كلية الهندسة بشبرا
FACULTY OF ENGINEERING AT SHOUBRA

Electromagnetic Fields / Fundamentals (ELE242)(CCE302)

Chapter (01) – Week (02)

A bird's eye view on EM waves

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Basic Rules

- No eating or drinking
- Don’t be late
- Silence except for asking questions (Not All the time)
- No Mobile, Tablet, etc.

Electrostatics

When amber stone is rubbed, it attract light objects at a distance.

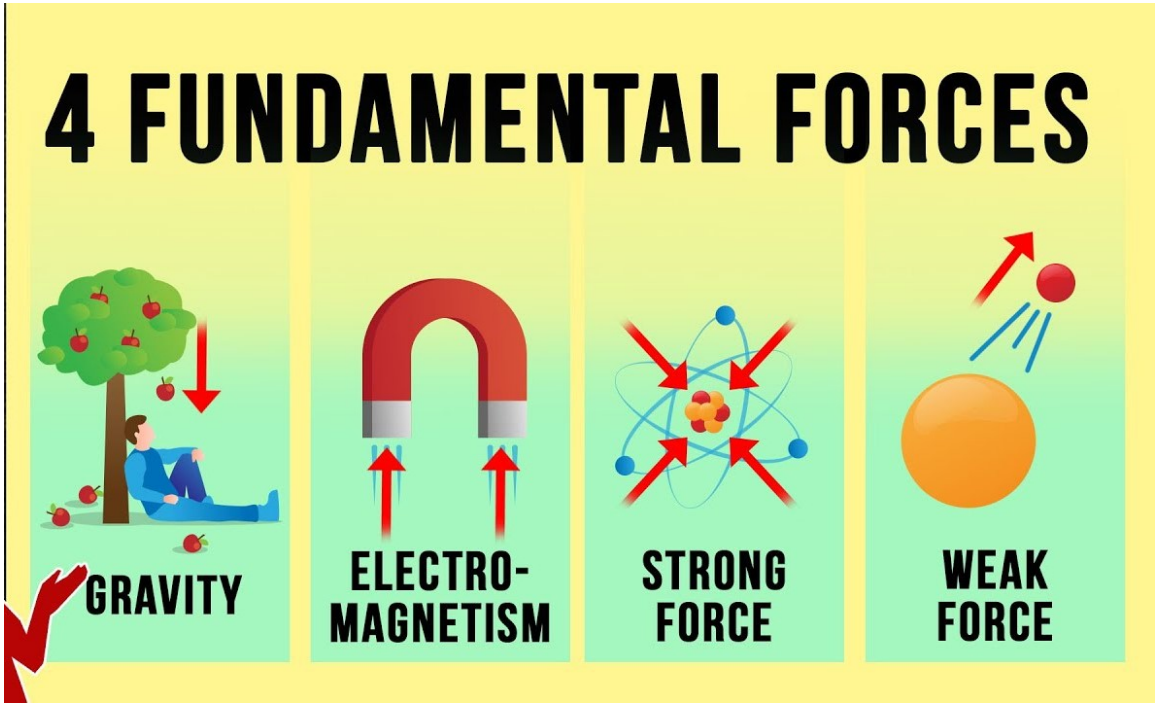
Discovered by **Thales** (a Greek philosopher) in 600 B.C.

Thales observed that a piece of amber rubbed with cat fur could attract small pieces of straw and wood shavings. By rubbing the amber and the fur, Thales had created an **electric**

Because the charge does not leave the material, it is said to be *stationary* or *static*. This led to the term **static electricity**.

Magneto statics

- About 2500 years ago in a mountain a shepherded boy found that his iron tipped stick got lightly attracted to some stone on the ground and his shoe nails stuck to the stone.
- When he tried to touch the stone with his finger, nothing happens. It only acted on the iron tip of his stick. So we have magic that attracted the iron.
- This was in area was called Magnesia in GREECE.
- According to that they called this type of material magnet stones

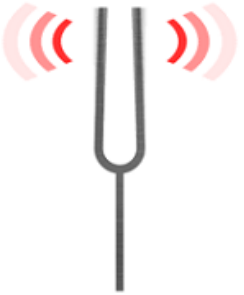


1. Strong — hold the nucleons together.
2. Electromagnetic — Most common phenomena.
3. Weak — electron ejected from the nucleus
4. Gravity force.

electric + magnetic ⟶ electromagnetic

What are Waves ?

