Dual Band UWB Pentagonal Antenna with Partial Ground

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Abstract : **This paper presents the design of UWB Antenna that are for two different frequencies,3.32GHz and 4.52GHz and with a return loss of -41.37dB and -26.82dB respectively. It shows good bandwidth of 2.55GHz ranging from 2.66GHz to 5.21GHz .Here a partial ground technique is adopted with a pentagonal patch antenna structure. Various parameters including gain, E-field, H-field, directivity and efficiency are shown. These results show that the design can be suitable for different applications with high accuracy and less losses.CST Microwave Studio software is used to perform simulations. This antenna also shows good radiation characteristics and obtains a desired gain across the band, which makes the antenna a perfect choice for UWB applications. Simulated parameters indicate that the proposed antenna exhibits good linearly polarized radiation pattern.**

***Index Terms*–UWB, Partial Ground, Pentagon, Dual feed.**

I. INTRODUCTION

Wide investigations are been going on in the field of Ultra wideband (UWB) communication systems to fulfill the demand for high data rate, low cost, and low power. Federal Communications Commission (FCC) allowed 3.1–10.6 GHz unlicensed band for UWB communication. As per Federal Communications Commission (FCC) UWB band ranges from 3.1 GHz to 10.6 GHz, a band of 7.3 GHz wide. Bandwidth of each radio channel is more than 500 MHz, depending on its center frequency .UWB antennas are vital for UWB communication systems and have attracted many researchers towards it. The design goal to be achieved in case of UWB antenna design is wide impedance matching, radiation stability, low profile, compact size etc. But UWB has a disadvantage of multipath fading like other wireless systems.

UWB provides high data rate that is suitable for different wireless applications. UWB technology also allows spectrum reuse.

The Micro strip antenna has become one of the most popular candidates for highly directive antenna applications due to its light weight, low profile, and easy fabrication, low cost and easy integration with other circuit components. The greatest challenge associated with Micro strip antenna design is to miniaturize the circuit dimension while maintaining certain antenna characteristics. A patch antenna consists of a metallic film bonded to a grounded dielectric substrate The thickness of the substrate layer and the relative permittivity are usually small, hence the patch behaves more like a parallel plate transmission line.

The partial ground plane removal reduces the back- lobe radiation of the micro strip antenna by suppressing the surface wave from the edges of the antenna ground plane. With partial ground plane removal, there are field minima at the ends of the removed ground plane.

II. DESIGN OF PATCH ANTENNA

It is important to have a deep knowledge about Microstrip Antenna before start a project work. Research papers, books, journal, thesis, dissertations and the internet are the sources of information .Antenna used as a device can improve the system performance in terms of bandwidth, efficiency and band width. Mainly micro strip patch antenna can fulfill the wireless system requirements. It has highly directive antenna applications. The associated challenges with microstrip antenna design are to miniaturize the circuit dimension by maintaining certain antenna characteristics. A patch antenna is a device of a metallic film bonded to a grounded dielectric substrate. The relative permittivity and thickness of the substrate layer are usually small hence patch behaves as a parallel plate transmission line. The dimensions of proposed patch antenna are as follows: substrate width(sw) is 27.83mm,substrate length(sl) is 38mm,substrate height (sh) is 1.524mm,ground width(wg) is 27.83mm,ground length(lg) is 20.19mm,ground height(gh) is .07mm,feed length(fl) is 24.16mm,feed width(fw) is 3.13mm,sides of patch are x1=5.63mm,x2=10.91mm,x3=3.78mm.The substrate used for design is FR4 with a height of 1.524mm, loss tangent of .02 and dielectric constant is 4.4.The screenshot of antenna in simulation window is as shown in figure below:

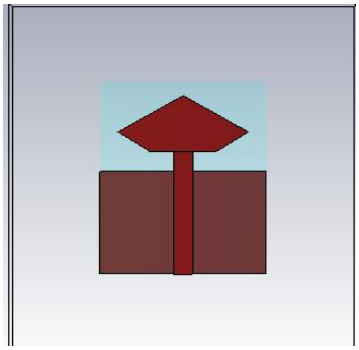

Fig.1 screenshot of front view of proposed antenna

The partial ground is rectangular in shape. The shape of the antenna is pentagonal with a microstrip feed line of 50ohm. Blue color shows the removed part of the full ground and the brown color shows the partial ground in fig.2.

