Unstable Velocity Gradient Flows With Aligned Magnetic Field: Theory And Observation Aspects Of A Near Earth Space Plasma Event

L. Bilbao[1], G. Gnavi[1], F. Gratton[1,2] and C. Farrugia[3]
[1]*Instituto de Física del Plasma (INFIP), CONICET-UBA, Buenos Aires, Argentina*
[2]*Facultad de Ciencias Físico-Matemáticas, Pontificia Universidad Católica Argentina (UCA), Buenos Aires, Argentina*
[3]*Space Science Center and Department of Physics, University of New Hampshire, Durham, NH, USA*

Theory results are reported on the instability of plasmas with velocity gradients, at interfaces where the magnetic field is aligned with the main flow on one side only, like at a magnetopause (MP) transition. The theoretical configuration is inspired by interactions of interplanetary plasma at the tail of coronal mass ejections with the terrestrial magnetic environment. The Kelvin Helmholtz (KH) instability is studied for main flows that are both supersonic, and super-Alfvenic, with compressible MHD theory, and models of the interface with continuous functions for the physical quantities. Although the interplanetary magnetic field (IMF) direction is considered to be adverse to the onset and development of KH perturbations, new aspects are found as the instability condition is explored along the equatorial MP, from the near Earth terminator to tailward regions. The KH theory is then applied to the analysis of large perturbations registered during a crossing of the MP by the spacecraft Wind (October 24, 2001 [1]). Field and plasma data statistics are elaborated, and arguments are given for the interpretation of the records as a passage of a long series of vortex structures (about 15) with remarkably similar patterns. The most significant feature is the presence of intense current sheets (which are also vorticity layers) in all the structures. The KH configuration studied is very different from that of most cases examined in the literature (mainly with northward pointing IMF). Proper numerical simulation studies of vortex development in this configuration are under way (work supported by the Argentine CONICET grant PIP 11220090100608 2010-13).

[1] C. Farrugia, et al., *J. Geophys. Res*., **115**, 549 (2010)