Diffraction

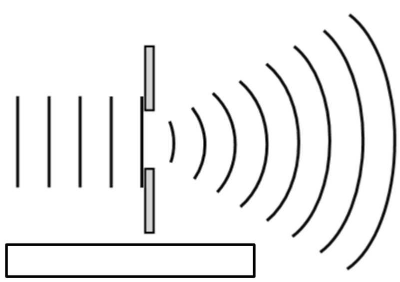
of

Light

1

Diffraction

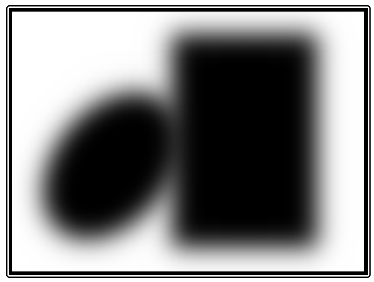
- **Bending of light around edges of barriers**



2

Diffraction and Shadows

- **The blurriness of shadows is evidence of light diffracting around a barrier.**



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Single - Slit Diffraction

- **Creates a broad central bright band, followed by dark and light bands**
- **Creates dark bands because of <u>destructive interference</u>**
- **Creates light bands because of <u>constructive interference</u>**

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Using Diffraction to Measure the Wavelength of Light

- Direct relationship between the distance between bands and the wavelength of the light source. (Larger wavelength = larger bands)
  - **Red Light**

a

  - **Blue Light**

b

  - **White Light**

c

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Diffraction Gratings

- **A thin film having a series of slits a few hundred nanometers apart**
- **Increases the effect of the interference pattern, making it easier to observe**

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Multi-Slit Interference

- **The larger the wavelength, the larger the amount of diffraction.**

  - Note: the violet band will appear closer (diffracts least) to the bright middle band than the red (diffracts most)

Finding the Wavelength

- **The amount of diffraction of light depends on the distance between the slits and the wavelength of the light shining through it.**
- **d is the distance between the slits on grating**
- **x is the distance between the light source and line or central band and line**
- **L is the distance viewer is from the light or from light to screen**

$$\lambda = \frac{dx}{L}$$

Diffraction Problem

- An experiment is performed to measure the wavelength of red light coming from a lamp. The slits in the diffraction grating are 1.9 x 10^{-3} cm apart. A screen is placed 0.600 m away and the separation between the central bright band and the first order bright line is 2.11 cm. What is the wavelength of red light?

d

L

x

$L = 0.600\text{m} = 60\text{cm}$ (ALL IN THE SAME UNIT)

$d = 1.9 \times 10^{-3}$ cm

$x = 2.11$ cm

$$\lambda = \frac{dx}{L} = \frac{(1.9\times10^{-3})(2.11)}{(60)} = 6.68\times10^{-5}\text{cm} \Rightarrow 6.68\times10^{-7}\text{m}$$

$\lambda = 6.68 \times 10^{-7}$ m

= 668 nm

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Diffraction Problem #2

- A violet light from a sodium lamp of wavelength 404 nm is aimed at two slits separated by 8.80 x 10^{-6} m. What is the distance from the central line to the first-order violet line if the screen is 0.700 m from the slits?

λ

d

L

$\lambda = 404\text{nm} = 404\times10^{-9}$ m

$d = 8.80\times10^{-6}$ m

$L = 0.700$ m

$$\lambda = \frac{dx}{L}$$

$$404\times10^{-9} = \frac{(8.8\times10^{-6})x}{(.700)}$$

$$\frac{(404\times10^{-9})(.700)}{8.8\times10^{-6}} = x \Rightarrow .0321\text{m}$$

x = .0321 m

= 3.21 x 10^{-2} m

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