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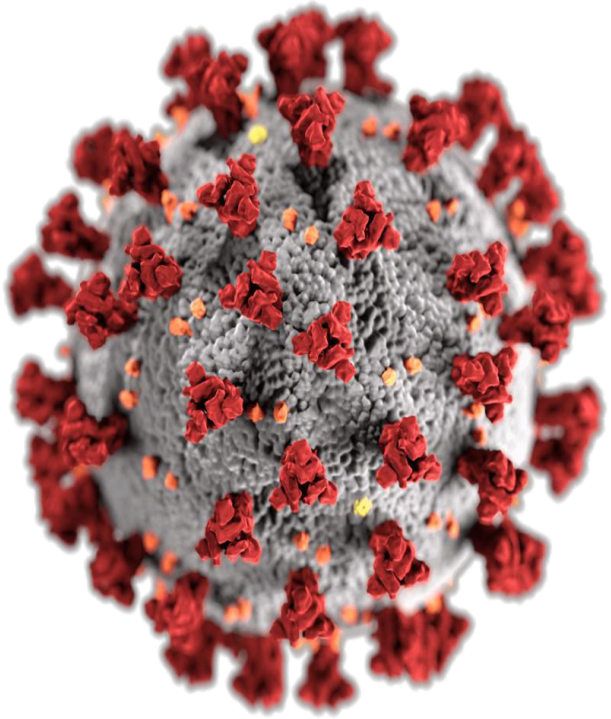
Welcome to my Class

Physics Ph 1229

11:45 AM
December 23, 2020

COVID-19 Precautions



- Don’t be afraid
- Be aware of the pandemic
- Use appropriate outfits if you compelled to go out
- Try to maintain proper diet
- Do not forget to exercise (at least one hour) regularly
- Try to follow the guidelines of WHO and Bangladesh Government
- Try to stay at home

