2. WIGGLER FIELDS IN A SWITCHED PLASMA MEDIUM

2.1 INTRODUCTION

Frequency shifting of an electromagnetic wave by switching the medium of propagation to a plasma medium is of considerable interest. [8]-[13]. The creation of the plasma medium is considered to occur at a boundary in time. An electromagnetic wave present prior to the creation of a plasma medium is converted to a number of new waves of different frequencies, after the switching occurs.

The problem is similar to the problem of an electromagnetic wave incident on a physical boundary in space. When the wave encounters the boundary it is converted into two new waves. One wave is considered the transmitted wave, which is the portion of the original wave that passes through the boundary into the other medium. The other wave is the reflected wave, which is the portion of the original wave that is reflected back by the boundary.

In each boundary problem, the incident wave is considered to be an electromagnetic plane wave of the form $\exp[j(\omega t - kz)]$. The new waves created by a space boundary have different wave numbers, k, while the frequency, ω, remains the same. The opposite occurs for new waves created by a time

boundary. Here, the new waves have different frequencies, while the wave number remains the same. We refer to these situations by saying either the wave number or the frequency is conserved.

When no static magnetic field is present, the case is considered isotropic. If a static magnetic field is present when the plasma is switched on, the plasma is referred to as a magnetoplasma and the case is considered anisotropic. In the isotropic case, the waves created by switching the plasma medium are called ordinary waves. In the anisotropic case, the ordinary waves are created as in the isotropic case, but the static magnetic field also gives rise to additional waves referred to as extraordinary waves.

In addition to the above waves, wiggler electric fields and wiggler magnetic fields are also created by switching of the plasma. These waves may be linearly or helically polarized. An examination, to gain insight into how the incident wave, the plasma, and the initial static magnetic field affect these wiggler fields, is made in this chapter.