

# The guide field effect to the saturation stage of the lower-hybrid-drift instability in the thick current sheet

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Magnetic reconnection gives an important field in which the energy conversions and releases are made among the collision-less plasmas. It is widely accepted that the magnetic reconnection participates in the onset of the magnetospheric substorm in the magneto-tail region. According to the in-situ observations in the magneto-tail by the spacecrafts, the time scale of the magnetic reconnection is a rapid phenomenon of several ion gyro periods, with the current sheet thickness of the ion inertial length.

The tearing instability (TI) is a candidate for the trigger of the magnetic reconnection. TI takes place when an infinitesimal fluctuation of the current appears in the neutral sheet. Two-dimensional full-particle simulation of TI shows that it needs much time to saturate for the thick current sheet and the large mass ratio.

The lower-hybrid-drift instability (LHDI) is known as an important process to achieve the rapid magnetic reconnection. LHDI is caused by the presence of the number density gradient of the plasma. According to the three-dimensional full-particle simulation of the plain Harris current sheet, a rapid saturation of TI is observed in the presence of LHDI.

In the real magneto-tail, it is natural that there exists a significant magnetic field along the sheet current, in other words, a guide field. This guide field suppresses the disturbance of LHDI.

In this presentation, we will report the critical state of the rapid magnetic reconnection in the thick current sheet. The uniform guide field is imposed along the sheet current direction.

The initial magnetic field condition consists of the plain Harris field and this guide field.

The half thickness of the current sheet is set to  $0.5\lambda_i$  ( $\lambda_i$ : the ion inertial length). The ion-to-electron mass ratio is set to 400. To examine how the guide field suppresses the rapid magnetic reconnection, two steps are made.

(1) Two-dimensional full-particle simulation with several guide fields

We have categorized some characteristic types at the non-linear state of LHDI according to the guide field strength.

We have found the critical guide field.

There is no significant LHDI disturbance with this guide field.

(2) Three-dimensional full-particle simulation

We have adopted the critical guide field, obtained from the 2-D result.

We have made the simulations varying the current sheet thickness.

The detail results will be reported in the presentation.