To carry energy without carrying matter (Medium)



Types of Waves

- **Mechanical Waves – need matter (or medium) to transfer energy**
  - A medium is the substance through which a wave can travel. Ex. Air; water; particles; strings; solids; liquids; gases

- **Electromagnetic Waves – DO NOT NEED matter (or medium) to transfer energy**
  - They do not need a medium, but they can go through matter (medium), such as air, water, and glass

Mechanical Waves

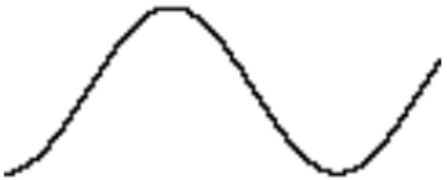
Waves that need matter (medium) to transfer energy:

Examples: Sound waves, ocean waves, ripples in water, earthquakes, wave of people at a sporting event

Transverse (Mechanical) Waves

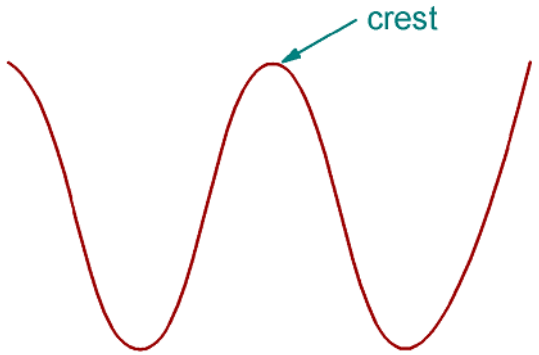
Energy causes the matter in the medium to move up and down or back and forth at right angles to the direction the wave travels.

Examples: waves in water

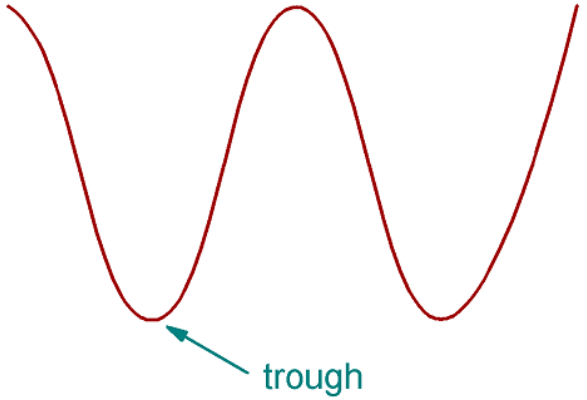


Parts of a Transverse Wave

The **crest** is the highe point on a wave.

