# INVESTIGATION OF AN ANNULAR DIELECTRIC RESONATOR ANTENNA FOR WIRELESS APPLICATIONS

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## ABSTRACT

In this paper we present a new topology of DRA at the frequency range 3-8 GHz that allows achieving a very high accuracy with low power consumption. An annular DRA design with different heights of monopole antennas, an air gap between the dielectric resonator and ground plane loaded on double monopole antenna. In this proposed antenna the monopole antenna and annular DRA is both centre about the same axis. This antenna is simulated using a CST-MWS and fabricated from methyl sulfate material of dielectric constant 48. This design of annular DRA is suitable for wireless application. The simulated result of Annular Dielectric resonator antenna loaded with monopole antenna provides high gain and radiation pattern, low return loss.

***Keywords: Annular DRA, CST-MWS, DRA,Monopole Antennas***

## I. INTRODUCTION

Dielectric resonator antennas are resonant antenna devices that radiate or receive radio waves at a chosen frequency of transmission and reception, as used for example in mobile telecommunications. Dielectric resonator antenna is fabricated from low-loss and high relative dielectric constant material of various shapes whose resonant frequencies are function of the size, shape and permittivity of the material. DRA can be in few geometries includingcylindrical, rectangular, spherical, half split cylindrical and hemispherical shaped. Dielectric resonators were first popular as filter element device in microwave circuits. The DRA has some interesting characteristics, like the small size, ease of fabrication, high radiation efficiency, increased bandwidth and low production cost, DRA are very promising for application in wireless communications.

The advantages of the DRA are stated briefly as:

A DRA is a resonance structure, various modes can be excited and each mode has its radiation characteristics depended on its shape, dielectric material and feed structure. DRA can be excited by various feeds, such as probes, slot, micro strip lines, dielectric image guides, coplanar lines and waveguide slot. These excitation methods can accommodate a variety of design restrictions or requirements.DRA not limited to linear polarization. The DRA can be designed for single, double or circular polarization. Its physical size is small since DRA is made of high dielectric

constant. Therefore, the DRA size decreases as the dielectric constant increases.

DRAs offer several attractive features including:

High dielectric constant, high radiation efficiency ( = 95%) due to the absence of conductor or surface wave losses, wide control over size and bandwidth, high quality factor Q : up to 10000(f = 10 GHz) and wide frequency range : f = 0.7 – 35 GHz.

## II. DESIGN AND SIMULATION OF THEPROPOSED ANTENNA

The DRA is designed to operate in the $TM_{01\delta}$ mode which has a circular symmetric modal field pattern similar to that of a short monopole antenna. The bandwidth of monopole antenna can be significantly extended by the addition of the annular DRA, as the monopole and annular DRA are both centered about the same axis, and the monopole simultaneously functions as a quarter wavelength radiator and as a feed for the DRA. The monopole is design to operate toward the lower end of the spectrum, while the DRA operates toward the upper end .For wideband operation resonant frequency are chosen so that a minimum return loss of 10 db is maintained over the operating bandwidth.

The specification of the dielectric resonator antenna is shown below.

**Table 1: Data of the Dielectric resonator antenna**

| **Parameters** | **Values** |
|---|---|
| Frequency range | 3-8GHz |
| Air gap (g) | 5.2 mm |
| outer radius of dielectric antenna | 9.5 mm |
| Inner radius of dielectric resonator antenna | 2.9 mm |
| Height of dielectric resonator antenna | 21.2 mm |
| Radius of monopole antennas | 1 mm |
| Height of monopole antenna | 37.9 mm |
| Height of monopole antenna | 38 mm |
| Dielectric constant | 48 |

## III. RESULTS AND DISCUSION

The proposed Annular DRA is analyzed using CST-MWS. The simulated return loss of the annular DRA plotted against frequency is shown in Fig. Fig. 3 and 4 reveals the simulated return loss with different height of monopole antennas. For the case

