A 2-D hybrid MHD-kinetic electron model for the study of electron acceleration in Alfvén waves

Peter Damiano, and J.R. Johnson

Princeton Plasma Physics Laboratory, Princeton, New Jersey

Understanding electron acceleration by Alfvén waves is a topic of fundamental importance in plasma phyics and of particular relevance to the Earth's magnetosphere where Alfvénic induced electron precipitation leads to the formation of some auroral arcs. These waves are important to the transfer of energy from the magnetosphere to the ionosphere both in the form of the precipitating electrons and the field aligned Poynting flux. In this presentation, we highlight a 2-D hybrid MHD-kinetic electron model in dipolar coordinates[1,2] and illustrate its application to the study of Field Line Resonances (FLR) which are global scale shear Alfvén waves that stand along the the Earth's closed dipolar magnetic field lines. The model incorporates the cold plasma MHD equations to describe the perpendicular ion polarization currents coupled to a system of guiding center electrons moving parallel to the ambient magnetic field. The system is closed via the parallel electric field which is calculated from a variant of the generalized Ohm's law incorporating the moments of the electron distribution function and an algorithm that enforces quasi-neutrality. We present the results of the first simulations for realistic ambient electron temperatures of a keV that illustrate mirror force effects within an FLR can generate parallel potential drops sufficient to accelerate electrons to the observed energies that power the aurora[3]. The significant damping of wave energy that results from the acceleration is highlighted along with the non-local dynamics of the electrons within the resonance structure. The extension of the model to include ion gyro-radius effects will also be briefly outlined.

[1]Damiano et al., *Physics of Plasmas*, **14**, 062904, 2007.
[2]Damiano and Wright, *J. Geophys. Res*, **113**, A09219, 2008.
[3]Damiano and Johnson, *Geophys. Res. Lett.*, submitted 2011.