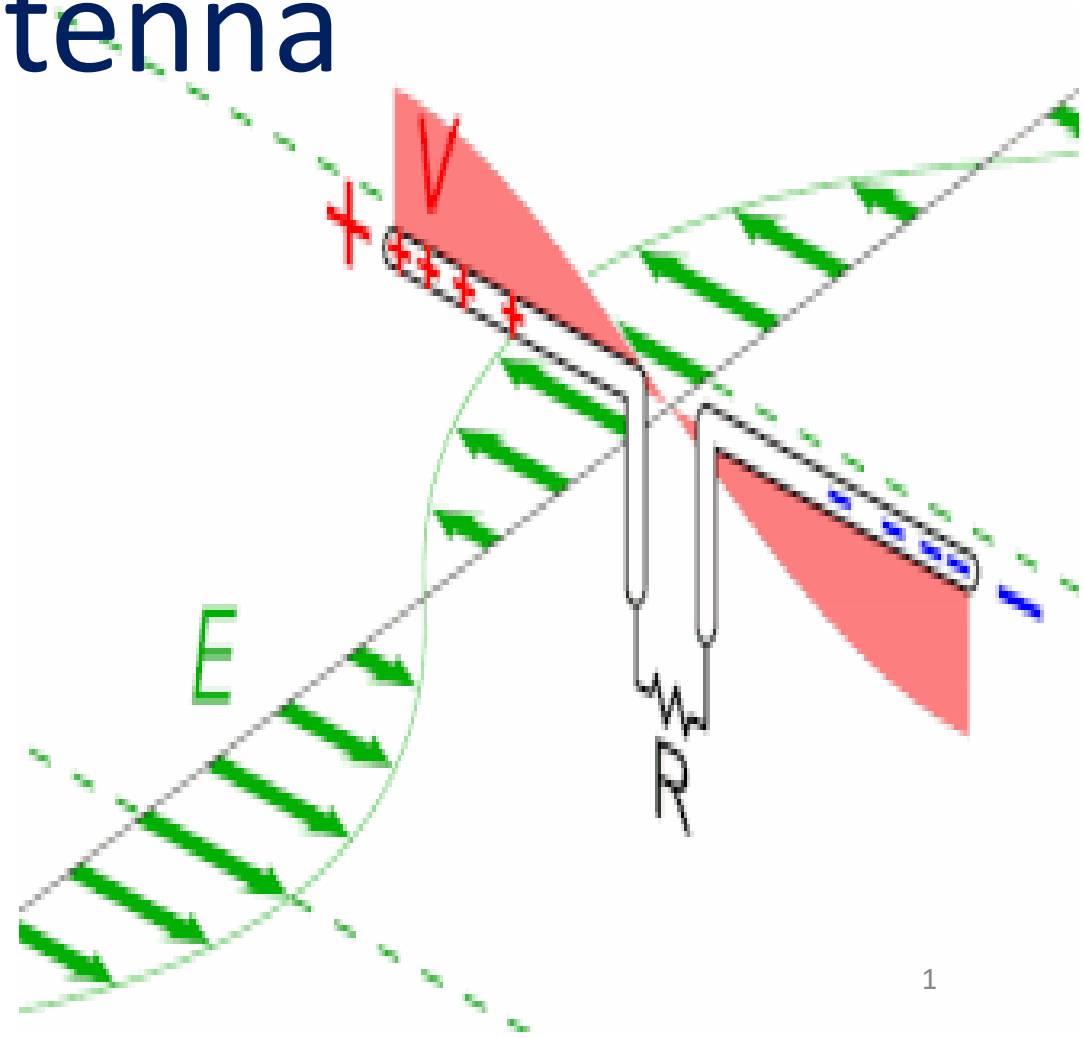
Antenna Engineering Laboratory
ECE-3208

Dual Band Dipole Antenna



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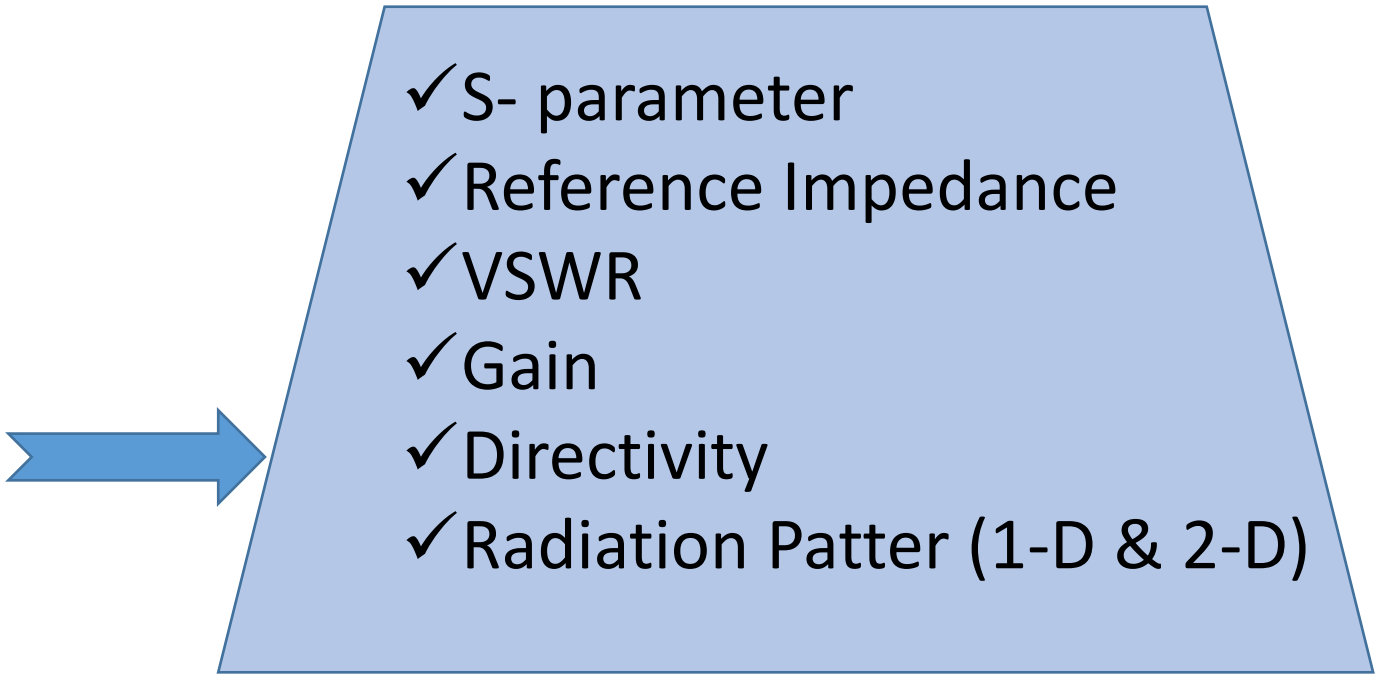
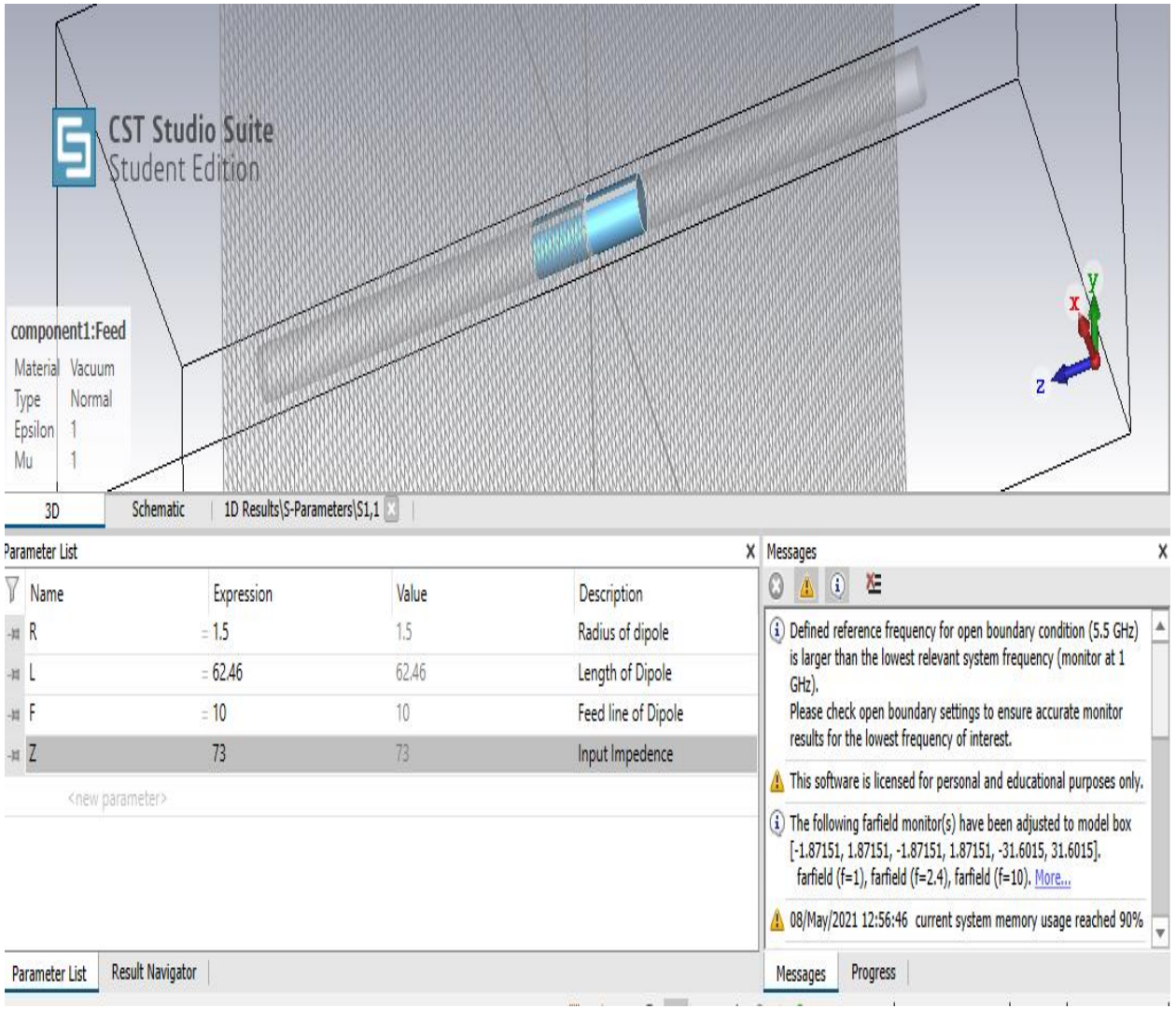


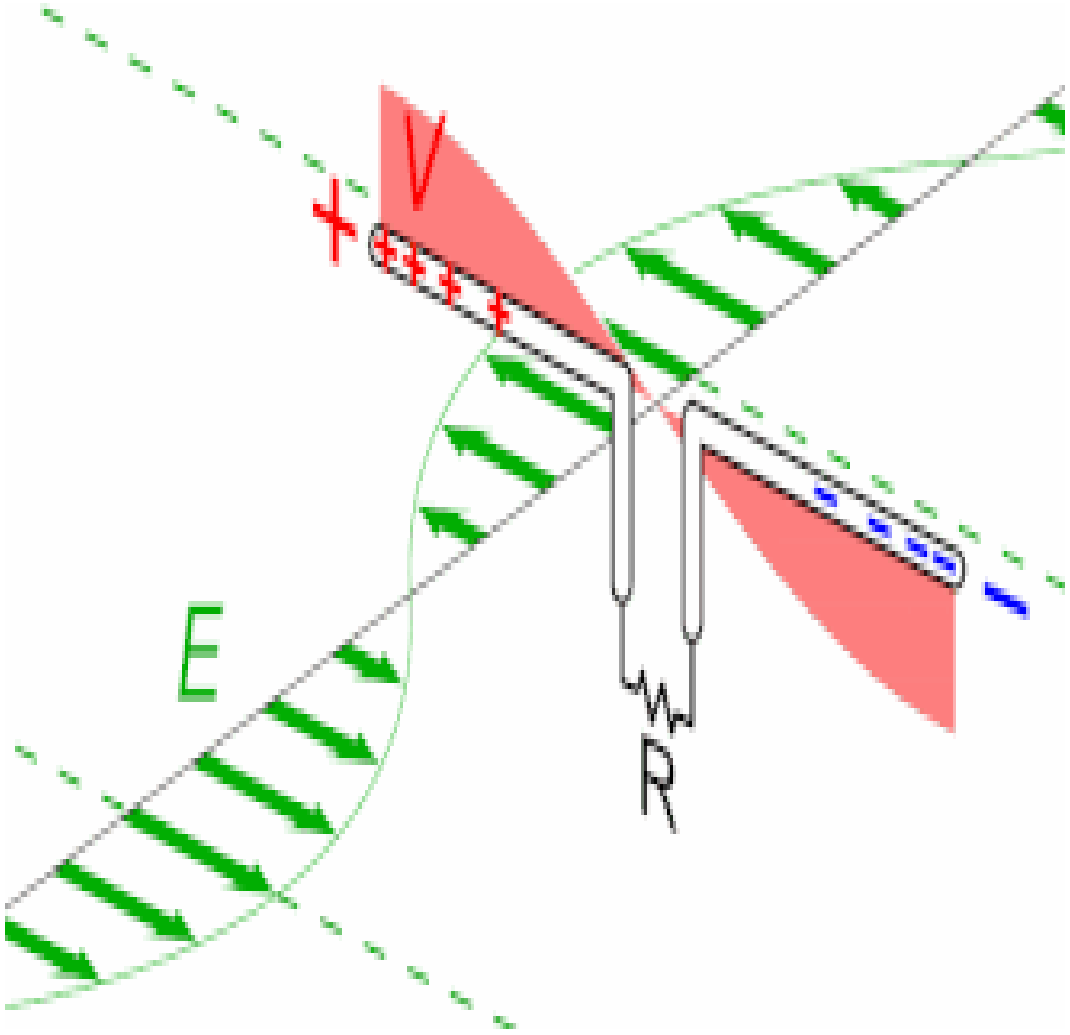
AIM OF THE DESIGN

- ✓Our aim is to design and simulate a basic dual band dipole antenna on a particular frequency and study radiation properties and frequency response with the help of various antenna parameters.
- ✓The process is done with the help of CST simulator Software.



