DIFFRACTION I

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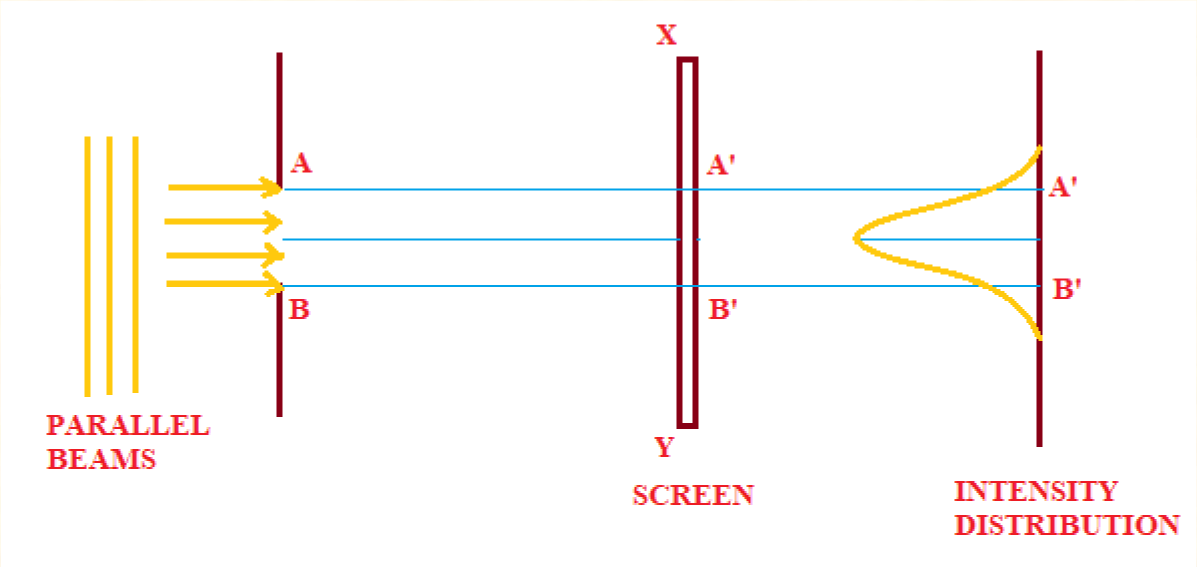
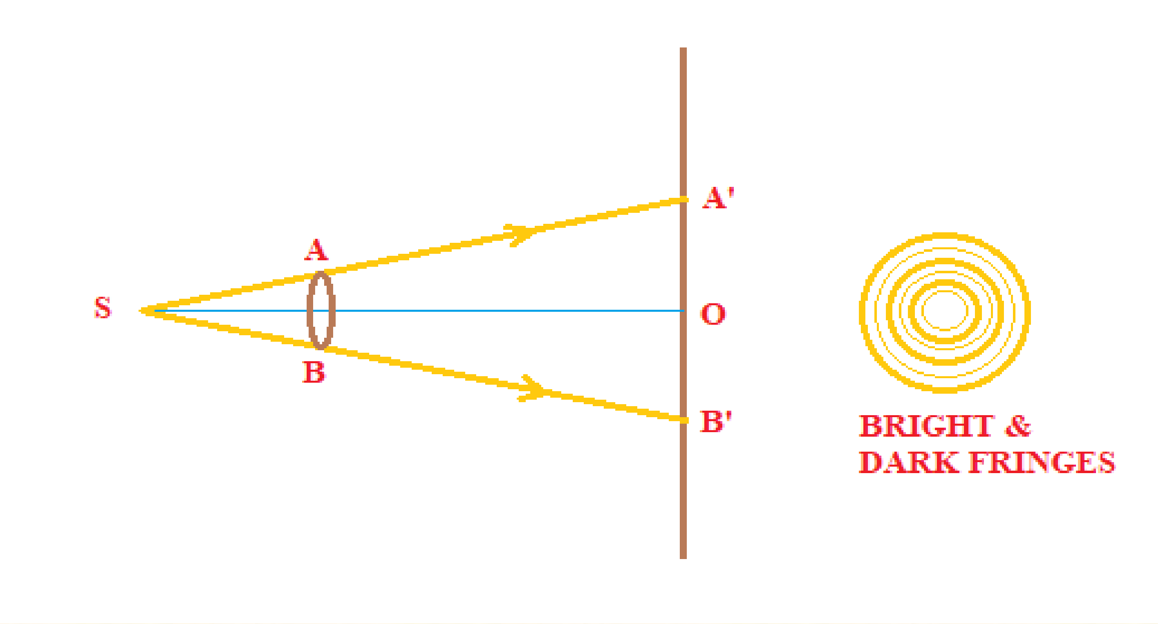
NARROW SLIT EXPERIMENT



