PhysicsLab-057	Light – Interference and Polarization

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1. Young's Double-Slit Experiment (Interference)

Condition of constructive interference (Bright lines)

i) $|l_1 - l_2| = m\lambda \quad (m = 0, 1, 2, 3 \cdots\cdots)$

ii) $|l_1 - l_2| \fallingdotseq d\sin\theta$

iii) $\rightarrow \quad d\sin\theta = m\lambda \quad (m = 0, 1, 2, 3 \cdots\cdots)$

iv) $d\sin\theta \fallingdotseq d\tan\theta \fallingdotseq d\frac{x_m}{L}$

v) $\rightarrow \quad x_m = m\frac{L\lambda}{d} \quad (m = 1, 2, 3 \cdots\cdots)$

vi) $\rightarrow \quad \Delta x = x_{m+1} - x_m = \frac{L\lambda}{d}$

- Wavelength λ = 632.8 nm
- Slit Separation d = 0.40 hm
- (Slit width w = 0.10 hm)
- Distance between slit and screen L = 0.6m

Theoretical value of Δx : 0.009492

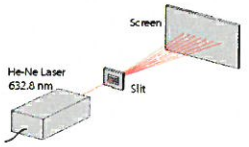
Measurement of X_m

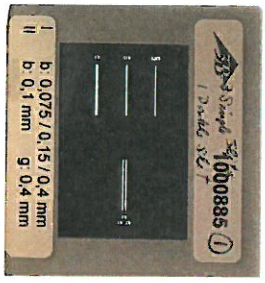
- Order m = ~~3~~ 5
- Distance Xm = ~~0.027 m~~ 0.03

$\Delta x = X_m / 2m$

Observed value of Δx : ~~0.0045~~ 0.003

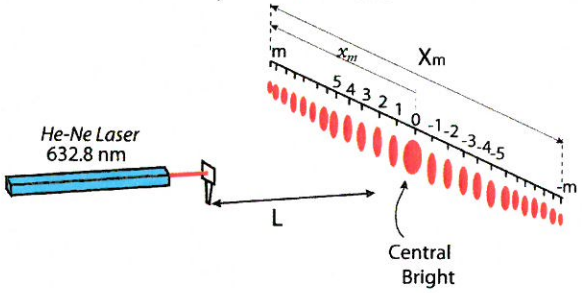
A) Set up



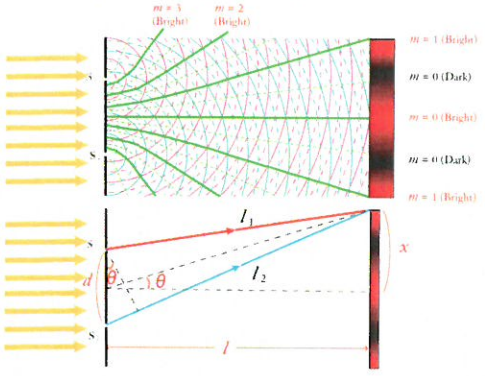


B) Fringes on Screen

C) Measurement



D) Mechanism of interference



2. Single-Slit Diffraction

Condition of destructive interference (Dark lines)

i) $|l_1 - l_2| = (2m+1)\,\lambda/2 \quad (m = 0, 1, 2, 3 \cdots\cdots)$

ii) $|l_1 - l_2| \fallingdotseq \frac{W}{2} \sin\theta$

iii) $\rightarrow W \sin\theta = m\lambda \quad (m = 1, 2, 3 \cdots\cdots)$

iv) $W \sin\theta \fallingdotseq W \tan\theta \fallingdotseq W \frac{x_m}{L}$

v) $\rightarrow x_m = m \frac{L\lambda}{W} \quad (m = 1, 2, 3 \cdots\cdots)$

vi) $\rightarrow \Delta x = x_{m+1} - x_m = \frac{L\lambda}{W}$

- Wavelength λ = 632.8 nm
- Slit width W = 0.075 mm
- Distance between slit and screen L = 0.6

