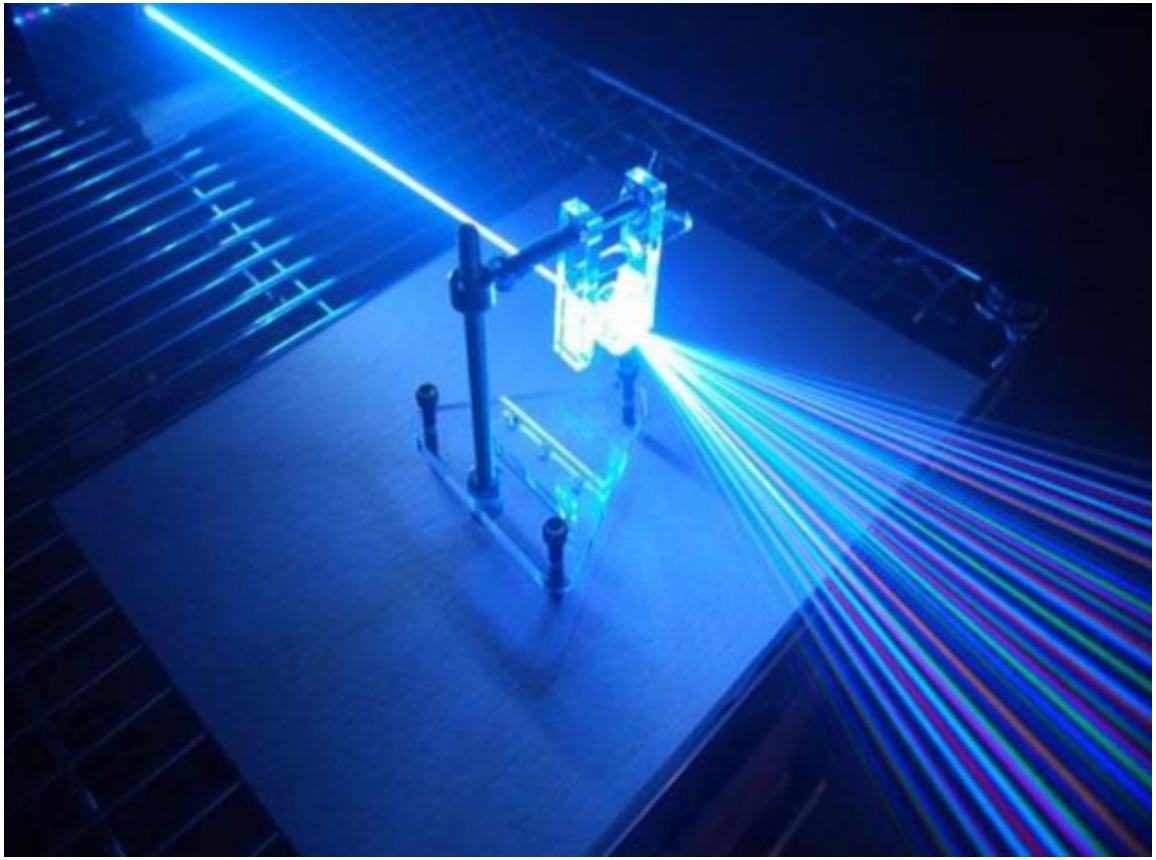
Diffraction Grating Experiment



Aim/Objective

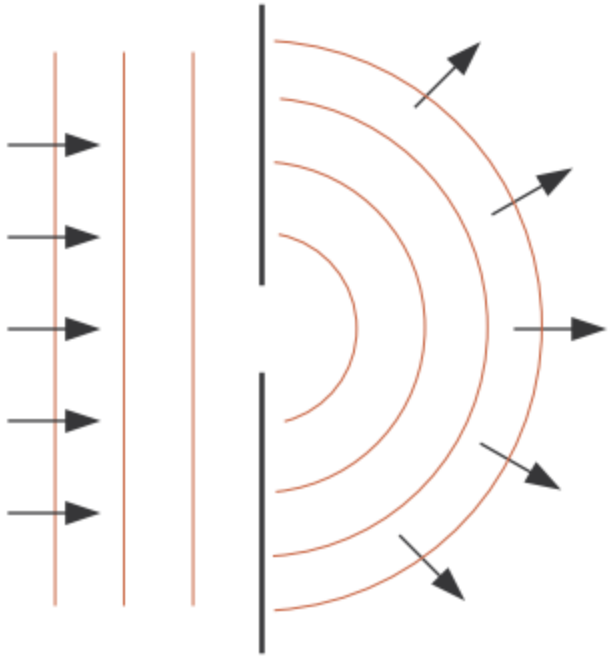
To determine the wavelength of the laser light using diffraction grating.

