Reconnection triggering in a thick current sheet with an embedded current layer

Takashi Oshima[1]; Takuma Nakamura[1]; Masaki Fujimoto[2]; Iku Shinohara[3]

[1] Earth and Planetary Sci., TITech; [2] DEPS, TITECH; [3] JAXA/ISAS

While magnetic reconnection is one of the most important processes in space plasmas, its physics is still not fully understood. Its explosiveness, which is what the observations in the solar system plasmas show, would imply some quick triggering processes to be operative, but the nature of the triggering has been left open. While reconnection can be initiated quickly by the tearing instability if the thickness of the current sheet is as small as comparable to the electron scale, the instability is helpless in terms of quick triggering for the current sheet thicknesses that are of interest to us, which are at least at ion scale.

In this study, we show the effects of a thin current layer embedded inside a thick parent current sheet. We use the two-fluid simulation including finite inertia of electrons. As the initial condition, we set the magnetic field to be anti-parallel across the current sheet. A thin current layer is located at the neutral sheet and a fraction of the magnetic field jump is attained across the thin-embedded layer. The thin layer thickness is fixed at 1.25 times the electron inertial length. The magnetic field jump across the thin layer and the thickness of the parent current sheet are varied and their effect on the reconnection triggering is explored.

By observing the temporal development of the reconnected flux, we find the followings:

(1) Reconnection rate is highly boost-up even if the thin layer current fraction is as small as 0.1-0.2.

(2) The boost is larger for larger parent sheet thickness.

The results imply that quick reconnection can be obtained as long as 0.1-0.2 of the magnetic jump is done across the thin layer. The presence of the thin layer, which gives birth to large amplitude inductive electric field, may be the key element for particle acceleration observed in Solar flares.