Course outline

Physical Optics

Nature of Light

Corpuscular Theory

Huygens Principle

Electromagnetic Theory

Quantum Theory of Light

Course outline

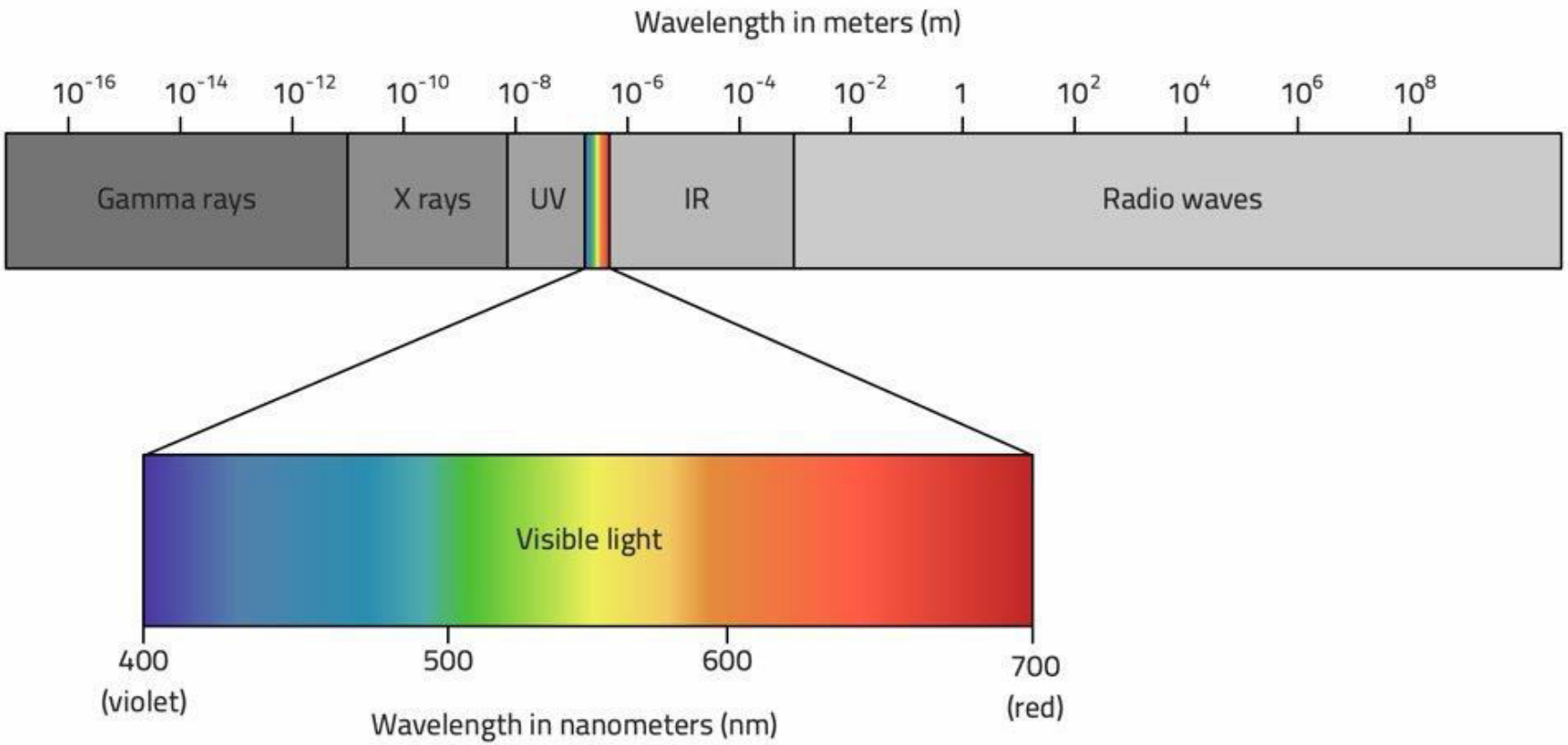
This part of the course is planned to comprise of **20 classes**. We wish to have **18 lectures** and a couple of class tests. After the end of Lec-4 we will have the **first Class Test** on the first four lectures. The **second Class Test** will be held after lec-12 on the last four lectures. Students may get one week for the preparation of each class test.

