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(E_2)

"Experiment - 11"

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"Resolving Power of a Telescope"

Objective :- To determine the resolving power of a telescope and compare it with corresponding theoretical value.

Apparatus required :- Sodium light source, Microscope, Telescope, Measuring Tape, Double slit holder, Micrometer slit.

Theory :-
The angle subtended by source on the aperture of telescope in just distinguishable condition is called resolving power.
It depends on the wavelength of light source and width of aperture.

Theoretically, the resolving power is given by.

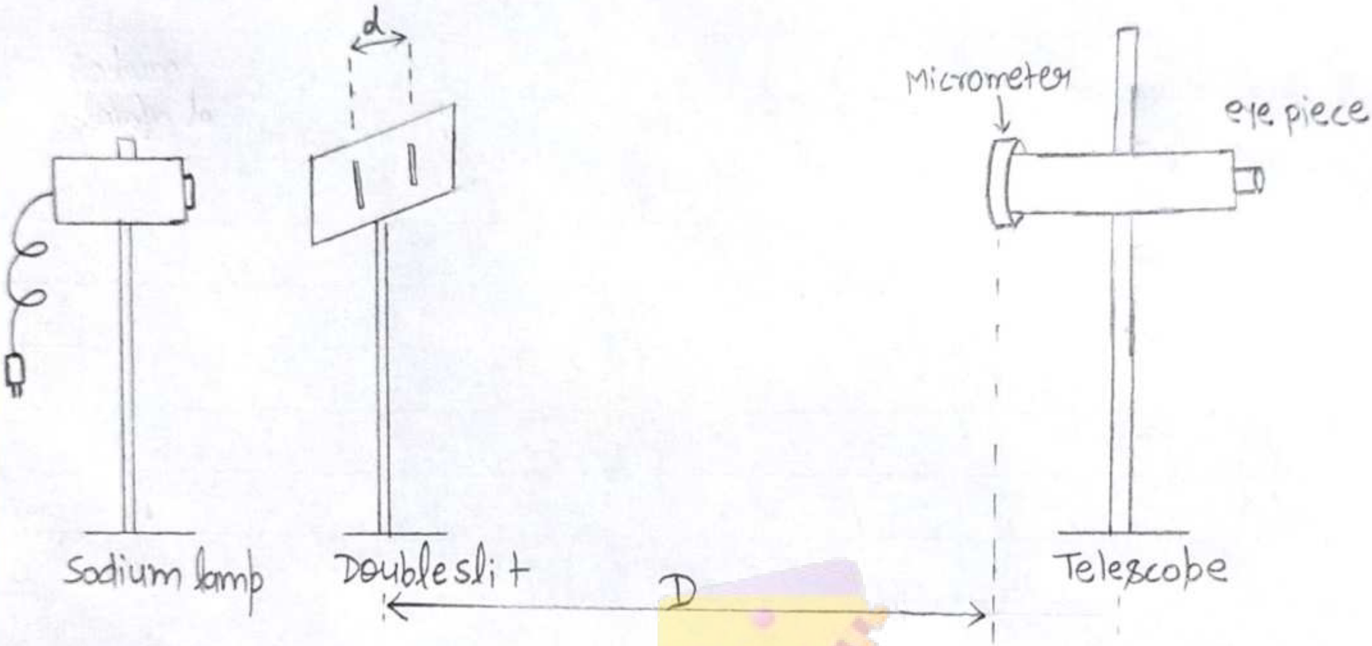
$$\boxed{\alpha = \frac{a}{\lambda}}$$

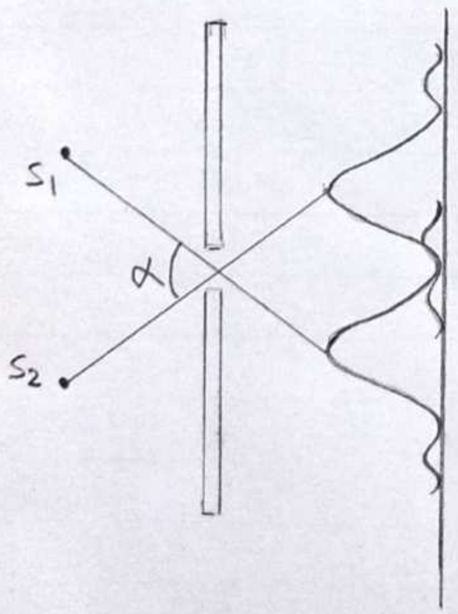
Experimentally, the angle α calculated as.