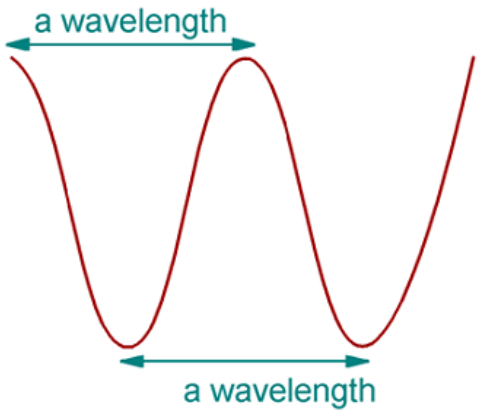


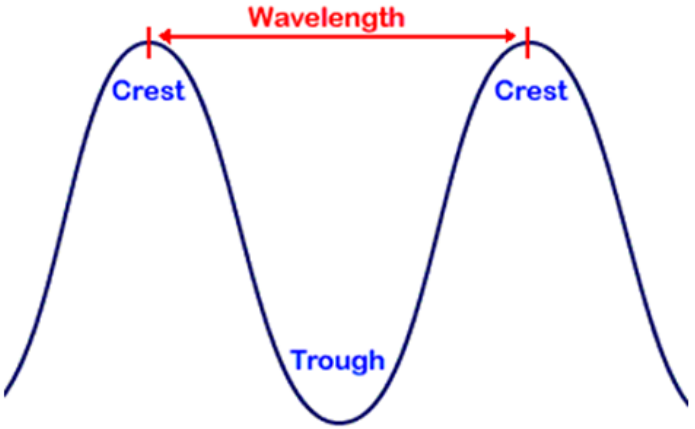
The **trough** is the valley between two waves, is the lowest point.



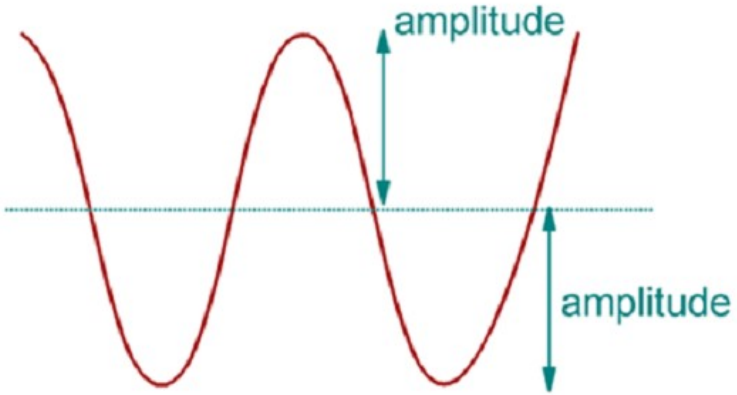
Parts of a Transverse Wave

The **wavelength** is the horizontal distance, either between the crests or troughs of two consecutive waves.





The **amplitude** is the peak (greatest) value (either positive or negative) of a wave. The distance from the undisturbed level to the trough or crest.



