(PO2-2) Single Slit Diffraction

Aim of experiment

Determination of the intensity distribution of diffraction pattern at a single slit

Apparatus

Optical Bench with Monochromatic Light Source (He-Ne Laser, l=633nm) – Plate with Single slit – White screen

Theory of experiment

In addition to interference, waves also exhibit a property – diffraction, which is the bending of waves as they pass by some objects or through an aperture.

The general condition for destructive interference is;

$$\sin\theta_{dark} = m\frac{\lambda}{a} \qquad m = \pm 1, \pm 2, \pm 3, ...$$

Where m is the order of interference, and a is the slit width. This equation gives the values of θ_{dark}, for which the diffraction pattern has zero light intensity—that is, when dark fringe is formed. For small θ , we employ the approximation *sin θ= tan θ ≈ y/ L* which yields

$$\frac{y}{L} \approx m\frac{\lambda}{a}$$

The intensity distribution of the observed diffraction pattern due to a single slit can be calculated according relation:

$$I = \frac{\sin^2 z}{z^2}$$

where

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

Thus, the value of z depends on the angle of the diffraction θ. The value of ($\frac{\sin^2 z}{z^2}$) for different values of θ gives the intensity at the point under consideration. *Figure 1* represents the intensity distribution. It is a graph of ($\frac{\sin^2 z}{z^2}$) (along the y-axis) as a function of z (along the x- axis).

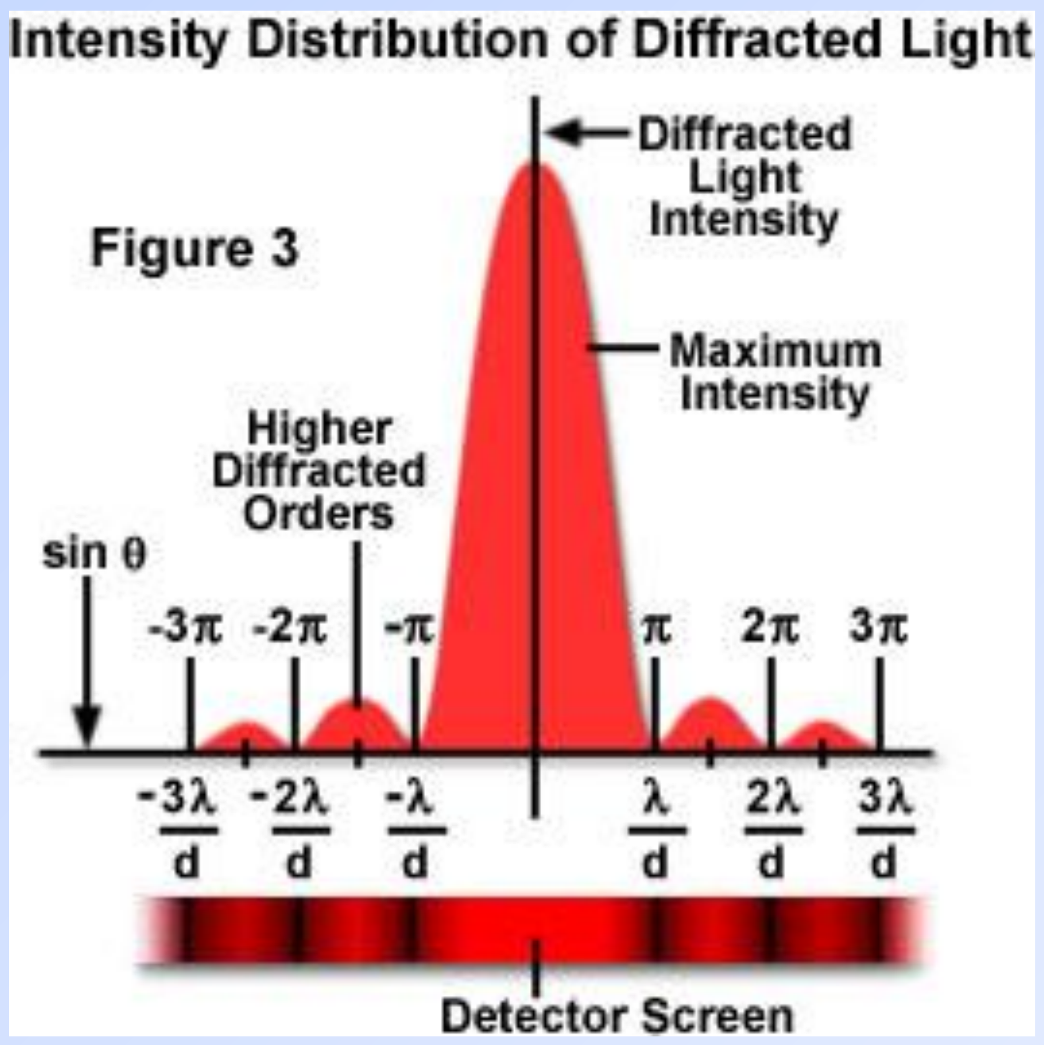

Figure 1 Intensity distribution for a single-slit diffraction

Procedure

1. Turn on the source of laser beam.
2. Put the plate which has the single slit in front of laser source at distance equal about 5 cm.
3. Put the screen behind the slit at distance L=80 cm.
4. Find the width $\beta = 2y_1$ of the central bright fringe, $m=1$.
5. Repeat the above steps by varying the distance between slits and screen in steps of 10cm until 120 cm, and record the fringe width, β, in each case.
6. Repeat steps 4-5 for same distances and tabulate the results
7. Draw a graph between the central bright fringe width β on y- axis and L on x-axis, a straight line is obtained from which the wavelength is given according to the relation λ = *slope* . $a/2$.

Results

a= cm

L (cm)					
β_1 *(cm)*					
β_2*(cm)*					
β_3*(cm)*					
β_{av} *(cm)*					

λ = cm

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