

## Experiment 2 Slit Interference 狹縫干涉與繞射

Translation: J D White (Bench 5)

### 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 table (including air compressor)	
可調式光圈	adjustable aperture,	
支撐棒	support rods,	
支撐座	support base,	
屏幕	screen,	
光度計(含偵測器)	photometer (with detector)	PD
	0.04mm slit	
	0.08mm slit	
	double slit	

### 3. 實驗目的 (Purpose)

3.1 From the observation of Young's Double Slit Interference pattern, calculate the wavelength of light.

3.2 From the observation of Single Slit Self Interference, calculate the width of the slit.

3.3 Using the photometer (PD), measure and graph the intensity change of the single slit self-interference (diffraction) pattern.

### 4. Key Theory

#### 4.1 Young's Double Slit

$$\frac{I}{I_0} = 4 \cos^2 \left( \frac{yd \pi}{L \lambda} \right)$$

where  $y$  is the distance from the center of the pattern,  $L$  is the distance from the slit to the detection location,  $d$  is the separation between adjacent slits

#### 4.2 Width of a single Slit

$$b = m \lambda L / y$$

where  $b$  is the slit width,  $L$  is the distance from the slit to the detection location,  $y$  is the distance from the center of the pattern to the fringe

#### 4.3 Intensity of Interference Pattern

### 5. 實驗步驟 (Procedure)

#### 5.1 Young's Double Slit

1. Collimate laser light to photometer along the optical rail.
2. Place double slit into the beam along with a white card to view the white and dark interference fringes.
3. Measure the distances between the center to the dark fringes. (note that the distances on each side of the center fringe are equal)
4. Read the distance between the white card and double slit

5. Calculate the laser wavelength by equation

6. Repeat using the bright patterns.

### 5.2 Width of a single slit

1. Replace the double slit with a single slit

2. Record the y values of the distances to the dark fringes

3. Use equation above to calculate the width of the slit (b)

4. Compare with the known slit width.

### 5.3 Intensity of the self-interference (diffraction) pattern of the single slit.

1. Collimate laser light to photometer along the optical rail.

2. Place the slits in the laser light

3. Place the PD on the x-translation stage after the slit to record power

4. turn micrometer to move the detector across the pattern recording intensities

5. Sequentially observe the patterns from the 0.04mm slit, 0.08mm slit and then double slit.

6. Keep the distance between the slit and PD detector constant for all measurements.

## 6. 實驗記錄 (Results)

### 6.1 Young's Double Slit

Theoretical  $\lambda=6.328\text{nm}$

1. Table 1: Dark fringes

d [mm] =	L [mm] =
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Step	y (mm)	m	λ [nm]	d <sub>i</sub>
1		1		
2		2		
3		3		
4		4		
5		5		

$\langle \lambda \rangle =$	$\langle \sigma(\lambda) \rangle =$	$\lambda = \langle \lambda \rangle \pm \langle \sigma(\lambda) \rangle =$	e=
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2. Table 2: Bright Fringes

d [mm] =	L [mm] =
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Step	y length [mm]	m	λ [nm]	d <sub>i</sub>
1		1		
2		2		
3		3		
4		4		
5		5		

$\langle \lambda \rangle =$	$\langle \sigma(\lambda) \rangle =$	$\lambda = \langle \lambda \rangle \pm \langle \sigma(\lambda) \rangle =$	e=
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## 6.2 Width of a single slit

b (known) [mm]=	L(mm)=	$\lambda$ (nm)=
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Step	m	y (mm)	b (nm)	$d_i$
1	1			
2	2			
3	3			
4	4			

$\langle b \rangle =$	$\langle \sigma(\lambda) \rangle =$	$b = \langle b \rangle \pm \langle \sigma(\lambda) \rangle =$	$e =$
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## 6.3 Intensity of the self-interference (diffraction) pattern of the single slit.

1. Slit Width=0.04mm (Take data every 1 mm)															
Location															
Strength															
Location															
Strength															
2. Slit Width=0.08mm (Take data every 1 mm)															
Location															
Strength															
Location															
Strength															
3. Slit Width=0.08mm slit space-0.25mm (Take data every 1 mm)															
Location															
Strength															
Location															
Strength															

## 7. After Class questions

### 7.1 [Incomplete](#)