Self-generation of Hollow Current Profile and Tilt Instability in Field-Reversed Configurations

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Two-dimensional electromagnetic particle simulation is performed to investigate the profile relaxation from a magnetohydrodynamic (MHD) equilibrium to a kinetic one and the physical property of the kinetic equilibrium in the field-reversed configuration. The radial oscillation is excited in order to relax an excess energy in the MHD equilibrium. After this profile oscillation, the system spontaneously relaxes toward a kinetic equilibrium, in which the electron current profile becomes hollow as a result of the combined effects of the gradient-B drift near the field-null line and the E$¥times$B drift generated by the ion finite Larmor radius effect near the magnetic separatrix. On the other hand, the ion current profile becomes peaked due to the effect of the ion meandering orbit near the field-null line. The stability of the obtained kinetic equilibrium against the tilt mode is also studied by means of three-dimensional full electromagnetic particle simulation. It is found that the growth rate of the tilt instability in the case of the hollow current profile is smaller than that in the case of the peaked current profile.