Instabilities and Energy Exchanges in 3D PIC simulations of reconnection∗

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Kinetic reconnection is characterized by a distinct behavior of electrons and ions with regions of strong relative speeds between the species. Electrons can flow at great speed relative to ions and can be characterized by a strong non-gyrotropy and anisotropy. When studied in full three dimensions, these electron peculiar properties can drive numerous instabilities that have been investigated in a number of recent published papers [2, 3, 4, 1]. Two regions have received most attention: 1) the separatrices where instabilities are caused by the electron flow and the electron phase space features [2, 3, 4], 2) the downstream fronts where an interchange instability leads to strong energy exchanges and secondary reconnection [1]. In both situations the ions are demagnetized but the electrons are not and their behaviour is rich in full kinetic processes. At the separatrices, two types of instabilities have been observed [4]. In the downstream fronts of reconnection, a density gradient develops in conditions where the acceleration is directed unfavourably for stability, leading to ballooning and interchange-type instabilities. Both cases are of great importance for the upcoming Magnetospheric Multiscale Mission that is bent on finding and analyzing the regions where the electron scale physics is dominant.

References


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