Geophysical Research Abstracts, Vol. 9, 10315, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10315

Nonlinear saturation of Farley-Buneman instability

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An important and specific example of the nonlinear stabilization of wave's growth due to development of the Farley–Buneman instability is considered. In the lower ionosphere in the E–region, a complex process transforms wind energy into currents creating the E–region of electrojet. If these currents exceed certain critical amplitude, a streaming instability called the Farley–Buneman or a collisional two-stream instability evolves. This instability grows more rapidly at shorter wavelengths and the waves propagate nearly perpendicular to the magnetic field. If characteristic time of plasma density oscillations exceeds an electron collision frequency the drift motion of electrons dominates and, accordingly, the vector nonlinearity is the strongest. From equations of electron and ion fluids with collisional friction we obtain the set of equations of auto oscillating type for finite (3-10) numbers of cooperating modes, the part of which is unstable, and the part damps. Then a process of parametric excitation of damping modes at presence of a growing unstable wave is treated analytically. With the help of numerical modeling the possibility of nonlinear stabilization of instability is shown and its various conditions are investigated and the conditions of stochastic behavior of a system with small number of modes, effects of correlation and decorrelation of a phase of waves are found. The possibility of formation, existence and stability of regular nonlinear structures at condition of Farley–Buneman instability is considered. In conclusion we discuss possibilities of observation of the investigated nonlinear processes in an ionosphere. This research is supported by KBN grant nr 0 T00A 014 29