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Dynamics of Plasmoid in Fast Magnetic Reconnection

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Magnetic reconnection is considered to play a crucial role in solar flares and magnetic disturbances. In space plasma observations, the magnetic diffusion region in the reconnection process, itself, may be sometimes invisible because the region is very narrow. While, the plasmoids ejected from the region will be clearly observable and the dynamics of the plasmoid should give important information for the reconnection process. As wel-known, after the fast magnetic reconnection has been developed, the plasmoid associated with the reconnection process propagates to downstream in the current sheet. At the time, the reconnection jet terminates at the plasmoid. In the Petschek model, a switch off shock drives the reconnection jet. However, it is very important that the plasmoid is not driven by the switch off shock and i.e. reconnection jet. Rather, the plasmoid is mainly driven by a slow shock formed around the plasmoid itself, which is clearly separated from the switch off shock of the reconnection jet. According to the Rankine Hugoniot analysis of those slow shocks, the supersonic or subsonic adiabatic expansion acceleration region formed between the reconnection jet region and plasmoid region always appears to balance the pressure of those two regions. It suggests that the adiabatic expansion acceleration region is strongly related to the plasmoid dynamics. MHD simulation and Rankine Hugoniot analysis are shown and discussed.