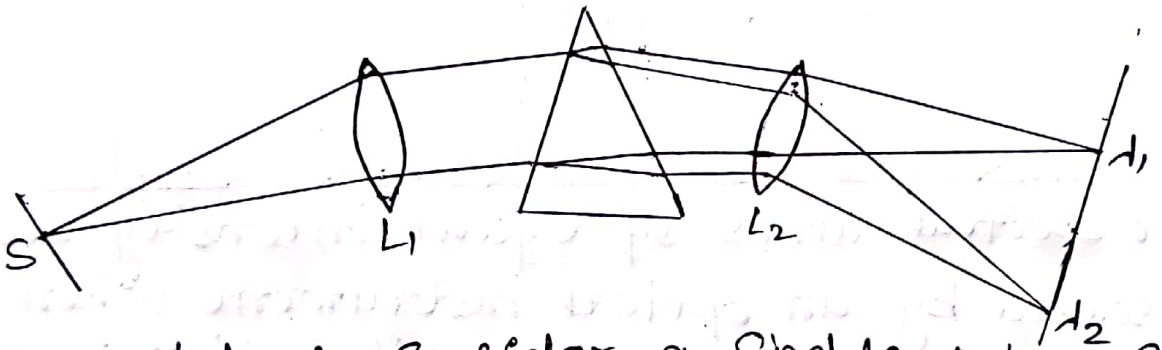
Prof. Vidya Sagar
Department of physics
Raja Singh College, Siwan

B.Sc (Part-II) Hons
paper – III

Resolving power of an optical Instrument and Rayleigh's criterion of Resolution.

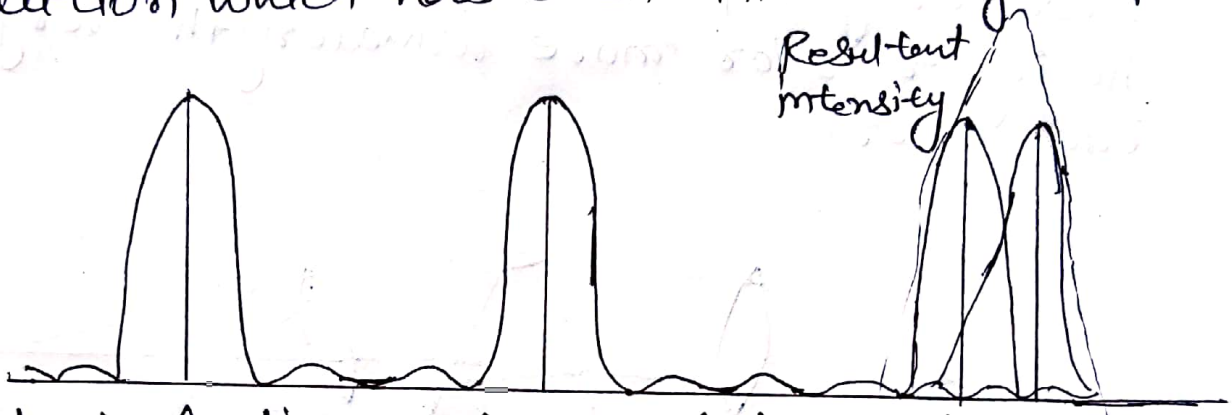
The Resolving power of an optical instrument represents its ability to produce distinctly separate spectral lines of light having two or more wavelengths very close to each other.



Let us consider a simple prism spectroscope If the narrow slit S illuminated by a source which emits two 'close' wavelength λ_1 and λ_2 a spectrum consisting of two lines corresponding to λ_1 and λ_2 is obtained in the focal plane of L_2. In fact, the faces of the prism as diffracting apertures. Therefore the two lines in spactrum are actually two Fraunhoffer patterns close together, having an intensity distribution as shown in figure. The two patterns, in general, overlap each other. If the overlaping is only to a little extent, the principal maxima of the two patterns are distinguishable. The lines

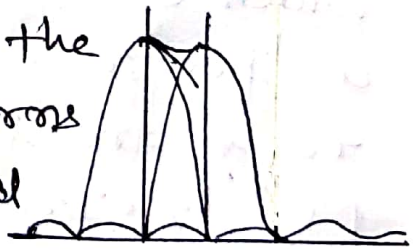
are then said to be resolved. If however, the patterns overlap to such an extent that the resultant intensity shows no drop in the middle then it is impossible to judge whether the pattern corresponding to a single line or two close lines. In this case the lines are not resolved.

Rayleigh's criterion of Resolution:— Lord Rayleigh proposed the following criterion for resolution which has been universally adopted.



Two spectral lines of equal intensity are just resolved by an optical instrument when the principal maximum of the diffraction pattern due to one falls on the first minium of the diffraction pattern of the other.

In this figure are shown the intensity curves of two patterns such that the the principal maximum of one coincides with the first minium of the other. The eye will see the combind effect of the two which is shown by the resultant dotted curve.



This curve shows a distinct dip in the middle, indicating the presence of two different spectral lines. The lines are said to be 'just resolved'.

If an optical instrument 'just resolves' two spectral lines of wavelengths λ and $\lambda + d\lambda$, then $\frac{\lambda}{d\lambda}$ is taken as a measure of the 'resolving power' or 'chromatic resolving power' of the instruments.

Rayleigh criterion provides us a simple method of calculating the resolving power of optical instruments. This is because when two spectral lines are just resolved by the instrument then, by Rayleigh criterion the principal maximum of one coincides with the first minimum of the other. This means that the angular separation between the principal maxima of the two lines is equal to half the angular width of either maximum.