

Multidimensional nonlinear ion-acoustic waves in a weakly relativistic plasma

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Abstract

We The structure and dynamics of the multidimensional nonlinear ion-acoustic waves in unmagnetized plasma including the case of collisional weakly relativistic plasma when it is necessary to take into account the high energy flows of particles are studied analytically and numerically on the base of the Kadomtsev-Petviashvili (KP) equation generalized by introducing the relativistic factor u/c , when the coefficients at nonlinear and dispersive terms are defined by this ratio. In particular, when kinetic energy of the ions at $u_0/c \sim 0.1$ reaches values of $\sim 4.7\text{MeV}$, the 2D weakly relativistic ion-acoustic solitary waves describe a motion of energetic protons with speed approaching to speed of light, that is observed in the magnetospheric plasma. It is shown that if a speed of particles in a plasma reaches speed of light that the relativistic effects at propagation of the 2D solitary ion-acoustic wave start to play rather essential role and influence on phase velocity, amplitude and characteristic sizes of 2D wave. Obtained results include more simple limited cases which were considered by other authors, but they are essentially more general. The results obtained can be useful at study of nonlinear wave processes in the magnetosphere. They also have obvious applications in such physical systems as laser plasma and astrophysics (including compact astrophysical systems, for example white dwarfs).

Recent Publications

1. Belashov VYu, Vladimirov SV (2005) Solitary Waves in Dispersive Complex Media. Theory, Simulation, Applications. Springer-Verlag 305.
2. Belashov VYu, Belashova ES (2016) Solitons: Theory, simulation, applications. Kazan, Publishing Center "School" 270.
3. Belashov VYu (2017) Multidimensional nonlinear ion-acoustic waves in a plasma with due account of relativistic effects. Geomagnetism and Aeronomy (to be published).
1. Belashov VYu (2016) Dynamics of Multidimensional Nonlinear Wave Structures of the Soliton and Vortex Types in Dispersive Complex Media. J. Astrophys. Aerospace Technol. 4(3):18.
2. Belashov VYu (2016) Nonlinear wave structures of soliton and vortex types in complex continuous media. J. Astrophys. Aerospace Technol. 4(3):52.



Biography

Prof. Vasily Yu. Belashov, PhD (Radiophysics), DSci (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 was Co-ordinator 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. 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, NEISRI FEB RAS, 1997.

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Notes/Comments: