Damietta University
Faculty of Science
Geology Department

# Geothermal Course

## For

## First Year Geophysics Program

**Code: 103 Geoph**

## Lecture 6:Remote Sensing For Geothermal Exploration Part1

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**2020**

# GEOTHERMAL ENERGY

## Trapping the Earth’s Internal Heat

# Remote Sensing For Geothermal Exploration Part1

# Remote Sensing: Definition

- ✓Science of measurement from a distance.
- ✓The process of obtaining information about an object using a sensor which is physically separated from the object.
- ✓The acquisition of data from a distance.

# Data Collection

**Satellite based remote sensing**

Advantages: Less geometric errors (platform is stable)

Disadvantages: Need to wait a time for certain event

Fixed spatial resolution

**Aerial surveying**

Advantages: Acquire any times any events

Variable spatial resolution by changing flight altitude and camera focal length

Disadvantages: High geometric errors; require sophisticated geometric correction model

Costly for specific area, specific purpose

**Ground based remote sensing GBRS or Low Altitude Remote Sensing**

Scientific experiment purposes

(e.g. study about canopy, soil contamination, etc.)

*Earth surface*

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# What is the five senses?

"Remote" means far away. Remote sensing means sensing things from a distance. Of **our** five senses **we** use three as remote sensors when we:

a. watch a football game from the stands (sense of sight)

b. smell freshly baked bread in the oven (sense of smell)

c. hear a telephone ring (sense of hearing)

What are our other two senses and why aren't they used "remotely"?

# Advantages of remote sensing

- Provides a regional view (large areas)
- Provides repetitive looks at the same area
- Remote sensors "see" over a broader portion of the spectrum than the human eye
- Sensors can focus in on a very specific bandwidth in an image or a number of bandwidths simultaneously
- Provides geo-referenced, digital, data
- Some remote sensors operate in all seasons, at night, and in bad weather

# Who uses remote sensing and why?

- The **Geologist**, who is interested in finding valuable minerals (minerals and oil prospecting).
- The **Geographer**, who looks for changes on the Earth' surface that need to be mapped.
- The **Environmentalist**, who wants to detect, identify and follow the movement of pollutants الملوث such as oil slicks بقعة on the ocean.

# Who uses remote sensing and why?

- The **Forester**, who needs information about what type of trees are growing and if they have been affected by disease.

- The **Farmer**, who wants to keep an eye on how his crops are growing and if they've been affected by drought جفاف, floods, disease or pests وباء.

- The **Ship Captain**, who needs to find the best route through the northern ice packs.

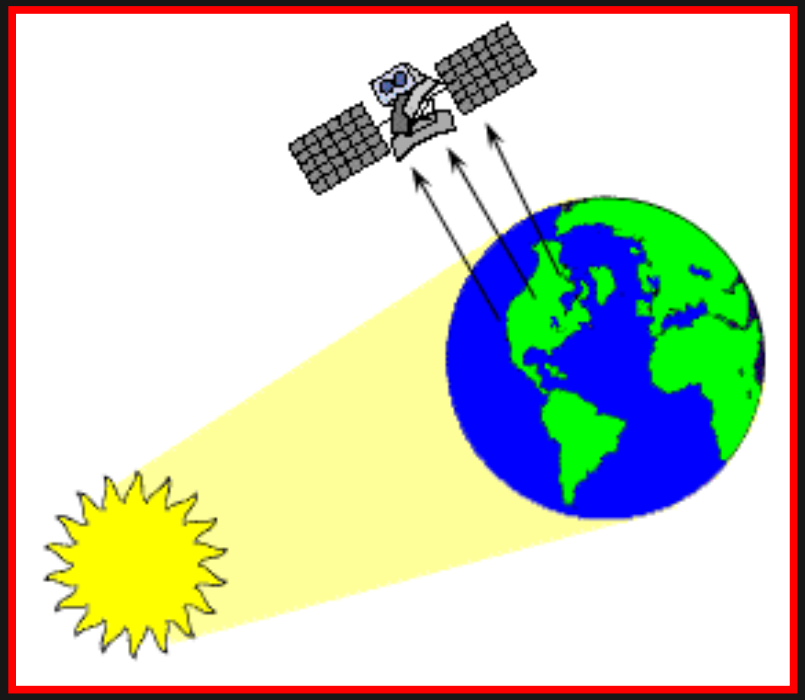
- The **Firefighter**, who sends out his crews based on information about the size and movement of forest fire.

