Field-line breaking and Alfvenic collapse: implementation for plasma separation and acceleration.

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Already from HEOS-2 data G. Haerendel had addressed the field strength rising in thin magnetic barriers to the work of streamlining magnetosheath (MSH) flow over MP boundary layer. But a comprehensive mechanism for the barrier growth had not been proposed up to now. Neither it had happened for the rising core field in substantial number of flux transfer events and for the barrier separatrix between the cusp and MSH plasmas. We account for the thin barrier growth by deformation of magnetic field lines in incompressible magneto hydrodynamic (MHD) flows, resulting from a compressible mapping associated with the transverse motion of fluid particles. Appearance of zeros for the Jacobian of this mapping corresponds to the breaking of magnetic field lines and the local blow-up of the magnetic field intensity. Comparison with 3D MHD simulations suggests that this Alfvenic collapse should appear for initial conditions, that do not lead to bi-dimensionalization and correspond to an initial velocity field, whose component transverse to the local magnetic field has a significant divergence. Recent Interball-1 and Cluster data demonstrate the thin barriers at the boundary of streaming and stagnant MSH over cusps. The characteristic barrier width is ranging down to the ion gyroradius, its pressure - up to full upstream plasma pressure. The plasma speed gradients are maximal at such boundaries, in correspondence to the predictions. Some barriers might be at MP or in the middle of the steaming MSH. To account for the characteristic barriers' width etc., we discuss the Alfvenic collapse termination due to ion finite- gyroradius effects, e.g. by equating of the plasma outflow from the region with rising |B| to the backward diffusion flow with the diffusion coefficient, taken for the characteristic displacement value of ˜ ion gyroradius. It gives the plasma speed near the collapse region of the order of ion thermal speed, visible in the Interball and Cluster data. We discuss how the magnetic field concentration influences on the plasma separation, energization and acceleration, including the registered by Cluster, Interball, Polar and Geotail plasma jets with extremely high ram pressure, 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. This work was supported by ISSI and INTAS grant 03-50-4872.