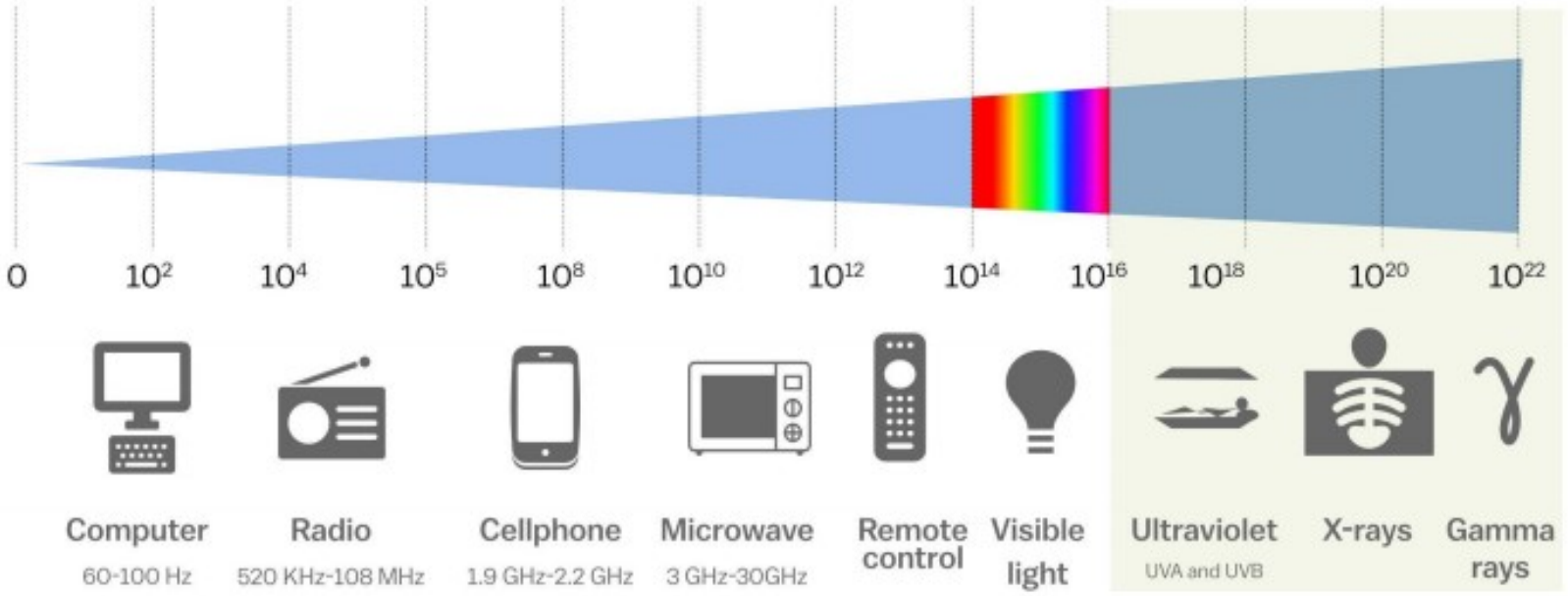
Electromagnetic Waves

- Waves that DO NOT NEED matter (medium) to transfer energy
  - Examples: radiation, TV & radio waves, X-rays, microwaves, lasers, energy from the sun, visible light
  - Electromagnetic waves are considered transverse waves because they have similar characteristics; therefore, they have the same parts.

Introduction

Electromagnetic Spectrum

- Electromagnetic Waves are characterized by:
  - Wavelength, λ [m, cm, mm, μm etc]
  - Frequency, f [s^{-1}, hertz (Hz), megahertz (MHz), gigahertz (GHz)
  - Phase velocity v = c in space where and = 3 x 10^8 m/s $\lambda = c / f$



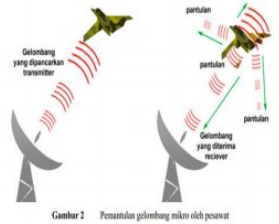
Electromagnetic spectrum.

Applications

TYPICAL FREQUENCIES

FM RADIO	88 - 108 MHZ
TV BROADCAST	200 MHZ
GSM PHONES	900 MHZ
GPS	1.2 GHZ
PCS PHONES	1.8 GHZ
BLUETOOTH	2.4 GHZ
Wi-Fi	2.4 GHZ

GLOBAL POSITIONING SYSTEM



Gambar 2 Pemantulan gelombang mikro oleh pesawat

RADAR (RADIO DETECTION AND RANGING)

MICROWAVE OVEN

1.1.2 Typical EM wave System

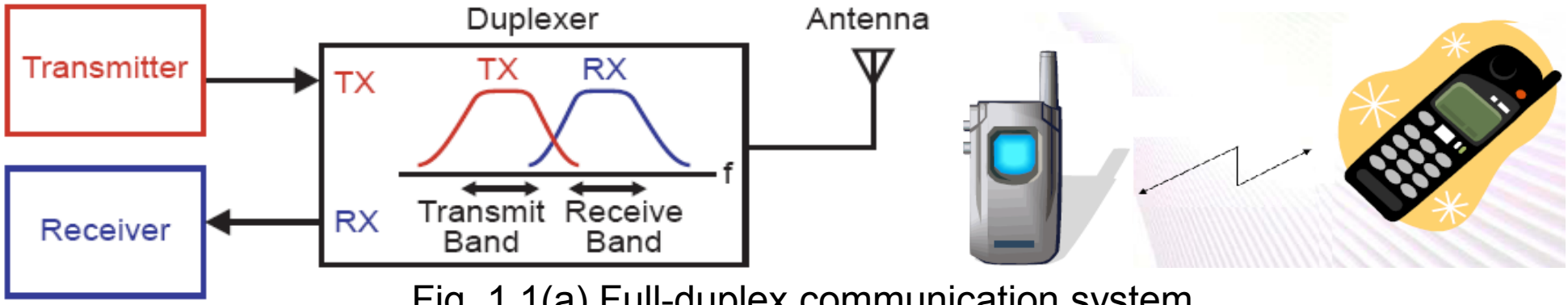


Fig. 1.1(a) Full-duplex communication system.