Apparatus Required

- **Spectrometer,**
- **Diffraction grating,**
- **He-Ne laser (632.8 nm) or Semiconductor laser,**
- **Optical bench and screen**

Theory

When a collimated beam of light passes through an aperture, or if it encounters an obstacle, it spreads out and the resulting pattern contains bright and dark regions. This effect is called **diffraction**, and it is characteristic of wave phenomena.



Diffraction effects are important when the size of the opening is comparable to or less than the wavelength.

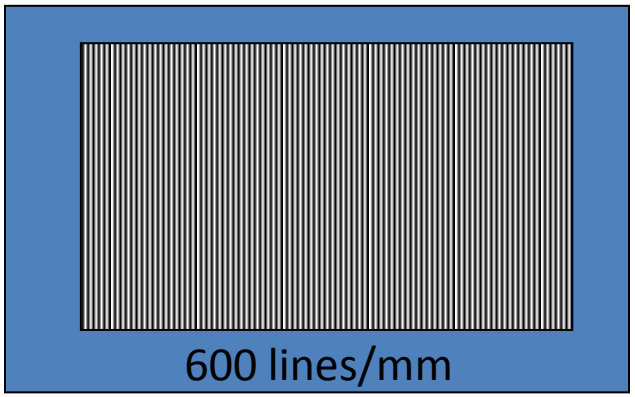
Diffraction Grating

A transmission diffraction grating consists of a very large number of equally spaced parallel lines scratched on a transparent surface.

It can split a beam of light up into different components.

A diffraction grating behaves as if it were a series of slits in an opaque screen.

The distance *d*, between centers of adjacent slits in the grating, known as the grating spacing or grating element.

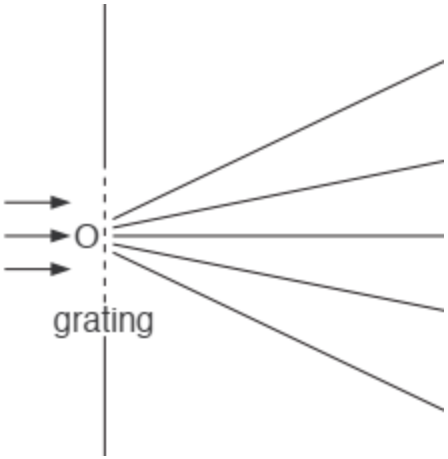


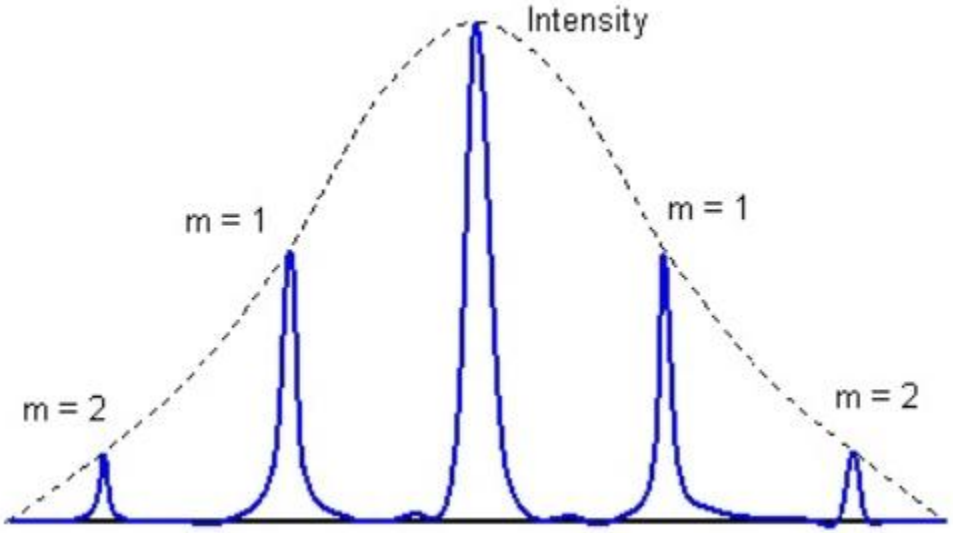
If the diffraction grating used in the experiment have 600 lines per mm. So the spacing ***d*** between lines is simply 1mm/600 = 1670nm.

