Diffraction

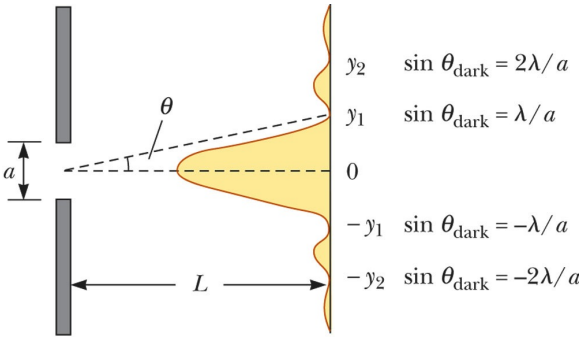


Figure 1

Prelab

Question 1. Write down the equation for the angle θ of the mth minimum in an interference experiment with a single slit of width a.

Question 2. Figure 1 shows a typical interference pattern for a single slit diffraction experiment. Suppose the width of the central maximum (the separation from y_1 to $-y_1$ in Figure 1) is $w = 6mm$, and the distance between the screen and the barrier with slits is $L = 600mm$. Find the angle θ between the central maximum and the first dark fringe. Draw a diagram when you calculate this.

Question 3. Given that the separation between the slits is $a = 0.125mm$, what is the wavelength λ?

Additional Information

Table 1: Slit Information

Slits	Width a (mm)
A	0.04
B	0.08
C	0.16

Procedure

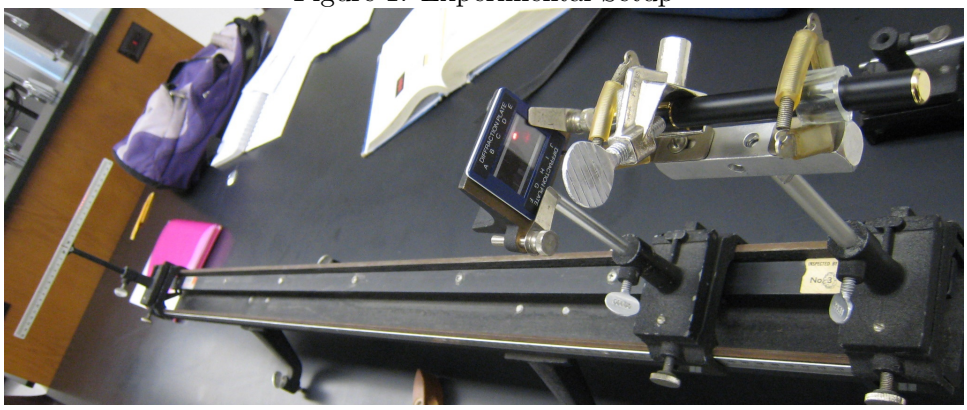
1. Set up the equipment on the optical bench as shown in Figure 1. You can use either the laser pointer or the gas laser. Put the slits as close to the laser as possible, but as far away from the screen as possible. Large separation (L) from the screen will give you a more accurate λ.

Table 2: Wavelength for Lasers

Laser Type	Wavelength (nm)
He-Ne	633
Red LED	$630 - 680^{\dagger}$
Green LED	532
Yellow LED	$589 - 594^{\ddagger}$
Blue LED	405
Purple LED	401

†: Wavelength depends on the laser. Find the range from the manual of the red laser and use the mean value. If no information available, use $\lambda = 654nm$.
‡: For the yellow laser, use the mean value $591.5nm$

Figure 1: Experimental Setup



2. Measure the distance between the first two dark fringes then follow the calculation above to calculate the wavelength. Do this for slits A, B and C. Find the average wavelength from these three cases.
3. Repeat the measurements for different lasers.
4. Now point the laser at a diffraction grating. From the diffraction pattern, find the wavelengths of the lasers again. (Sorry, no hints this time. Think about how to do this! You will have to draw your own tables too.)

Data

Table 3: Data and Analysis for Laser 1

Slits	Width of the central maximum (mm)	θ (rad)	λ (nm)	Percentage Difference
A				
B				
C				
Average	NA	NA		

Laser type: _____

Actual wavelength: $\lambda_{actual} =$ _____

Distance between the screen and the barrier with slits: $L =$ _____

Table 4: Data and Analysis for Laser 2

Slits	Width of the central maximum (mm)	θ (rad)	λ (nm)	Percentage Difference
A				
B				
C				
Average	NA	NA		

Laser type: _____

Actual wavelength: $\lambda_{actual} =$ _____

Distance between the screen and the barrier with slits: $L =$ _____

Table 5: Data and Analysis for Laser 3

Slits	Width of the central maximum (mm)	θ (rad)	λ (nm)	Percentage Difference
A				
B				
C				
Average	NA	NA		

Laser type: _____

Actual wavelength: $\lambda_{actual} =$ _____

Distance between the screen and the barrier with slits: $L =$ _____

Table 6: Data and Analysis for Laser 4

Slits	Width of the central maximum (mm)	θ (rad)	λ (nm)	Percentage Difference
A				
B				
C				
Average	NA	NA		

Laser type: _____

Actual wavelength: $\lambda_{actual} =$ _____

Distance between the screen and the barrier with slits: $L =$ _____

Table 7: Data and Analysis for Laser 5

Slits	Width of the central maximum (mm)	θ (rad)	λ (nm)	Percentage Difference
A				
B				
C				
Average	NA	NA		

Laser type: _____

Actual wavelength: $\lambda_{actual} =$ _____

Distance between the screen and the barrier with slits: $L =$ _____