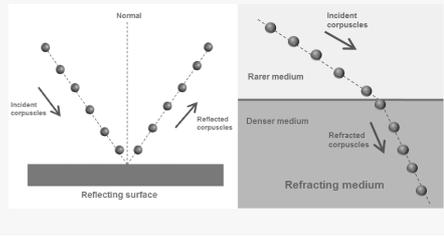


### Newton's Corpuscles



### Newton's Corpuscular Theory of Light

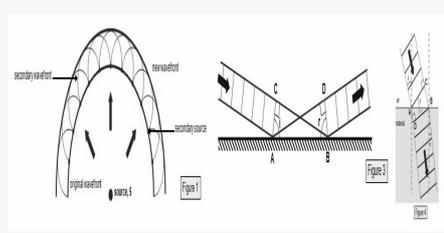
Newton theorised light was made up of particles called corpuscles.

Reflection caused by corpuscles colliding with surface and repulsive force pushing them back. Caused perpendicular component of velocity to change direction, the parallel component stays the same.

Refraction caused by corpuscles approaching denser medium. Short-range forces of attraction causes perpendicular component of velocity to increase, parallel component stays the same. Light bends towards normal.

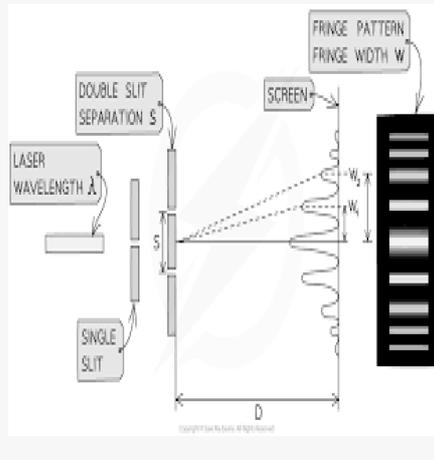
According to Newton's theory, light travels faster in denser mediums.

### Huygen's Waves



### Huygen's Wave Theory of Light

### Young's Double Slit Apparatus



### Young's Double Slit Experiment

Coherent light shone through two slits so that it diffracts. Each slit is a coherent point source making a pattern of light and dark fringes.

Light fringes formed where light meets in phase and interferes constructively, occurs when path difference is a whole number of wavelengths.

Dark fringes formed where light meets completely out of phase and interferes destructively, occurs when path difference is a whole number plus half wavelengths.

If Newton's theory was correct: Only two bright fringes corresponding to the two slits. Experiment demonstrated diffraction and interference, both properties only explained by Huygen's theory.

Even after experiment: Huygen's theory still wasn't accepted because Newton was a historical figure who scientists expected to be correct.

Newton's theory only disregarded after speed of light was measured in water, it was shown that light actually moves slower in denser substances contradicting the corpuscular theory.

### Electromagnetic Waves

### Maxwell's equation for EM waves

Electromagnetic waves: alternating magnetic (B) and electric (E) fields travelling in phase and at right angles to each other. Direction of wave travel perpendicular to oscillations

Maxwell predicted EM waves existed: Theorised formula for their speed in a vacuum (c) before experiment evidence.

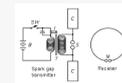
$$c = 1 / \sqrt{\mu_0 \epsilon_0}$$

c = Speed of Light ( $3 \times 10^8 \text{ ms}^{-1}$ )

$\mu_0$  = Permeability of free space ( $4\pi \times 10^{-7} \text{ Hm}^{-1}$ )

$\epsilon_0$  = Permittivity of free space ( $8.85 \times 10^{-12} \text{ Fm}^{-1}$ )

### Hertz' Apparatus



### Hertz' Radio Wave experiment

Hertz discovered radio waves by using apparatus to allow sparks to jump across a gap of air.

Dipole receiver detects electric field. Made by placing second set of charged plates parallel to those forming the voltage sparks.

Loop of wire with gap detects magnetic field as field enters loop causing change in magnetic flux inducing p.d causing spark to cross the gap in the wire.

Metal sheet in front apparatus, radio waves reflect back creating stationary waves. Use one of the detectors to find the distance between adjacent nodes to find the wavelength.

Wavelength multiplied by frequency of the waves to find speed of waves. Hertz's value same as Maxwell's therefore radio waves are EM waves.

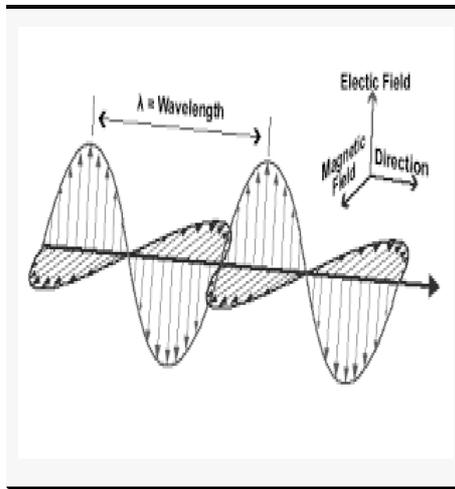
Rotating receiver: Plane of detector perpendicular to EM waves produced maximum value. Plane of detector parallel to EM waves produces minimum value and no signal detected. Therefore radio waves are polarised.

Huygen theorised light was a wave, every point on a wavefront is a point source to secondary wavelets which spread out to form next wavefronts. This is Huygen's principle.

Reflection caused by whole wavefront not reaching surface at once. Wavelets spread away from surface once they reach it and rejoin with others to form reflected wavefront.

Refraction caused by light entering more optically dense medium. This slows down light and makes it bend towards normal.

Newton's theory preferred over Huygen's because Newton had very high reputation at the time, diffraction had not yet been observed and the speed of light had not yet been measured.



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