Diffraction Grating Working

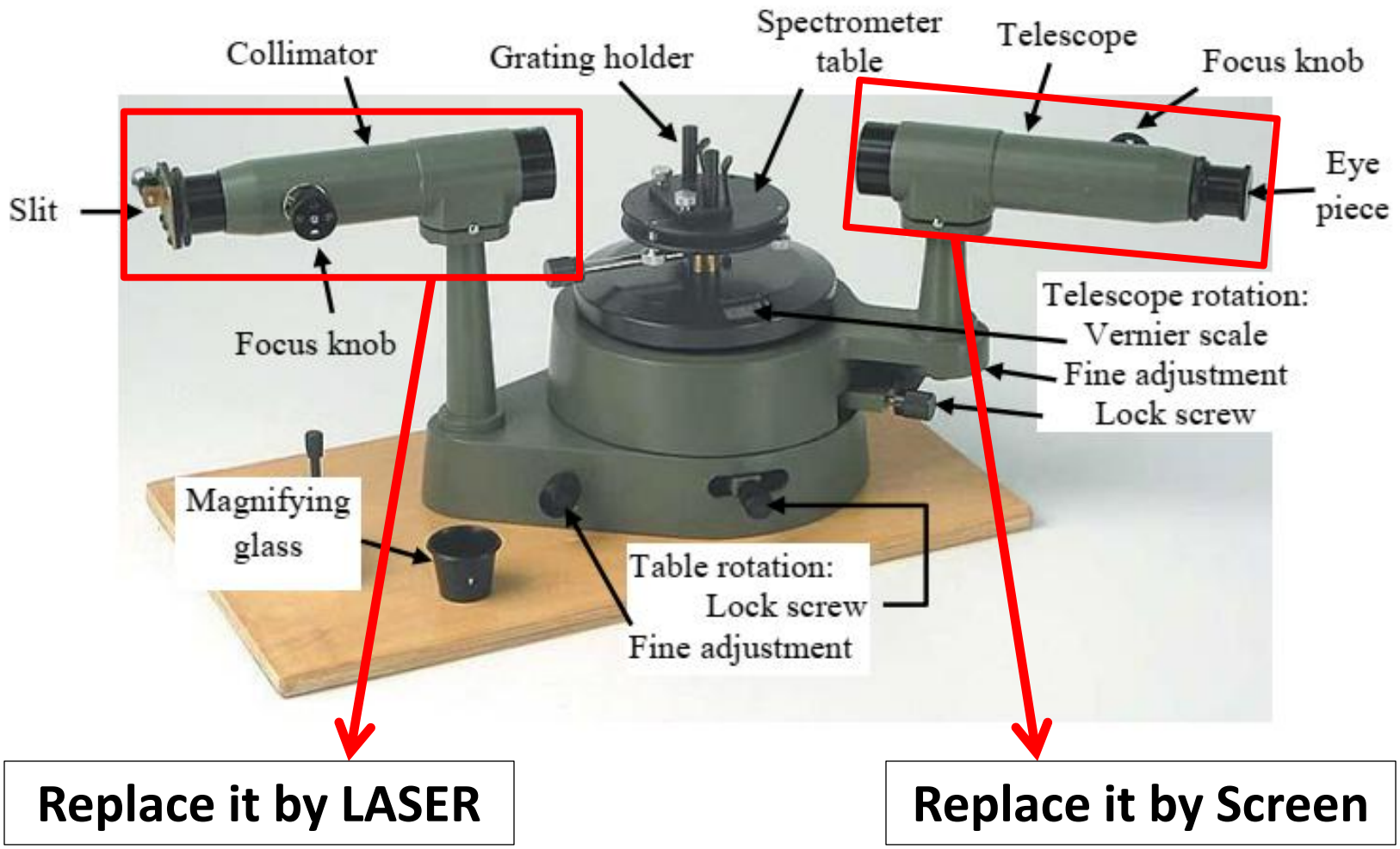
When light from a bright and small source passes through a diffraction grating, it generates a large number of sources at the grating. The very thin space between every two adjacent lines of the grating becomes an independent source that sends out waves in all directions. When all the waves spreading out from all the slits are added up, they cancel out everywhere except in certain directions along which all the crests of all the waves exactly coincide and add up constructively. These particular directions (θ_m) for maxima are determined by the wavelength of the light, λ, and the grating spacing d as

