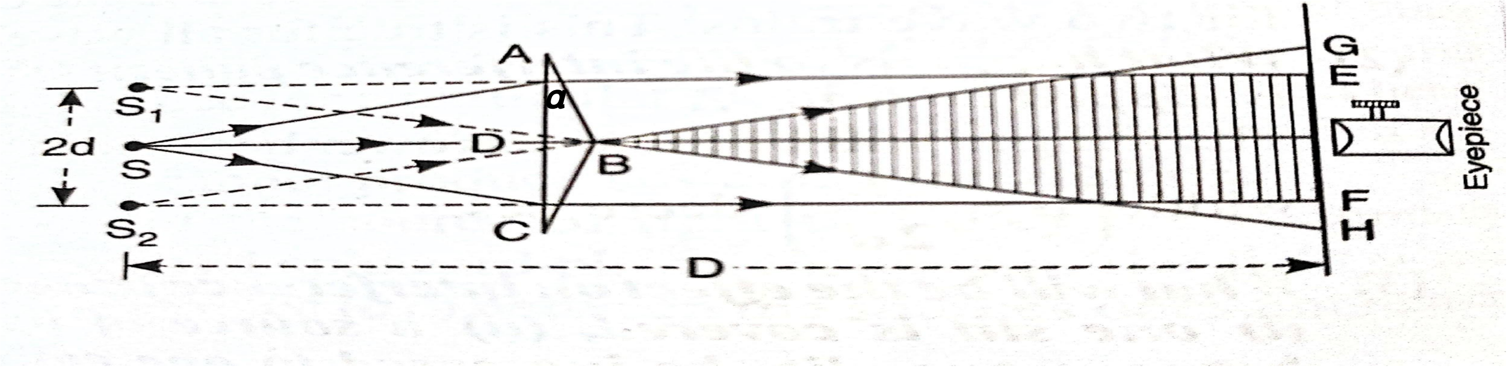
FRESNEL'S BIPRISM

M.SATYA VANI
Lecturer in Physics
D N R College Bhimavaram

FRESNEL'S BIPRISM

- Fresnel used a Biprism to show the phenomenon of Interference.
- Fresnel's Biprism is a combination of two acute angled prisms placed base to base. The acute angle (α) on both sides is about 0.5°. Actually it is constructed as a single prism of obtuse angle of about 179°.
- The action of the Biprism is to produce two coherent images of a given slit which are separated at a certain distance and behaves as two coherent sources.

ABC is a Biprism. S is a narrow vertical slit illuminated by monochromatic source of light. The Biprism is placed with its refracting edge parallel to the slit 'S', such that SB is normal to the face AC of the prism.



When light from 'S' falls on the lower position of the Biprism, it is bent upwards and appears to come from the virtual source S_2.

Similarly light falling on the upper portion of the prism is the bent downwards and appears to come from virtual source S_1. The two emergent wave fronts are derived from the same wavefront hence they are in a condition to interfere.

$\therefore S_1$ & S_2 act as two coherent sources,the two beams of light diverging from S_1 & S_2 overlap on the screen within in the region EF and interference fringes are observed through microscope .

Determination of wavelength :

Fresnel's Biprism is also used to determine the wavelength(**λ**) of a given monochromatic source of light.

$$\boldsymbol{\lambda = \beta(2d)/D}$$

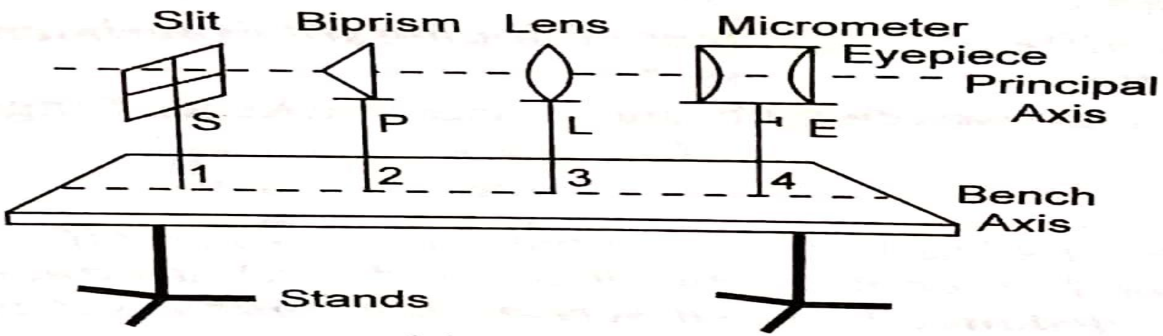
where β = fringe width

2d = distance between the sources S_1 & S_2

D = distance between source and screen

Experimental Setup

- The Experimental setup is as shown in the figure.
- The slit ‘S’ , Biprism ‘P’, eyepiece (E) are adjusted to the same height on the optical bench.
- The eye piece,biprism and slit are adjusted to obtain interference fringes.