Theory

- ✓Consists of two identical conductive elements
- ✓Lowest impedance
- ✓Voltage and current varies along the radiating section
- ✓Resonant condition



Input Parameters

Length of the Dipole

$$L = \frac{c}{f}k$$

Where,

L= length of dipole

f= frequency of dipole antenna

c= velocity of light

k= adjustment factor (generally 0.95)

λ= wavelength of dipole antenna

Radius of the Dipole

$$r = \lambda/1000$$

Input Parameters

Input Impedance of the dipole

Radiation Intensity of the dipole, $U(\theta) = \frac{1}{2} r^2 \frac{|E_\theta|^2}{\eta} = \frac{1}{2} \frac{\eta I_m^2}{(2\pi)^2} \frac{\cos^2(\pi/2 \cos\theta)}{\sin^2\theta}.$

Radiated Power by the antenna,

$$\begin{aligned} W_{rad} &= \int_0^{2\pi} \int_0^{\pi} U(\theta) \sin\theta d\theta d\phi \\ &= \frac{1}{2}(2\pi) \frac{\eta I_m^2}{(2\pi)^2} \underbrace{\int_0^{\pi} \frac{\cos^2(\frac{\pi}{2}\cos\theta)}{\sin\theta} d\theta}_{\text{1.2188 numerically}} \\ &= 30(1.2188) I_m^2 = 36.5640 I_m^2. \end{aligned}$$

Input Impedance, Z= $\frac{2W_{rad}}{I_m^2} = 73.1280\ \Omega$

Calculated Parameters

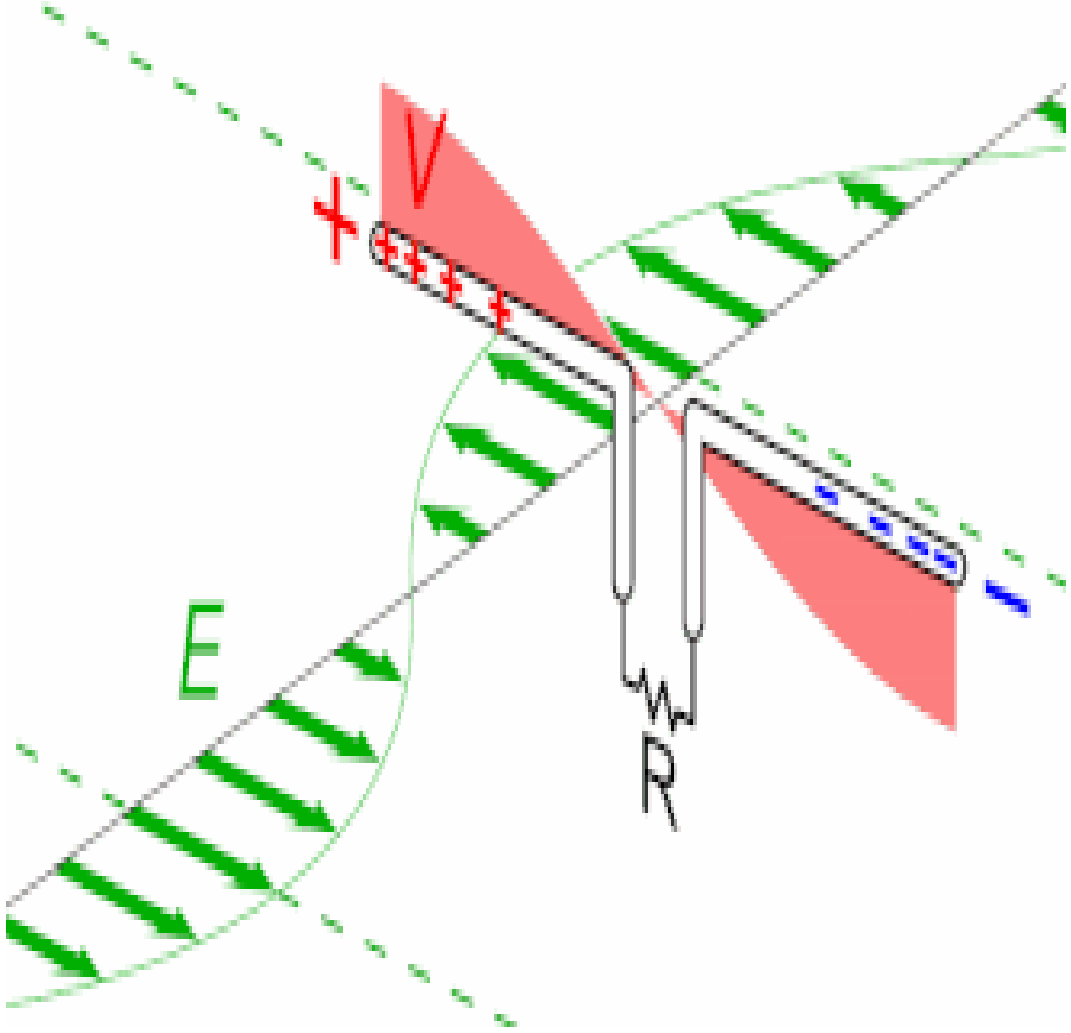
Frequency of the antenna= 2.4 GHz

Symbols	Value	Description
R	1.5	Radius of Dipole
L	62.46	Length of Dipole
F	10	Feed line of Dipole
Z	73	Input Impedance of Dipole

Technical Objectives

To design a dual band dipole antenna, the following parameters should be considered-

- ✓Radiation Pattern
- ✓Frequency Response
- ✓Gain



Design Optimization

Parameter List

Name	Expression	Value	Description
R	= 1.5	1.5	Radius of Dipole
L	= 62.46*a	55.886085	Length of Dipole
F	= 10	10	Length of Feed
Z	= 73	73	Input Impedence
a	= 2.1474/2.4	.89475	
<new parameter>			

