Particle Acceleration by Alfvén Waves in the Auroral Zone

Robert L. Lysak and Yan Song
School of Physics and Astronomy
University of Minnesota, Minneapolis, USA

Recent observations have confirmed the notion that kinetic Alfvén waves are associated with electron and ion acceleration on auroral field lines. Test particle models as well as self-consistent kinetic calculations have been performed to describe this acceleration, both in the relatively uniform outer plasma sheet and in the low-altitude auroral zone where the gradients of plasma parameters are very large. In the first case, a standard local theory of kinetic Alfvén waves indicates that Landau damping can provide a significant heating of electrons along field lines. The situation is more complicated in the second case, since the strong gradients require a non-local approach to electron acceleration. The results from such calculations indicate that a significant fraction of the Poynting flux incident on the auroral acceleration region can be converted into precipitating electron flux that can cause the aurora. The resulting precipitation produces increased ionization in the ionosphere. The resulting conductivity gradients lead to additional production of Alfvén waves that structures the auroral current system and may lead to narrow auroral arcs.