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ペチェック型磁気リコネクションに対する熱伝導効果
Thermal conduction effect on the Petschek magnetic reconnection

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We simulated the magnetic reconnection including the nonlinear thermal conduction effect with two-dimensional MHD equations. Magnetic reconnection is considered to be the basic process of the solar explosive phenomena. In the atmosphere with high temperature and low density like solar corona, time-scale of the nonlinear heat conduction becomes shorter and can become comparable to the Alfven time-scale. Thermal conduction effect should be considered. Previous studies have showed that, in the model of magnetic reconnection produced by Petschek, adiabatic slow mode shock wave generated from the localized diffusion region is dissociated into isothermal shock wave and conduction front due to the thermal conduction. However, the effect of the thermal conduction on the energy release rate in the magnetic reconnection is not explained enough in the past.

Here we investigated how the thermal conduction influences the energy conversion rate. We calculated the energy release rate in different magnitude of the magnetic diffusivity to see the dependence on the Lundquist number. As a result, due to the thermal conduction effect, adiabatic shock wave is dissociated into isothermal shock wave and conduction front and this makes temperature in the reconnection outflow jet smaller. In the outflow region with small temperature, density becomes larger. Considering mass conservation between the mass flux in the reconnection inflow and that in the outflow, inflow velocity is accelerated because of larger density in the outflow region. This causes increase of the energy release rate in the magnetic reconnection. That increase rate tends to become larger as the magnitude of magnetic diffusivity becomes smaller. Smaller magnetic diffusivity correponds to the larger Lundquist number. In the real solar atmosphere, plasma gas has larger Lundquist number than that in this numerical simulation. This means that thermal conduction effect on the energy release rate in magnetic reconnection might become more effective in the real solar atmosphere.

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