Output Considerations

✓S-parameter

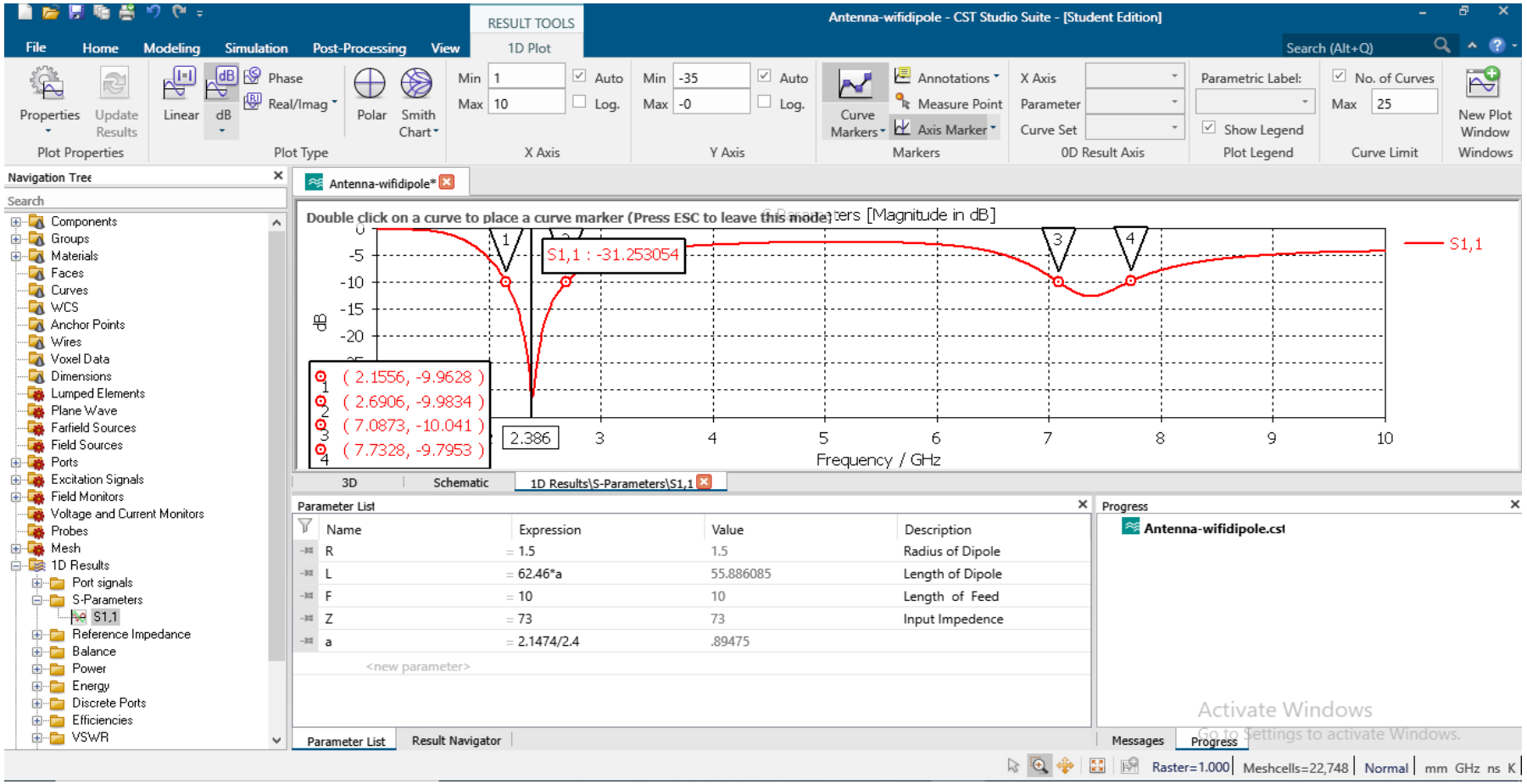


Fig-01: S-parameter of dual band dipole antenna

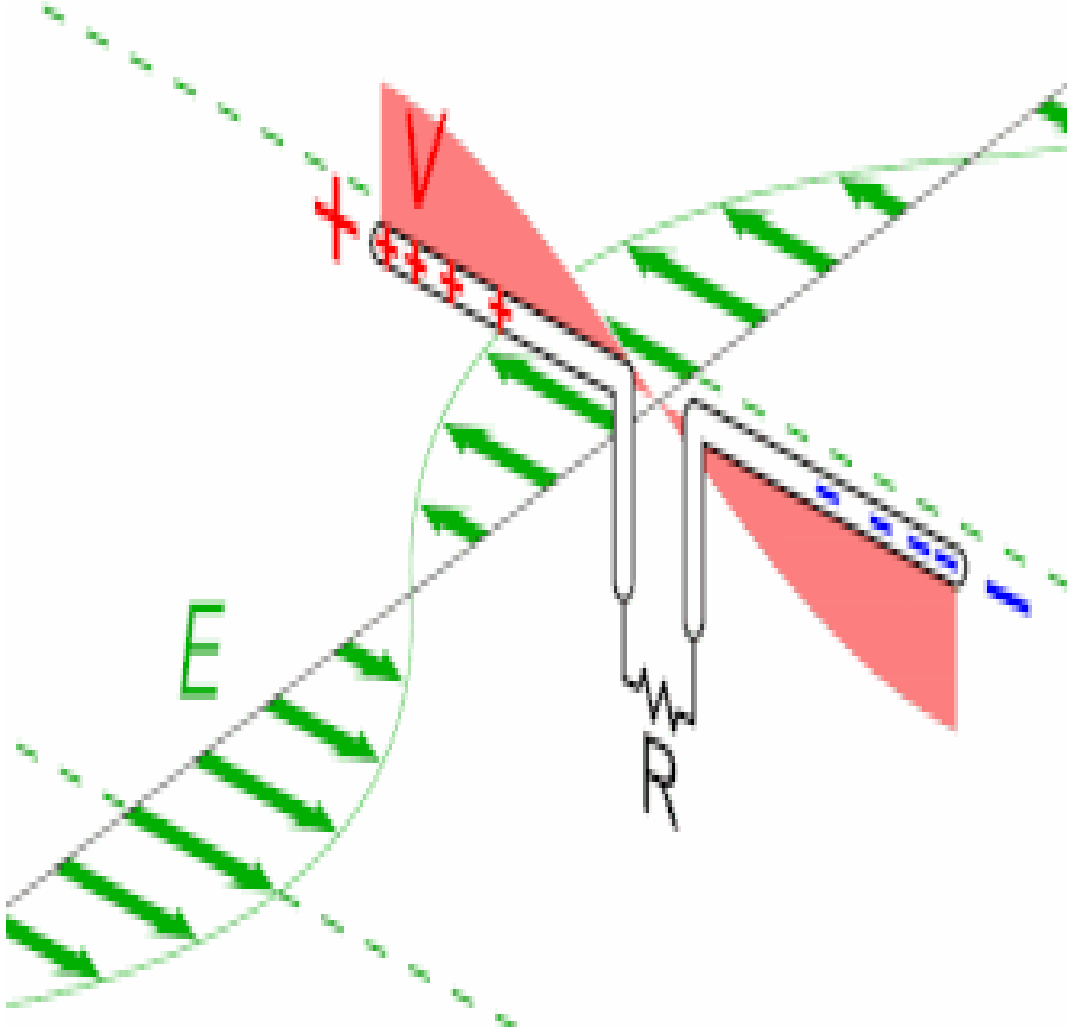
Bandwidth Calculation from S-parameters

✓Dual Band dipole antenna
