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
- Slit Separation d = 4.0×10^{-4} m
- (Slit width w = 0.10 mm) 1.0×10^{-4}
- Distance between slit and screen L = 0.60

Theoretical value of Δx : 9.49×10^{-4}

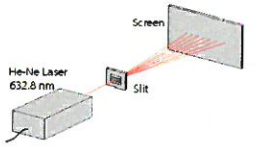
Measurement of X_m

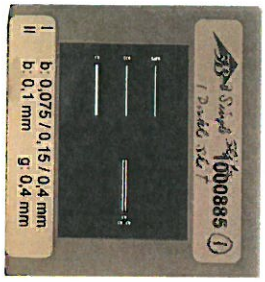
- Order m = 15
- Distance Xm = 1.42×10^{-2}

$\Delta x = X_m / 2m$

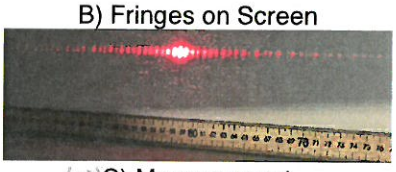
Observed value of Δx : 5.0×10^{-2}

A) Set up



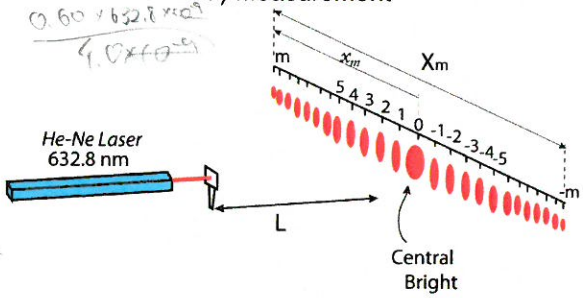


B) Fringes on Screen

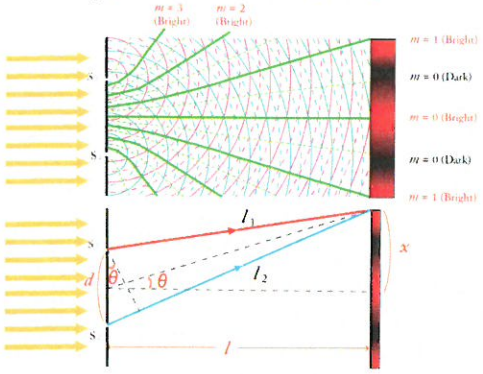


C) Measurement

$\frac{0.60\times632.8\times10^{-9}}{1.0\times10^{-4}}$



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 = 632.8×10^{-9}
- Slit width W = 1.0×10^{-4}
- Distance between slit and screen L = 0.60

Theoretical value of Δx : 3.8×10^{-3}

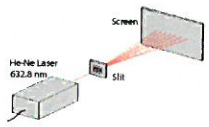
Measurement of X_m

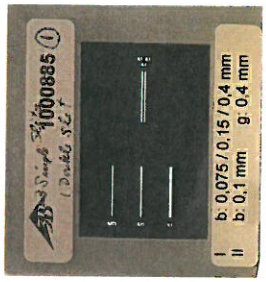
- Order m = 10
- Distance Xm = 3.7×10^{-2}

