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Magnetic reconnection in asymmetric systems: x-line orientation and guide field acceleration

Michael Hesse (1), Nicolas Aunai (1), Seiji Zenitani (2), Masha Kuznetsova (1), and Joachim Birn (3)

(1) NASA Goddard Space Flight Center, United States (michael.hesse@nasa.gov), (2) National Astronomical Observatory of Japan, Tokyo, Japan , (3) Space Science Institute, Boulder, CO, USA

Magnetic reconnection in asymmetric systems has presented a number of enigmas. Beginning with the structure of the diffusion region, where nonideal electric fields, which regulate the transfer of magnetic flux from the inflow regions to the outflow regions, are often overshadowed by much larger electric fields in the vicinity, and continuing to the complex structure of the outflow regions, asymmetric reconnection has been an on-going research challenge. While MHD and Hall MHD theory and modeling has shed light into the behavior of fluid systems, kinetic physics appears to modify the dynamics substantially. In this paper, we take a new look at the kinetic structure of asymmetric, reconnecting, current sheets. The main focus of the present investigation is on both the structure of the electron diffusion region, and on the modifications to the large-scale dynamics brought about by kinetic effects. Specifically, we will analyze kinetic simulations, which indicate a preferred direction of the reconnection line, and which shed light on the question why reconnection can, at times, operate faster in the presence of a guide field than without it.