

1.2 Electromagnetic Spectrum

The **electromagnetic spectrum** is a band of electromagnetic waves. It is the range of all types of electromagnetic radiation.

The electromagnetic spectrum includes the following waves:

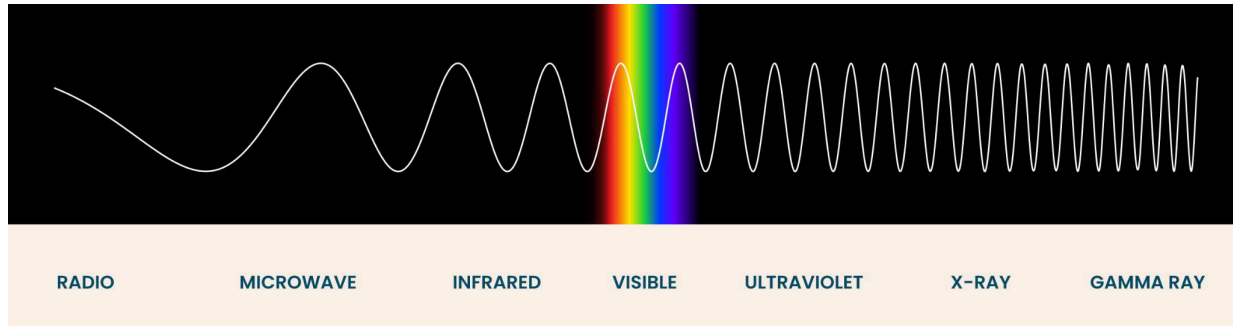


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- Gamma rays have the shortest wavelength and radiowaves have the longest wavelength.
- Gamma rays have the most frequency and radio waves have the least frequency.

Note: The higher the frequency, the shorter the wavelength.

Radiowaves

- They have the largest wavelength.
- These waves can be longer than a football field as short as a football (ranging from about 1m to km).
- Radiowaves do more than just bring music to the radio. They can also carry signals for your television and cellular phones.
- The antenna on your television set receives signals in the form of electromagnetic waves, which are broadcast from the television station. It is played on your television screen.

Main property: They are reflected by metal sheets.

Sources of radiowaves:

- Radio
- TV transmitter

Detectors of radiowaves:

- Receivers with aerials
- Mobile phones

Microwaves

- They have wavelengths that can be measured in centimeters (cm).

- These are waves that can heat food in a microwave oven.
- Microwaves are good for transmitting information from one place to another because microwave energy can penetrate light rain, snow, clouds, and smoke.

Main property: They are reflected by steel and metal sheets. They are absorbed by water.

Sources of microwave:

- Microwave transmitter
- Microwave oven

Uses of microwaves:

- Communication
- Satellite links
- Heating food

Infrared Radiation

- Its wavelength is longer than that of visible light and shorter than that of radio waves.
- It is invisible to the eye but the sensation of warmth on the skin can be detected.

Main property: Heat-inducing property, transverse wave, exhibit refraction.

Sources of infrared radiation:

- Solar radiation
- Fire
- Infrared lamps

Detectors of infrared radiation:

- Thermal detector
- Photonic detector

Light Waves

- Each wave has two parts: An electric part and a magnetic part.
- They have a speed of $3 \times 10^8 \text{ ms}^{-1}$.

Main property: The shorter wavelengths correspond to higher energy (blue and violet light), and the longer wavelengths correspond to lower energy (red and infrared light).

Sources of infrared radiation:

- Sunlight
- Fireflies
- Light bulbs

Detectors of infrared radiation:

- Photo resistors
- Photovoltaic devices

- Photodiodes

Gamma rays

- Gamma rays have the smallest wavelengths and the most energy of any wave in the electromagnetic spectrum.
- They are produced by the hottest and the most energetic objects in the universe such as neutrons, stars and pulsars, supernova explosions, and regions around the black hole.
- Gamma rays are a form of electromagnetic radiation arising from the radioactive decay of an atomic nuclei.

Main property: They do not have mass.

Uses of gamma rays:

- Sterilizing medical equipments
- To kill cancer cells

Detectors of gamma rays:

- Spectrometers
- Imagers

X-rays

- They have high energy and can pass through most objects e.g. human body.
- Medical X-rays generate images of tissues and structures inside the body.

Main property: X-ray photons are highly energetic and have enough energy to break up molecules and hence damage living cells.

Source of x-rays:

- Radioactive elements in Earth
- X-ray machines

Detectors of x-rays:

- Imaging detectors
- X-ray film