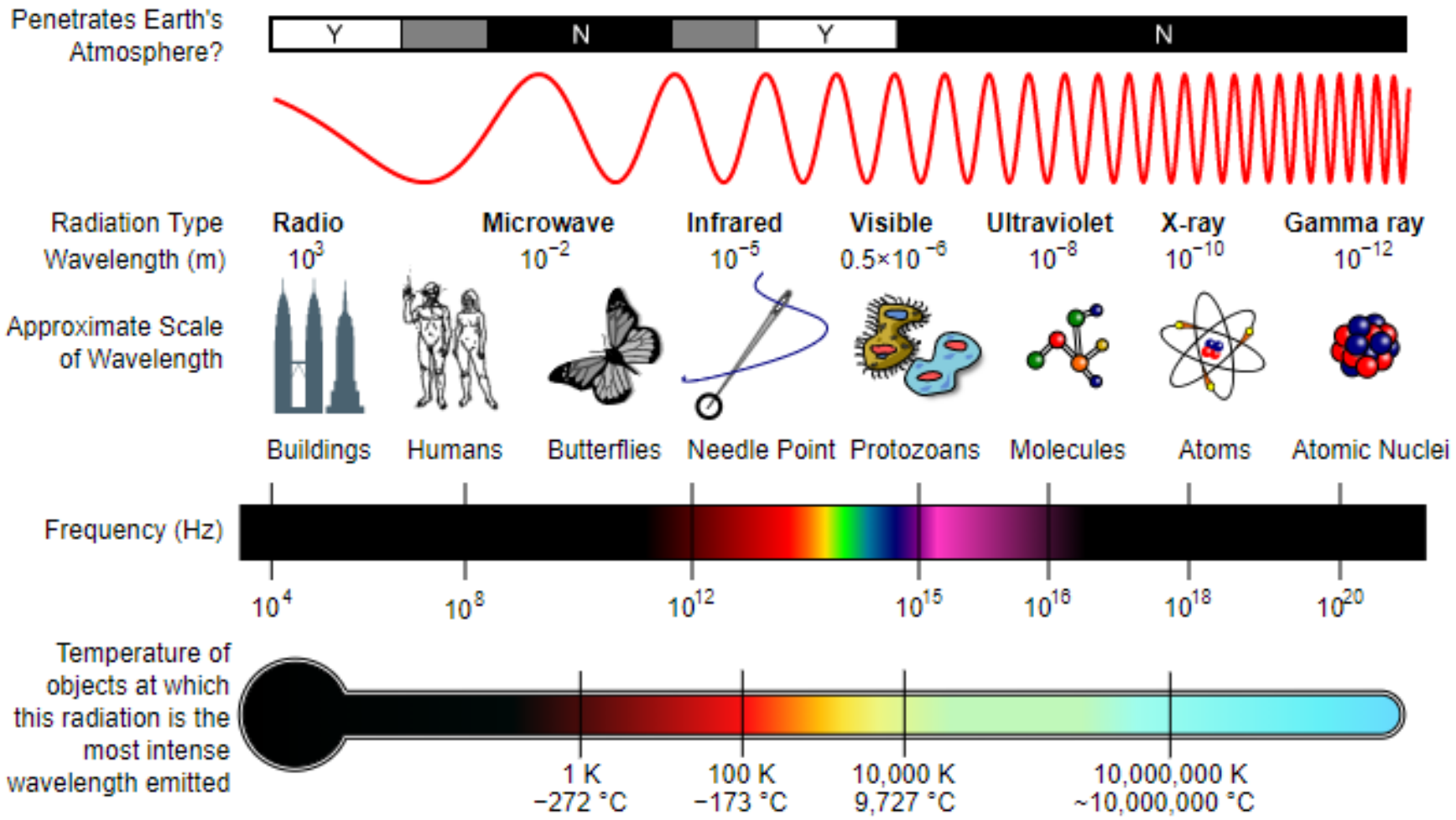
There will be home work or assignment on the lessons and it will be announced during the class. Students will have to turn in their home work or assignment in time as per instruction.

Physical Optics

The branch of optics that deals with the production, emission and propagation of light, its nature and the study of the phenomena of interference, diffraction and polarization is called physical optics.

Theories of Light




Penetrates Earth's Atmosphere?
Y
N
Y
N
Radiation Type
Wavelength (m)
Approximate Scale of Wavelength
Radio
10^{3}
Microwave
10^{-2}
Infrared
10^{-5}
Visible
0.5×10^{-6}
Ultraviolet
10^{-8}
X-ray
10^{-10}
Gamma ray
10^{-12}
Buildings
Humans
Butterflies
Needle Point
Protozoans
Molecules
Atoms
Atomic Nuclei
Frequency (Hz)
10^{4}
10^{8}
10^{12}
10^{15}
10^{16}
10^{18}
10^{20}
Temperature of objects at which this radiation is the most intense wavelength emitted
1 K
−272 °C
100 K
−173 °C
10,000 K
9,727 °C
10,000,000 K
~10,000,000 °C

Corpuscular Theory

The basic principles regarding the nature of light were formulated in the latter half of the seventeenth century. Until about this time the general belief was That light consisted of a stream of particles called corpuscles. These corpuscles were given out by a light source (an electric lamp, a candle, sun etc.) and they travelled in straight lines with large velocities. The originator of the emission of the corpuscular theory was Sir Isaac Newton.