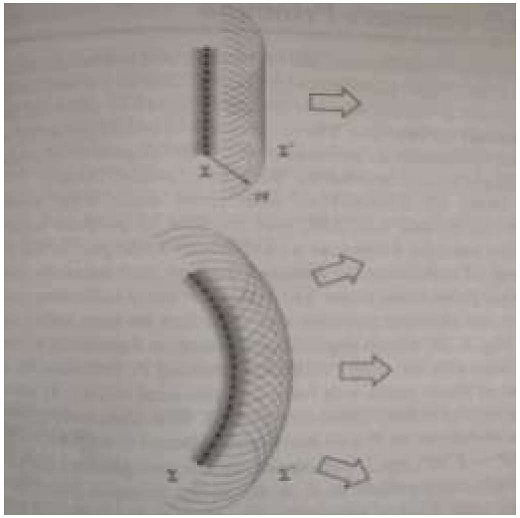
The second experiment which shows the diffraction phenomenon of light. Here AB is asmall circular disc placed in the path of light from a source S. Concentric circular rings , alternately dark and bright are observed.



In the course of encountering an obstacle, either transparent or opaque, a region of the wave front is altered in amplitude or phase, diffraction will occur.

The various segments of the wave front that propagate beyond the obstacle interfere, causing the particular energy distribution referred to as diffraction pattern, i.e. superposition of many many waves.

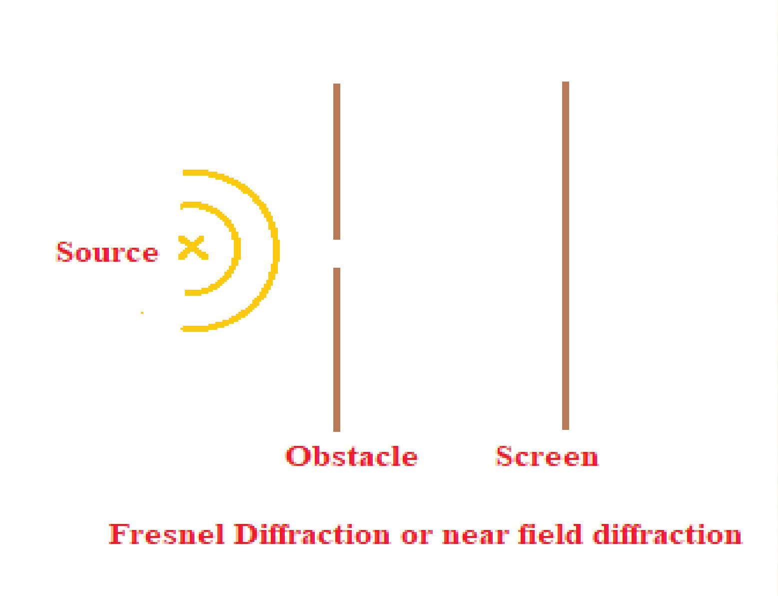
HUYGENS – FRESNEL PRINCIPLE



1. Every point on a propagating wave front acts as the source of secondary wavelets, such that the wave front at later time is the envelope of these wavelets.
2. And if the propagating wave has a frequency v, and is transmitted through the medium at a speed v_t, then the secondary wavelets have that same frequency and speed.

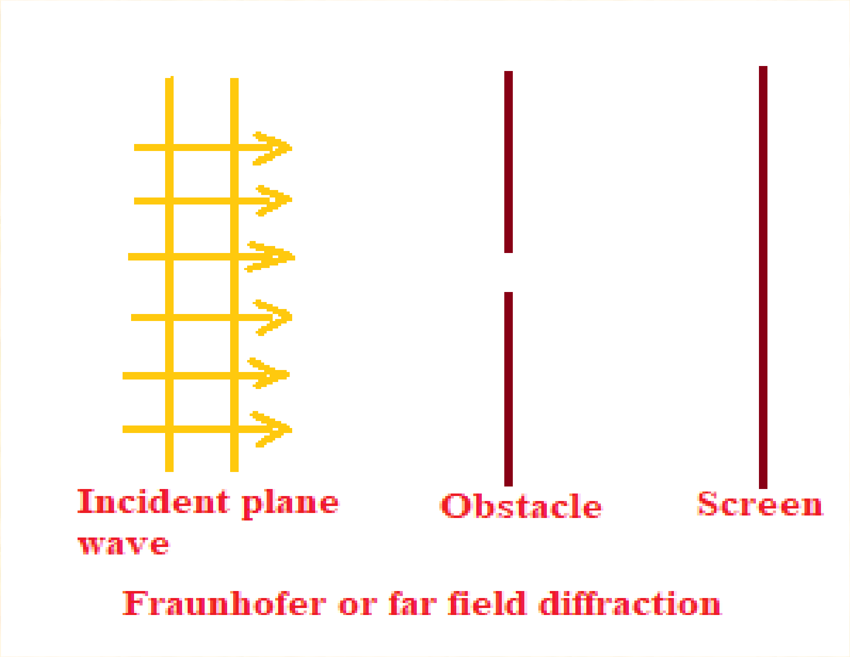
The HUYGENS-FRESNEL PRINCIPLE states that every unobstructed point of a wave front, at a given instant, serves as a source of spherical secondary wavelets (with the same frequency as that of primary wave). The amplitude of the optical field at any point beyond is the superposition of all these wavelets (considering their amplitude and phases).