# Applications of Remote Sensing

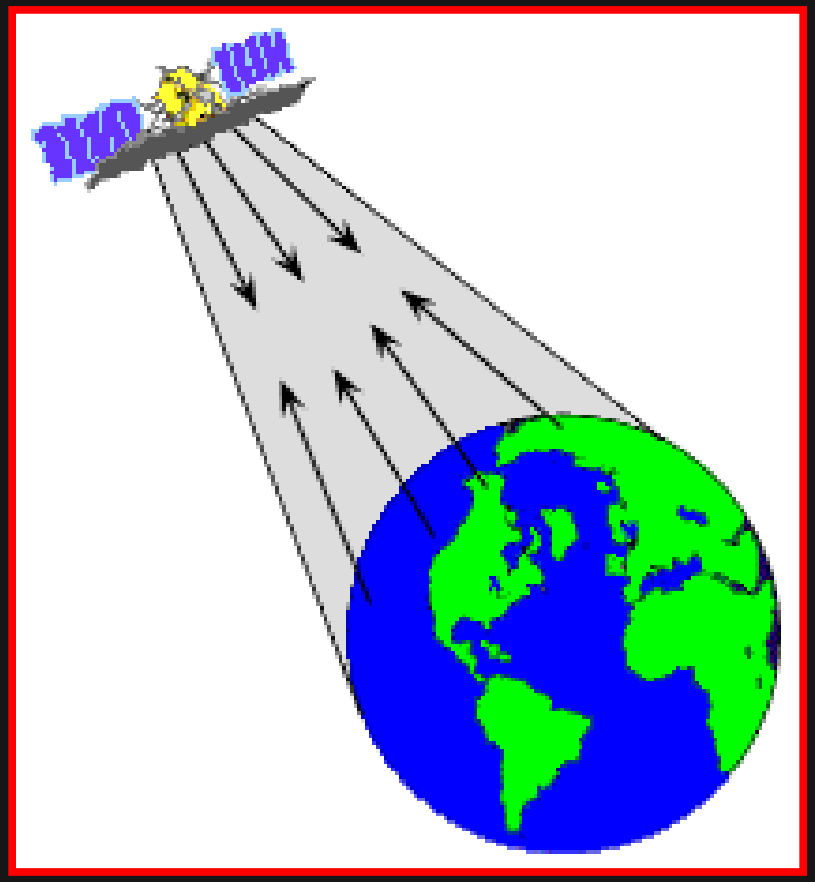
- Military operation.
- Geological Mapping.
- Geothermal.
- Geomorphology.
- Hydrology.
- Vegetation.
- Agriculture.
- Weather.
- Disaster.

