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Generation of High-Frequency Electrostatic Wave by Nonlinear Low-Frequency Waves

GURBAX SINGH LAKHINA[1], BRUCE T. TSURUTANI[2], JOLENE S. PICKETT[3]

[1] *Indian Institute of Geomagnetism, New Panvel (W), Mumbai, India*

[2] *Jet Propulsion Laboratory, Pasdena, California, USA*

[3] *Department of Physics and Astronomy, University of Iowa, Iowa City, IA, USA*

Analyses of high resolution electric and magnetic wave data, recorded during Polar passage through the polar cap/cusp boundary layer, reveal the presence of large amplitude low-frequency electromagnetic waves, electrostatic solitary waves in the form of short duration bipolar pulses, and electromagnetic electron cyclotron waves. A generation mechanism for the high-frequency electrostatic waves by the currents, arising from the relative motion of electron and ions in the field of large amplitude low-frequency waves, is proposed. The nonlinear low-frequency waves may consist of Alfvén and/or proton cyclotron waves. The high-frequency waves grow by extracting free energy available in the parallel or perpendicular currents. These waves can saturate by trapping electrons, thereby leading to the generation of electron holes. This mechanism is quite general and provides a good example of coupling of plasma processes occurring at macro- and micro-scales.