

STUDY OF POLARISATION AND MALUS'S LAW

AIM: To study Polarization of light and verification of Malus's law.

APPARATUS: Laser (diode/He-Ne), Optical profile bench, analyzer (polarising filter) photo detector, and digital multimeter attached to an amplifier, mounts for all above components.

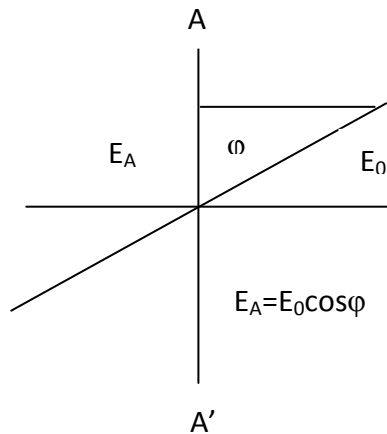
THEORY:

Let AA' be the Polarization planes of the analyzer in the figure given below. If the linearly polarized light, the vibrating plane of which forms an angle ϕ with the polarization plane impinges on the analyzer, only the part

$E_A = E_0 \cos \phi$ -- (1) will be transmitted.

As the intensity 'I' of the light wave is proportional to the square of electric field intensity vector E, the following relation on (Malus' law) is obtained.

$$I_A = I_0 \cdot \cos^2 \phi \quad \text{-- (2)}$$



PROCEDURE:

1. Laser should be warmed up for about 15-30 minutes to prevent intensity of fluctuations.
2. Make sure that the photo detector/photocell is totally illuminated when the polarization filter is set up.
3. The background voltage V_0 must be determined with the laser switched off and this must be subtracted from actual readings.
4. The polarization filter is then rotated in steps of 5° between the filter positions $\pm 90^\circ$ and note down corresponding photo cell voltage V.
5. Plot $(V - V_0) V_s \phi$ and determine the angle of polarization of the given laser(θ).
6. Plot $\cos^2 (\phi - \theta) V_s (V - V_0) / (V_{\max} - V_0)$ and fit the straight line to find slope and verify Malus's law.

TABULATION:

$V_0 = \text{_____} V$

Table 1

| Sl. No. | Angular Position of analyzer in degrees | Photo cell voltage(V) in volts | $V - V_0$ in volts |
|---------|---|--------------------------------|--------------------|
| 1 | | | |
| 2 | | | |
| .. | | | |
| .. | | | |

Angle of polarization of the laser $\theta = \text{_____}$

Table 2

| Sl. No. | $\cos^2(\phi - \theta)$ | $(V - V_0)/(V_{\max} - V_0)$ |
|---------|-------------------------|------------------------------|
| 1 | | |
| 2 | | |
| .. | | |
| .. | | |

PRECAUTIONS:

1. Never look directly into the laser beam.
2. Photocell readings should be taken carefully.
3. Do not change the direction of the laser as it may affect other experiments in the room.
You are allowed only slight adjustment of the direction.