(a)

MEASUREMENT OF FRINGE WIDTH(β) :

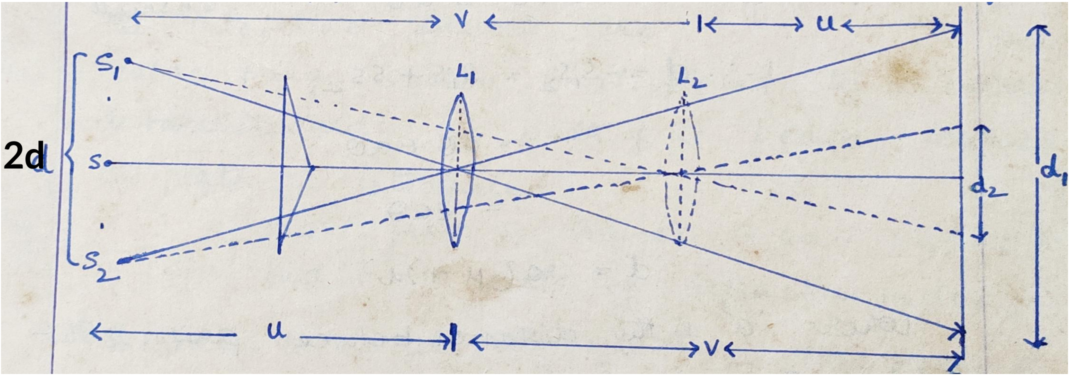
- The eyepiece is focused on it's cross wires. The vertical crosswire is made to coincide with one of the bright fringes and the reading is noted.
- The eyepiece is moved across the fringes and the number of fringes that pass the cross wire are counted.
- The vertical cross wire is made to coincide with another bright fringe and micrometer reading is noted.
- Difference of these two readings is equal to the distance moved by the screw.
- ∴ Fringe width (**β**) = Distance moved by the screw / Number of fringes
- In this way the mean distance between two consecutive fringes 'β' is found out.

MEASUREMENT OF ‘D’ :

Distance between slit and eyepiece can be read directly on the optical bench.

MEASUREMENT OF ‘2d’ :

To determine ‘2d’ a lens of focal length less than the 1/4th of the distance between eyepiece and Biprism is placed between the eyepiece and Biprism.



The lens is adjusted in two positions L1 & L2 till the sharp images of S1 & S2 are formed and they are observed in the eyepiece.

The distances d_1 & d_2 between the two images in two cases are measured from the above figure...

$$d_1 / 2d = v / u \quad \text{---------} \; (1)$$

$$d_2 / 2d = u / v \quad \text{---------} \; (2)$$

$$(1) \times (2) \Rightarrow \quad d_1 d_2 / (2\,d)^2 = 1$$

$$\Rightarrow \quad (2d)^2 = d_1 d_2$$

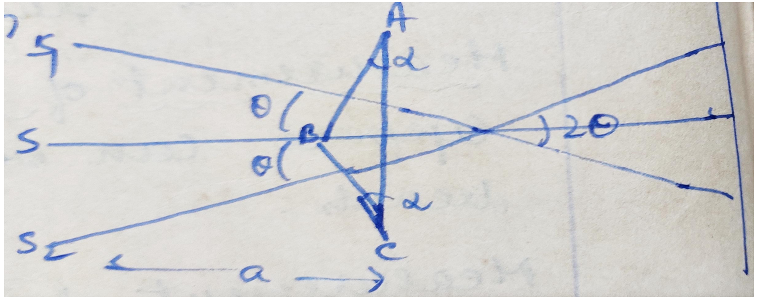
$$\Rightarrow \quad 2d = \sqrt{d_1 d_2}$$

Thus the wavelength can be determined by measuring the value β ,2d , D.

Measurement Of '2d' (Deviation method):

If θ is the angle of Refraction deviation produced

$$\theta = (\mu - 1)\,\alpha \quad \text{-------} \; (1)$$



Angle between S_1B & S_2B $= 2\theta$

$$= 2(\mu - 1)\,\alpha$$

$$SS_1 = SS_2 = a\tan\theta = a\,\theta \qquad \because \theta \text{ is small}$$

$$\therefore 2d = S_1S_2 = S_1S + SS_2 = a\,\theta + a\,\theta = 2a\,\theta$$

$$\therefore 2d = 2a\,(\mu - 1)\,\alpha$$

Where 'a' is the distance between prism & slit (α must be in radian)