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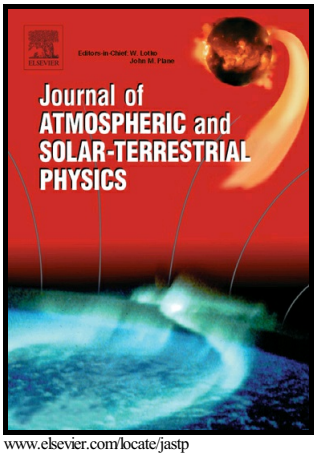

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Turbulent processes in Earth's magnetosheath by Cluster mission measurements

Kozak L.V. and A.T.Y. Lui and E.A. Kronberg and A.S. Prokhorenkov

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Abstract

Methods and approaches which can be used for the analysis of hydrodynamic and magnetohydrodynamic turbulent flows are chosen for this study. It is defined that the best methods for determination of turbulent process types are the methods of statistical physics. Within the statistical approach the fractal analysis (height of the maximum of probability density fluctuations of the studied parameters) and multifractal analysis (study of a power dependence of high order statistical moments and construction of multifractal spectrum) are considered. It is indicated that the statistical analysis of turbulent process properties can be supplemented with spectral studies (wavelet analysis).

Physical processes in the transition regions of the magnetosphere: foreshock, shock, post-shock and magnetosheath are investigated using high frequency measurements by Cluster satellites. Extended self-similarity analysis and structure function analysis demonstrate the presence of super-diffusion processes and the highest values of generalized diffusion coefficients observed in post-shock region.

It can be noted that different approaches for the analysis of turbulent processes give similar results and indicate the presence of super-diffusion processes in the transition region of the Earth's magnetosphere. This fact must be taken into account when constructing quantitative models of a transfer process. Wavelet analysis shows the presence of cascade and inverse cascade processes in the Earth's magnetosheath. Good agreement with other studies and our new results contribute to improvement of our understanding of turbulence.

1 Introduction

Interaction of the solar wind with the Earth's magnetosphere leads to an exchange of matter and transition of energy and momentum, which affects near-space conditions. This gives rise to a three-dimensional current system and generates large-scale electric fields.

Satellite experiments indicate that the boundary magnetospheric regions