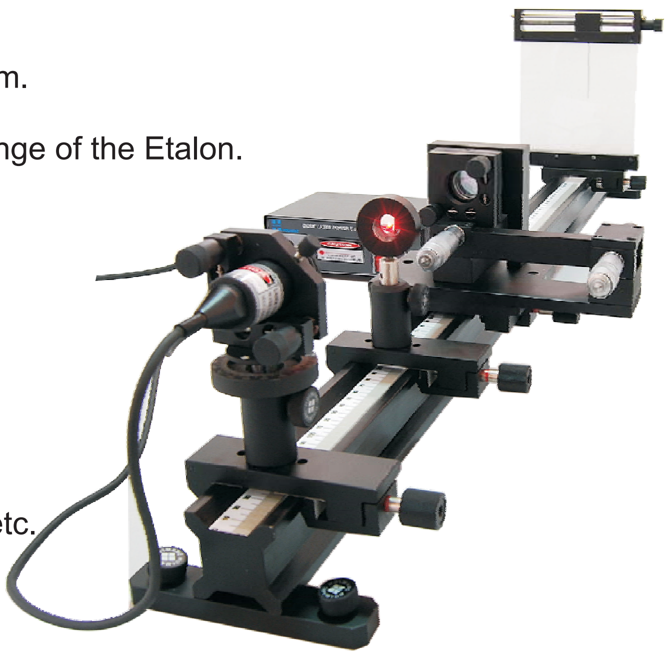
FABRY-PEROT INTERFEROMETER

Model No: HO-ED-INT-10

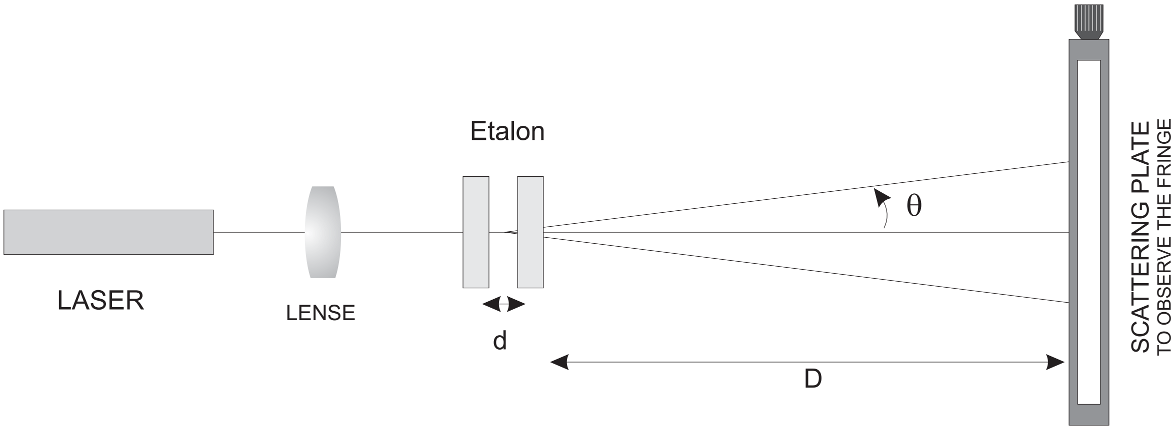
AIM: -

1. Determination of wavelength of laser beam.
2. To find the spacing of the Etalon.
3. To find the Finesse and Free Spectral Range of the Etalon.



Components and Equipments: -

- Bread board / Optical Rail
- Diode Laser with power supply
- Laser mount
- Divergence Lens with mount
- Fabry-Perot Etalon
- Translucent screen with scale & needle, etc.