✓Hence, there will be two bandwidths

From the previous figure,

BW1= (2.6906-2.1556)
= **0.535 GHz**

BW1= (7.7328-7.0873)
= **0.645 GHz**



✓Reference Impedance

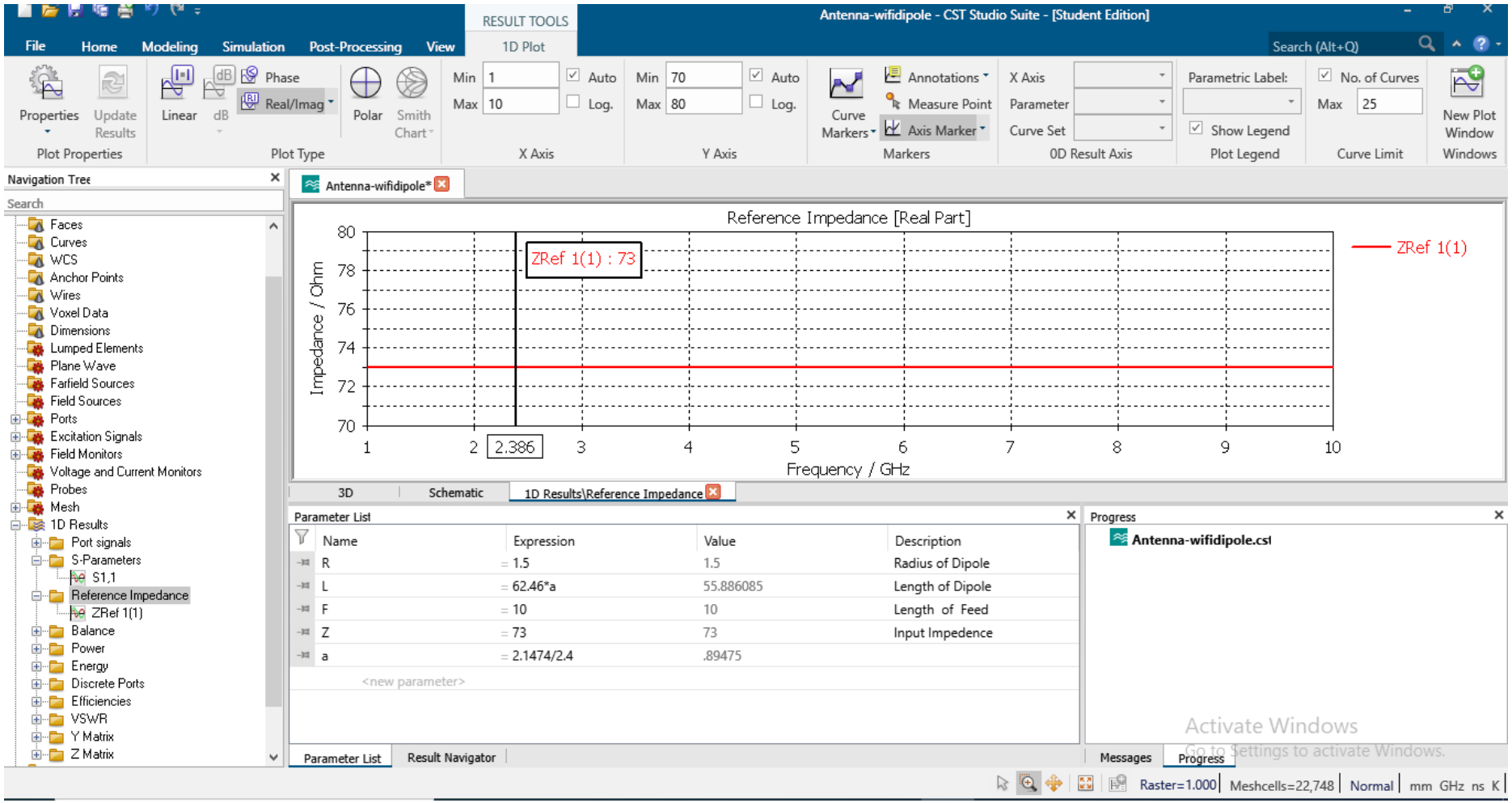


Fig-02: Input Impedance of dual band dipole antenna

