KELVIN-HELMHOLTZ INSTABILITY IN THE PLASMA SHEET BOUNDARY LAYER

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Field-aligned ion beams, so called beamlets, are often observed in the plasma sheet boundary layer, the region of the Earth's magnetotail that separates the cool tenuous lobe plasma from the hot dense central plasma sheet. The recent multipoint Cluster observations have revealed flapping of localized beamlet structures and related propagation of magnetic perturbations with a phase velocity of the order of the local Alfven speed. Since the Kelvin-Helmholtz (K-H) instability is a very probable candidate for the excitation of such Alfven type disturbances, a general stability analysis is performed for the K-H instability in a three-layered system, when a background magnetic field is directed parallel to the plasma flow. Solutions of the dispersion equation for the compressible plasma have shown that there is no upper critical sonic Mach number ($M_S = 2$) even for velocity shear layer of zero thickness, contrary to the classical case of two plasmas. For sonic Mach numbers higher than 2, the instability arises in a limited range of wave numbers, thus fixing the upper and lower cut off frequencies for the wave spectra. It has been found that for plasma parameters typical for the plasma sheet boundary layer the K-H instability can set in through the quasi-antisymmetric mode. The comparison of obtained theoretical results with experimental data have shown that conditions for the development of K-H instability are satisfied for the majority of beamlet observations. The work is supported by grant RFBR 07-02-00319.