Outstanding questions and future research on magnetic reconnection in MMS era

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Abstract

With the advanced in-situ measurement capability to resolve electron-scale physics, the four Magnetospheric Multiscale (MMS) spacecraft together with the relevant simulations significantly advanced the study of magnetic reconnection. These studies conducted in the MMS era motivated us to summarize the current understanding of magnetic reconnection that arises from new observations mainly in geospace and in other environments as well as from theoretical studies. This presentation highlights the unsolved problems of magnetic reconnection in collisionless plasma based on the discussions at an ISSI Workshop "Magnetic Reconnection: Explosive Energy Conversion in Space Plasmas" held on 27 June– 1 July 2022 convened by J. L. Burch, J. F. Drake, B. L. Giles, M. Hesse, M. Hoshino, B. Lavraud, R. Nakamura, R. B. Torbert and based on the discussions compiled in a collection of the

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review papers as out come of the workshop._We highlight several outstanding questions concerning the complex dynamics and structures in the diffusion region, cross-scale and regional couplings, the onset of magnetic reconnection, and the details of particle energization. We discuss future directions for magnetic reconnection research, including new observations, new simulations, and interdisciplinary approaches.