Diffraction phenomenon is divided into two groups
1.Fresnel diffraction
2.Fraunhofer diffraction

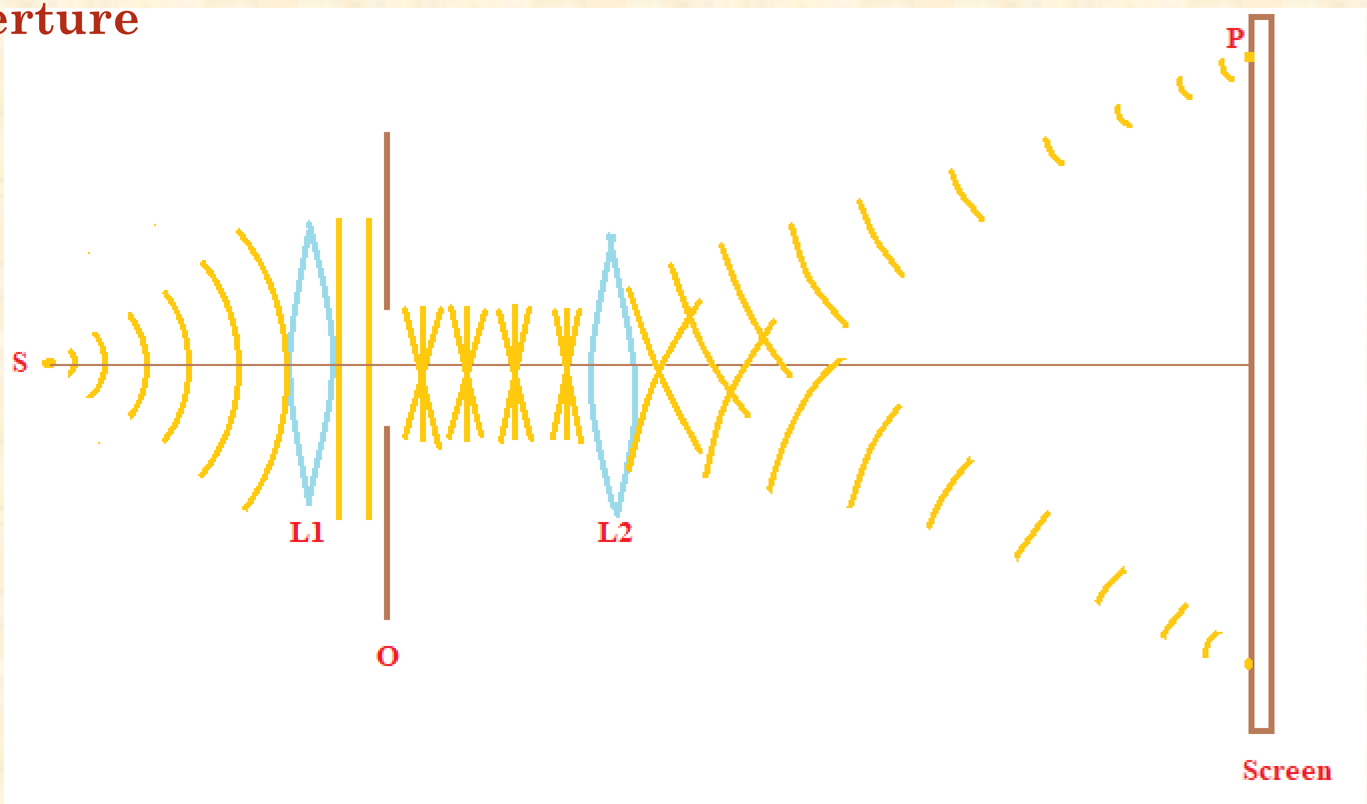


In Fresnel class of diffraction, the source and screen are at finite distance from the obstacle. Here wave front incident on obstacle is either spherical or cylindrical. The secondary wavelets from different points of the obstacle are not in same phase.

In Fraunhofer class of diffraction , the source and the screen are effectively at infinity.
The incident wave front on the obstacle is plane, all points in the obstacle become a source of secondary wavelets simultaneously.
The secondary wavelets starting from the obstacle are in phase.



Fraunhofer diffraction using lenses so that the source and fringe pattern can both be at convenient distances from the aperture



Fraunhofer diffraction occur at an aperture(or obstacle) of greatest width a when

$$R > \frac{a^2}{\lambda}$$

R= smaller of the two distances from source, S to the aperture, O and aperture, O to P.

An increase in λ clearly shifts the phenomenon toward the Fraunhofer class.