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Electron heating and thermalization in asymmetric reconnection: laminar and turbulent mechanisms

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Magnetic reconnection is basically a mechanism which converts the energy of stressed magnetic field lines into heat and bulk acceleration of plasma. In this study we present a detailed investigation of diffusion region of asymmetric magnetic reconnection by means of large-scale two and three dimensional Particle-in-Cell (PIC) simulations. We study the turbulent physics of diffusion region crossing event of 6 December 2015, 23:38:30 UT by MMS spacecraft which is a magnetopause reconnection event with a moderate $(\sim 20\%)$ guide field. Opposite to a two dimensional simulation, streamlines of cold magnetosheath electrons in 3D run experience on average an U-turn right at the X-line, which is interpreted as thickening of the reconnection layer by LHDI-range wave activity. On top of that, averaged streamlines from a 3D run do not display oblique whistler wave feature at separatrices [Swisdak, 2017] in contrast to a two-dimensional simulation. Energy exchange due to $E_{||}J_{||}$ appears several times higher in a 3D run. Simulations indicate that when considering electron dynamics, including 3D effects is a must to have a good agreement with observations.