Coherent Sources :→ Two Sources are said to be Coherent if They emit continuous light waves of the same frequency or wave length, nearly of the same amplitude should either be in phase with each other or have a constant phase difference.

Interference :→ The phenomenon of interference of light has proved The validity of the wave theory of light.

"when the two light waves of the same frequency and having a constant phase difference traverse simultaneously in the same region of a medium and cross each other, then there is a modification in the intensity of light in the region of superposition, which is different from the sum of intensities due to individual waves at that point. this modification in intensity of light resulting from the superposition of two or more waves of light is called interference.

- At some points the intensity is a maximum, the interference at these points is called constructive interference.
- At some other points the intensity is a minimum (possibly even zero) at these points interference is called destructive interference.

usually when two light waves are made to interfere, we get alternate dark and bright bands of a regular or irregular shape. These are called interference fringes.

Group of interference → The phenomenon of interference may be grouped into two categories depending upon the formation of two coherent sources.

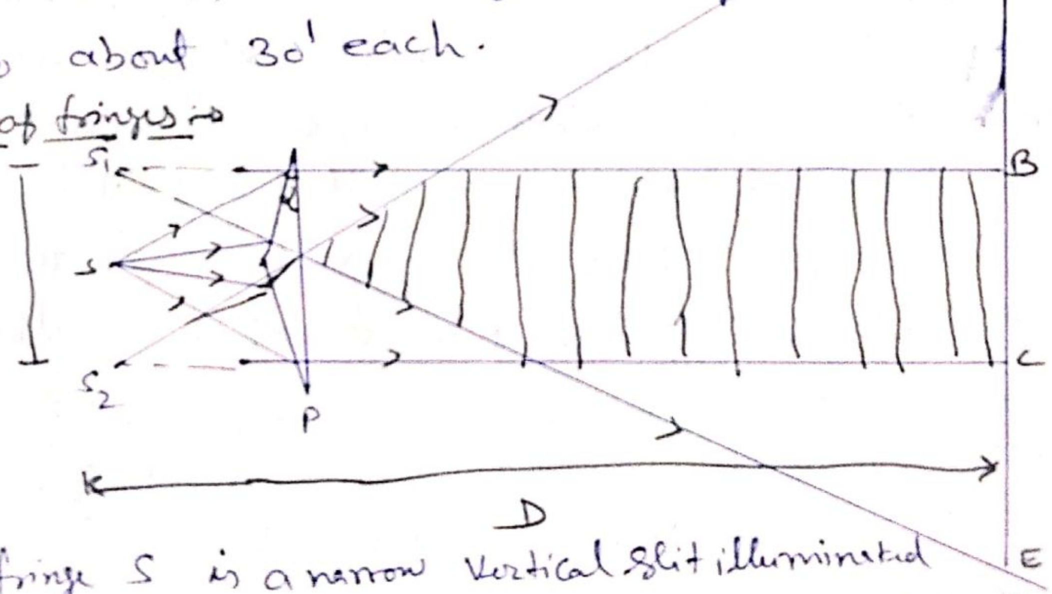
1- Division of wave front → in this coherent sources are obtained by dividing the wavefront, originating from a common source by employing mirrors, biprism or lenses. This class of interference requires essentially a point source or a narrow slit source.

Example → Fresnel's biprism, Fresnel mirrors, Lloyad's mirror, laser, Youngs double slit experiment

2- Division of amplitude → In this, The amplitude of the incident beam is divided into two or more parts either by partial reflection or refraction, So we have coherent beam produced by division of amplitude. So beam travel through different paths and are finally brought together to as two beam interference and those resulting from superposition of more than two beams are reffered to as multiple beam Interference.
Example – in thin films, Newton's ring, Michelson's Interferometer etc.

Fresnel's biprism → The biprism is a device to obtain two coherent sources to produce sustained interference. It is a combination of two prisms of very small refracting angles placed base to base. In practice the biprism is made from a single plate by grinding and polishing, so that it is a single prism with one of its angles about 179° and other two about 30' each.

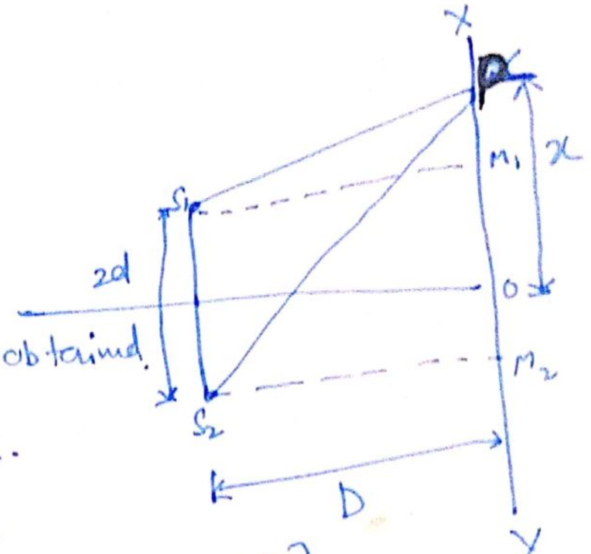
Production of fringes →



In above fringe S is a narrow vertical slit illuminated by monochromatic light the light from S is allowed to fall symmetrically on the biprism P placed at a small distance from S and having its refracting edge parallel to the slit. The light beams emerging from the upper and lower part of the prism appear to start from two virtual image of S namely S_1 and S_2, which act as coherent sources.