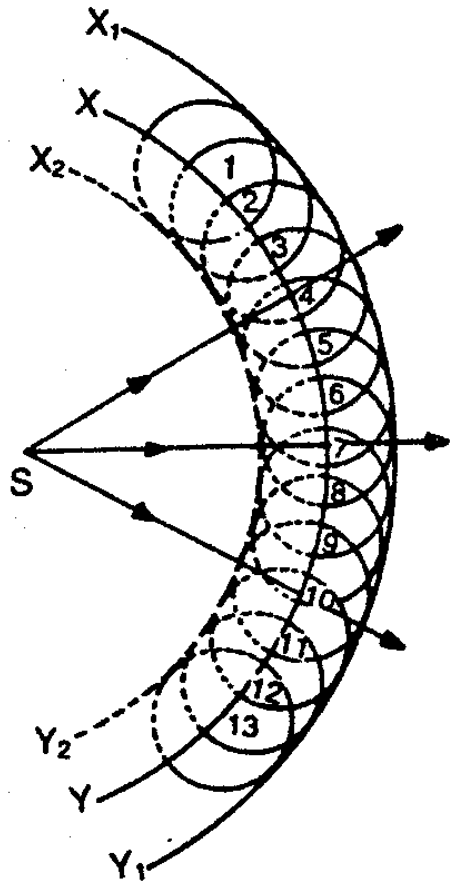
According to this theory, a luminous body continuously emits tiny, light and elastic particles called corpuscles in all directions. These particles or corpuscles are so small that they can readily travel through the interstices of the particles of matter with the velocity of light and they possess the property of reflection from a polished surface or transmission through a transparent medium.

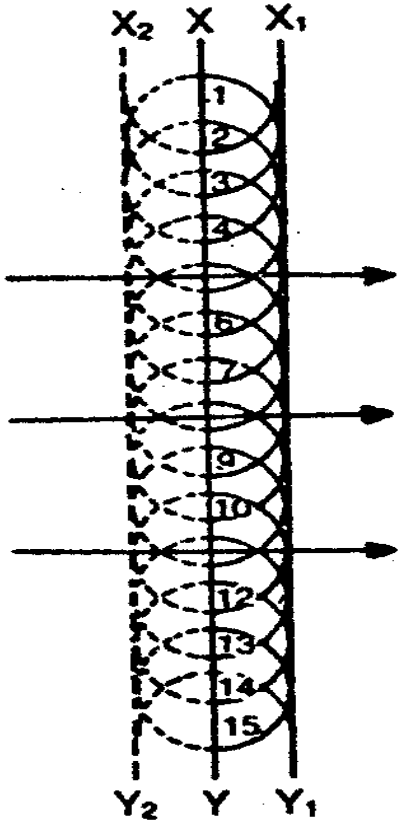
When these particles fall on the retina of the eye they produce the sensation of vision. On the basis of this theory phenomena like rectilinear propagation, reflection and refraction could be accounted for satisfactorily.