# Passive and Active System

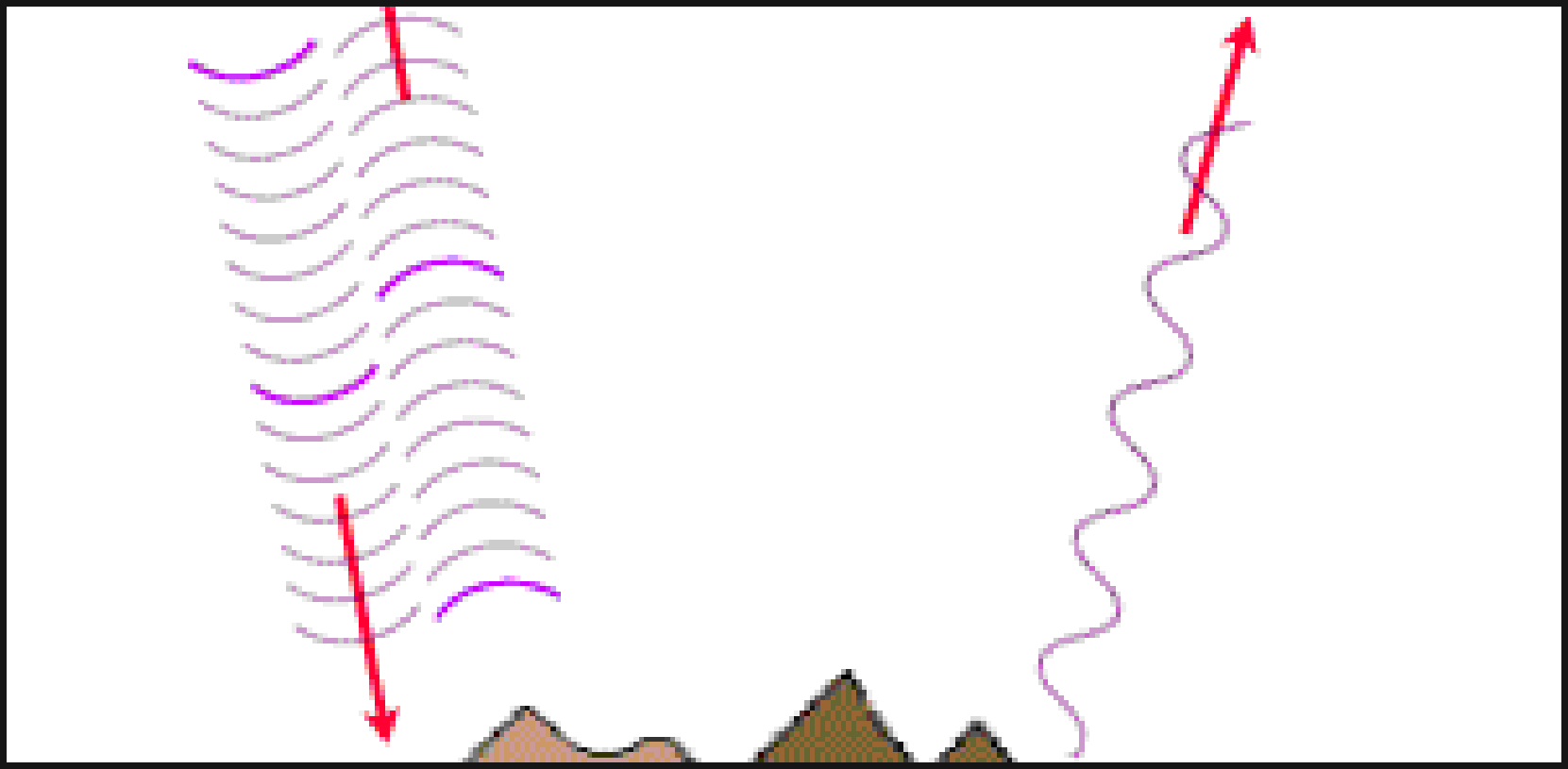
Passive



Active



# Passive and Active System



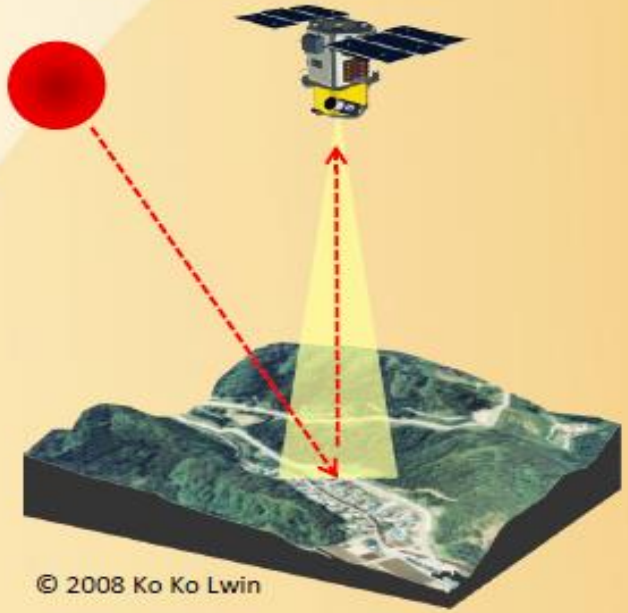
# Passive and Active System

## 1.4 Types of Remote Sensing

Passive Remote Sensing and Active Remote Sensing

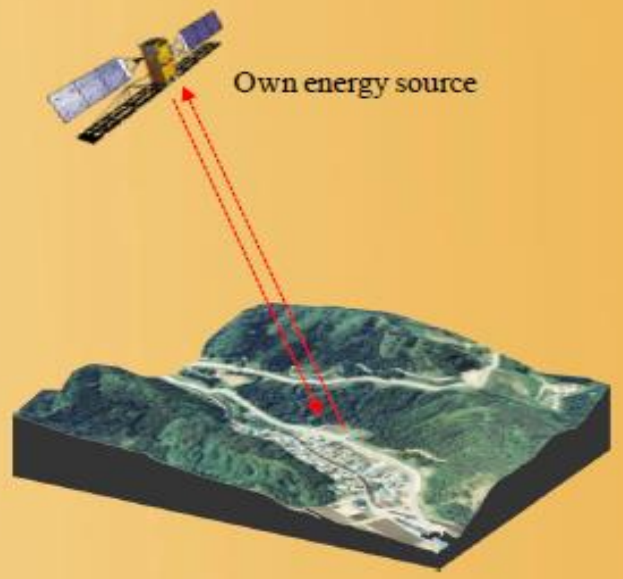
**Passive Remote Sensing**

Remote sensing of energy naturally reflected or radiated from the terrain.




**Active Remote Sensing**

Remote sensing methods that provide their own source of electromagnetic radiation to illuminate the terrain. Radar is one example.



# Radar is active remote sensing

Radar used by police to measure the speed of traveling vehicles is a use of active remote sensing.

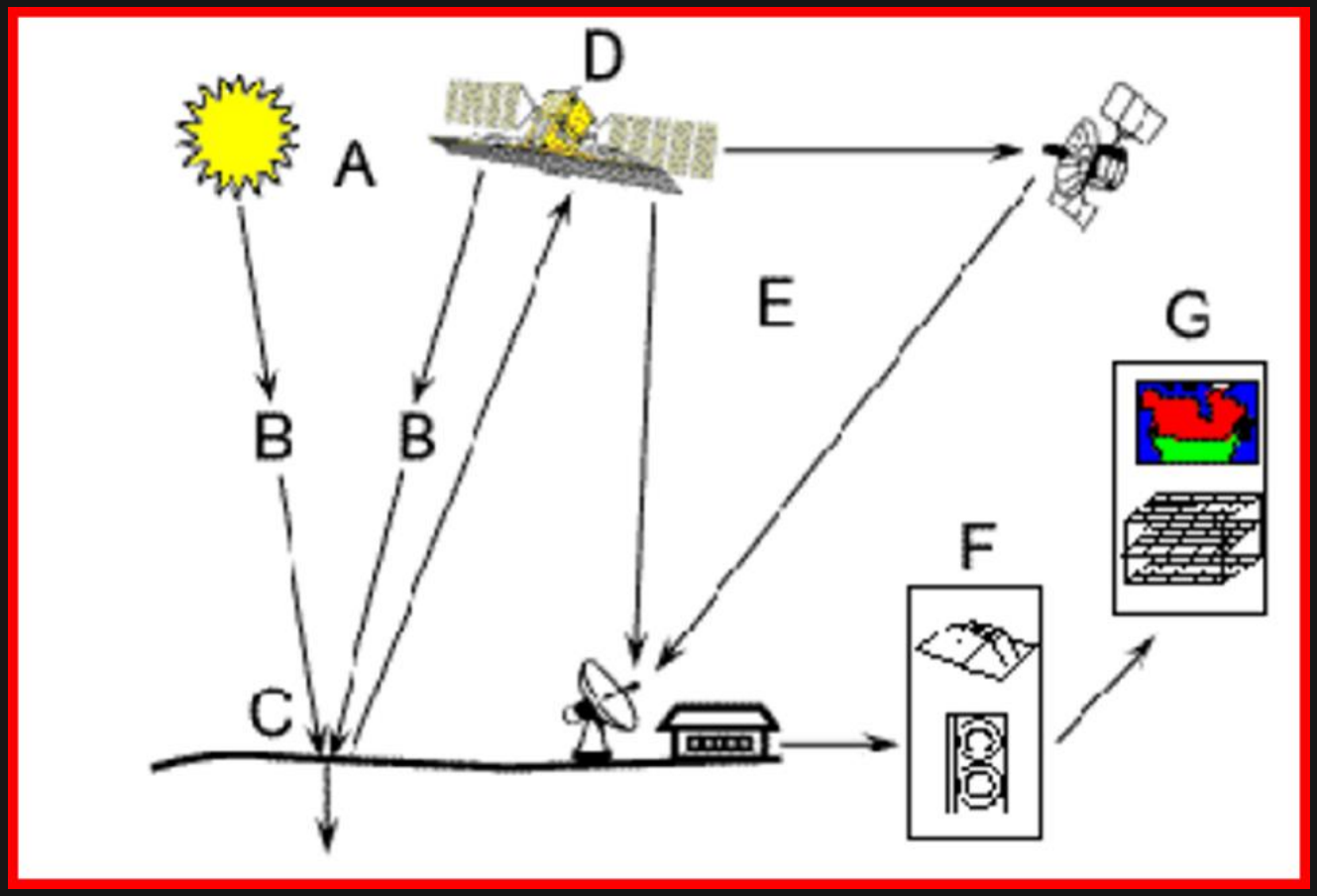
The radar device is pointed at a vehicle, pulses of radiation are emitted, and the reflection of that radiation from the vehicle is detected and timed.