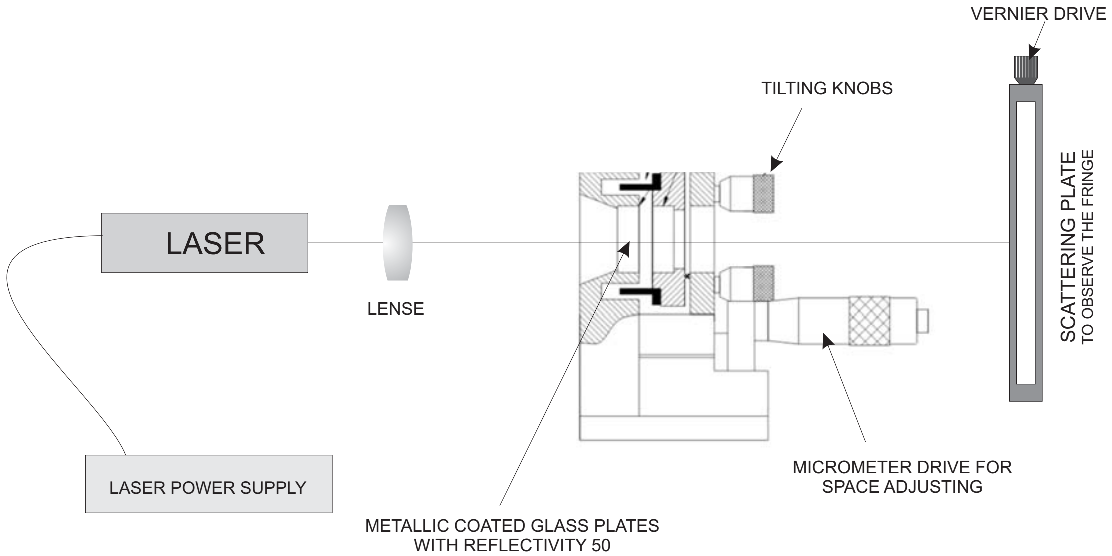
Theory: -

Fabry-Perot design contains plane surfaces that are all partially reflecting so that multiple rays of light responsible for creation of the observed interference patterns. For high resolution spectroscopy where a resolution of MHz to GHz is required, a Fabry-Perot interferometer (FP) is used. The FP consists of two plane mirrors mounted accurately parallel to one another, with an optical spacing **d** between them.

Calibrating the micrometer

For even more accurate measurements of the mirror movement, you can use a laser to calibrate the micrometer. To do this, set up the interferometer. Turn the micrometer knob as you count off at least 20 fringes. Carefully note the change in the micrometer reading and record this value as d'. The actual mirror movement d = N λ /2 , where λ is the known wave length of the laser and N is the number of fringes that were counted. Δ = d/d' is the calibration constant for the micrometer.

Procedure



First we place the laser, etalon and the screen in a single line. Then align the laser beam so that it passes through the etalon and get the clear spot on the screen. Then adjust the etalon to get a single spot on the screen. After these settings we insert the beam expander in between the laser and etalon. Then we get a clear interference pattern on the screen.

Wave Length of Laser Beam

The wavelength of laser is calculated by:

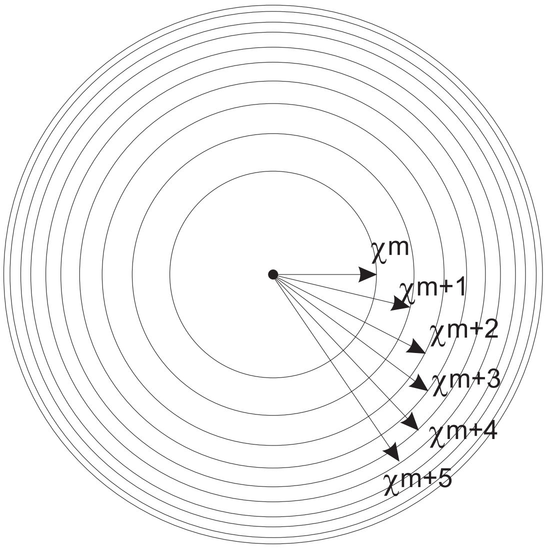
$$\lambda = (2d / N)\, \Delta,$$

Where **d** is the change in position that occurs 'N' fringes to pass and Δ is the calibration constant of the micrometer.

To find the spacing of the Etalon

For finding the thickness of the etalon we measure the radius of the circular fringes. The radius of the first circular fringe is taken as χ_m and the following as χ_m, χ_{m+1}, χ_{m+2}, χ_{m+3} etc. Note the distance between the etalon and the screen as D. Repeat the experiment by changing the distance D.

Center of fringe bands



Line drawing of Fabrey Perot fringe pattern

χ_m =

χ_{m+1} =

χ_{m+2} =

χ_{m+3} =

χ_{m+4} =

χ_{m+5} =

No.	$\chi_n^2 = \chi_{m+n}^2 - \chi_m^2$ (m^2)	D (m)	$d = nD^2\lambda/\chi_n^2$ (mm)

Mean 'd' =

To find the Free Spectral Range of the Etalon and Finesse

The Free Spectral Range of the Etalon is given by ,

FSR = c/2d, where,

c = speed of light in air

d = spacing of the Etalon

Finesse: -

The finesse is a measure of the interferometer's ability to resolve closely spaced spectral lines. The finesse **F** is defined by the following equation.

$$F = \frac{\pi \sqrt{R}}{1 - R}$$

Where, R = the reflectivity of the surfaces.

In fact, the resolving power RP is given by the equation:

RP = NF,

Where, N = the order of the interference,

F = the finesse.

Result:-

Wave length of light used λ = ...

Spacing of the Etalon d = ...

Finesse F = ...

Free Spectral Range of the Etalon FSR = ...