Theoretical value of Δx : 0.005062 m

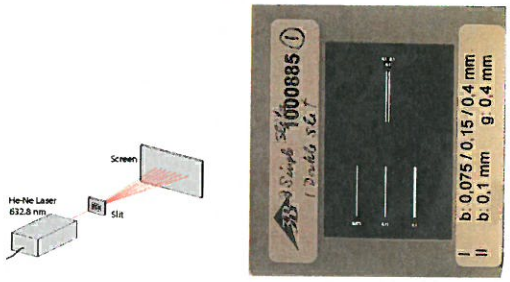
Measurement of X_m

- Order m = 5
- Distance Xm = 0.038

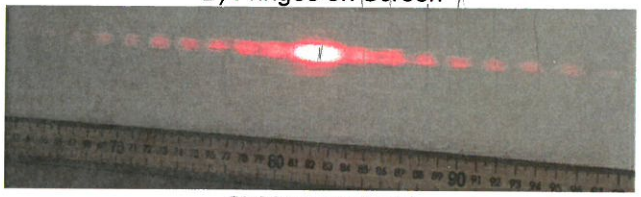
$\Delta x = X_m / 2m$

Observed value of Δx : 0.0038

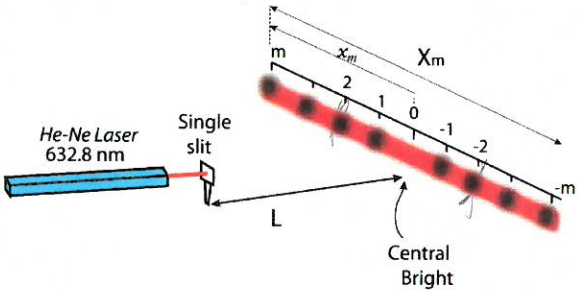
A) Set up



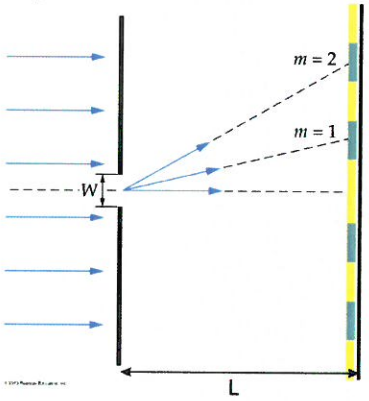
B) Fringes on Screen



C) Measurement



D) Mechanism of interference



3. Diffraction Grating

Condition of constructive interference (Bright lines)

i) $|l_1 - l_2| = m\lambda \quad (m = 0, 1, 2, 3 \cdots\cdots)$

ii) $|l_1 - l_2| \fallingdotseq d\sin\theta$

iii) $\rightarrow \quad d\sin\theta = m\lambda \quad (m = 0, 1, 2, 3 \cdots\cdots)$

iv) $d\sin\theta \fallingdotseq d\tan\theta \fallingdotseq d\frac{x_m}{L}$

v) $\rightarrow \quad x_m = m\frac{L\lambda}{d} \quad (m = 1, 2, 3 \cdots\cdots)$

vi) $\rightarrow \quad \Delta x = x_{m+1} - x_m = \frac{L\lambda}{d}$

- Wavelength λ = 632.8 nm
- Grating lines/mm N = 100
- Slit Separation $d = \frac{1\times10^{-3}}{N}$ 0.01 (m)
- Distance between slit and screen L = 0.6m

Theoretical value of Δx : 0.037968

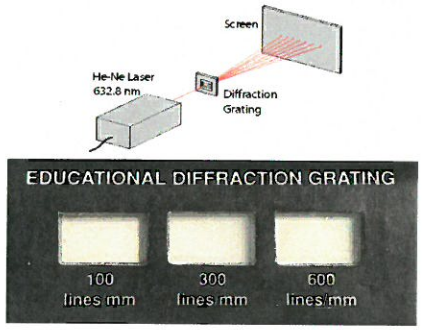
Measurement of X_m

- Order m = 5
- Distance Xm = 0.42m

$\Delta x = X_m / 2m$ 0.042

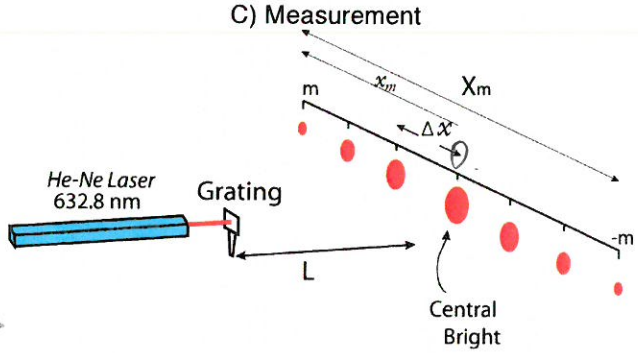
Observed value of Δx : 0.042 / 0.04

A) Set up

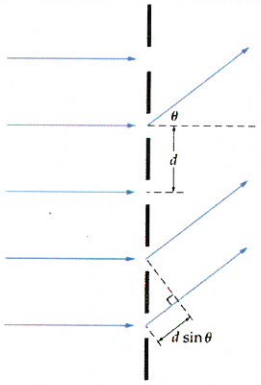


B) Fringes on Screen

C) Measurement

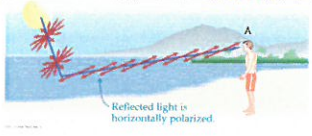
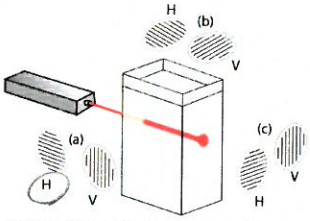
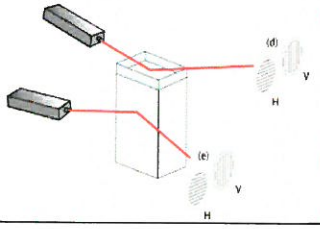


D) Mechamism of interference



PhysicsLab-057	Light – Interference and Polarization

Polarization

			Results
1	Reflected light on the windows		みえる ↔ みえない (−) (|)
2	Reflected light on the water surface		底がみえる（光の反射がさえぎられるから）
3	Reflected light outside, such as road suface and water surface		太陽光はよこ向きである。 ポラライザー（たて）で見た時、光と垂直になって見えにくくなる
4	Blue sky	 Interestingly, the blue sky is also polarized.	空が水色→暗い青 ポラライザー(|)で暗くなった ↳太陽光はよこ向き
5	Water including milk	 The direction depends on the places	a) H b) H c) V 光はたて向き 光の向きと垂直になるから見えなくなる
6	Reflection		d) V e) H
7	Opinions 光には向きがあり、ポラライザーを使うと、それを知る 太陽光は横向きである＜よこ（反射）赤い光 ポラライザー(−)のときみえる たて（反射）青い光 ポラライザー(+)のときみえる		