$\Delta x = X_m / 2m$

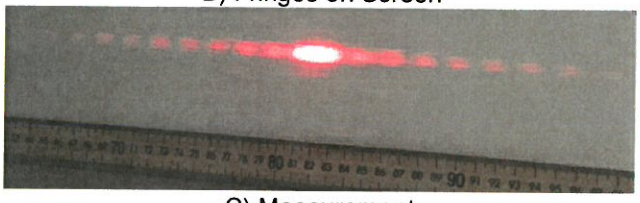
Observed value of Δx : 1.1×10^{-3}

A) Set up

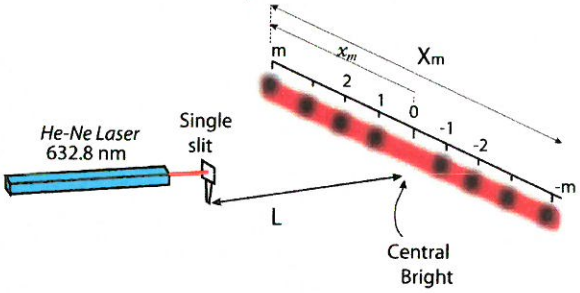




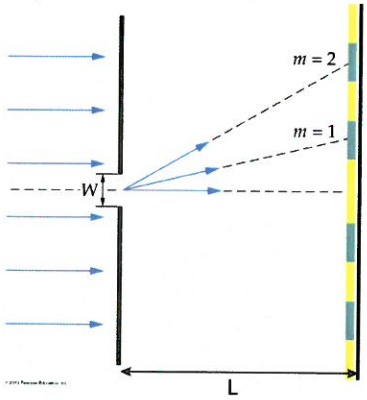
B) Fringes on Screen



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

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

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

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

- Wavelength λ = 632.8×10^{-9}
- Grating lines/mm N = 100
- Slit Separation $d = \frac{1\times10^{-3}}{N}$ 1.0×10^{-5} (m)
- Distance between slit and screen L = 0.60

Theoretical value of Δx : 3.2×10^{-2}

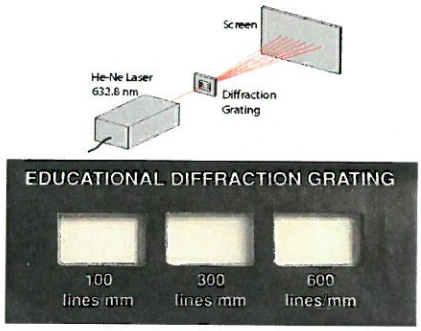
Measurement of X_m

- Order m = 1
- Distance Xm = ?

$\Delta x = X_m / 2m$

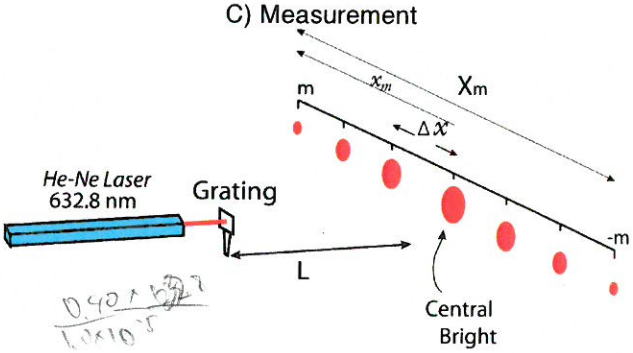
Observed value of Δx : 3.5×10^{-2}

A) Set up



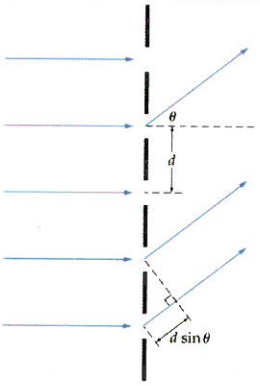
B) Fringes on Screen

C) Measurement

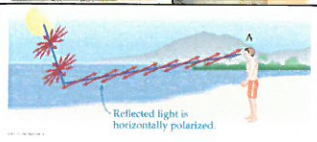
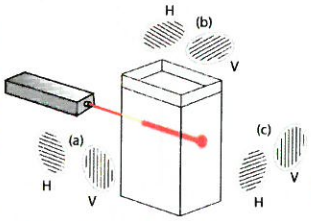
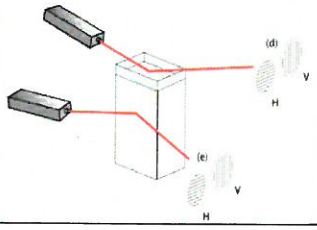


$\frac{0.60\times632.8\times10^{-9}}{1.0\times10^{-5}}$

D) Mechamism of interference



Polarization

			Results
1	Reflected light on the windows		When the slit is horizontal you can't see the reflected light. When vertical, we can see.
2	Reflected light on the water surface		when slit is vertical, you can see scissors clearly. horizontal, nothing happens.
3	Reflected light outside, such as road suface and water surface		when the slit is vertical you don't see reflected light
4	Blue sky	 Interestingly, the blue sky is also polarized.	When the slit is vertical the sky is little redish.
5	Water including milk	 The direction depends on the places	the case (a) H, you can't see light. the case (b) H, you can't see light. case (b) H, you can't see.
6	Reflection		the case (e) H, you can't see light the case (d) V, you can't see light
7	Opinions	It was pretty fun	

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