

Experiment 4 Polarization

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1. Theory (See Online Links)

2. 實驗儀器 (Laboratory instruments)

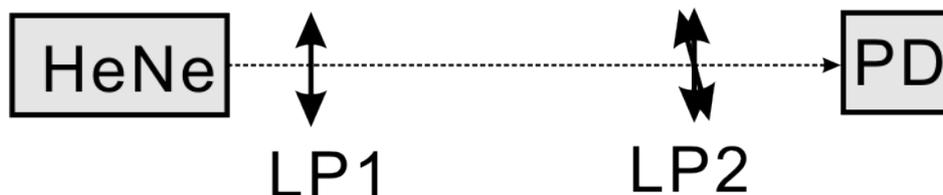
Chinese	English Name	Label
氦氖雷射(含雷射架)	Helium-neon laser (with laser frame)	HeNe
45 deg 反射鏡組	mirror group,	
光學桌(含空壓機)	optical tables (including air compressor)	
可調式光圈	adjustable aperture,	
支撐棒	support rods,	
支撐座	support base,	
屏幕	screen,	
壓板組	the platen group,	
底片架	film carrier	
光度計(含偵測器)	photometer (with detector)	PD
光孔罩	aperture mask,	
偏振片(含架)	Linear Polarizer (including mount),	LP
相位延遲片(波片)(含架)	phase retardation plates (including mount) Quarter Wave Plate Half Wave Plate	WP QWP HWP

3. 實驗目的 (Purpose)

- To understand the polarization of light types and their characteristics,
- To learn to control the polarization state of light

4. 實驗步驟 (Procedure)

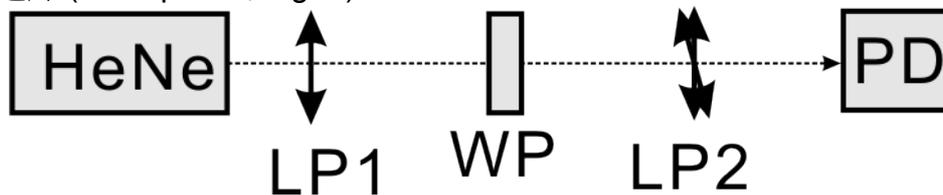
4.1 Malus's Law (Fig. 1)



- Collimate laser light to photometer.
- Insert LP1. Rotate to maximize detected light.

- c. Insert LP2 after LP1. Rotate LP2 to maximize detected light. (Polarizers are aligned).
- d. Rotate LP2 a total of 360 degrees. Record transmitted intensity every $\Delta\phi=10$ degrees. Plot using polar coordinates.

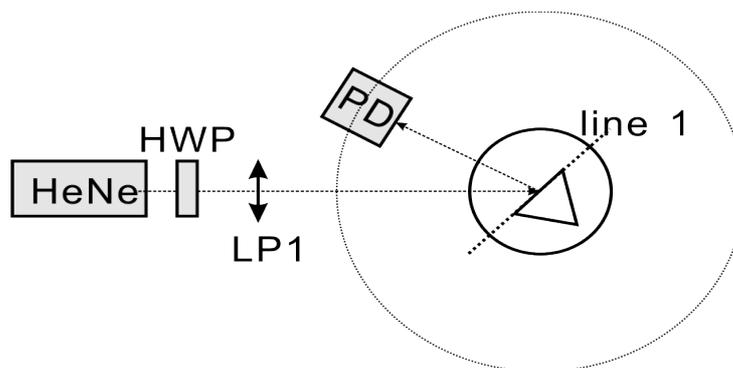
4.2 相位延遲片 (Waveplates, Fig. 2)



- a. Collimate laser light to photometer.
- b. Insert LP1. Rotate to maximize detected light.
- c. Insert LP2 after LP1. Rotate LP2 to minimize detected light. (Polarizers are crossed).
- d. Insert HWP between LP1 and LP2. Rotate HWP to minimize detected light. (Either the fast or slow axis of the HWP is parallel to the laser polarization)
- e. Rotate HWP ($\theta=30,45,60$ deg). At each angle, rotate LP2, taking data at $\Delta\phi =10$ degree intervals. Plot the results.
- f. Repeat steps a,b,c,d and e using a QWP (After step d, either the fast or slow axis of the HWP is parallel to the laser polarization)

4.3 偏振光的反射率的關係、及量測布魯斯特角 (Reflectance & Polarization, Measure Brewster Angle, Fig. 3)

- a. Place prism placed on the rotating platform so that the prism surface (Fig. 3 line1) is aligned with the center of the rotating platform.



- b. Rotate platform until reflected and incident light coincide. Record this angle.
- c. From experiments in section 4.2, we understand effect of the waveplates on polarization. Adjust the polarization to the horizontal direction and record the power at the detector (I_{incident})
- d. Rotate the stage and record laser power as a function of angle $I_{\parallel}(\phi)$ (At Brewster angle there should be no reflected light) Calculate reflectivity as a function of angle. $R_{\parallel}(\phi) = I_{\parallel}(\phi)/ I_{\text{incident}}$