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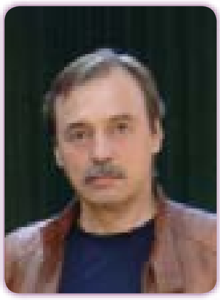

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Nonlinear dynamics of the 3D solitary Alfvén waves in the ionospheric and magnetospheric plasma

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 Alfven solitary waves including propagation of the Alfven waves' beams in magnetized plasma the equation is 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.

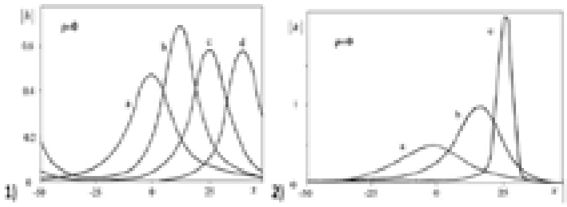

Figure: 1) Evolution of a 3D right circularly polarized nonlinear pulse in stability case: a) $t=0$, b) $t=25$, c) $t=50$, d) $t=75$. 2) Wave collapse of a 3D right circularly polarized nonlinear pulse: a) $t=0$, b) $t=25$, c) $t=30$.

Biography

Vasily Yu Belashov has completed his PhD in Radiophysics and DSci in Physics and Mathematics. His main fields include 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 was Coordinator of studies on the International Program "Solar Terminator" (1987-1992) and took part in programs WITS/WAGS and STEP. He is author of 288 publications including 6 monographs.

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