Interaction of EM waves with nonuniform plasma slab

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Abstract

This paper aims at introducing an analytic technique to solve the problem of electromagnetic waves interaction with nonuniform plasma slab. This technique is referred as Ray Tracing Technique (RTT), based on transforming the rays inside the slab into an equivalent binary tree in the computer memory. This tree stores all information about the rays inside the slab. In the RTT, all multireflections rays are taken into account which has not been done in previous similar work. This results in exact solution to this problem in the form of infinite series. Plasma slab under consideration is nonuniform, cold, weakly ionized, steady-state, collisional, and magnetized by a uniform background magnetic field with general orientation with respect to the slab. It is modeled as a stratified plasma consisting of flat layers, the electron number density is fixed in each layer while the overall electron density profile follows a predefined distribution function. When the waves incident on the 1st interface of the plasma slab, a reflected and refracted rays are generated. The reflected rays go outside the slab and the refracted ray is propagating into the 1st layer until it reaches the 2nd interface. The incident ray is divided again into reflected and refracted rays and so on. It is aimed at tracing the rays inside the slab.

The tracing process means generation of nodes in the equivalent binary tree. These nodes store the amplitude of rays of magnetic field at each interface. The tracing process ends either all the rays reach the upper or lower side free space, or their intensity inside the slab become smaller a predefined value. At the end of tracing process the simulation program has a huge binary tree containing all the information about the rays inside the slab. Then the required reflected, transmitted and absorbed powers are evaluated. Sample of numerical results will be presented and discussed during the presentation.