# Camera good example for passive and active remote sensing

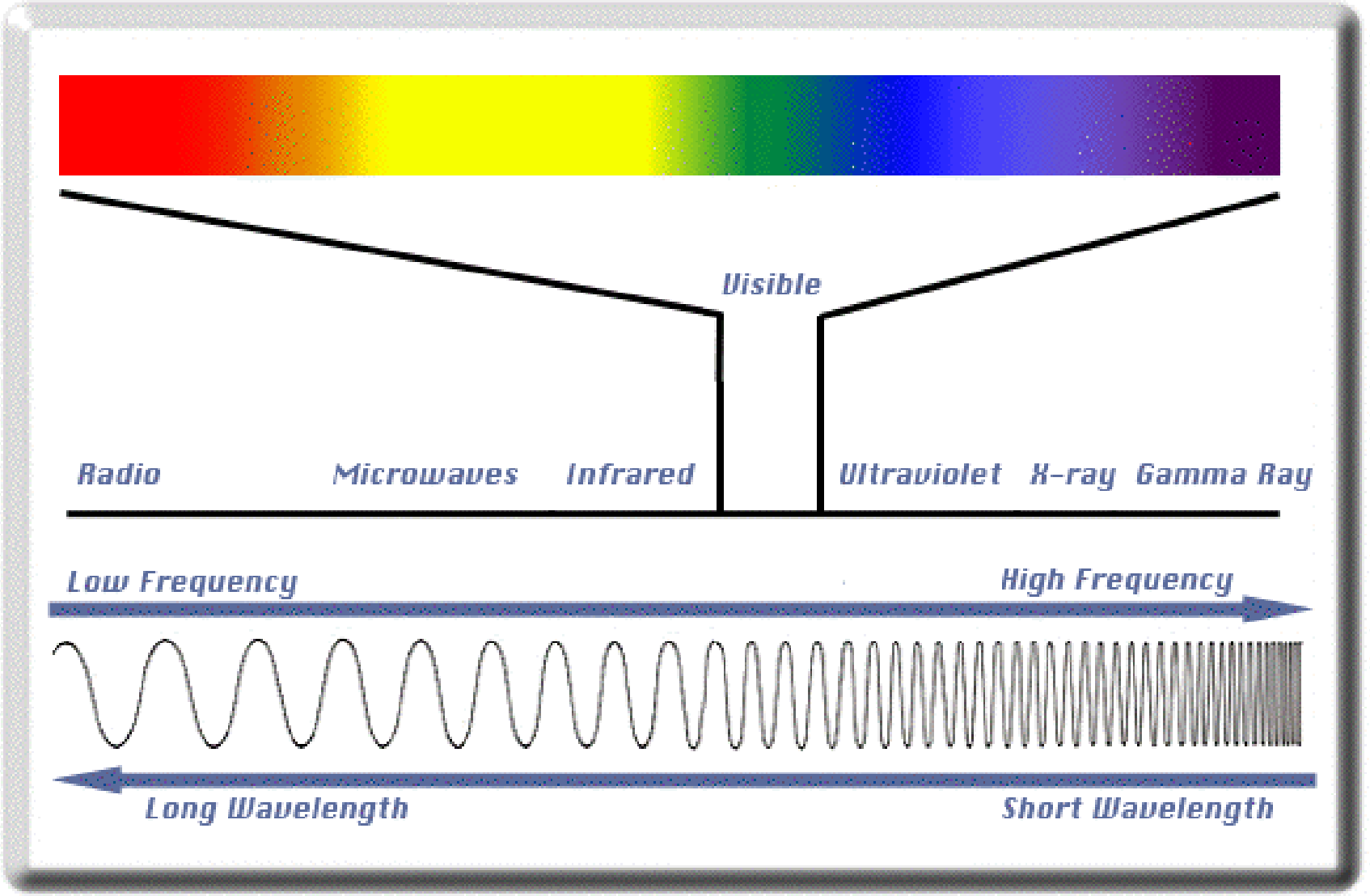
A camera provides an excellent example of both passive and active sensors.