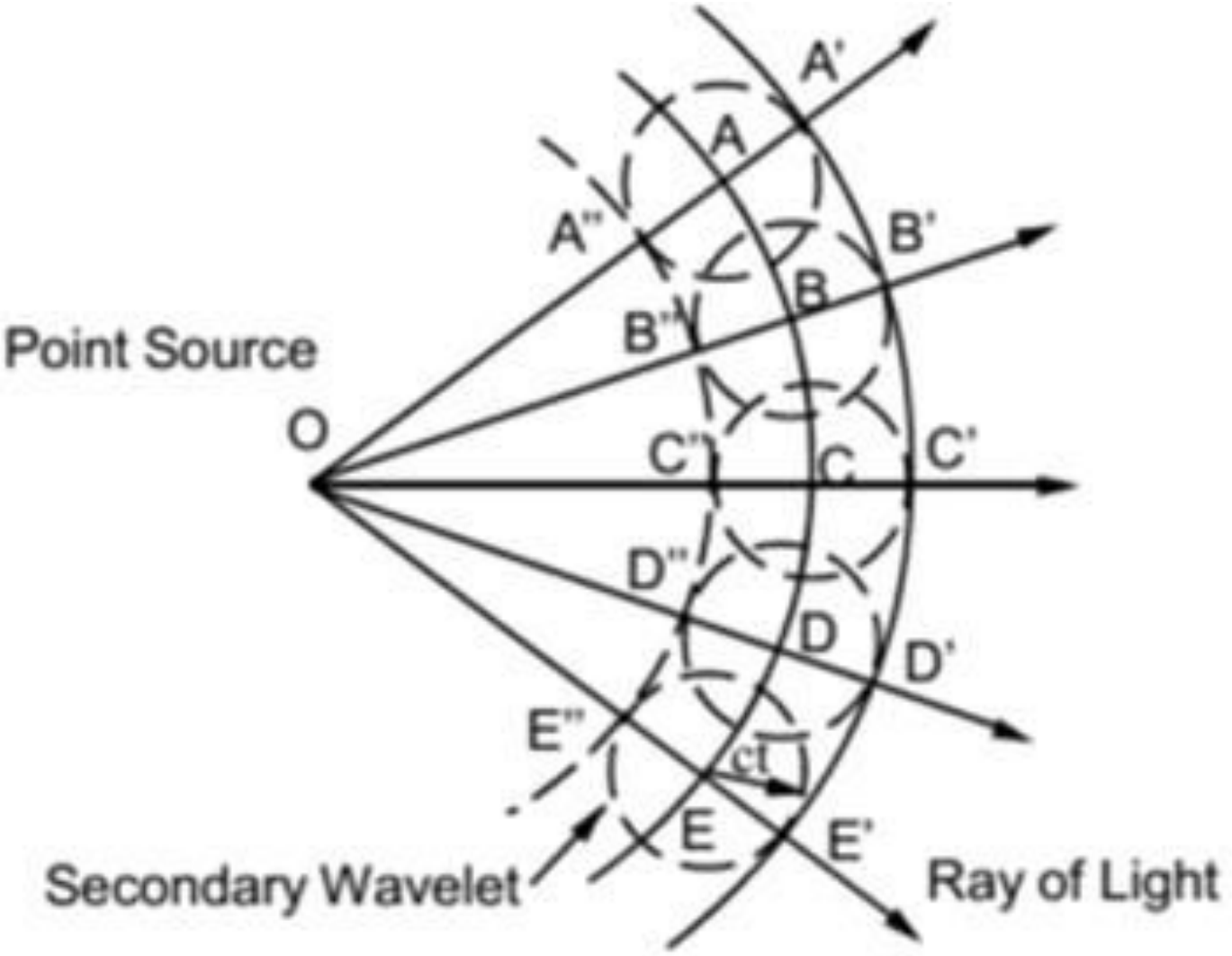
Since the particles are emitted with high speed from a luminous body, they in the absence of other forces travel in straight lines according to Newton's second law of motion. This explains rectilinear propagation of light.

Huygens Principle

According to Huygens, a source of light sends out waves in all directions, through a hypothetical medium called ether.

