EXPERIMENT No.10.

AIM: To determine the resolving power of the Telescope.

APPRATUS REQUIRED: A telescope provided with a variable rectangular slit, a card-board with equi-spaced white strips, meter scale etc.

THEORY: The resolving power of telescope is equal to the reciprocal of the angle subtended at the objective lens of the telescope by the two far point objects when their images formed in the focal plane of telescope are just resolved.

In fig 10.1 A and B are the two far objects. The light rays of the wavelength λ from these objects are incident on the objective lens of the telescope subtending an angle θ. After refraction, they form images A' and B' in its focal plane. From the diagrams, it is clear that angular separation between principal maxima A' and B' is θ. But from the theory of diffraction at a circular aperture, the angular spread of principal maxima

$$\alpha = \frac{1.22}{d}\lambda$$

Where d is the diameter of circular aperture and

λ is wavelength of light.

According the Rayleigh criterion, for just resolution the principal maxima of image of one object must be at the minima of images of other object i.e. the angular separation between the two maxima = angular spread of principal maxima or

$$\theta = \frac{1.22}{d}\lambda$$

Hence,

Resolving power of telescope = $\frac{1}{\theta} = \frac{b}{1.22\,\lambda}$

Now if the width of slit mounted on the objective lens is 'a' when it is just resolves the two strips at separation 'b' on the card board, kept at a distance D then, the angle subtended by the strips at the slit = b/ D.

Angular separation between the two principal maxima = λ/a.

Hence, just at the limit of resolution

$$\frac{\lambda}{a} = \frac{b}{D} \quad or \quad \lambda = \frac{ab}{D}$$

For equation 1 and 2, resolving power of telescope is

$$R.P. = \frac{dD}{1.22\ ab} \quad rad^{-1}$$

FORMULA USED:

Theoretical resolving power = $\frac{\lambda}{a}$

Practical resolving power = $\frac{b}{D}$

Where: λ is wavelength of light used.

a is the width of the rectangular slit.

b is the separation between the objects from the objective lens of the telescope.

Hence, $\frac{\lambda}{a} = \frac{b}{D}$

PROCEDURE:

1. Mount the telescope on a stand such that its axis lies horizontal and the rectangular lines marked on the other stand such that they are vertical. Place the two stands at a suitable distance (say 4-5 m).
2. Illuminate the object with source of light.
3. Now open the slit with the help of micrometer screw and focus the telescope on the strips, so that distinct image of strips is seen in the field of view.
4. Now gradually decreases the width of slit by the micrometer screw till the separate visibility of the two strips just disappears. Note the reading of micrometer screw in this position.
5. Again close the slit till there is complete darkness in the field of view. The reading of micrometer screw is again noted. The difference of the two reading gives the width ‘a’ of the rectangular slit.

6. The experiment is repeated for the strips of different separation or different distance ‘D’.

FIGURE:

OBSERVATION:

1. Value of wavelength λ = ...Å.
2. Least count of micrometer screw = (x/n) =.....

3. Table for width of the slit ‘a’

S. No.	Reading of micrometer screw						Width of the slit a = x-y	Theoretical resolving power (λ/a)	Distance D
	When images ceases			When slit is closed					
	M. S. R.	V. S. R.	Total Reading (x)	M. S. R.	V. S. R.	Total Reading (y)			

CALCULATIONS:

RESULTS:

The theoretical and practical resolving power of the telescope is shown in the table below:

S. No.	Distance	Theoretical resolving power (λ/a)	Practical resolving power(b/D)

PRECAUTIONS:

1. Adjustment of the slit and the lines on the steps should be parallel.
2. The distance D should be measured carefully from the objective of the telescope to the equidistant lines on the strips.
3. The axis of telescope must be horizontal.
4. The strip on the card-board should be vertical and the plane of the slit must be parallel to the card-board.
5. Backlash error should be taken care.

6. The width of slit at the prism of just resolution must be adjusted carefully.

VIVA-VOCE

1. What is the Rayleigh Criterion?

   .....

   .....

   .....

2. What is the resolving power of the telescope?

   .....

   .....

   .....

3. Explain the meaning of just resolve.

   .....

   .....

   .....

4. Does telescope have large aperture? Why?

   .....

   .....

   .....

5. What is‘d’ in the calculation?

   .....

   .....

   .....

6. On what factors do the resolving power depends?

   .....

   .....

   .....

7. What is the resolving power of the normal eye?

.....

.....

.....

8. What is the resolving power of the telescope you are using?

.....

.....

.....

9. How is the least count of the telescope calculated?

.....

.....

.....

10. Define limit of resolving power of a telescope.

.....

.....

.....