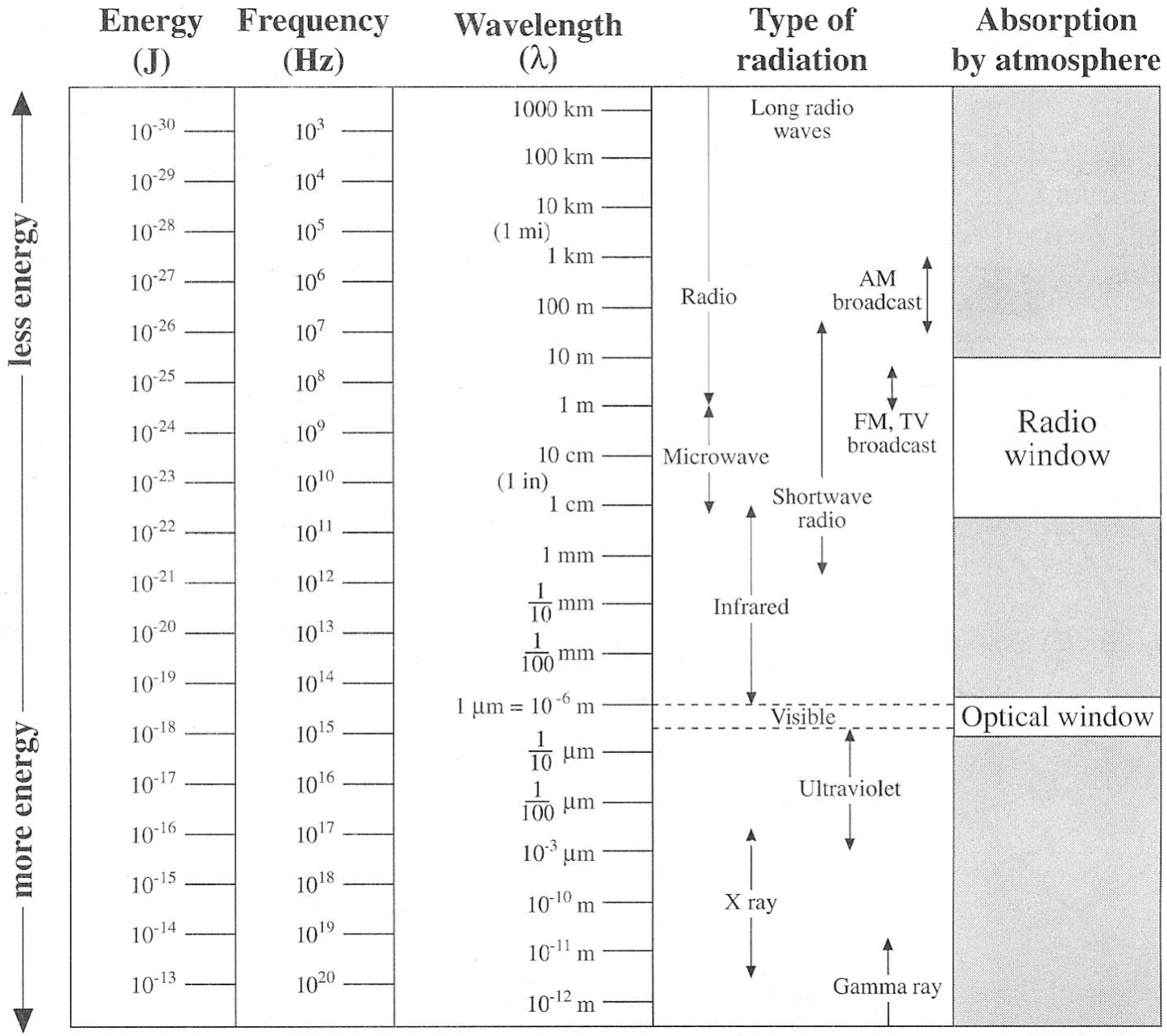
During a bright sunny day, enough sunlight is illuminating the targets and then reflecting toward the camera lens, that the camera simply records the radiation provided (passive mode).