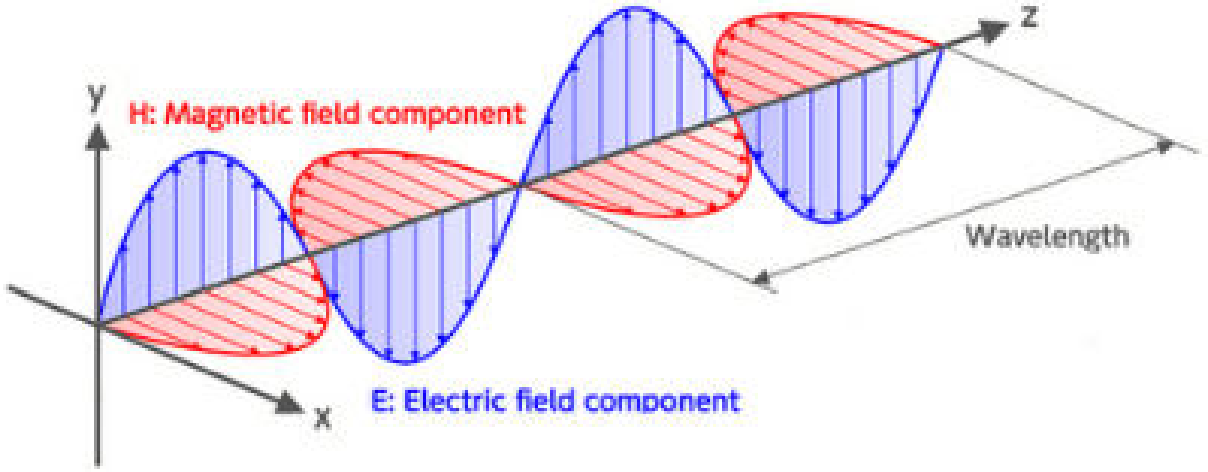





Point Source
O
A'
A
A''
B'
B
B''
C''
C
C'
D''
D
D'
E''
ct
E
E'
Secondary Wavelet
Ray of Light

Electromagnetic Theory

$\nabla \cdot \mathbf{D} = \rho$	(1)	Gauss' Law
$\nabla \cdot \mathbf{B} = 0$	(2)	Gauss' Law for magnetism
$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$	(3)	Faraday's Law
$\nabla \times \mathbf{H} = \frac{\partial \mathbf{D}}{\partial t} + \mathbf{J}$	(4)	Ampère-Maxwell Law


z
y
H: Magnetic field component
Wavelength
E: Electric field component
x


Radio & TV
Mobile Phone
Wi-Fi
NMR
Maxwell's Equations
GPS
Lasers
Radar
Radio Astronomy
Medical - Communication - Navigation - Science &

Nature of Light

Rectilinear propagation of light is a natural deduction on the basis of corpuscular theory. This theory can also explain reflection and refraction, though the theory does not clearly envisage why, how and when the force of attraction or repulsion is experienced perpendicular to the reflecting or refracting surface by a corpuscle. Newton assumed that the corpuscles possess fits which allow them easy reflection at one stage and easy transmission at the other.

According to corpuscular theory the velocity of light in a denser medium is higher than the velocity in a rarer medium. But the experimental results of Foucault and Michelson show that the velocity of light in a rarer medium is higher than that in a denser medium.

Huygens wave theory could explain satisfactorily the phenomena of reflection and refraction. Applying the principle of secondary wave points, rectilinear propagation of light can be correlated. The phenomenon of interference can also be understood considering that light energy is propagated in the form of waves. Two wave trains of equal frequency and amplitude and differing in phase can annul one another's effect and produce darkness.

Double refraction can also be explained on the basis of wave theory. According to Huygens, propagation of light is in the form of longitudinal waves. But in the case of longitudinal waves, one cannot expect the unsymmetrical behavior of a beam of light about the axis of propagation. This difficulty was overcome when Fresnel suggested that the light waves are transverse and not longitudinal.

On the basis of this concept, the phenomenon of polarization can also be understood. Finally, on the basis of wave theory it can be shown mathematically, that the velocity of light in a rarer medium is higher than the velocity of light in a denser medium. This is in accordance with the experimental results on the velocity of light.

The controversy between the corpuscular theory and the wave theory existed till about the end of the eighteenth century. At one time the corpuscular theory held the ground and at another time the wave theory was accepted.

The discovery of the phenomenon of interference by Thomas Young in 1800, the experimental results of Foucault and Michelson on the velocity on light in different media and the revolutionary hypothesis of Fresnel in 1816 that the vibration of the ether particles is transverse and not longitudinal gave, in a way, a solid ground to the wave theory.

The next important advance in the nature of light was due to the work of Clerk Maxwell. Maxwell's electromagnetic theory of light lends support to Huygens wave theory whereas quantum theory strengthens the particle concept. It is very interesting to note that light is regarded as a wave motion at one time and as a particle phenomenon at another time.

Corpuscular Theory

Huygens Principle

Electromagnetic Theory

Quantum Theory of Light


I Thank you