Geophysical Research Abstracts,
Vol. 11, EGU2009-6842-1, 2009
EGU General Assembly 2009

Superdiffusion versus Alfvenic collapse: plasma flow bounding and penetration

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A geophysical flow is the solar plasma one around the Earth's magnetosphere. We discuss an anomalous MHD plasma mixing with concentrated kinetic energy bursts – 'plasma jets' – in view of common features of the geophysical flows, along with the laboratory and astrophysical plasma ones.
While the plasma flows are quite dilute, they probably can lead to electric power system collapses on the ground, radiation hazards in space, including geostationary spacecraft faults, and communication interrupts etc.
We would like to concentrate on a unique case of plasma mixing by the jets in the streamlining flow with quite effective transport barrier , most probably, due to Alfvenic collapse of the magnetic field at the interface of their streaming and stagnant plasma ahead the Earth magnetopause on February 2, 2003 from the Cluster spacecraft data.
On the basis of outer magnetospheric spacecraft observations in the magnetosheath (MSH) we provide evidence for the temporary existence of the anomalously concentrated plasma jets as well in the region close to the bow shock (BS) as near the magnetopause (MP). Disturbed zones of duration of up to 2 hours are regularly detected in the MSH, preferably downstream of the quasi-parallel and oblique BS with average energy density well above that of the un-shocked solar wind (SW). These zones are similar to high-latitude MSH near the MP, known as the 'turbulent boundary layer' (TBL), which is the result of the interaction of the MSH flow with the throat of the cusp. In both these disturbed zones the field and plasma fluctuations have comparable intensity and similar spectral properties. Determination of the structure functions of the magnetic field and ion flux also reveals similar multifractal and intermittent properties. The same holds for fitting a Log-Poisson cascade model.
A new phenomenon – Alfvenic collapse – is discussed as a 'tool' for separating of the MHD flows: in the MHD limit it predicts infinite field rising due to magnetic field-line breaking (or piling-up). Both Interball and Cluster case and statistical data demonstrate the appearance of the Alfvenic barriers between the plasmas for a 3D nearly transverse flow. The ratio of electric to magnetic disturbance amplitudes is close to Alfven speed, the magnetic disturbances are transverse to the electric ones and to the background magnetic field. The latter agrees with the Alfvenic nature of the process. We account for the barrier minimal scale of the order of ion gyroradius, regularly seen by Interball and Cluster, by the collapse termination due to compensation of the magnetic field concentration into the rising |B| regions by its backward finite-gyroradius diffusion. The resulting equilibrium requires the transverse plasma flow at nearly ion thermal speed, which namely is detected by Interball and Cluster. The interface between flowing and stagnant boundary layers has inside the dominant magnetic pressure, it can be seen at distances of about 1 Re, but its highly variable fine stricture looses correlation at few thousand km.
Estimates of the time scaling for the diffusion coefficient in the highly fluctuating jet region yields strong indications for the presence of superdiffusion. Obviously the jets serve to dissipate the kinetic energy in boundary layers. This seems to be typical for boundary layers in the astrophysical plasma as well as and in laboratory plasmas.