# Remote Sensing System



# Electromagnetic Spectrum




Energy (J)
Frequency (Hz)
Wavelength (λ)
Type of radiation
Absorption by atmosphere
less energy
more energy
$10^{-30}$
$10^{-29}$
$10^{-28}$
$10^{-27}$
$10^{-26}$
$10^{-25}$
$10^{-24}$
$10^{-23}$
$10^{-22}$
$10^{-21}$
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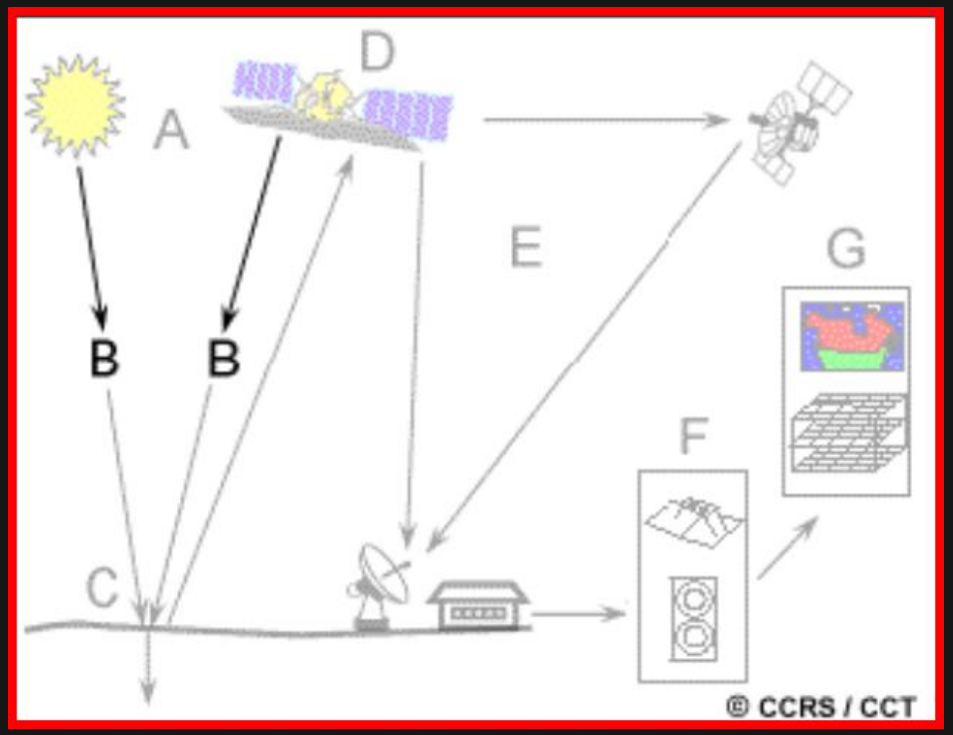
$10^{18}$
$10^{19}$
$10^{20}$
1000 km
100 km
10 km
(1 mi)
1 km
100 m
10 m
1 m
10 cm
(1 in)
1 cm
1 mm
$\frac{1}{10}$ mm
$\frac{1}{100}$ mm
1 μm = $10^{-6}$ m
$\frac{1}{10}$ μm
$\frac{1}{100}$ μm
$10^{-3}$ μm
$10^{-10}$ m
$10^{-11}$ m
$10^{-12}$ m
Long radio waves
Radio
AM broadcast
FM, TV broadcast
Microwave
Shortwave radio
Infrared
Visible
Ultraviolet
X ray
Gamma ray
Radio window
Optical window

# Interaction with atmosphere

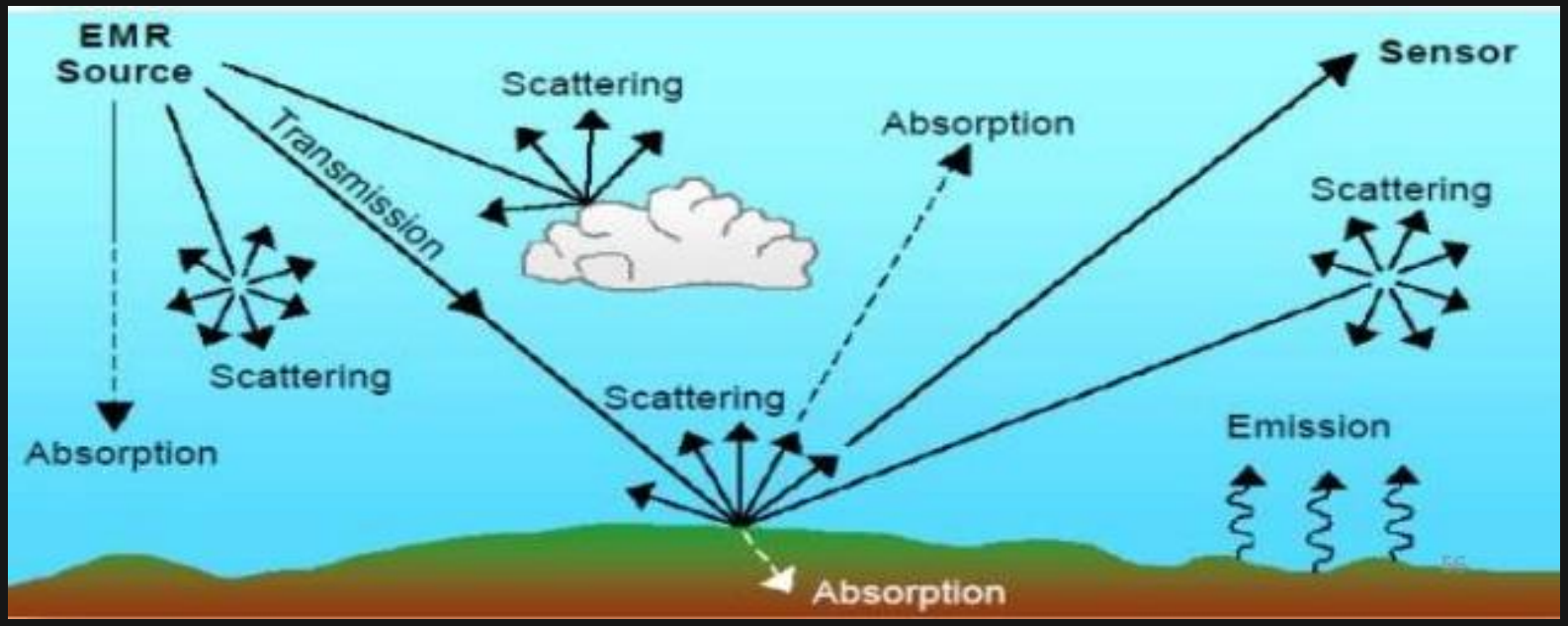


# Interaction with atmosphere

- Before radiation used for remote sensing reaches the Earth's surface it has to travel through some distance of the Earth's atmosphere.
- These effects are caused by the mechanisms of **scattering** and **absorption**.

