Propagation of EM Waves in a Bounded Plasma Region

A. Helaly*, E. A. Soliman and Adel A. Megahed,
Department of Engineering Physics,
Faculty of Engineering, Cairo University,
Giza 12211, Egypt

- A. Helaly is currently with Phys. Dept., Sohar college of Educ., Sultanate of Oman, P.O.Box : 135, Postal Code : 311

Abstract

In recent years there has been a definite trend toward using plasmas as absorbers or reflectors of the electromagnetic radiation depending on a specified application. Such study is very important to find out the suitable parameters of the plasma which affect the electromagnetic energy. Studying the electromagnetic waves interaction with a stratified layered media can be carried out using either analytical or numerical methods.

An analytic technique is developed to calculate the reflection, absorption and transmission of electromagnetic waves by a bounded plasma region. The model chosen for this study is a magnetized, cold, steady-state, two dimensional, non uniform plasma slab, which is presented by a number of parallel flat layers. It is assumed that the electron density is constant in each layer such that the overall electron density profile across the slab follows any prescribed distribution function. The proposed technique is referred to as scattering matrix model (SMM). The incident wave is a transverse electromagnetic plane wave (TEM). The fields in each layer are written in the form of summation of the appropriate eigen functions weighted by unknown scattering coefficients. The coefficients are determined via the application of the appropriate boundary conditions at each interface. The effect of varying the wave frequency as well as the plasma parameters on the degree of reflection, absorption and transmission are investigated. Referring to the numerical results, it is found that the main function of plasma slab has been greatly dependent on the wave frequency. Also, the degree of reflection and transmission has been found to be affected by the plasma parameters. A sample of numerical results will be presented and discussed.