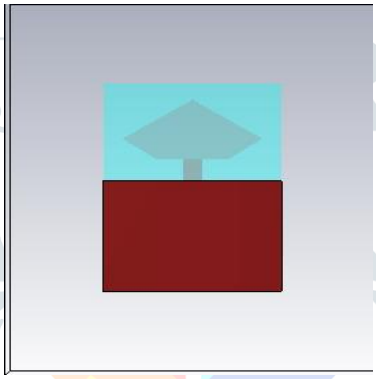

Fig.2 screenshot of back view of proposed antenna

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III. SIMULATION RESULTS AND DISCUSSION

The proposed antenna parameters are optimized to get minimum return loss and good radiation efficiency using pentagonal patch antenna.

3.1 S-parameters for slotted ground

Simulation results for pentagonal patch antenna are show in fig.3 and fig4. It shows the UWB range 2.66GHz to 5.21GHz. This range provides 2.55GHz bandwidth. At 3.32GHzresonant frequency the return loss is -41.37dB and at 4.52GHz frequency the return loss is -26.82Db in partial ground. Greater bandwidth is achieved by using partial ground.

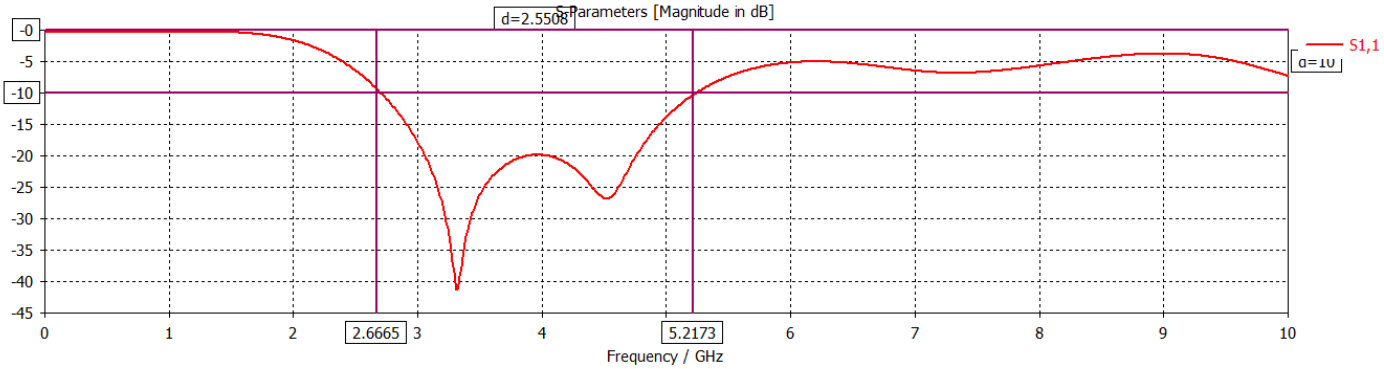

Fig.3 Resultant waveform for UWB range2.66GHz to 5.21GHZ

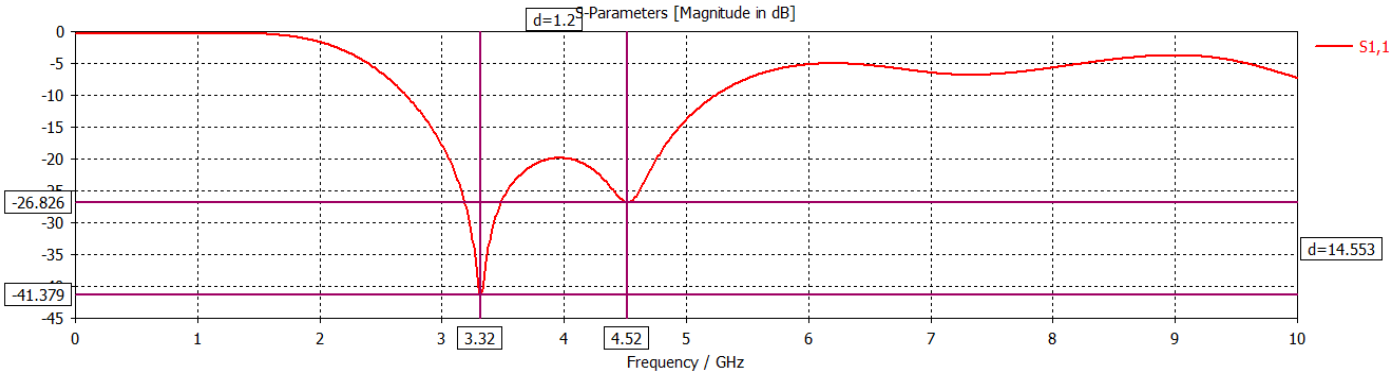

Fig.4 Resultant waveform at peak 3.32GHz and 4.52GHz with return loss -41.3dB and-26.82dB

3.2 Radiation pattern (E-Plane and H-Plane)

The radiation pattern of proposed antenna is given in fig.5, fig.6, fig.7 and fig.8. Partial ground provides -1.3dB side lobe at E-field radiation pattern's- field also contain the -1.dB side lobe.