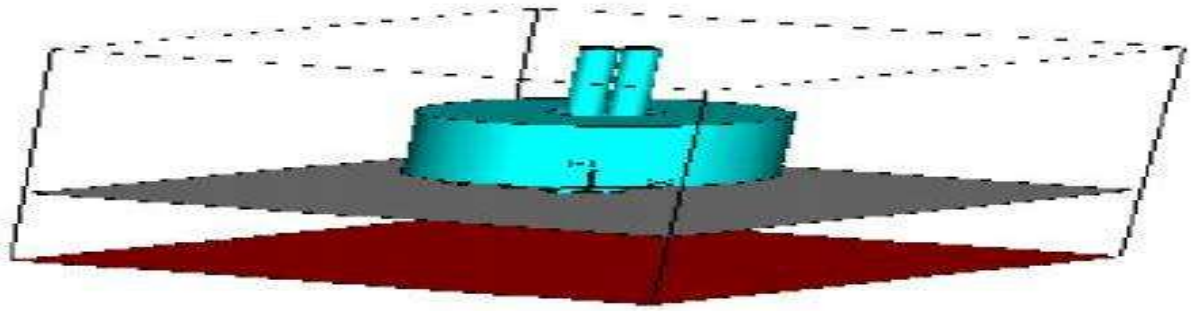

**Fig1: Annular Dielectric Resonant Antenna Loaded With Double Monopole Antennas At Monopoles Antennas Height 37.9mm**

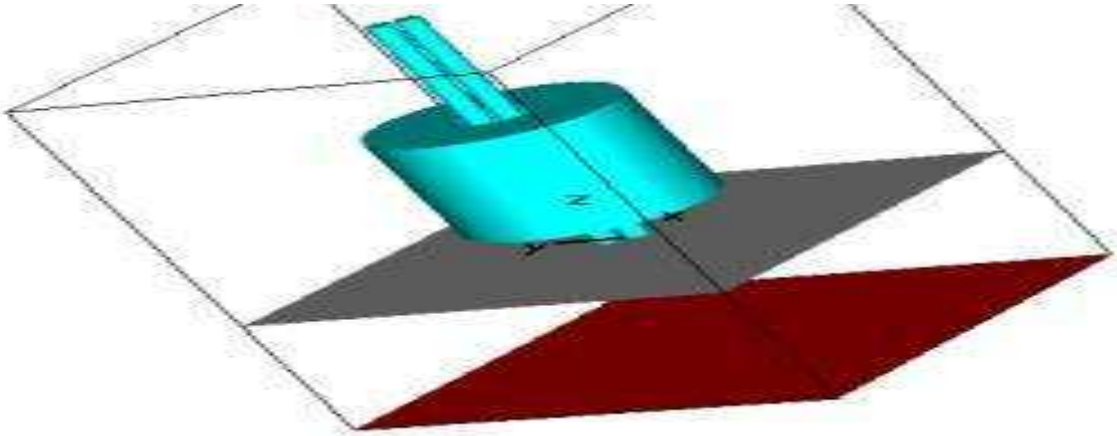

**Fig2: Annular Dielectric Resonant Antenna Loaded With Double Monopole Antennas at Monopoles Antennas Height 38mm**

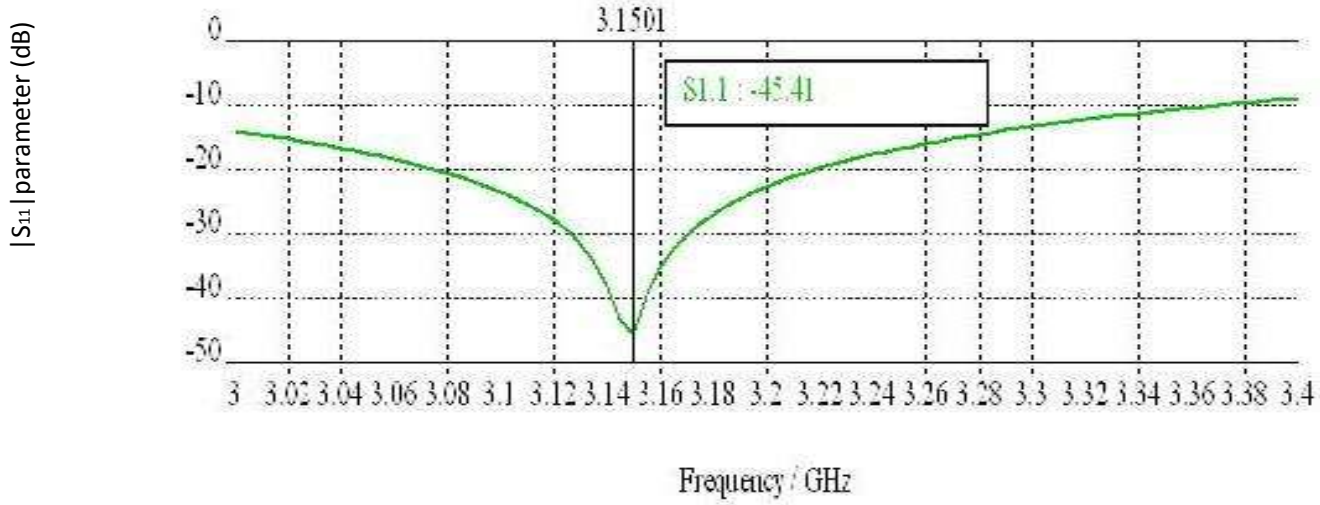


**Fig 4: Simulated Returnloss of Annular DRA At H=38 Mm**

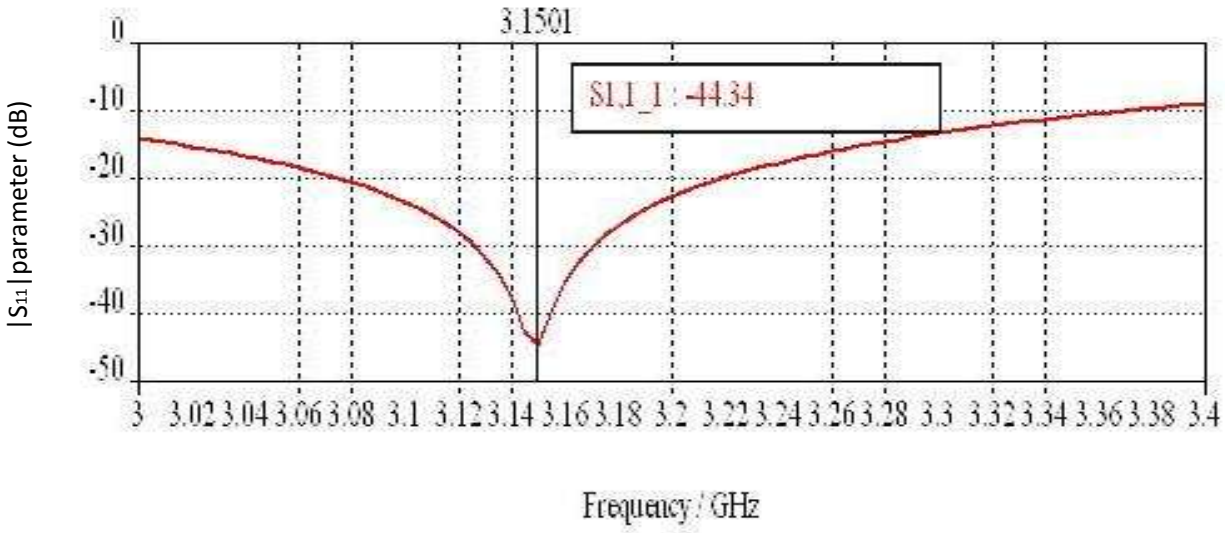


**Fig 3: Simulated Return Loss of Annular DRA at h=37.9mm**

h = 38 mm, less return-loss is observed .The far field radiation patterns of the proposed DRA arealso simulated. Fig. 5 reveals the simulated radiation patterns at 