SFP Meeting May 22-23, 2012 - Orleans, France - Invited talk

Simulations of magnetic reconnection - kinetic mechanismsunderlying the fluid description of ions

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Because of its ability to transfer the energy stored in magnetic field together with the breaking of the flux freezing constraint, magnetic reconnection is considered as one of the most important phenomena in plasma physics. When it happens in a collision less environment such as the terrestrial magnetosphere, it should a priori be modelled with in the framework of kinetic physics. The evidence of kinetic features has incidentally for a long time, been shown by researchers with the help of both numerical simulations and satellite observations. However, most of our understanding of the process comes from the more intuitive fluid interpretation with simple closure hypothesis which do not include kinetic effects. To what extent are these two separate descriptions of the same phenomenon related? What is the role of kinetic effects in theaveraged/fluid dynamics of reconnection? This thesis addresses these questions for the proton population in the particular case of antiparallel merging with the help of 2D Hybrid simulations. We show that one can not assume, as is usually done, that the acceleration of the proton flow is only due to the La place force. Our results show, for symmetric and asymmetric connection, the importance of the pressure force, opposed to the electric one on the separatrices, in the decoupling region. In the symmetric case, we emphasize the kinetic origin of this force by analyzing the proton distribution functions and explain their structure by studying the under lying particle dynamics. Protons, as individual particles, are shown to bounce in the electric potential well created by the Hall effect. The spatial divergence of this well results in a mixing in phase space responsible for the observed structure of the pressure tensor. A detailed energy budgetanalys is confirms the role of the pressure force for the acceleration ; but, contrary to what is sometimes assumed, it also reveals that the major part of the incoming Poynting flux is transferred to the thermal energy flux rather than to the convective kinetic energy flux, although the latter is generally supposed dominant. In the symmetric case, we propose the pressure tensor to be an additional proxy of the ion decoupling region in satellite data and verify this suggestion by studying a reconnection event encountered by the Cluster spacecrafts. Finally, the last part of this thesis is devoted to the study of the kinetic structure of asymmetric tangential current sheets where connection can develop. This theoretical part consists in finding a steady state solution to the Vlasov-Maxwell system for the protons in such a configuration. We present the theory and its first confrontation to numerical tests.