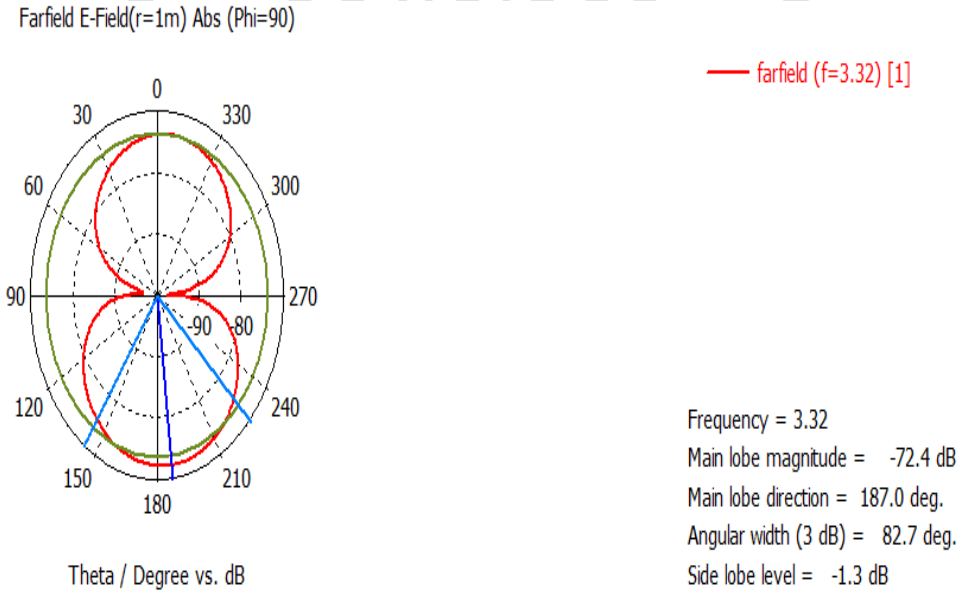

Fig.5: 3.32 E-field polar plot

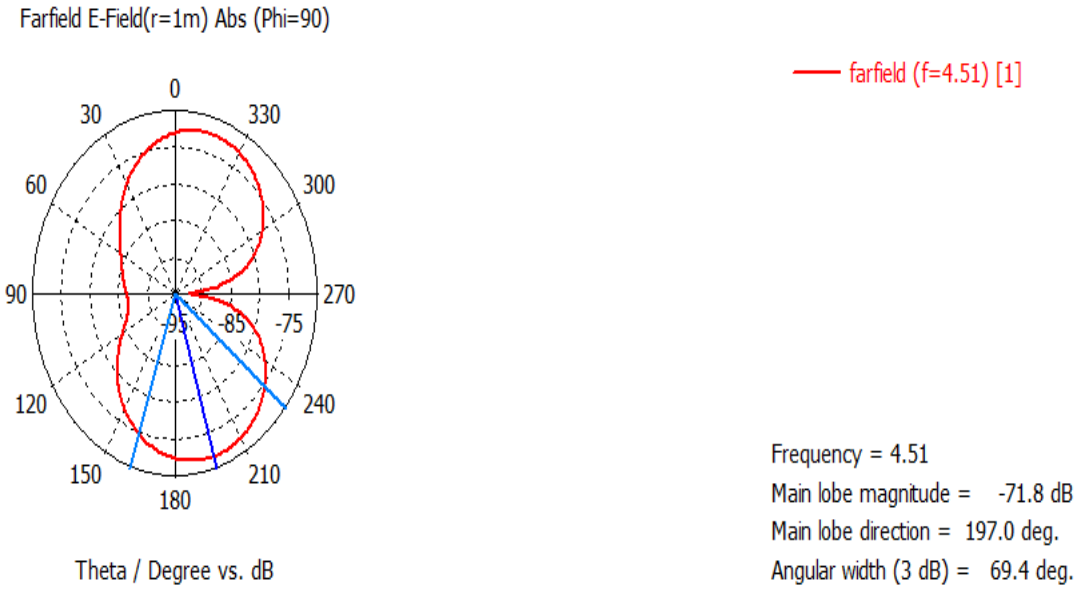

Fig.6: 4.51 GHz E-field polar plots

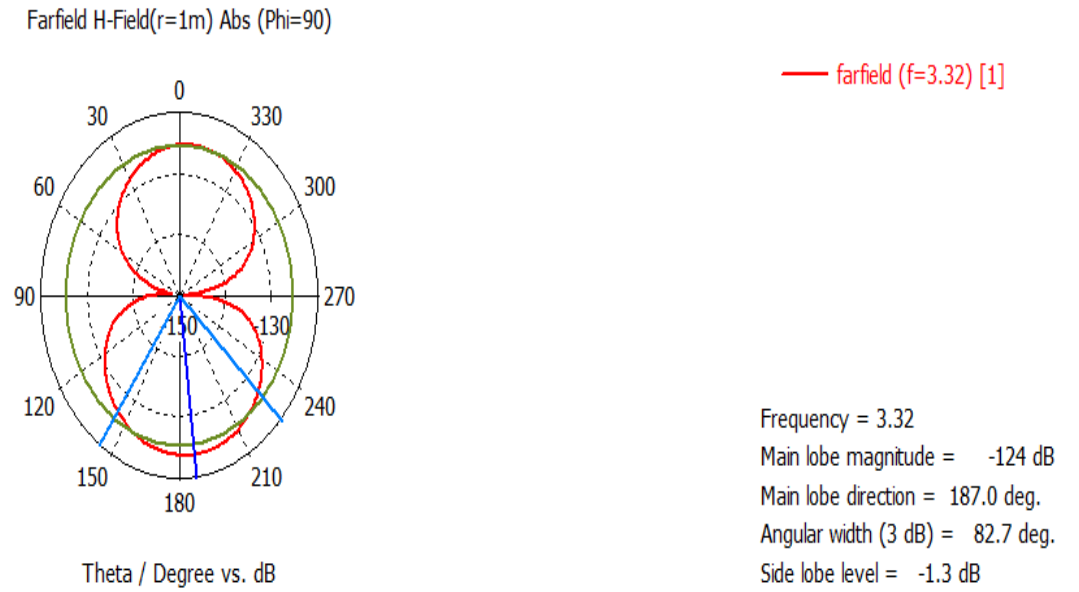

Fig.7:3.32 GHz H-field polar plots

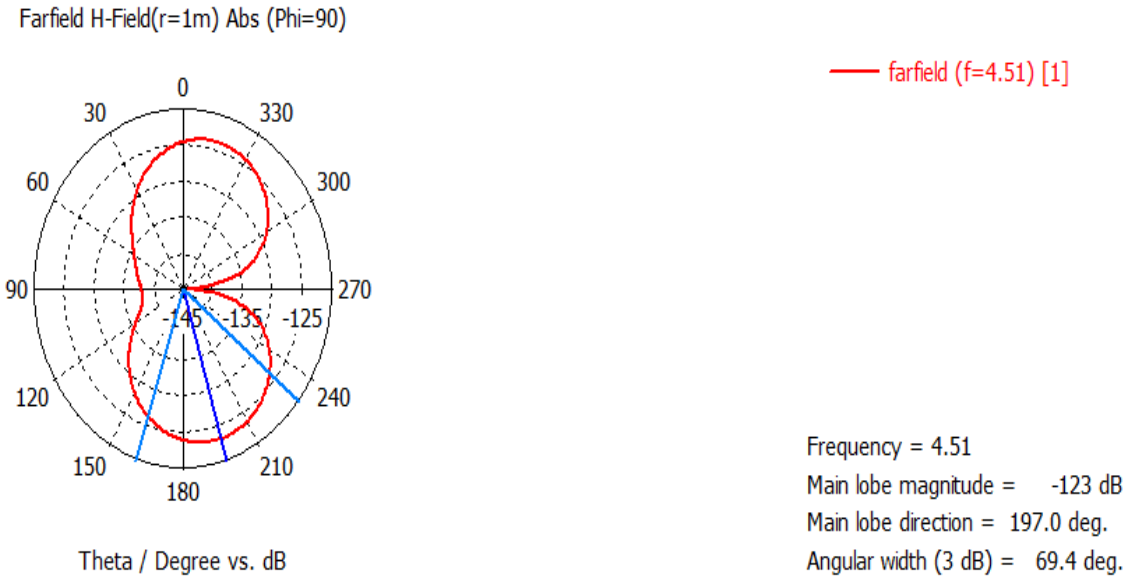

Fig.8: 4.51 GHz H-field polar plots

3.2 Gain and radiation efficiency

Gain and radiation efficiency is given in fig.9, fig.10, fig.11 and fig.12 using the polar plots and 3D plots at resonant frequency 3.32GHz and 4.52GHz.It provides -86.57dB gain and -.5484dB radiation efficiency.

