An Analytical Model of "Electron-Only" Magnetic Reconnection Rates

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Abstract

"Electron-only" reconnection, which is both uncoupled from the surrounding ions and much faster than standard reconnection, is arguably ubiquitous in turbulence. One critical step to understanding the rate in this novel regime is to model the outflow speed that limits the transport of the magnetic flux, which is super ion Alfvenic but significantly lower than the electron Alfven speed based on the asymptotic reconnecting field. Here we develop a simple model to determine this limiting speed by taking into account the multiscale nature of reconnection, the Hall-mediated electron outflow speed, and the pressure buildup within the small system. The predicted scalings of rates and various key quantities compare well with fully kinetic simulations and can be useful for interpreting the observations of NASA's Magnetospheric-Multiscale (MMS) mission and other ongoing missions.

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