✓VSWR

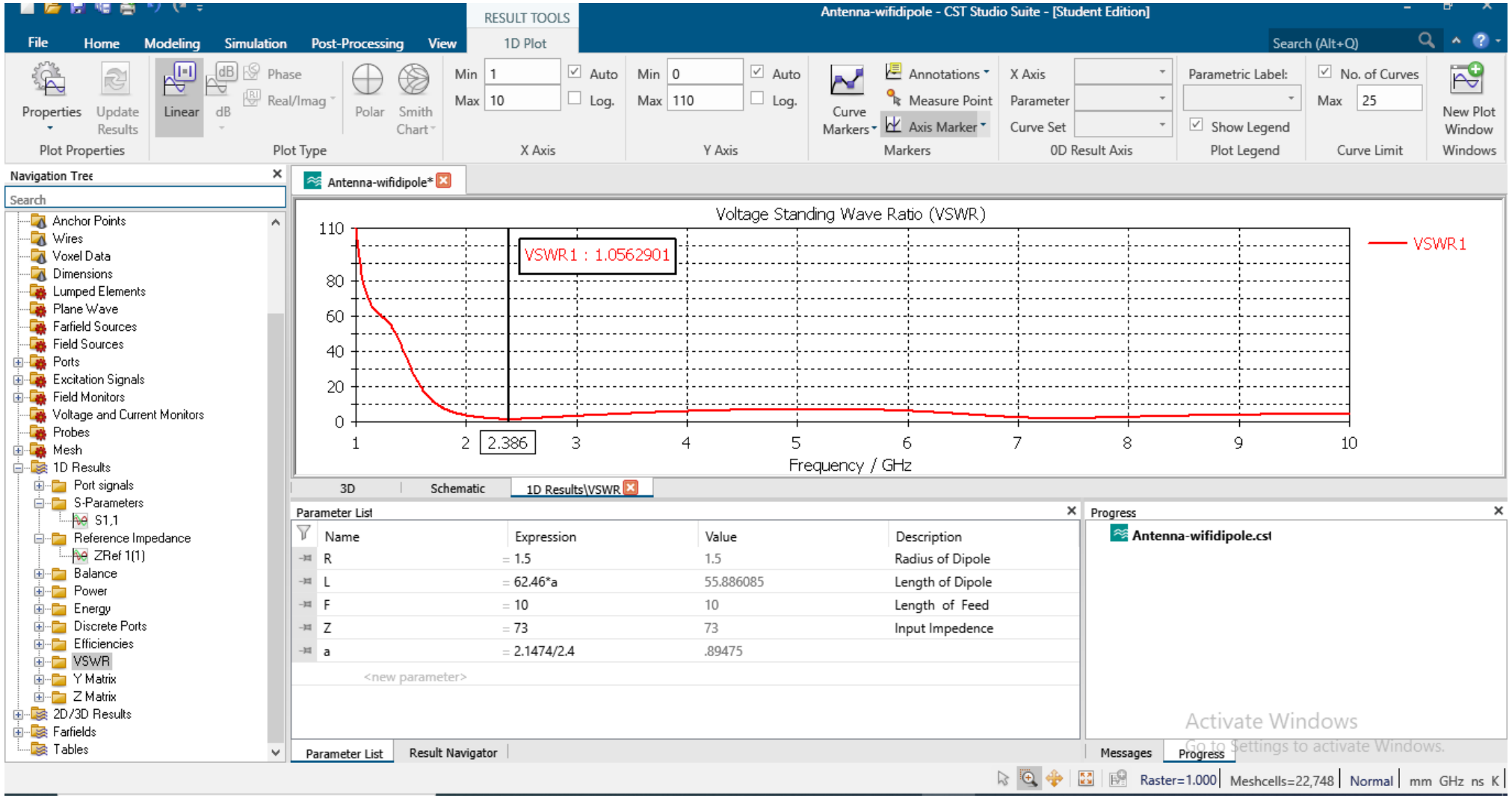


Fig-03: VSWR of dual band dipole antenna

✓Gain

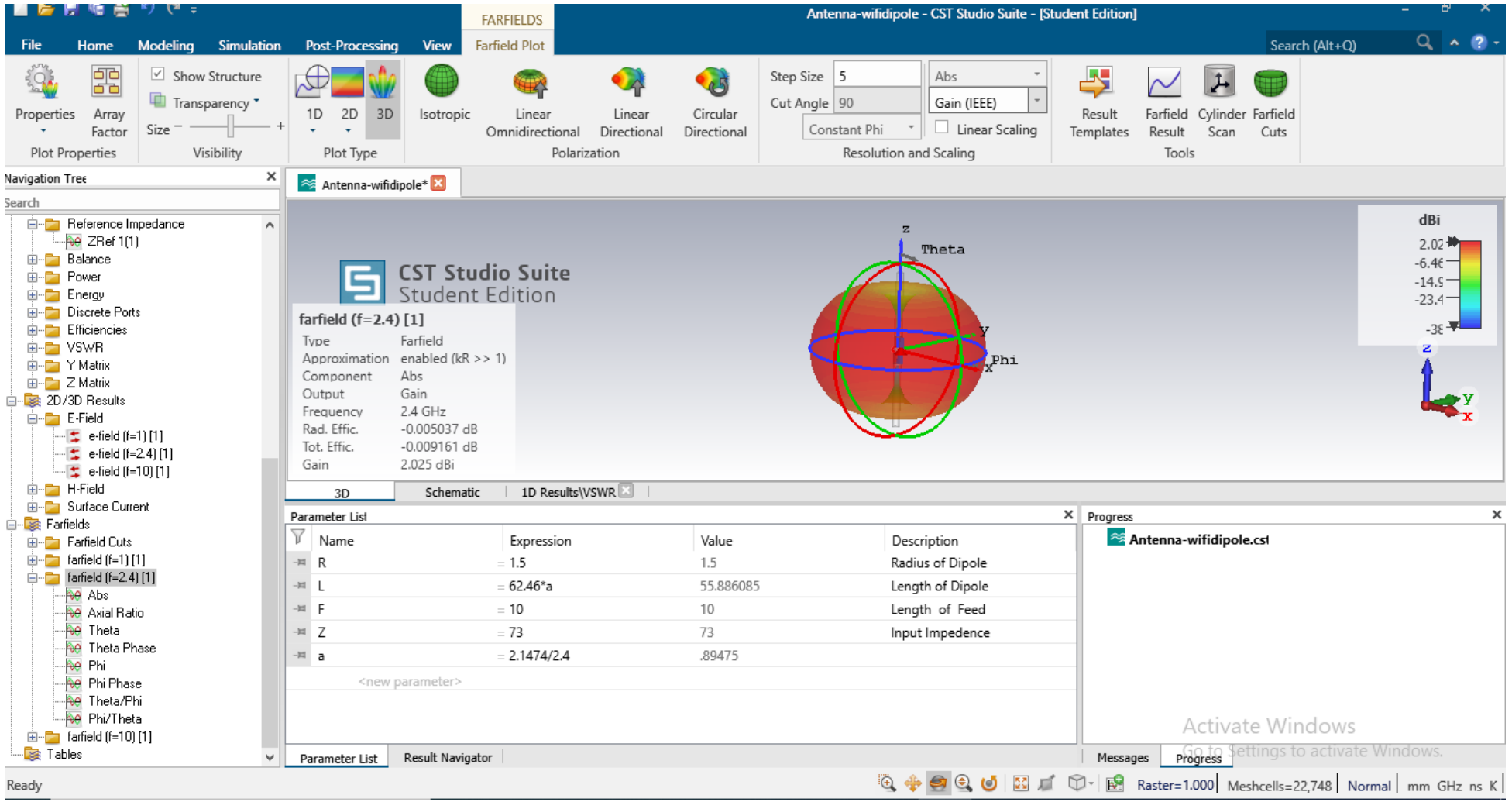


Fig-04: Gain of the dual band dipole antenna **(Gain= 2.025 dBi)**

✓Directivity

