Electron Pressure Effects on Auroral Shear Alfvén Waves

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The dynamic magnetosphere—ionosphere coupling in the auroral region is mainly provided by shear Alfvén waves. A fully kinetic description of the electron dynamics in these waves has been given only in the linear approximation, valid in the limit of small amplitudes. High-amplitude low-frequency shear Alfvén waves on auroral field lines have been treated by numerical simulations based on fluid models assuming the electrons to be isothermal. However, the parallel and perpendicular temperature variations in the presence of a steady field aligned electric field can be calculated from kinetic theory, and such calculations show that the temperature variations are of the same order as the electrostatic potential. If the wave fields vary little during a typical electron transit time (a few seconds), the electrons will have a distribution resembling that in a stationary field. The kinetic results for a steady state then allow us to estimate the electron pressures that we need to close the set of fluid equations. The propagation and reflection of shear Alfvén waves is very sensitive to how the electron pressures vary, and our findings indicate that results derived from isothermal models should be carefully revised.