$$d \sin(\theta_m) = m\lambda \qquad (m = 0,1,2.....)$$

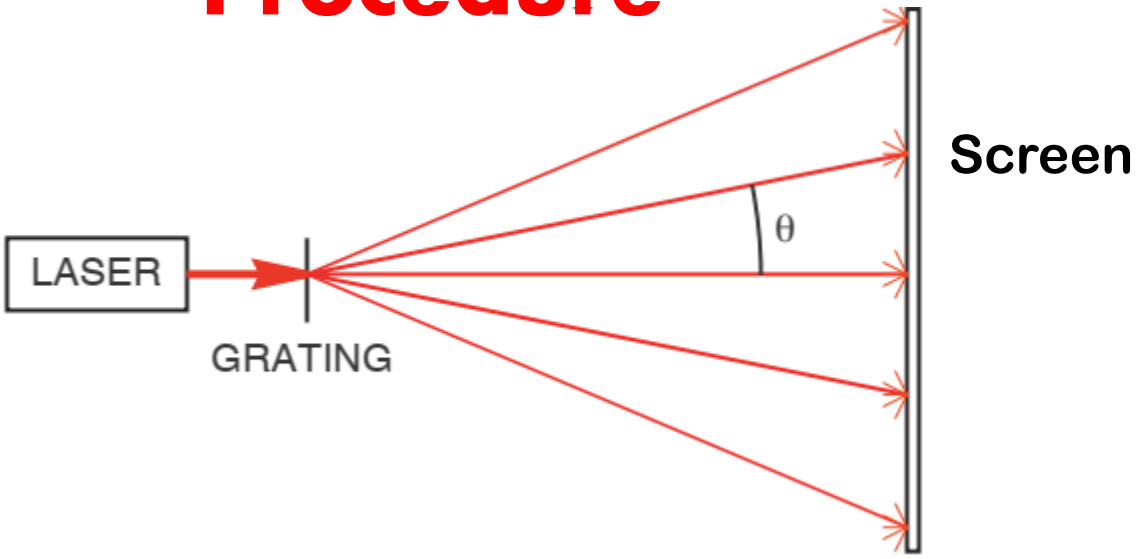




Description of Apparatus



Procedure



1. Set up the laser, diffraction grating, and screen as shown above.
2. Take special care to ensure that the incident laser beam is perpendicular to the screen and the grating.
3. Make adjustments until you are able to view 1st and 2nd order spots (maxima) on the screen.

4. Measure and record the location of the first order spots on either side of the central spot on screen and corresponding θ.
5. Repeat the measurements and calculations for the second order spots and calculate the wavelength λ.

m	θ_{Right}	θ_{Left}	$\theta_{Average}$	λ
1.				
2.				

Results

The calculated wavelength of LASER light is ……..

Standard Value of He-Ne LASER is 632.8 nm

$$\text{Percentage error} = \frac{[\text{Calculated Value} - \text{Standard Value}] \times 100}{\text{Standard Value}}$$

Precautions

(i) LASER and Grating must be aligned and optically levelled.
(ii) While handle the grating one should not touch its faces but hold it between the thumb and the fingers by edges only.
(iii) While taking the observations, the grating table must be clamped.

Thank You