



Extremely disturbed magnetosheath zones: evidence for superdiffusion

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Basing on comparison of the Cluster, Interball and Geotail data we discuss extremely disturbed magnetosheath (MSH) regions either closer to the bow shock (BS), or ahead of magnetopause (MP), which provide an evidence for superdiffusion. Between the bow shock and middle MSH extremely disturbed zones are regularly registered, preferably downstream of quasi-parallel and intermediate BS. These zones have longer duration (up to 2 hours) than that ahead high-latitude MP with similar features, called 'turbulent boundary layers' (TBL). While the TBL origin is rather clear identified with the MSH flow interaction with the cusp throat, the far MSH zones require further search for a generation mechanism. However, both super-disturbed zones have very close intensity and spectral characteristics. Our analysis of structure functions in the zones also revealed similar multifractal and intermittent properties of the magnetic field and ion flux. Also the similar is fitting with the Log-Poisson cascade model. In the zones the resonant-like perturbations at few mHz are often amplified, while decay-like bi-coherent phase coupling is substantial only in TBL near MP. The disturbed zones contain ram pressure bursts, which we call 'plasma jets'. About 20% of the jets impact MP and either come through the dayside magnetosphere into the geomagnetic tail or are reflected backward, depending on if the maximum magnetic pressure on their path is smaller or greater than their ram pressure. These intermittent/transient ram pressure concentrations up to several times over that of SW, are opposite to the predictions of MHD for the transformation of SW kinetic energy into thermal energy at the BS since

in the jets the dynamic pressure is rising instead of falling. Finally, we estimate time scaling for the time-dependent diffusion coefficient in the zones, and get strong indication for superdiffusion there. As substantial part of the jets interacts or even skews the MP, this superdiffusion should noticeably enlarge the MSH plasma penetration into high-latitude magnetosphere. This work was supported by ISSI, INTAS-03-50-4872 and 05-100008-8050 and RFFS 06-02-17256 grants.