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Diffusion region in magnetopause reconnection observed by the MMS mission[1]

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The diffusion region is the primary location where the plasmas are energized to dissipate the magnetic energy in reconnection. The NASA Magnetospheric Multiscale (MMS) mission, capable of resolving sub-gyroscales of both electrons and ions, has created new frontiers in the state-of-the-art understanding of the diffusion region. The MMS detection of reconnection at Earth's magnetopause will be discussed to highlight the roles of demagnetized particle orbits and wave fluctuations in the reconnection dynamics. When the guide field is significantly weaker than the reconnecting magnetic field, the reconnection current layer is gyro-resistive and the electron distribution functions exhibit strong finite-gyroradius effects with crescent and counterstreaming characteristics. When the guide field is comparable to the reconnecting component, the electron jets are mainly the E cross B drift due to the polarization electric field and the guide magnetic field, and the energy conversion at the jet reversal is dominated by the wave electric field near the lower hybrid frequency. Insensitive to the guide-field, the dense magnetosheath electrons in the reconnection exhaust are transported, by wave turbulence, across the magnetospheric separatrix to modify the plasma properties and field structures in the magnetosphere. The MMS results will be compared with available laboratory measurements from the Magnetic Reconnection Experiment in Princeton, and challenges in diffusion region physics will be discussed.

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