

Formation of Alfvénic Double Layers and Auroral Particle Acceleration

Y. Song, R. L. Lysak

University of Minnesota, Minneapolis, MN

The acceleration of charged particles to high energy and the associated emission of electromagnetic (EM) radiation produced by the accelerated electrons and ions, occur throughout space and cosmic plasmas. In general, applying parallel electrostatic electric fields associated with charge separation is the simplest and powerful method to directly accelerate particles to high energy. However, once the electric fields are produced, they will quickly short themselves out by the motion of free charges. Thus, a central question in auroral physics is to find the mechanism by which long-lasting parallel electrostatic electric fields can be generated.

The generation of parallel electric fields is favored by a low plasma density and high magnetic shear. In the auroral current system, nonlinear Alfvénic interactions between Alfvén wave packets can produce EM plasma structures, such as Alfvénic Double Layers. The Alfvénic Double Layer consists of localized long-lasting electrostatic electric fields, which are embedded in low density cavities and surrounded by enhanced magnetic stresses. These structures are dynamical in nature, where the Poynting flux carried by Alfvén waves continuously supplies energy to the Alfvénic Double Layers to maintain strong electrostatic electric fields for a fairly long time. These structures become a new fundamental dynamical state in cosmic plasmas, which constitute powerful high energy particle accelerators.