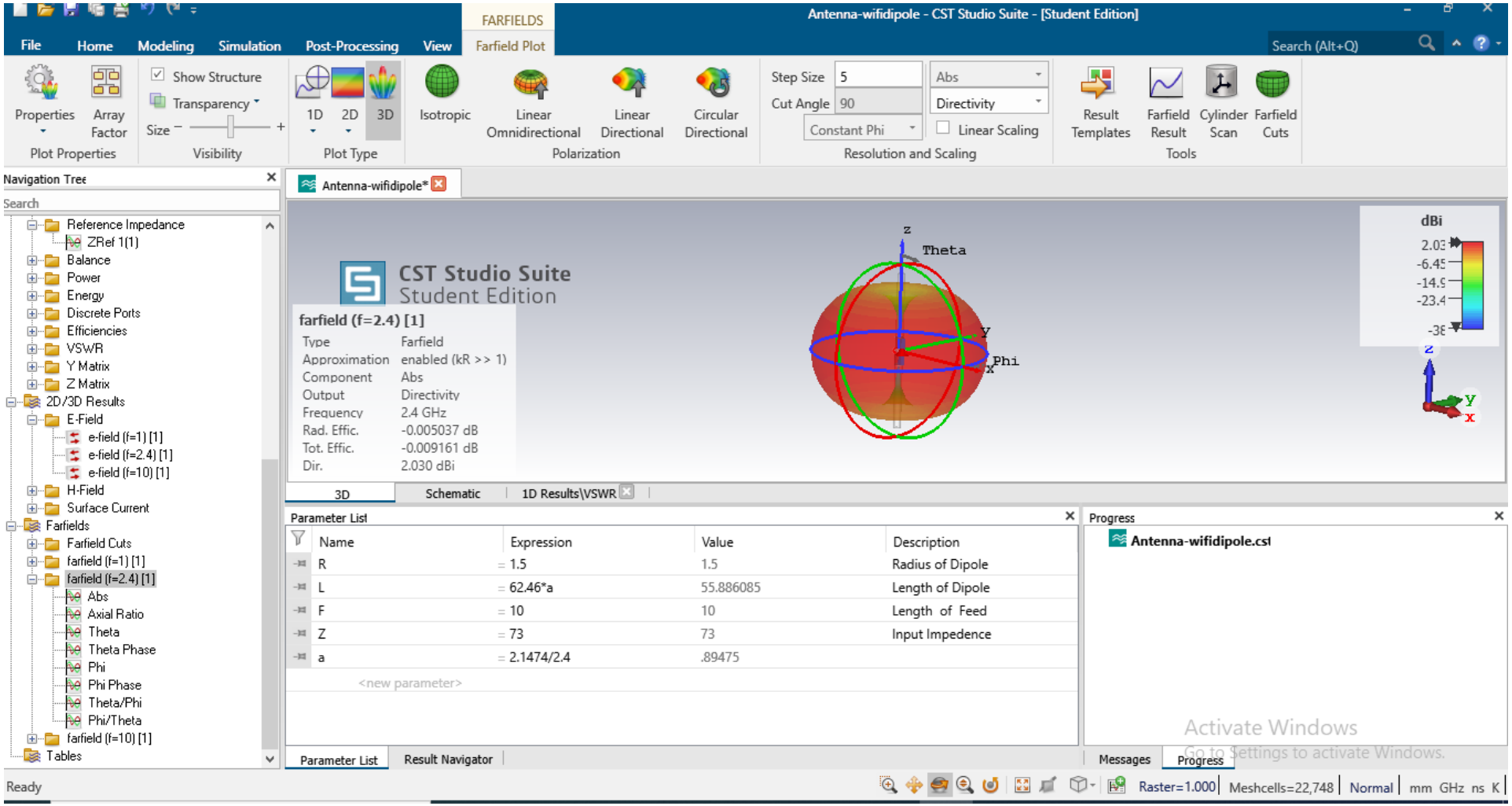


Fig-05: Directivity of dual band dipole antenna

✓ Radiation Pattern (1-D)

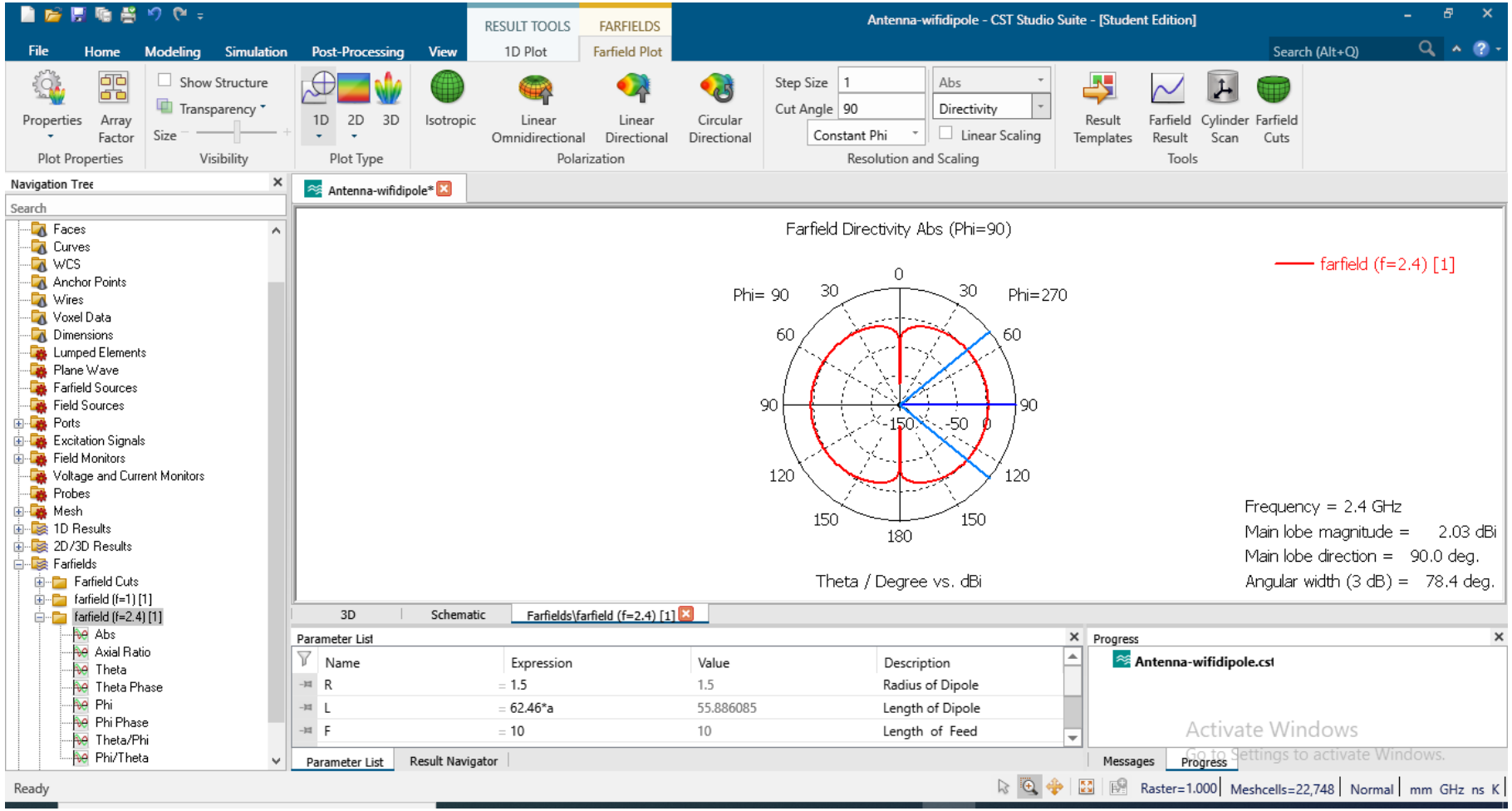


Fig-06: 1-D Radiation Pattern of Dipole Antenna

✓ Radiation Pattern (2-D)