The Cones of light BS_1E and AS_2C, diverging from S_1 and S_2 are ~~superposited~~ superposed and the interference fringes are formed in the overlapping region BC. These fringes are non localised and may be obtained on a screen or seen through an eyepiece.

Theory of Fringes of Bi-prism -



Let S_1 and S_2 two virtual sources produced by the biprism, and XY the Screen on which the fringes are obtained. Point O is Centre of a bright fringe.

From fig $S_2P^2 = (S_2M_2)^2 + (PM_2)^2$

$$= D^2 + (x+d)^2 = D^2\left[1+\frac{(x+d)^2}{D^2}\right]$$

$$S_2P = D\left[1+\frac{(x+d)^2}{D^2}\right]^{1/2} = D\left[1+\frac{1}{2}\frac{(x+d)^2}{D^2}\right] \quad \text{as } x+d \ll D$$

$$= D + \frac{1}{2}\frac{(x+d)^2}{D} \quad \text{--- (1)}$$

Similarly $S_1P = D + \frac{1}{2}\frac{(x-d)^2}{D}$ --- (2)

So path difference (For P to be Centre of bright fringe)

$$S_2P - S_1P = \left(D+\frac{1}{2}\frac{(x+d)^2}{D}\right) - \left(D+\frac{1}{2}\frac{(x-d)^2}{D}\right)$$

$$= \frac{2xd}{D} = n\lambda \quad \text{where } n = 0, 1, 2 \ldots$$

$$\text{so } \boxed{x = \frac{D}{2d}n\lambda} \quad \text{--- (3)}$$

(For P to be dark fringe) $S_2P - S_1P = \frac{2xd}{D} = (2n+1)\frac{\lambda}{2}$ where $n = 0, 1, 2 \ldots$

$$\text{So } \boxed{x = \frac{D}{2d}\frac{(2n+1)\lambda}{2}} \quad \text{--- (4)}$$

Let X_n and X_{n+1} denote the distances of the nth and (n+1)th bright fringes. Then the distance between (n+1)th and nth bright fringes is given by

$$X_{n+1} - X_n = \frac{D}{2d}(n+1)\lambda - \frac{D}{2d} n\lambda = \frac{D}{2d}\lambda \quad - (5)$$

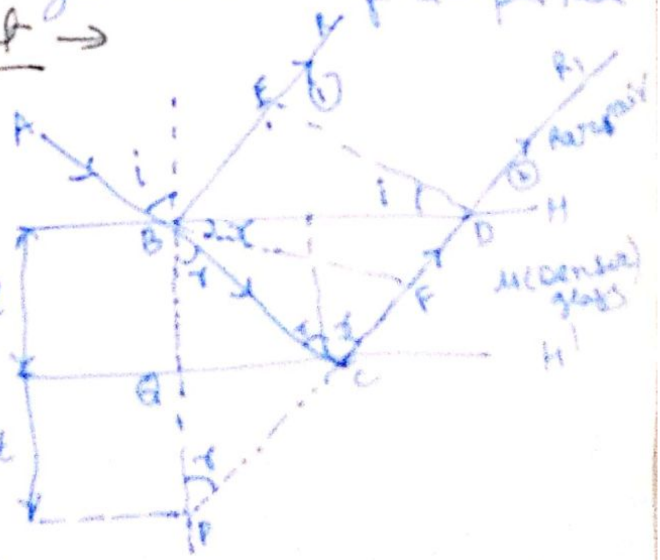
This is independent of n so that the distance between any two consecutive bright fringes is the same $D\lambda/2d$. Same result holds for dark fringes. The distance $\frac{D\lambda}{2d}$ is called fringe width denoted by w. So.

$$\boxed{w = \frac{D\lambda}{2d}} \quad - (8)$$

Interference in parallel (uniform) Thin film →

Thin film of soap bubbles or drop of oil spread on the surface of water show brilliant colours when exposed to sun light or to soap other extended source of light. This is an example of interference due to multiple reflections from thin films. This interference pattern produced by division of amplitude.

1- Interference due to reflected light →



Let GH and G'H' be the parallel faces of a thin transparent film of Thickness t and refractive index μ as shown in figure. Suppose a ray AB (single wave train) from a monochromatic source A of light is incident on the surface of GH at an angle i. A part of the incident ray will be reflected along BR. Another part will be