(VIRTUAL LAB)

EXPERIMENT-1

Aim:

To verify the Brewster's law and to find the Brewster's angle.

Introduction:

An ordinary light source consists of a very large number of randomly oriented atomic emitters. They radiate polarized wavetrains for roughly 10^{-8} s. These wavetrains combine to form a single resultant polarized wave which persists for a short time, not more than 10^{-8} s. Since natural light composes of a large number of rapidly varying succession of the different polarization states it is said to be an unpolarised or randomly polarized light.

The natural light can be expressed in terms of two arbitrary, incoherent, orthogonal, linearly polarized waves of equal amplitude. Figure (a) shows randomly polarized natural light and figure (b) shows the splitting at 50% horizontal and 50% vertical states.

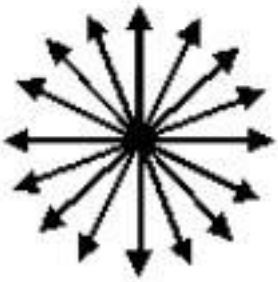


Figure (a)

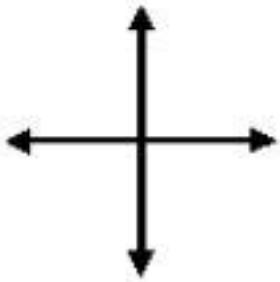
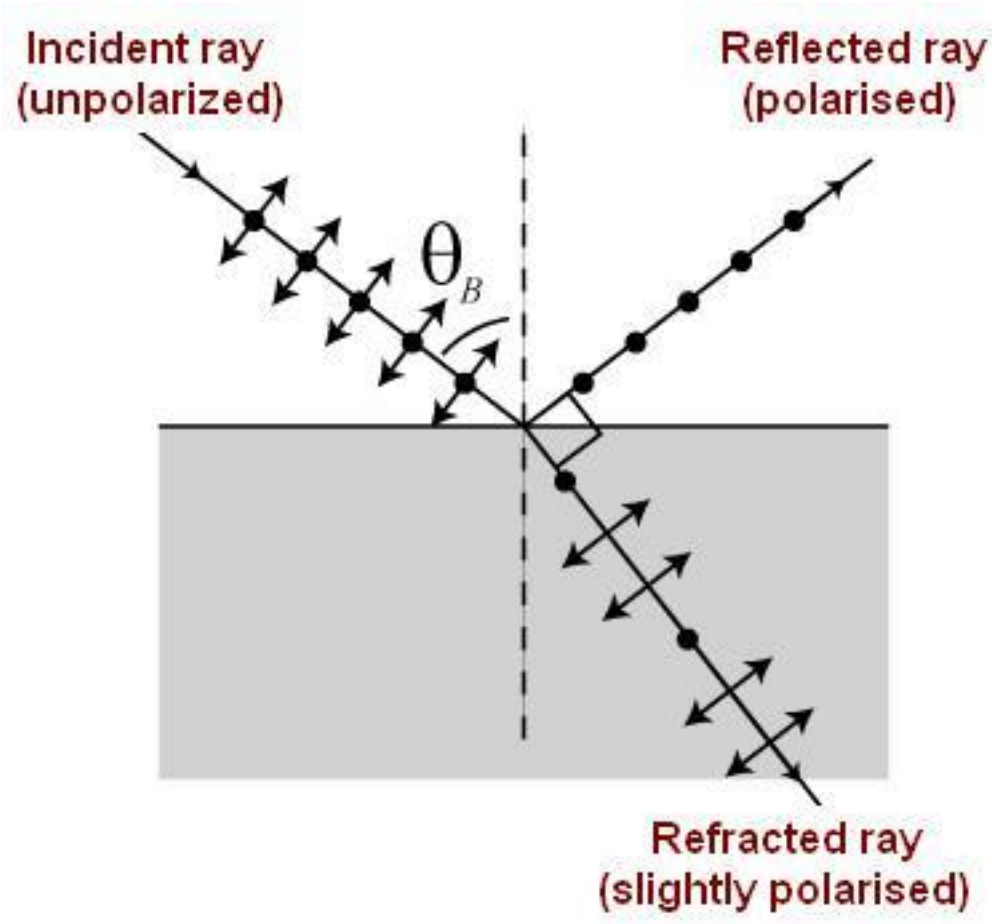


Figure (b)

A light is said to be a plane polarised light, if all the vibrations are confined to a single plane. Consider an unpolarised light incidents on a transparent surface. If the angle of incidence is equal to a particular angle of incidence, the reflected light produced will be completely plane polarized. This particular angle is called the Brewster's angle or the polarizing angle θ_B.

