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Modeling of dynamics of vortex structures in continuous media

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We study analytically and numerically the dynamics and interaction of vortex structures in the continuum, and, specifically, in fluids and plasmas in two-dimensional approximation, when the Euler-type equations are applicable for modeling of vortex motion of inviscid fluid and guiding-center plasma. For numerical simulation we used the modified contour dynamic (CD) method. We fulfilled a number of the series of numerical simulations for study of two-vortex interaction, the interaction in the N-vortex systems, including interaction between the vortex structures and the dust particles, and also interaction of three-dimensional plane-rotating vortex structures within the framework of many-layer model of medium. We investigated the applications of the results obtained from dynamics of the vortex structures in the atmosphere, hydrosphere and plasma, for example: the problem of dynamics of evolution of the cyclonic type synoptic and ocean vortices which can be considered as a vorticity front, and also interaction in the vortex-dust particles system, and the dynamics of charged filaments which represent streams of charged particles in a uniform magnetic field in 2D model of plasma of Taylor-McNamara. The results obtained showed that for all cases in dependence on initial conditions two regimes of the interaction can be observed, namely: weak interaction with quasi-stationary evolution and active interaction with the "phase intermixing", when the evolution can lead to formation of complex forms of vorticity regions. The theoretical explanation of the effects, which we observed, is given on the basis of the generalized critical parameter introduced which determines qualitative character of interaction of vortices.

Biography

Vasily Yu Belashov has done his PhD (Radiophysics) and Doctor of Science (Physics and Mathematics). His main fields of research are: Theory and numerical simulation of the dynamics of multi-dimensional nonlinear waves, solitons and vortex structures in plasmas and other dispersive media. Currently, he is a Professor at the Kazan Federal University. He was the Coordinator of Studies for the International Program "Solar Terminator" (1987-1992), and took part in Programs WITS/WAGS and STEP. He is author of 288 publications and one book "*Solitary Waves in Dispersive Complex Media*".

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