Geophysical Research Abstracts
Vol. 12, EGU2010-4826, 2010
EGU General Assembly 2010

A new Vlasov equilibrium in asymmetric current sheets

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In the purpose of studying the reconnection of magnetic field at the magnetopause, kinetic simulations are of great importance. They describe more physics than fluid simulations, however they come with the drawback of the initial state. If one can setup a fluid equilibrium easily no matter what are the density, pressure and magnetic field profiles, finding the Vlasov-Maxwell equilibrium necessary to setup a steady initial state in a kinetic simulation is way more difficult. One steady distribution has been found by Harris (the so-called Harris equilibrium, 1962), and is extensively used has an initial setup. Unfortunately this distribution, quite unrealistic, gives symmetric moments profiles and thus cannot be used to describe a steady current sheet modeling the magnetopause. In this situation one as for the moment no choice but to study the reconnection starting with an unsatisfactory fluid equilibrium and a local Maxwellian distribution function. This local Maxwellian is not steady and gives rise to plasma perturbations and wave emissions polluting the whole simulation. Using the 2D Hybrid approximation, we present our attempt to find a steady solution to the Vlasov equation, that models an asymmetric current sheet. The usual research method of Vlasov equilibrium suppose both the electrons and ions distribution to be known and of the same algebraic form and calculate the consistent electromagnetic (EM) fields via Maxwell's equations. On the contrary, the hybrid approximation allows us to set the EM fields a priori as well as the first moments and calculate the consistent form of the ion distribution. The electrons are then considered to be in a magnetohydrostatic equilibrium so that the system is closed. This powerful new semi-analytical method should create a steady distribution function for the ions in an asymmetric current sheet and thus could, among other applications, be used to initialize properly 2D Hybrid simulations.