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B.Sc (Part-II) Hons
Paper – III

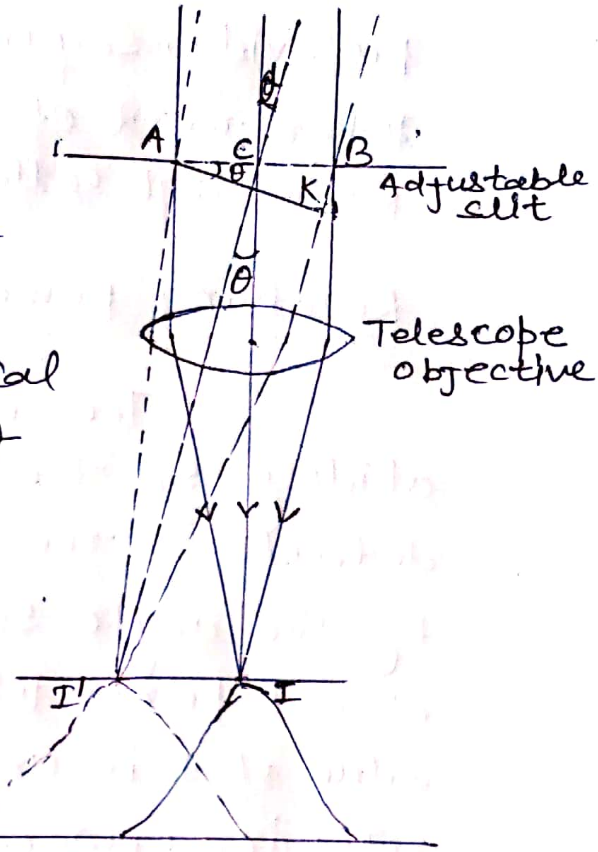
Resolving power of a telescope.

The resolving power represents the ability of the instrument to show the fine details in the object to the eye. It is measured by the angle subtended at the objective by two object points which are just resolved. Smaller the value of this angle, higher is said to be the resolving power.

Its limit of resolution is defined as the angle subtended at the objective by the two point ~~of~~ objects which are just resolved when seen through the telescope.

Derivation of the formula:— Suppose a parallel beam of monochromatic light, starting from a distance object O is falling normally on the adjustable slit AB. According to ~~Hu~~ Huygen's principle, each point in AB is sending secondary wavelets in all direction. Let us consider the wavelets travelling normally to the slit. These wavelets meet at the focus I of the objective in the same phase, because they starts from AB in the same phase and cover equal ~~to~~ distance from AB to I. Here I is the central maximum of the diffraction pattern.

Let us next consider the wavelets diffracted in a direction θ normal to the slit. These are brought to focus at a point I in the focal plane of the objective. Let us draw a line AK normal to the rays. It is seen that the path diffrance between wavelets starting from the extreme points A and B moving in the direction θ is BK.



If BK be equal to λ then the wavelets from A and C shall reach I' with a path diff-rance $\frac{\lambda}{2}$. Further corresponding to each point in AC there will be a point in CB such that the wavelets from them reach I' with a path diffrance of $\frac{\lambda}{2}$. The point I' will therefore be the first minimum of the pattern. Thus for the first minimum, we must have

$$BK = a\sin\theta = \lambda$$

where a is the width of the slit AB. from this, we get

$$\sin\theta = \frac{\lambda}{a}$$

In practice $a >> \lambda$, so $\sin\theta$ is small and we may put $\sin\theta \simeq \theta$

$$\therefore \theta = \frac{\lambda}{a}$$

Since the central maximum is obtained
in the direction $\theta = 0$, λ/a is the angular separ-
ation between the central maximum and the
first minimum. If there is another object
O' situated near O then by Rayleigh's criterion
O and O' will just resolved when the central
maximum of O' falls at I', the first minimum
of O. Hence in the limit of resolution, the
angular separation between the maxima of O
and O' is $\theta = \frac{\lambda}{a} = \alpha$, the angle subtended by the
objects O and O' at the objective, which is
the minimum angle of resolution

$$\therefore R.P = \lambda/a$$

If d be the linear separation between
the objects O and O' and D be their distance
from telescope objective, then

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

$$\therefore \quad \frac{\lambda}{a} = \frac{d}{D}$$

$\frac{\lambda}{a}$ is called the theoritical resolving
power where as $\frac{d}{D}$ is called the practical
resolving power of the telescope.