Comparison of ballooning and interchange instabilities in the near-Earth plasma sheet and effects of non-adiabatic particles

Akira Miura[1]

[1] Earth and Planetary Physics, Tokyo Univ

In the near-Earth plasma sheet the ballooning and interchange instabilities occur. The former is stabilized when the plasma beta exceeds O(1) and it is governed by the ionospheric condition. When the field line curvature radius becomes comparable to the ion Larmor radius, the non-adiabatic particle effects strongly stabilize the interchange mode, whereas they increase the growth rate of the ballooning mode. Therefore, the ballooning instability seems to be more important and to play more important roles than the interchange instability in the late growth phase of substorms.

In the near-Earth plasma sheet both ballooning instability and interchange instability occur due to the field line curvature and the pressure gradient. However, the interchange instability is stabilized when the plasma beta exceeds O(1) in the tail-like configuration. The interchange mode is also governed by the ionospheric boundary condition, because the interchange motion involves a motion of the whole flux tube. Furthermore, when the field line curvature radius becomes comparable to the ion Larmor radius in the near-Earth plasma sheet during the late growth phase, the non-adiabatic particle effects strongly stabilize the interchange mode, whereas they increase the growth rate of the ballooning mode. Taking into account these considerations, the ballooning instability seems to be more important and to play more important roles than the interchange instability in the near-Earth plasma sheet especially when the near-Earth plasma sheet becomes more tail-like in the late growth phase of substorms.