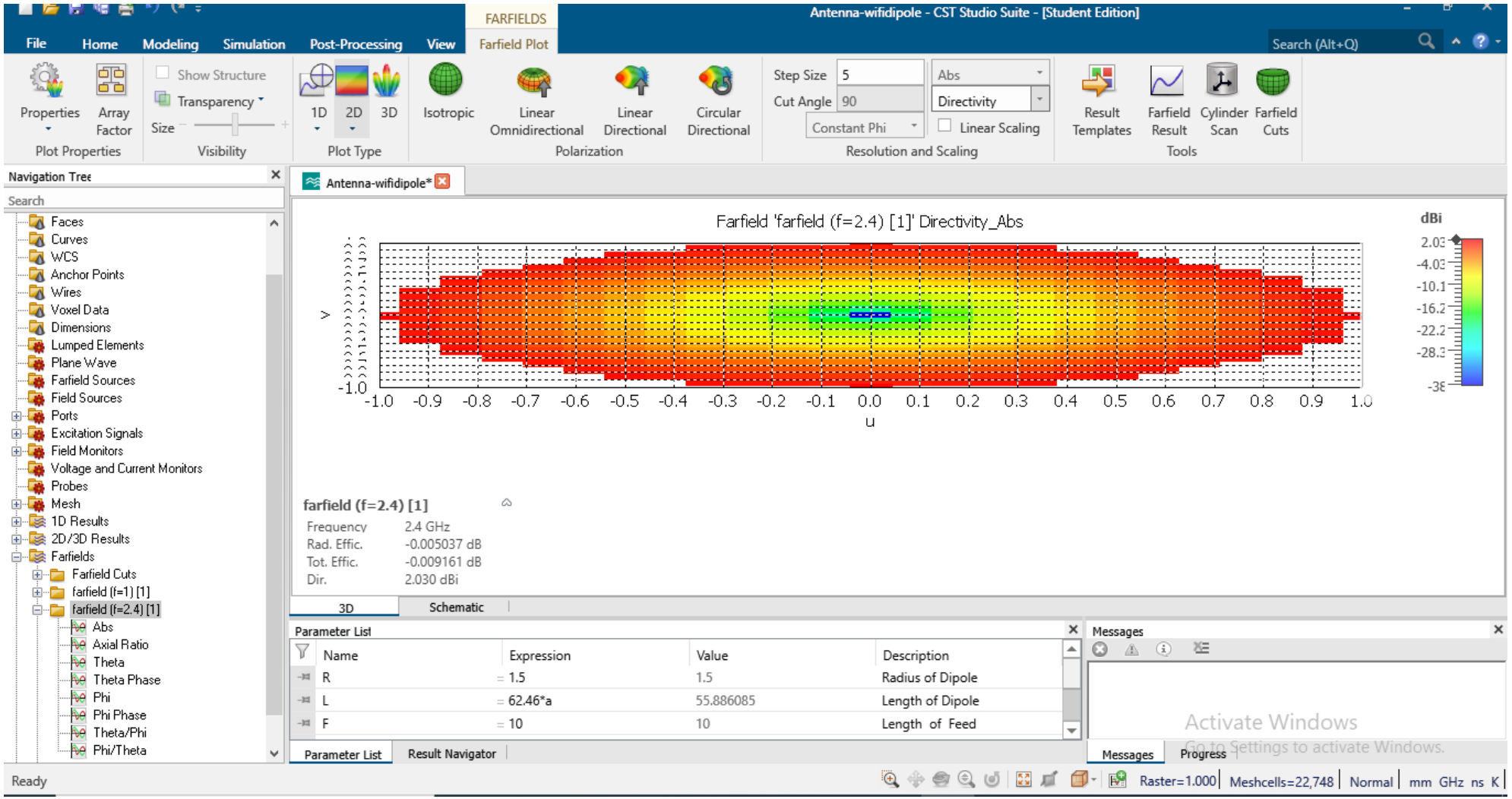


Fig-07: 2-D Radiation Pattern of Dipole Antenna

Design Accuracy

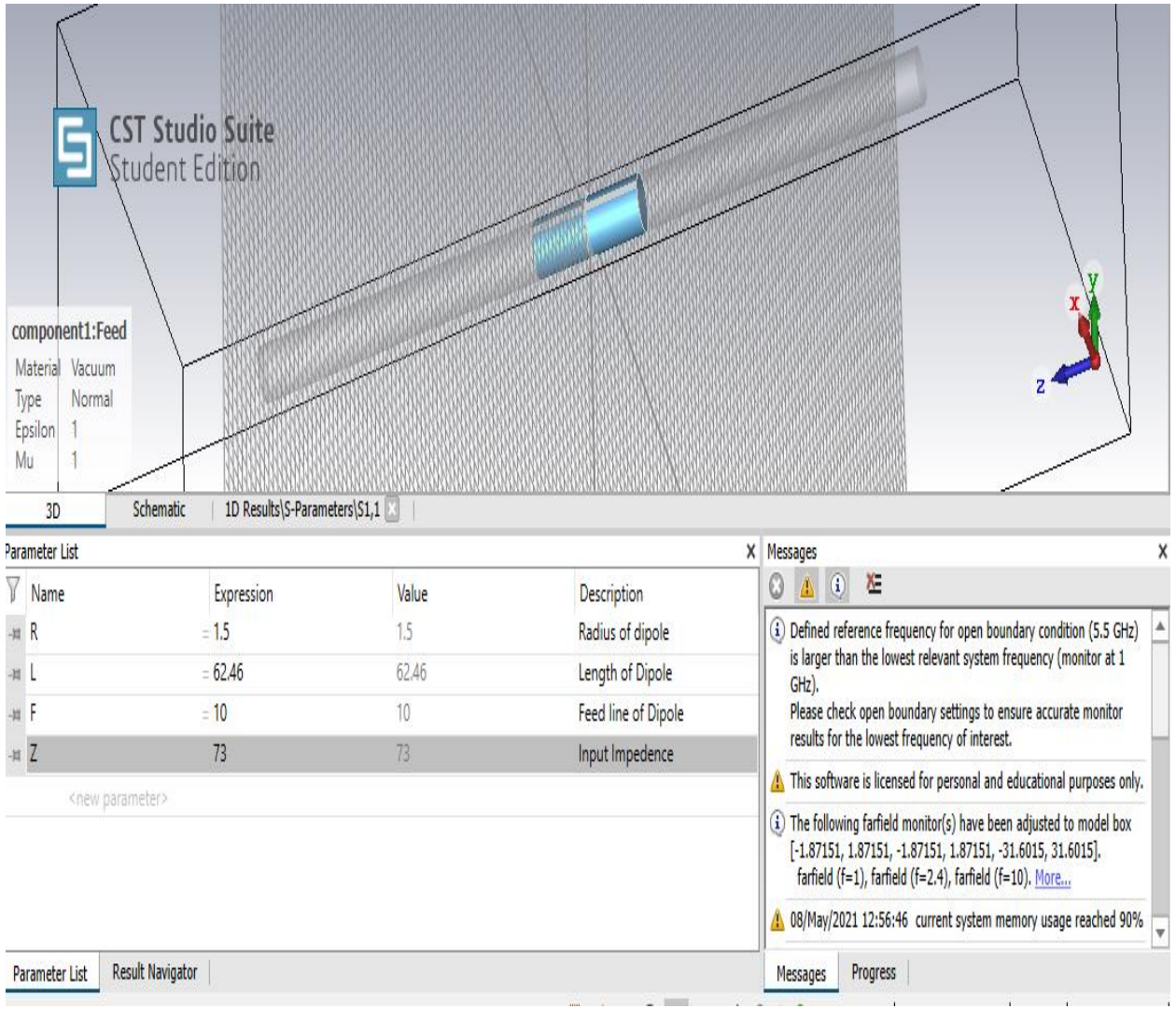
Directivity of the dipole, $D_m = \frac{4\pi U_m}{W_{rad}} = \frac{4\pi}{8\pi^2}\eta I_m^2 \cdot \frac{1}{36.5640 I_m^2} = 1.64$

$$D_{dipole} = 1.64 = 2.15 \text{ dBi} = 0 \text{ dBd.}$$ (Calculated)

From the figure, we can determine the directivity of the dipole achieved by the simulation process.

Directivity= 2.030 dBi (simulated)

Finally…



- ✓A dual band dipole antenna designed successfully.
- ✓All the output parameters are found with maximum accuracy.

Thank you

for your attention!!