Geophysical Research Abstracts, Vol. 7, 08393, 2005
SRef-ID: 1607-7962/gra/EGU05-A-08393

The interchange instability in collisionless, multi-component plasmas

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We will start by giving a theoretical overview of low-frequency waves and instabilities in collisionless, multi-component plasmas whose thermal pressure is gyrotropic, i.e., characterized by two distinct components, $P_\perp$ and $P_\parallel$, perpendicular and parallel, respectively, to the magnetic field. We will show that the complete dispersion relation can be obtained in the framework of a mixed MHD-kinetic formalism, which uses the standard MHD mass and momentum equations together with a corrected version of the double-adiabatic equations of state. Our complete dispersion relation contains not only the three standard (fast, slow, and Alfvén) modes from double-adiabatic MHD, but also the mirror mode from kinetic theory. We will examine the physical characteristics and stability properties of each of these four modes, and we will discuss their connections with the interchange mode whose signatures have been repeatedly observed by Galileo in the Jovian magnetosphere and are also expected to be soon detected by Cassini in the Saturnian magnetosphere.