GENERATION OF ALFVENIC QUASI-STATIONARY ELECTROMAGNETIC PLASMA STRUCTURES AND AURORAL PARTICLE ACCELERATION

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One of the most important and unsolved questions in magnetospheric physics, solar physics and cosmic plasma physics is to find the mechanisms by which charged particles are accelerated to high energy. We suggest that Alfvenic Double Layers (DLs) and Charge Holes (CHs) in the Earth's magnetosphere play a crucial role in creating powerful self-sustained electrostatic electric fields, causing the acceleration of auroral particles and the generation of auroral kilometric radiation.

Propagation and reflection of Alfven waves can redistribute mechanical and magnetic stresses along magnetic field lines, producing localized stress concentration regions in the auroral acceleration region. The nonlinear interaction of incident and reflected Alfven waves and wave packets in the stress concentration regions can create Alfvenic quasi-stationary electromagnetic (EM) plasma structures, such as Alfvenic DLs and CHs in the auroral acceleration region. Such dynamical EM plasma structures often consist of localized self-sustained electrostatic electric fields associated with charge separation, which are embedded in the low density cavities and surrounded by enhanced magnetic or mechanical stresses. The enhanced magnetic and velocity fields carrying free energy serve as the local dynamo. The Poynting flux carried by Alfven waves continuously supplies energy to the localized dynamo region to support the continuous generation of electrostatic electric fields for a fairly long time. The generated electrostatic electric fields will deepen the seed low density cavity, which can further enhance the generation of more powerful electrostatic electric fields, causing auroral particle acceleration. The Alfvenic DLs with powerful electrostatic electric fields may also cause the generation of Auroral Kilometric Radiation. Similar electromagnetic plasma structures should also be generated by Alfvenic interaction in other inhomogeneous active cosmic plasma regions.

We suggest that these Alfvenic quasi-stationary EM plasma structures containing self-sustained powerful electrostatic electric fields in the low density cavity are commonly created in active cosmic plasma regions. These dynamical structures become a new fundamental dynamic state in cosmic plasmas, which constitute powerful high energy particle accelerators and act as a source of high energy electromagnetic radiation.