Sir David Brewster, in 1892, found that the maximum polarization of the reflected ray occurs when the reflected ray is perpendicular to the refracted ray. This is called the Brewster's law.

$$r = 90° - \theta_B$$



Brewster's equation:

$$\tan \theta_B = \frac{\mu_2}{\mu_1}$$

Where, μ_2 is the refractive index of the reflecting surface and μ_1 is the refractive index of the surrounding medium. The refracted ray so produced will be partially polarized. As the refractive index changes the polarizing angle differs but it is independent of the wavelength of light used.

Procedure:
Performing the Simulation:

Drag the components from the right panel and place them correctly in the optic bench.

Start : This button enables the user to start the experiment.

Side view/Top view : Using this, different views of the experimental arrangement can be seen.

Choose light : Using this combo box, one can select different lasers.

Choose medium : The medium of different refractive index can be selected using this combo box.

Choose material : Different materials can be selected using this combo box.

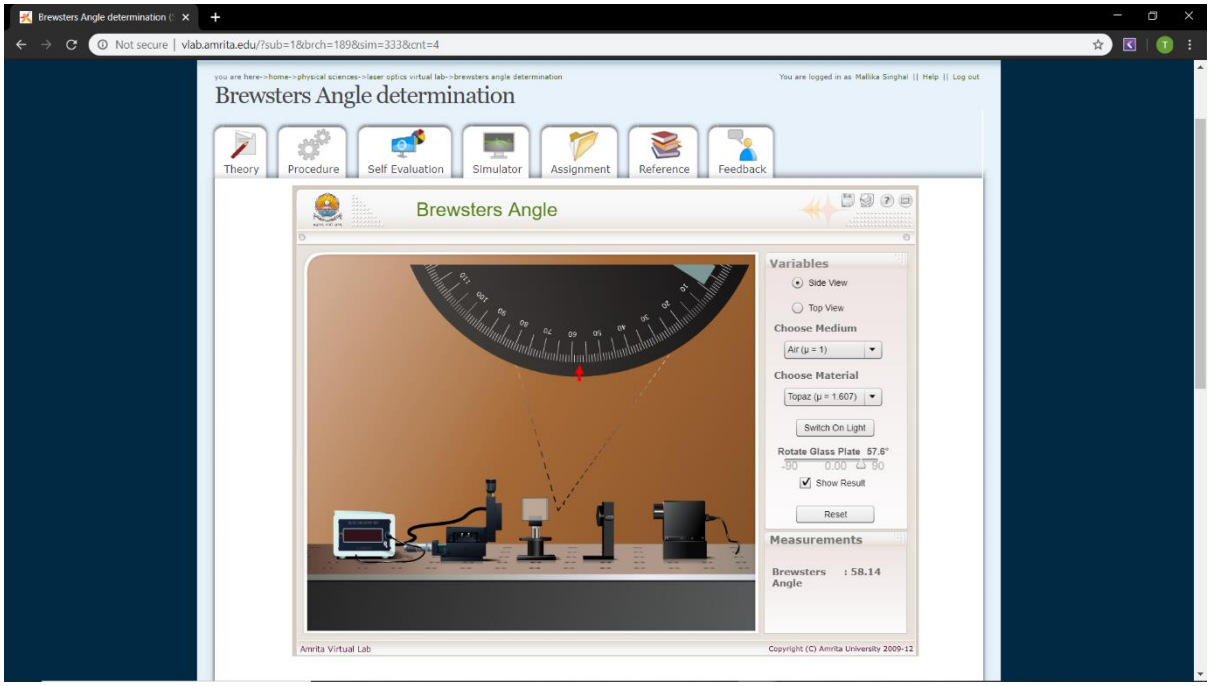
Switch on light : The user can make the laser source ON/OFF using this button.

Angle of the polariser : Using this slider, one can change the angle of the polariser from zero to 360 degrees.

Angle of incidence : This slider helps one to change the angle of incidence, which can be varied from zero to 360 degrees.

Reset : The experimental arrangement can be reset using this button.

Observation:



Brewsters Angle = 58.14 degrees

Calculations:

$\theta_2 = 58.14°$ $\quad \mu_2 = 1.607$ (Topaz)

By snell's law, $\quad \mu_1 = 1$ (Air)

$$\frac{\sin\theta_2}{\sin\theta_1} = \frac{n_1}{n_2}$$

$$\longrightarrow \quad \frac{\sin(58.14°)}{\sin\theta_1} = \frac{1.607}{1}$$

$$0.8493 \times (1.607)^{-1} = \sin\theta_1$$

$\theta_1 = 31.862$ degrees

$\theta_1 \approx 31.86$.

$\theta_1 \longrightarrow$ refracted angle

$\theta_2 \longrightarrow$ incident angle

Acc. to brewster's law,

$$\theta_1 = 90 - \theta_2$$
$$= (90 - 58.14) \text{ degrees}$$
$$= 31.86 \text{ degrees}$$

Hence, verified.

Results : Hence verified.