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Generation and propagation of the Auroral Kilometric Radiation in small-scale plasma cavities

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The Auroral Kilometric Radiation (AKR) is the most powerful natural emission emanating from the Earth magnetosphere. Experimental data obtained during the last decade have shown that sources of AKR have a small extension perpendicular to the geomagnetic field. The plasma of these regions is tenuous with an electron population essentially constituted by particles with low parallel velocities and keV energies. AKR sources are separated from the denser and colder external plasma by a sharp density and energy gradient with typical scale length smaller than 1 km (Louarn and Le Queau, 1996).

In the light of the experimental results, a waveguide model of the AKR generation by the cyclotron maser instability in the limited plasma cavity taking into account the influence of inhomogeneous magnetic field is developed. An equation of dispersion describing the inhomogeneity effects is obtained and properties of its solutions are investigated. It is shown that when waveguide modes propagate parallel to the magnetic field the structure of their electromagnetic fields may be symmetric or antisymmetric about the waveguide centre plane. In the general case of propagation at arbitrary angle to the magnetic field, waveguide modes are assimetric. Using the eikonal approximation for a slowly varying magnetic field, the propagation of electromagnetic waves excited by the cyclotron maser instability in small-scale plasma cavities is studied. Parallel wave vectors, growth rates and an amplification factor are found in relation to the altitude. The influence of the electron flow velocity parallel to the magnetic field on the value of amplification factor is investigated. The comparison of theoretical results with experimental data is discussed.

P. Louarn and D. Le Queau, Planet. Space Sci., v.44, N3, 199-210, 1996