Geophysical Research Abstracts, Vol. 7, 04258, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04258

Properties of LHR waves generation and propagation in the upper ionosphere

D.L. Pasmanik (1), A.G. Demekhov (1), V.Y. Trakhtengerts (1), E.E. Titova (2), M.J. Rycroft(3), J. Maninnen (4) and T. Turunen (4)

(1) Institute of Applied Physics RAS, Nizhny Novgorod, Russia, (2) Polar Geophysical Institute, Apatity, Russia, (3) De Montfort University, Leicester, UK, (4) Sodankyla Geophysical Observatory, Sodankyla, Finland

Propagation of a low-hybrid resonance (LHR) waves in the upper ionosphere is studied in the plasma having inhomogeneous density distribution along and across the geomagnetic field. The possibilities of their observation on the ground are analysed. These waves can be generated by beams of electrons and protons with energies above 1 keV appearing due to their acceleration in the auroral region during magnetic disturbances.

Special attention is paid to the case of wave propagation in cavities of depleted ionospheric plasma density. This case is interesting because the propagation in such a region can result in the transformation of LHR waves into whistler mode waves with the wave vector close to the direction the geomagnetic field. These whistler waves can be registered at the ground station. A two-dimensional model for the cavity is considered. The density depletion is assumed to be aligned with the geomagnetic field and to have symmetric profile across the magnetic field. The ray-tracing technique is used to study the properties of LHR waves propagation with account of the inhomogeneity of the plasma. On the basis of this analysis, the parameters of the cavity (such as its width and density decay) are found for which the mentioned transformation of LHR waves into whistler waves and subsequent transition to the Earth's surface can occur.

As the source of LHR waves, the generation by beams of energetic particles is considered. Electron beams generate non-structured ELF/VLF hiss emissions while ion beams can generate a hiss with a harmonic spectral structure. In the case of a proton beam with ring distribution in transverse velocities with respect to the magnetic

field the most effective generation occurs under the following condition of the double resonance: $\omega = \omega_{LHR}(x, z) = n\Omega_H(z)$, where ω_{LHR} is the local lower-hybrid resonance frequency depending on the coordinates along (z) and across (x) magnetic field, Ω_H is the local gyrofrequency of energetic ions, and n is an integer. The path-integrated gain due with account of resonant interaction with a beam and collisional damping along the obtained ray trajectories is calculated. It is demonstrated that the joint action of generation of the LHR waves at points of double resonance by transversal proton beam and following transformation of these waves into the whistler mode wave in the cavity may result in the banded spectrum of waves detected on the ground. Similar spectra were observed in several events observed at a ground-based station in Sodankula. The calculations results are compared with experimental data.