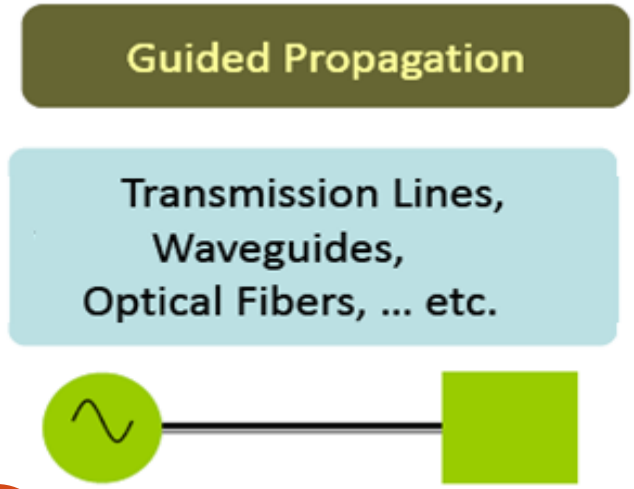
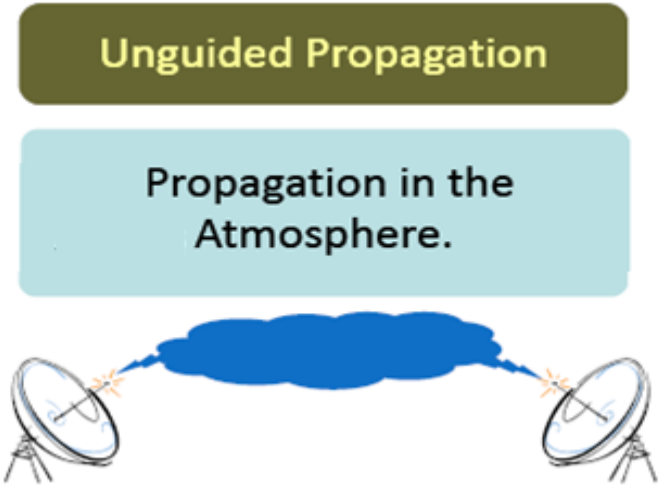


Fig. 1.1(b) Guided vs. unguided propagation



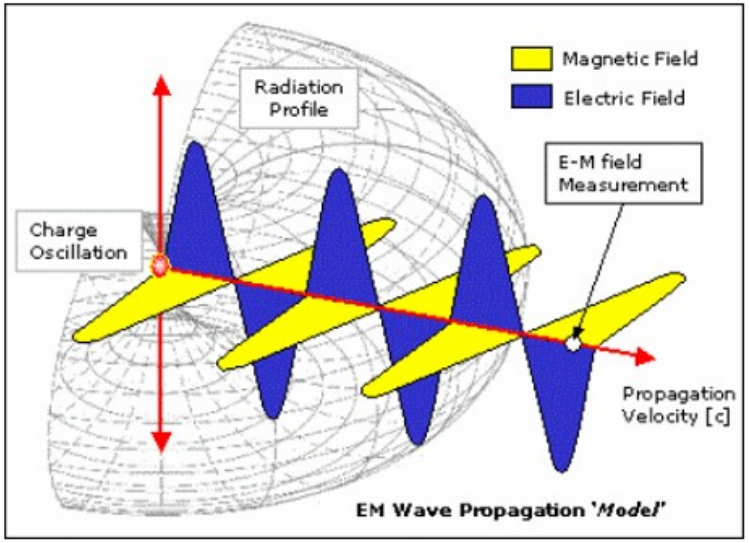
o Typical Example: Magnetron

- Microwave ovens operate at the frequency 2,450.00 MHz
- Microwave output power in the range of 1000 Watts

o Typical Example: Solid State Device

- Low noise block (LNB) attached to a satellite receiving dish, I/P frequency band 10.7 GHz to 11.8 GHz, O/P 950 MHz to 1950 MHz

Examples of EMW propagation



Glare reduction

- Reflected sunlight partially polarized.
- Horizontal reflective surface ->the E field vector of reflected light has strong horizontal component.