# Two primary interaction

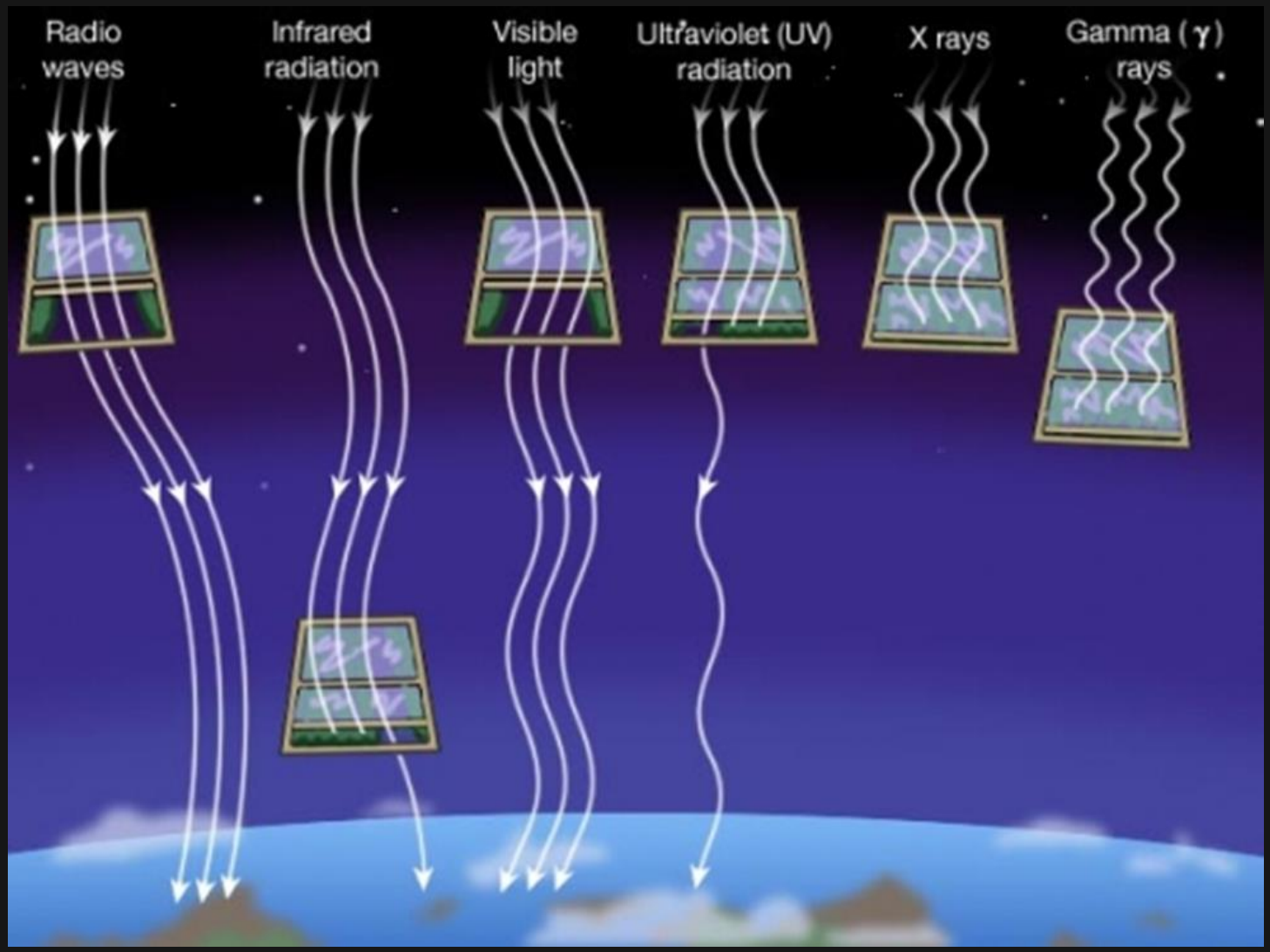
Scattering Absorption



# Primary absorber are

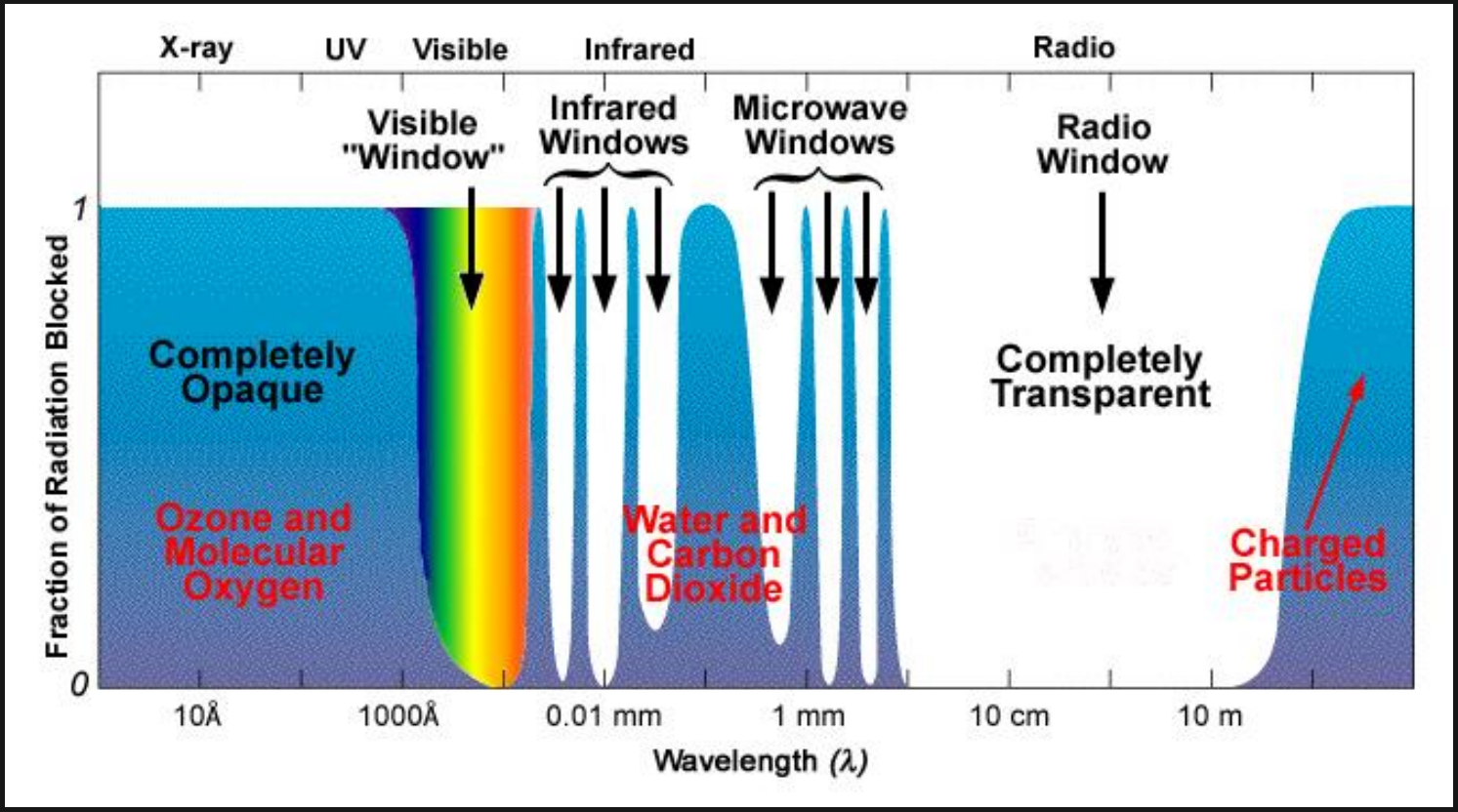
- Water Vapor
- Carbone dioxide
- Ozone

# Atmospheric windows

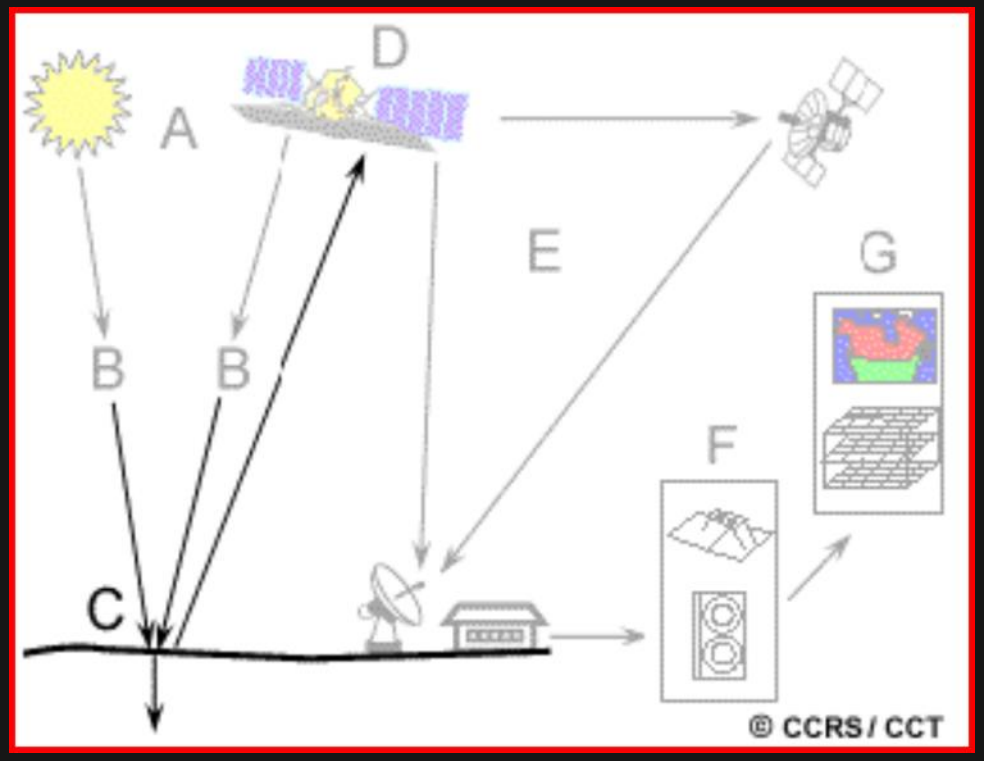


# Atmospheric windows

Those areas of the spectrum which are not severely influenced by atmospheric absorption and thus, are useful to remote.



# Interaction with target



# Three forms of interaction

There are three (3) forms of interaction that can take place when energy strikes, or is **incident (I)** upon the surface. These are:

- **Absorption (A)**;
- **Transmission (T)**;
- R**eflection (R)**.

The proportions of each will depend on the wavelength of the energy and the material and condition of the feature.

# Three forms of interaction