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Magnetic barrier generation between moving plasmas: evidence for Alfvenic collapse

S. Savin (1), E. A. Kuznetsov (1,2), E. Amata (3), M. Dunlop (4), V. Genot (5), Yu. Khotyaintsev (6), J. Buechner (7), E. Panov (1,7), J. Blecki (8), A. Asadchiy (1)

(1) IKI, Moscow, Russia, (2) Landau ITP, Moscow, Russia, (3) IFSI, Roma, Italy, (4) RAL, UK, (5) CESR, Toulouse, France, (6) IRF-U, Uppsala, Sweden, (7) MPSP, Germany, (8) SRC, Warsaw, Poland, (ssavin@iki.rssi.ru)

A new mechanism has been recently proposed for the magnetic barrier growing between plasma regions in relative motion with 3D features - Alfvenic collapse of magnetic field lines. In 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 regular detection of thin barriers with dominant magnetic pressure over the rest ones. Their appearance conform to MHD predictions for 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 display a Cluster case, clearly showing the barrier growth and thinning untill reaching the scale of proton gyroradius and dominating magnetic pressure in the surrounding high-beta plasma. 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 (i.e. MHD breaking). 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 for more than half an hour at distances of about 1 Re, but its highly variable fine stricture looses correlation at few thousand km. We discuss how the magnetic barriers provide the plasma separation, energization and acceleration, along with their relation to the plasma jets with extremely high ram pressure, registered by Cluster, Interball, Polar and Geotail, which

are not accounted for a reconnection. The field- line breaking is predicted to operate also in astrophysical and heliospheric plasma flows with the divergent transverse velocity, e.g. at the convection cell boundaries on the Sun. Intercomparison of the theory, modeling, experiment examples and statistics points out that the Alfvenic collapse is a promising mechanism for the magnetic field generation in the Universe. This work was supported by ISSI and INTAS grants 03-50-4872 and 05-1000008-8050