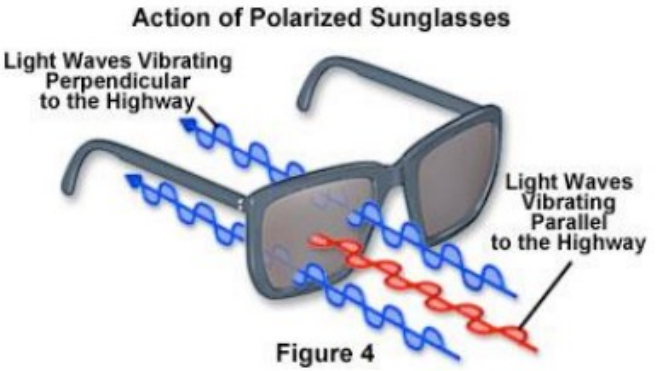


Figure 4

Free Speaking on
EM waves in our life , Novel applications , why we need Antennas

TYPES OF ANTENNAS

Dipole

Building , automobile

Dish (Reflector)

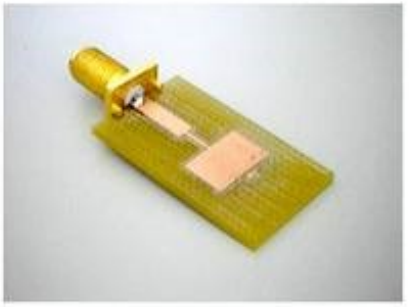
