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Alfvenic collapse as a mechnism for formation of thin magnetic barriers

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Scince G. Haerendel and his HEOS-2 colleagues' studies in late 70s, it had been outlined that near the magnetopause (MP) there were detected thin (usually $<$1 min) magnetic barriers with the field strength much over that of the surrounding or model field. While G. Haerendel had generally addressed the field strength rising to the work of sreamlining magnetosheath (MSH) flow over MP boundary layer, the particular mechanism for the barrier grouth had not been proposed up to now. Neither it had happenned for the rising core field in substantial number of flux transfer events. We propose to account for the thin barrier growth by deformation of magnetic field lines in incompressible magnetohydrodynamic (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 bidimensionalization 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 upsream plasma pressure. The plasma speed gradients are maximal at such boundaries, in correspondance 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 Alvenic 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 diffision flow with the diffusion coeffecient, taken for the characteristic displacement value of ˜ ion gyroradius. It gives the characteristic plasma speed near the collapse region of the order of ion thermal speed, visible in the Interball-1 data. 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.