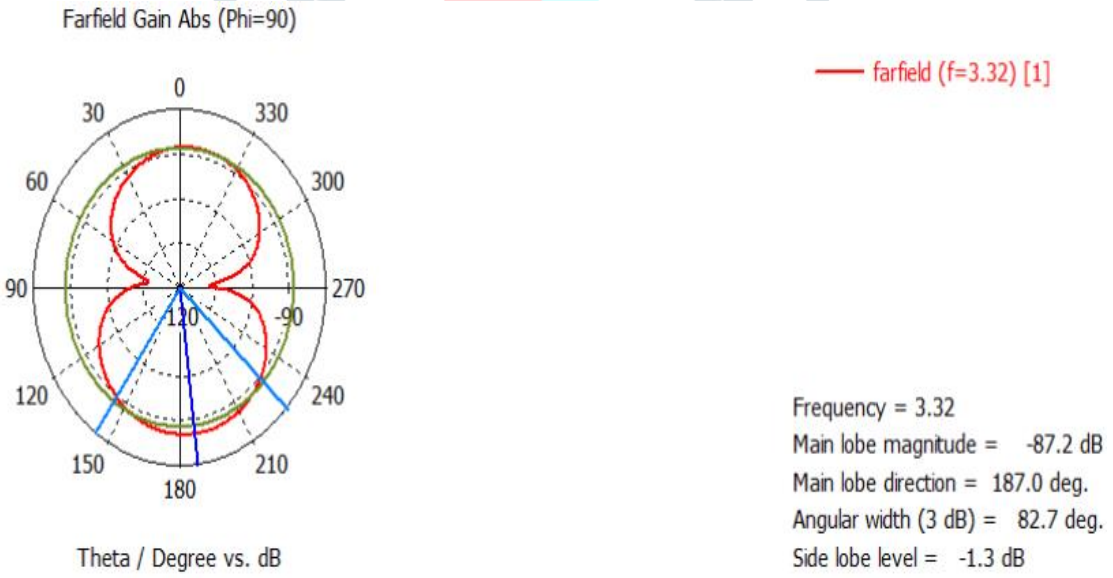

Fig.9 3.32GHz gain polar plot

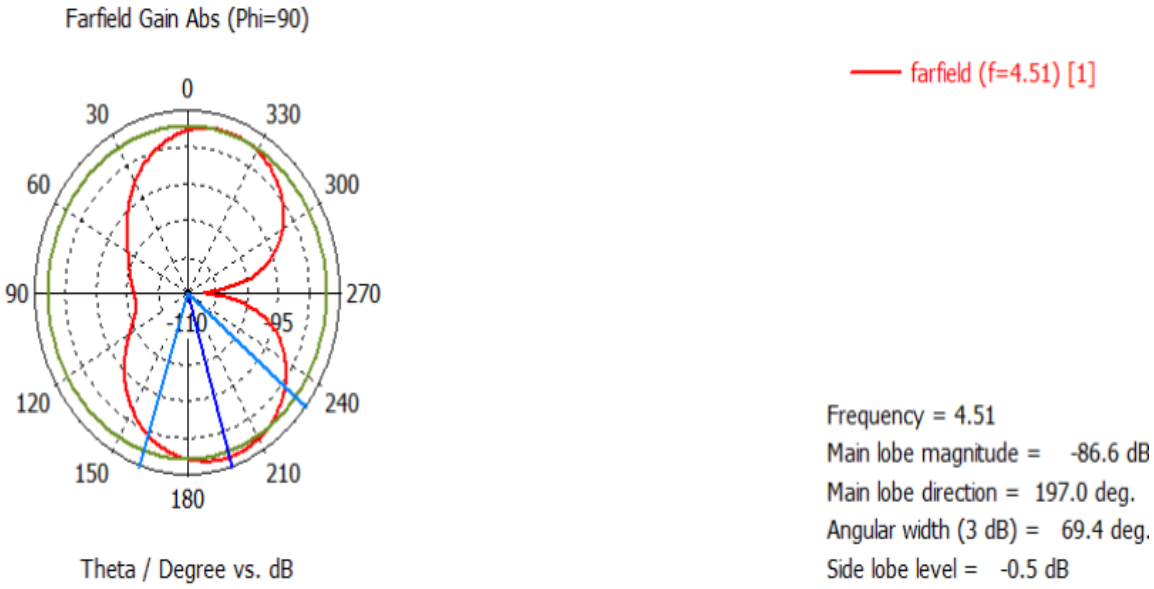

Fig.10 4.51GHz gain polar plot

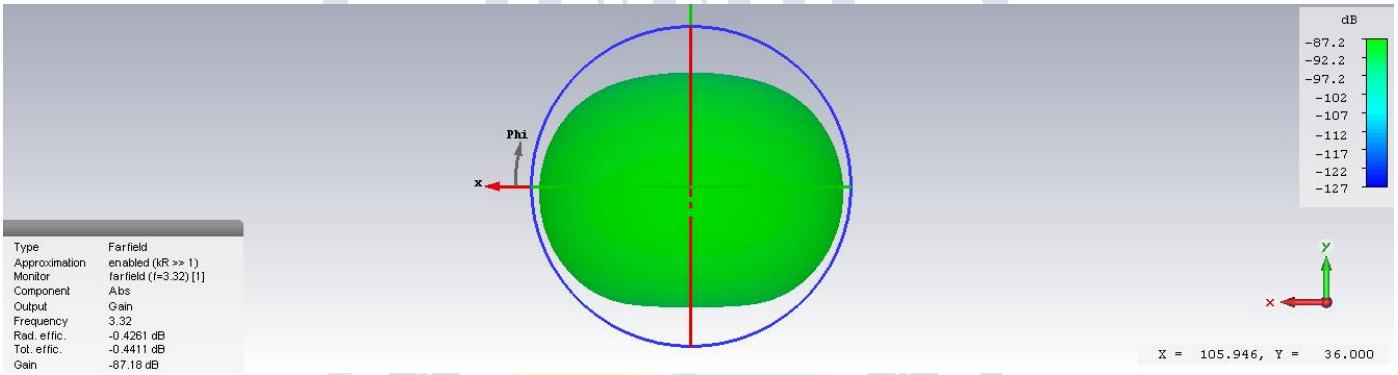

Fig.11 3.32GHz gain 3D plot

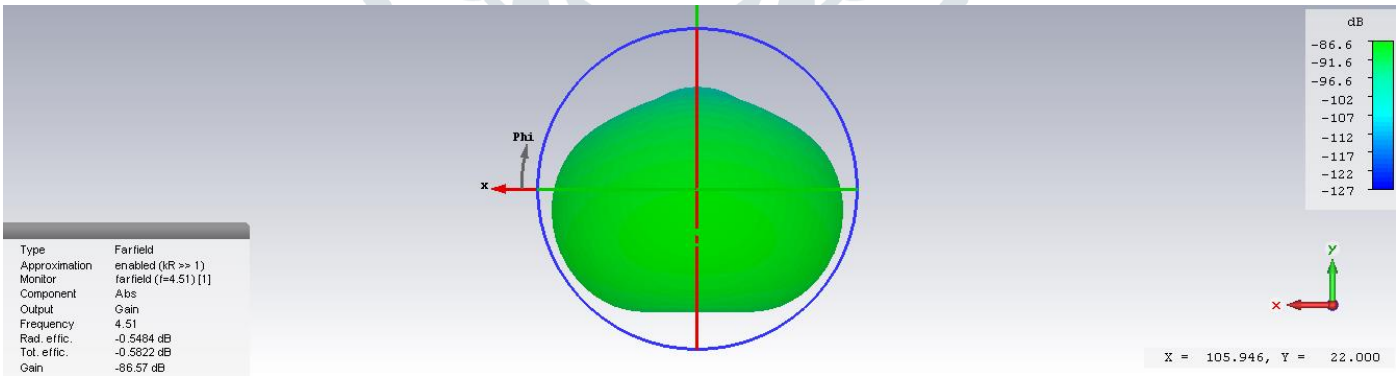

Fig.12 4.41GHz gain 3D plot

IV.CONCLUSION

A Pentagonal Microstrip Patch Antenna was proposed for UWB range 2.66GHz to 5.21GHz range using partial ground technique and shows 2.55GHz bandwidth. Many aspects of UWB antennas are available for the effectiveness of design on S parameters and axial ratio. The proposed UWB Antenna resonate at peak frequency 3.32GHz and 4.53GHz with poor return loss. Partial ground technique is also useful to obtain higher gain.

V.SUGGESTION FOR FUTURE WORK:

It can be extend to two, four or more antenna like antenna array with proper dimension, different different shapes of patch and many other assumptions in right direction. One can also calculate the bandwidth effect, gain many other parameter effects using different dielectric material or Meta material and different types of DGS and many other techniques.

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