Helix

Yagi Atenna

Pyramidal Horn

Conical Horn

aircraft and spacecraft applications

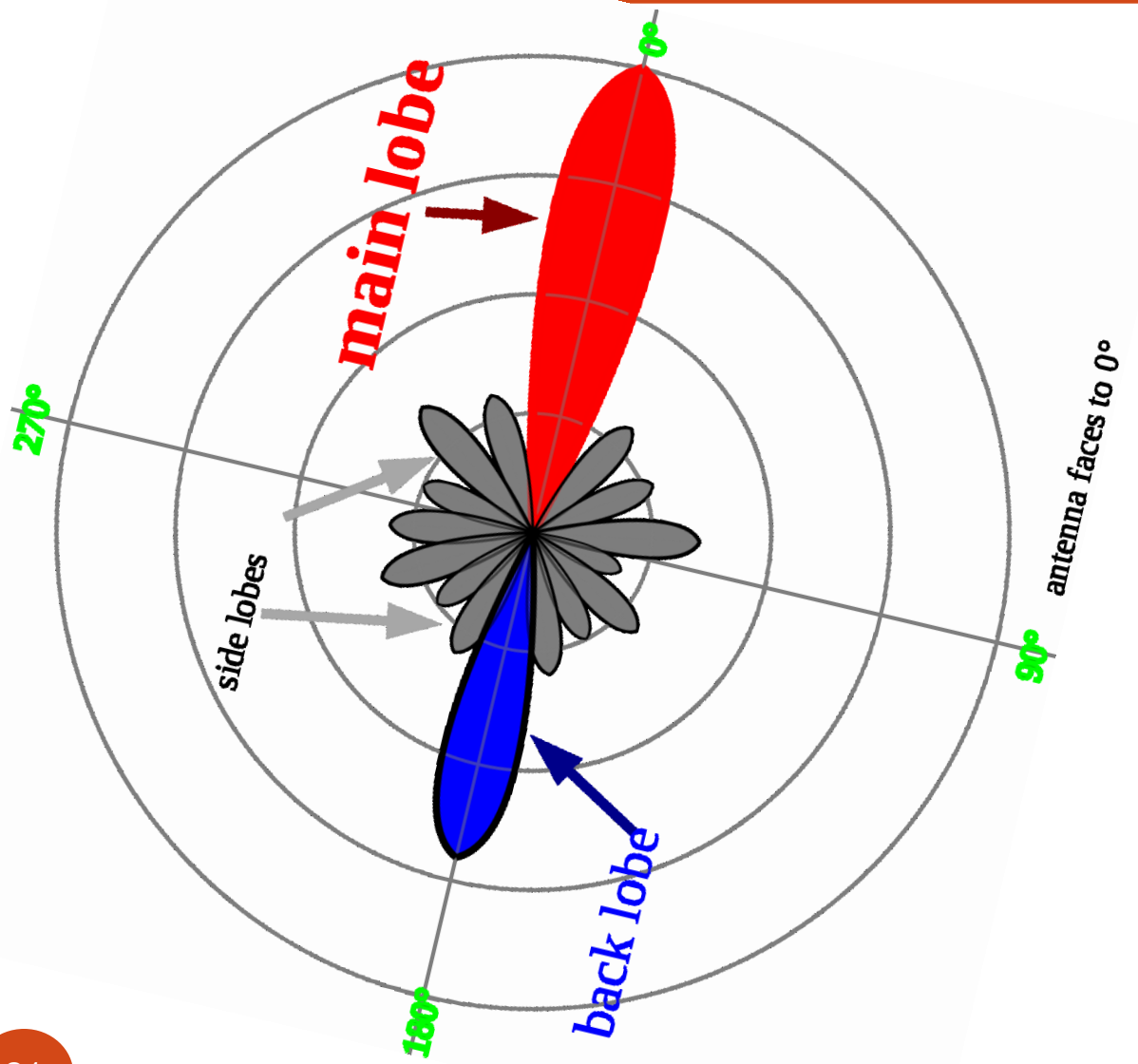


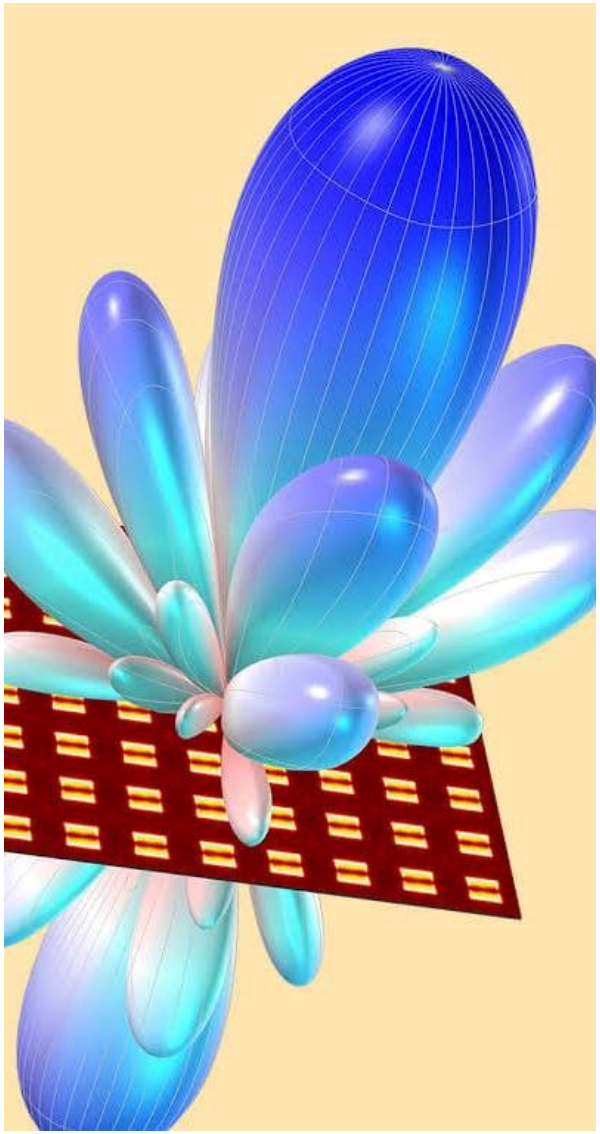
Microstrip patch

Loop Atenna

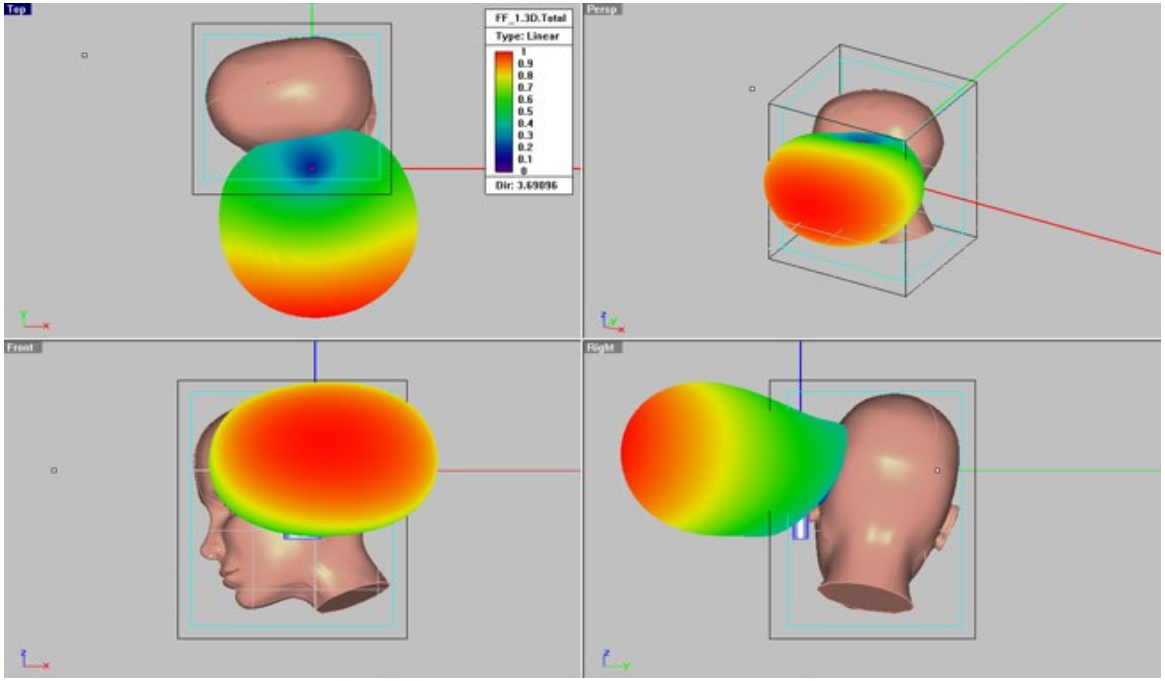
Arrays

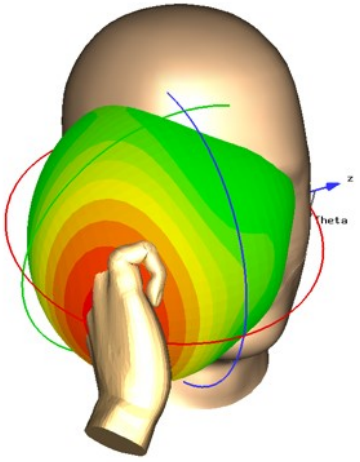
EXAMPLES FOR RADIATION PATTERNS

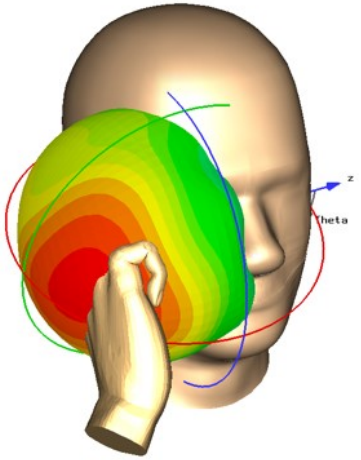




❑ RADIATION PATTERNS







Thank you for your attention

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