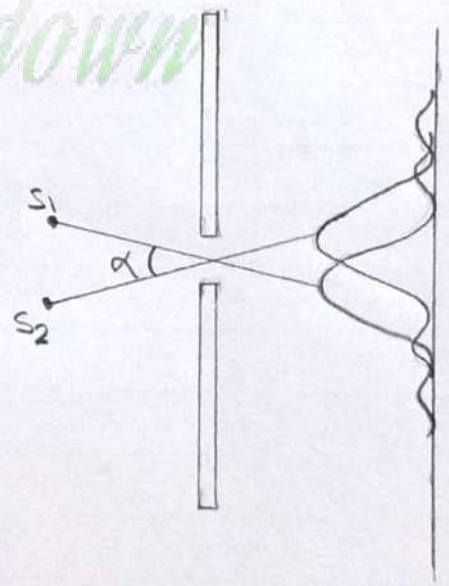
$$\boxed{\alpha = \frac{D}{d}}$$

where,
d = distance b/w^n two light source / two slits.
a = width of the aperture of telescope
λ = wavelength of the light source.
D = distance between slits and aperture of telescope.

Experimental setup





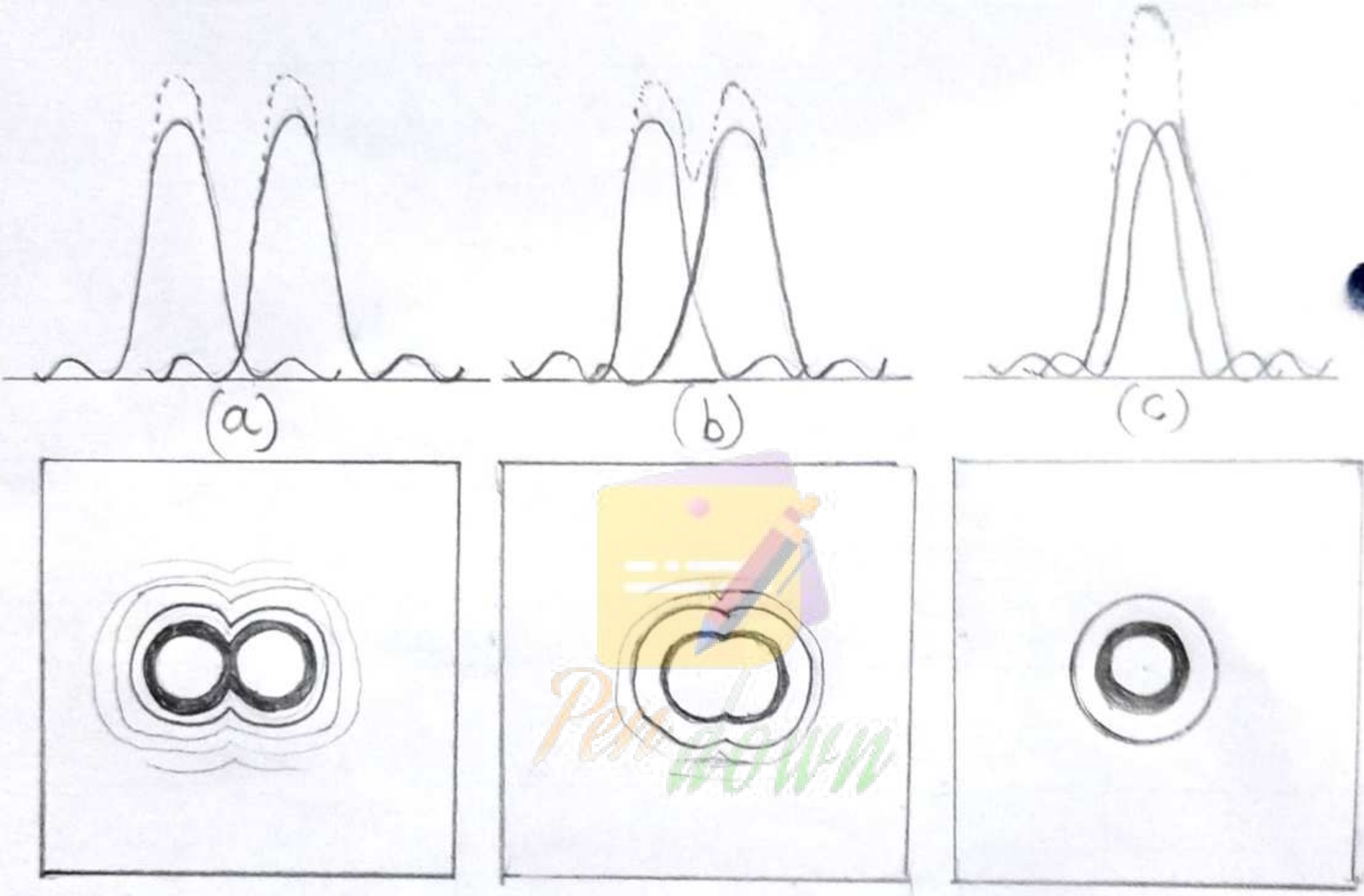


(a)

α is large, allowing us to distinguish two sources

(b)

Critical value of α when two images are just distinguishable.
(Resolving Power)



- figure(a) representing when light source is far away (α is large) their principal maxima in diffraction pattern are also far away, allowing to distinguish two sources.

  figure(b) representing when sources come closer (α decreases) their primary maxima come closer and $\alpha =$ critical α , two images are distinguisable called as resolving power.

  figure(c) representing when primary maxima overlaps and make a single image.

Observation :-

① Measurement of d :-

The centre of Ist slit is given by, $x_1 = \frac{(x_{1l} + x_{1r})}{2}$

The centre of IInd slit is given by, $x_2 = \frac{(x_{2l} + x_{2r})}{2}$

Now, the distance b/w both slits is given by,

$$d = |x_1 - x_2| = \left| \frac{(x_{1l} + x_{1r})}{2} - \frac{(x_{2l} + x_{2r})}{2} \right|$$

Least Count of Microscope = 0.01 mm.

First slit			Second slit			d
left edge (x_{1l}) (in cm)	right edge (x_{1r}) (in cm)	centre (x_1) (in cm)	left edge (x_{2l}) (in cm)	right edge (x_{2r}) (in cm)	centre (x_2) (in cm)	$d = \lvert x_1 - x_2 \rvert$ (in cm)
0.02	0.22	0.120	0.42	0.53	0.475	0.355

② Measurement of D :- set the slits more than 2 meter away from telescope. Meter tape is used to measure distance.

