Geophysical Research Abstracts, Vol. 9, 06996, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06996

Determination of 3D k-turbulent spectra from multipoint measurements: Cluster and Cross-Scale missions

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Magnetic turbulence is known to play a key role in magnetospheric physics since it is involved in all the microphysical processes: energy cascade and dissipation, structure formation, mass transport and particles acceleration, magnetic reconnection, etc. Identifying the experimental properties of turbulence has been therefore one of the major goals of the previous space missions. The results obtained on this issue from the Cluster mission are, certainly, the most accomplished ones. Here we present the last results obtained on the determination of the spatial k-spectra of magnetic turbulence in the terrestrial magnetosheath and in the cusp region using the k-filtering technique and the Cluster data. In this statistical study of **k**-spectra, we focus on magnetosheath data when mirror structures are dominant. The purpose is to confirm the universal features (scaling law, anisotropies, etc) of mirror k-spectra reported by Sahraoui et al. (PRL, 2006). We will also present a first determination of 3D **k**-spectra of Alfvénic turbulence in the Cusp.

However, for a given Cluster separation, all the scaling laws that one can obtain are limited to an inertial range of about one decade. This limitation handicaps seriously any attempt to interpret safely the obtained spectra. We will therefore discuss the new experimental requirements that future multi-satellite missions ($e.g.$ Cross-Scale) will have to satisfy in term of spatial separations. We will provide arguments on the necessity of exploring simultaneously short ($\sim$10 km), intermediate ($\sim$100 km) and large

scale ($\sim$1000 km), which will allow to cover at least three decades and to identify therefore physical processes/scales of injection, transfer, and dissipation of energy and any other invariant ($e.g.$ helicity).