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Data analysis and simulation of plasma flow vortices in the magnetotail

ULF electromagnetic planetary waves can self-organize into vortex structures (monopole, dipole or into vortex chains). They are often detected in the plasma media, for instance in the magneto sheath, in the magnetotail and in the ionosphere. Large scale vortices may correspond to the injection scale of turbulence, so that understanding their origin is important for understanding the energy transfer processes in the geospace environment. In a recent work, the THEMIS mission has detected vortices in the magnetotail in association with the strong velocity shear of a substorm plasma flow which has conjugate vortices in the ionosphere. By analyzing the THEMIS data for that event, we found that several vortices can be detected together with the main one, and that the vortices indeed constitute a vortex chain. The study is carried out by analyzing both the velocity and the magnetic field measurements for spacecraft C and D, and by obtaining the corresponding holograms. It is found that both monopolar and bipolar vortices may be present in the magnetotail. The comparison of observations with numerical simulations of vortex formation in sheared flows is also discussed.

Biography

Prof. Oleg Kharshidze is associated professor at physics department of Iv. Javakhsishvili Tbilisi State University. His research interests are modeling of nonlinear dynamics and chaos processes in space plasma, radiophysics, earthquakes, application of numerical methods in nonlinear differential equations. He is involved in international scientific group, working on analytical and numerical analysis of ionospheric and magnetospheric processes (turbulence, shear flows, BBF and others).

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Prof. Gaetano Zimbardo is associate professor of space plasma physics at the University of Calabria, Italy. He received his Ph.D. from the Scuola Normale Superiore in Pisa with a thesis on Jupiter's magnetosphere. His research interests include space and astrophysical plasmas, chaos and nonlinear systems, anomalous transport of energetic particles in solar system plasmas, and particle acceleration in astrophysics, and also in the historic and educational aspects of physics.

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Prof. Jemal Rogava received the M.S. Candidate and Doctor of physics and mathematics degrees in computational mathematics from Tbilisi State University (TSU), Georgia, in 1968, 1985 and 1997. He is a Professor at TSU from 1997 and Senior Researcher at the I. Vekua Institute of Applied Mathematics, Tbilisi. During 1990-2000, he was the Head of the Applied Mathematics Scientific Research Laboratory Georgian Technical University. His research interests include numerical analysis, mathematical modeling and applied mathematics.

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