

ELECTROMAGNETIC SPECTRUM

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Outline

- \circ Introduction
- $\circ~$ Wavelength and frequency
- Electromagnetic spectrum
 - Electromagnetic waves



Objectives

 $\circ~$ Our main aim is to understand various types of radiation and how they can have applications in day to

day life.



Introduction

*Electromagnetic radiation is the technical term for light; not just visible light, but any light, ranging right through from radio frequencies to gamma rays.

When we look at the world around us we are seeing visible light waves (or visible radiation).

*However, there are many other forms of radiation that we cannot see with our eyes.

These types include gamma rays, x-rays, ultraviolet, infrared, microwaves and radio waves.

*Together with visible light, all these types of radiation make up what we call the electromagnetic spectrum -

the complete spectrum of radiation.



Light (or radiation) is made up of vibrating waves of electrical and magnetic fields. This is where the term electromagnetic radiation comes from.

*Electromagnetic radiation travels in waves that have different wavelengths, energies, and frequencies.



Oscillating electric field E and magnetic field B associated with monochromatic radiation



Wavelength frequency

*The wavelength is the distance between individual waves (e.g. from one peak to another).

*Light waves are waves of energy and the amount of energy in a wave is proportional to its frequency.

Wavelength increases, while frequency and energy decreases as we go from gamma rays to radio

waves.

*All electromagnetic radiation travels at the speed of light.





Electromagnetic spectrum

*The electromagnetic spectrum is a continuum of all electromagnetic waves arranged according to frequency and wavelength.

*The visible spectrum is the part of the electromagnetic spectrum that can be detected by the human eye.

*Electromagnetic radiation in this range of wavelengths is called visible light or simply light (VIBGYOR)







1) Radiowaves



*The waves in the electromagnetic spectrum that have the longest wavelengths and lowest frequency are called radio waves.

*Radio waves are used to transmit information from the antenna of a broadcasting station to the antenna of your radio or TV.

*In astronomy radio waves are used to gain information from distant stars using radio telescopes.

*Radio telescopes have the advantage that radio waves are not blocked by conditions of the Earth's

atmosphere as light waves are.



2) Microwaves

*Their wavelength is only a few centimeters long.

*While microwaves pass right through some materials others absorb them.

*Water and some other molecules found in food absorb microwaves and turn the energy into heat. This is what

makes a microwave oven work.

*Glass and plastic do not absorb microwaves so they do not heat up.





3) Infra-red



✤It lies between the visible and microwave portions of the electromagnetic spectrum.

Shorter, near-infrared waves are not hot at all - in fact, you cannot even feel them. These shorter wavelengths

are the ones used by your TV's remote control.

*Far infrared waves we experience every day in the form of heat. The heat that we feel from sunlight, a fire, a

radiator, or a warm sidewalk is infrared.



4) Visible

* These waves are the only electromagnetic waves we can see.

↔We see these waves as the colors of the rainbow.

◆Each color has a different wavelength.

*Red has the longest wavelength and violet has the shortest wavelength.

↔When all the waves are seen together, they make white light

WAVE LENGTH IN NANOMETER





5) Ultra-violet

* It has a wavelength shorter than that of visible light, but longer than X-rays, in the range 10 nm to 400.

*Though these waves are invisible to the human eye, some insects, like bumblebees, can see them.

◆It is ultraviolet waves that are responsible for causing our sunburns.

↔UV light cannot pass through glass unless it is made of quartz





6) X rays

* They have smaller wavelengths and therefore higher energy than ultraviolet waves.

☆X-rays are most known for their use in medicine.

* Huma bones and teeth are dense and absorb more X-rays than your skin does, images of your bones or teeth

are left on the X-ray film while your skin appears transparent.





7) Gamma rays

* They have the smallest wavelengths and the most energy of any other wave in the electromagnetic spectrum.

*These waves are generated by radioactive atoms and in nuclear explosions.

*Gamma-rays can kill living cells, a fact which medicine uses to its advantage, using gamma rays to kill cancer

cells.



References



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