Least Count of meter Tape = 1 mm.

Taking two observations for D = 210 cm and D = 215 cm

③ Measurement of a :- open the aperture completely and see the slit through telescope, reduce the width until two light sources cease to be resolved.

Least count of micrometer = 0.01 mm
zero error = 0 mm

S.No	slit width (d) (in cm)	Critical width of aperture (a) (in mm)	Corrected width of aperture (a) (with zero error if any) (in mm)	Distance (D) (in cm)	$\frac{D}{d}$
1	0.355	0.291	0.291	210	591.54
2	0.355	0.301	0.301	215	605.63

④ Mean value of λ = 5893 Å = 5893×10^{-8} cm

Comparision b/w[n] Experimental and Theoritical value of α

S.No	width of aperture (a) (in cm)	Theoritical value $\alpha = \left(\frac{a}{\lambda}\right)$	Experimental value $\alpha = \left(\frac{D}{d}\right)$	Difference
1.	0.0291	493.80	591.54	97.74
2.	0.0301	510.77	605.63	94.86

Result :- The Theoretical and Experimental resolving power for different values of aperture are Tabulated in Table 4.

Sources of error and precautions :-

1. The just resolved position of slit must be exactly located.
2. Double slit on glass slide and adjustable rectangular slit should be vertical
3. Double slit and Telescope should exactly at same height.
4. Backlash error in micrometer screw should be avoided.

Comments on result :-

The resolving Power of telescope increases on increasing the width of aperture.
For correctness of results, we should take correct value of width of aperture as much as possible at the just resolved condition. As well as Consider zero error for more Corrected value of width of aperture.
Use the Rampsden eye piece carefully and use its Cross wire to measure value of d.