solitary Waves in Dispersive Complex Media. Theory, Simulation, Applications.* Springer-Verlag GmbH, 2005; *The KP Equation and Its Generalizations. Theory and Applications.* Magadan, NEIGRI FEB RAS, 1997.

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Dr. Elena S. Belashova, PhD (Physics of Atmosphere and Hydrosphere). Main fields: numerical simulation of the dynamics of nonlinear waves and solitons in complex dispersive media. Presently, she is Associate Professor at the Kazan National Research Technical University named after A. N. Tupolev – KAI. She is author of 50 publications including 2 monographs. Main books: *Solitons: Theory, simulation, applications.* Kazan, Publishing Center "School", 2016; *Solitons as Mathematical and Physical Objects.* Kazan, IBSPEU, 2006

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