International Journal of Scientific Research in Physics and Applied Sciences
Vol.6, Issue.4, pp.88-94, August (2018)

Research Paper

E-ISSN: 2348-3423

# Parametric Study of Plasma and Metallic Antenna

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**Available online at: www.isroset.org**

Accepted: 24/Dec/2017, Online: 30/Aug/2018

***Abstract*—** This paper is intended to the study of antenna parameters of plasma antennas to help the optimization of plasma antenna dimensions (radius and length). To accomplish this, three configurations of plasma antenna are simulated. The observations are taken on variations in the antenna parameters with the different radius and length of the plasma column. Additionally, to acquire similarity with metallic antenna, three models of metallic (copper) antenna are also be simulated with same configurations as plasma antennas. It is a comprehensive study of antenna parameters of the different configurations of plasma antennas and comparative study between the metallic and plasma antennas. Results suggest, the plasma antenna and metallic antenna are showing similar radiation patterns for each types of modals and at all the resonance frequencies, however the resonance frequencies and gain are different for different configurations of plasma antennas. The plasma antenna has become very useful applications in the field of communication and this paper provide important information about the antenna parameters of plasma antenna, along with the comparative study of antenna parameters with the metallic antenna. The paper deals with the different resonance frequencies of plasma antenna and hence reports about the re-tunability of plasma antenna as well.

***Keywords*—** *Plasma Antenna, Antenna Parameters, Resonance Frequency, Antenna and communication*

## I. INTRODUCTION

The plasma based technologies are in the age of evolution, researchers are continuously working on the plasma based industrial applications. Among the various applications of plasma based technology the most interesting one is the plasma antenna. Actually plasma antenna is an antenna in which metallic counterpart of an antenna is replaced by the plasma, in order to achieve many attractive characteristics that makes plasma antenna more advantageous than conventional metallic antenna [1]. The conventional antennas are made up of metal and metals are solid in nature and hence they have a particular shape and size. To change the configuration of a metallic antenna, we need to change the whole antenna mechanically. But in the recent time these limitations make metallic antenna uncomfortable in many fields where space and time is limited. As well as nowadays people needed multipurpose device to reduce the need of several devices. Based on the above discussed difficulties the plasma antenna may be a suitable option for the metallic antenna because it has following characteristics. The plasma antenna is constructed by a dielectric tube, which is filled with a noble gas. The gas is ionized to convert into the plasma and then this column of plasma is used as an antenna [2]. Since plasma antenna is made up of gas and dielectric tube hence it is light weighted than the metallic antenna of same configuration. The existence of plasma inside the dielectric column is depends on the ionizing potential, so it is possible to control appearance of plasma antenna by the electric switches [3]. The length of plasma column is directly proportional to the applied potential and hence length of plasma antenna can be controlled by the amount applied potential [4]. A monopole plasma antenna can work similar as a metallic antenna of copper [5]. The striations formed in a plasma column by changing some operating parameters, can be transformed a plasma antenna into a re-configured plasma antenna or in an array antenna [6]. A smart plasma antenna can steer the radiation pattern in different directions electronically [7]. On the basis of above advantages plasma antenna now it is becomes an intrusting topic for research.

Most of the earlier works on plasma antenna are deals with experimental approach and short discussion about the theory of plasma antenna. This paper is discuses basic theory about plasma antenna, plasma parameters (i.e. plasma frequency, plasma conductivity, plasma density) with simulating the plasma antenna on HFSS software and find antenna parameters of it, to understand performance of plasma antenna in comparison with the metallic antenna.

 