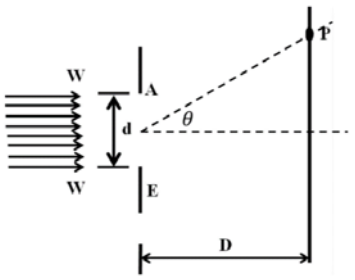
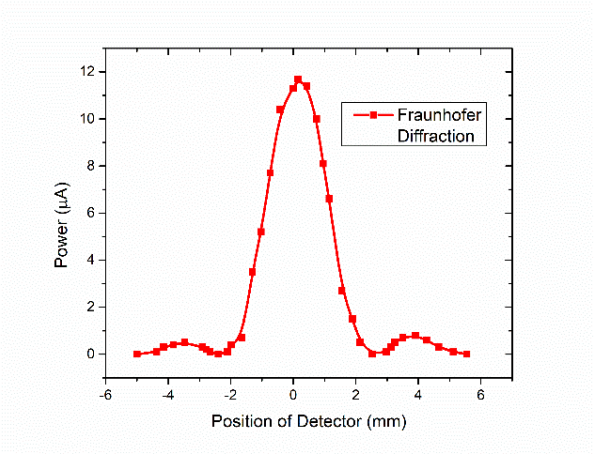
# 9. To determine the wavelength of laser light using single slit diffraction pattern.

| Position of detector (mm) | Power in terms of current (μA) |
|---|---|
| -5.00 | 0.0 |
| -4.37 | 0.1 |
| -4.15 | 0.3 |
| -3.84 | 0.4 |
| -3.48 | 0.5 |
| -2.91 | 0.3 |
| -2.78 | 0.2 |
| -2.66 | 0.1 |
| -2.40 | 0.0 |
| -2.11 | 0.1 |
| -1.99 | 0.4 |
| -1.64 | 0.7 |
| -1.31 | 3.5 |
| -1.03 | 5.2 |
| -0.74 | 7.7 |
| -0.42 | 10.4 |
| 0.00 | 11.3 |
| 0.15 | 11.7 |
| 0.44 | 11.4 |
| 0.74 | 10.0 |
| 0.95 | 8.1 |
| 1.15 | 6.6 |
| 1.55 | 2.7 |
| 1.89 | 1.5 |
| 2.14 | 0.5 |
| 2.53 | 0.0 |
| 2.97 | 0.1 |
| 3.12 | 0.3 |
| 3.25 | 0.5 |
| 3.50 | 0.7 |
| 3.90 | 0.8 |
| 4.26 | 0.6 |
| 4.65 | 0.3 |
| 5.12 | 0.1 |
| 5.55 | 0.0 |




**For Slit width (d):**

| Left Position (mm) | Right Position (mm) | d (mm) |
|---|---|---|
| 8.85 | 8.57 | 0.28 |
| 8.88 | 8.58 | 0.30 |
| 8.85 | 8.56 | 0.29 |

**Observation**

d= 0.29 mm, LC: 0.01mm
D=1090 mm, LC: 1mm
2L= 2.53- (-2.4) = 4.93mm, LC:0.01mm
$\Delta\theta_{\pm1}$= 0.0045

$$\Delta\theta_{\pm1} = \frac{2L}{D} \quad \Rightarrow \quad \Delta\theta_{\pm1} = \theta_1 - \theta_{-1} = \frac{2\lambda}{d}$$

**Calculated Wavelength = 652 nm**

# Error Analysis

The angular separation is defined as:

$$\Delta\theta_{\pm 1} = \frac{2L}{D} \qquad \ldots\ldots (1)$$

Also,

$$\Delta\theta_{\pm 1} = \frac{2\lambda}{d} \qquad \ldots\ldots (2)$$

From (1) & (2)

$$\lambda = \frac{d\ x\ L}{D}$$

Calculation of log error in wavelength (λ) is given by:

$$\log(\lambda) = \log(d) + \log(L) + \log(D)$$

$$\frac{\mathrm{d}\lambda}{\lambda} = \frac{\mathrm{d}d}{d} + \frac{\mathrm{d}L}{L} + \frac{\mathrm{d}D}{D}$$

Here, $\mathrm{d}d = 0.01$, $\mathrm{d}L = 0.01$, $\mathrm{d}D = 1$

$$\frac{d\lambda}{\lambda} = \frac{\mathrm{d}d}{d} + \frac{dL}{L} + \frac{dD}{D}$$

$$\frac{d\lambda}{\lambda} = \frac{0.01}{0.29} + \frac{0.01}{2.46} + \frac{1}{1090}$$

$$\frac{d\lambda}{\lambda} = 0.0389$$

$d\lambda = \lambda \times 0.0389 = 652 \times 0.0389 = 25.36$ nm. (Calculated error in wavelength)

$\lambda = 650 \pm 30$ nm