5.5 GHz. It is observed that the E plane radiation patterns are similar to a half wave length dipole antenna over the entire frequency range. In H plane, omni-directional radiation pattern are found.

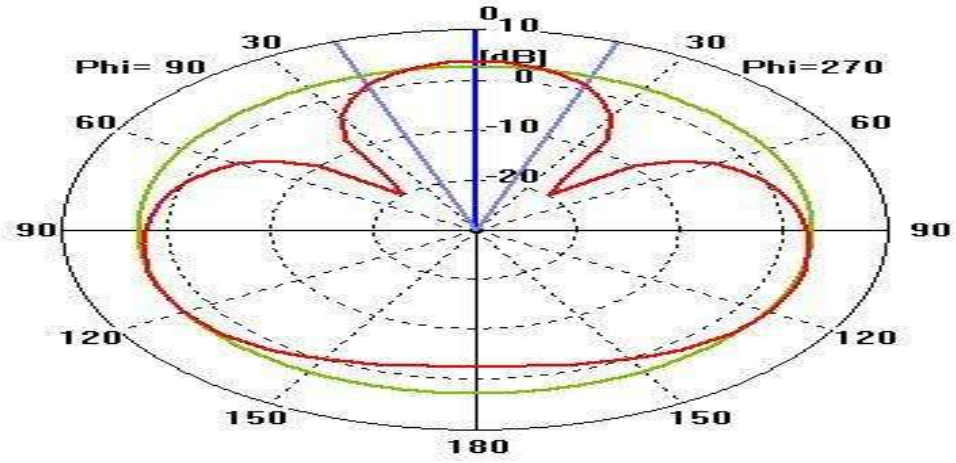


**Fig 5: Far Field Radiation Pattern of Annular DRA**

## IV. CONCLUSION

A novel annular dielectric resonator antenna is presented to support the wideband operation. By adjusting the height of monopole antennas, a very good return-loss and radiation pattern over a wide frequency range. As a result, the proposed antennais attractive and can be use for various wireless communication systems.

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