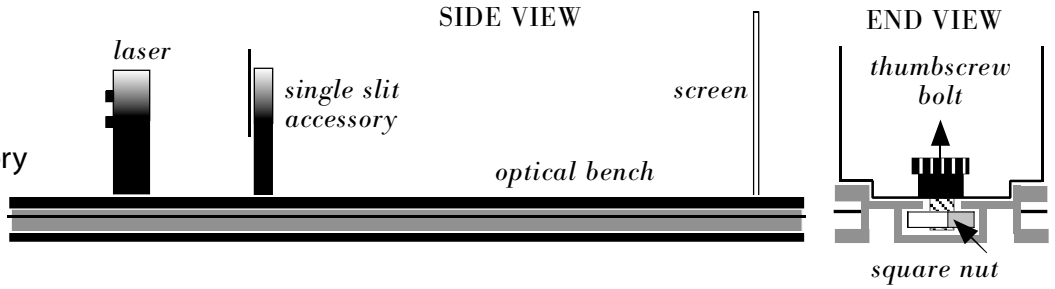
PhyzLab Springboard: Single Slit Diffraction

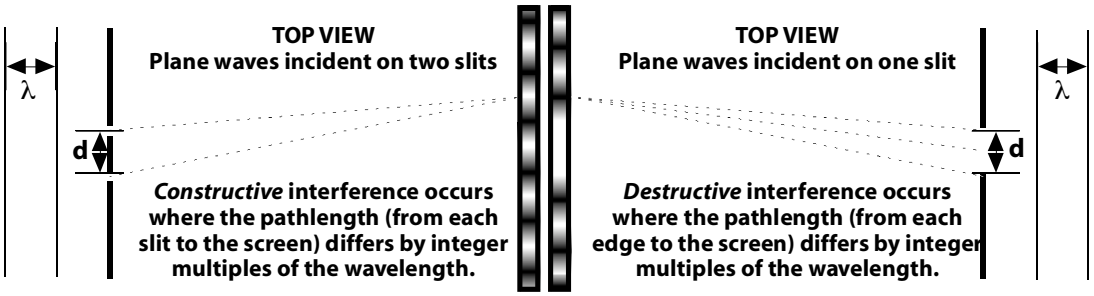
Apparatus

___optical bench
___diode laser
___power supply
___single slit accessory
___screen



Interference? From a Single Slit?

Yes. When incident light waves encounter the slit, the edges of the slit act as sources for the emerging light waves. The only tricky thing is that light that passes through the slit interferes with light emerging from the edges. Fortunately, the consequence is simple: the interference equation we've come to know and love, $m\lambda = d\sin\theta$, is an expression for the location of interference **minima** instead of **maxima.** It is customary to refer to single slit patterns as **diffraction** (as opposed to **interference**).



Take a Look

1. Arrange the apparatus.

a. Attach the screen to the optical bench; secure the attachment nut in the center channel of the optical bench. Place the screen at 110 cm.

b. Attach the diode laser to the optical bench; face it toward the screen and place it at 0 cm. Connect the power supply to the laser, plug it in and turn it on. You should see the red laser spot on the screen.

c. Turn the laser off. Attach the Single Slit Accessory to the optical bench at the 10cm position. The pattern information of the disc should be readable from the laser side (as opposed to the screen side). Dial up the variable slit and position it at about the halfway point. Turn on the laser. You should see an interference pattern on the screen. Adjust the LASER beam (using the two thumbscrews on the back of the laser head) until you get the beam to hit the center of the pattern. Adjust the Single Slit Accessory by rotating the RING (not the disc) that attaches the disc to the bench mount until the pattern appears horizontal on the screen.

2. a. Describe and sketch the pattern. (Remember, this was a **cylindrical** beam before it hit the **vertical** slit.) Reverse the light and dark in your sketch—darken the paper to match light on the screen.

b. What—if anything—happens to the pattern when the slit width is INCREASED?

c. What—if anything—happens to the pattern when the slit width is DECREASED?

d. How does this observation support the interference equation?

Number Time!

3. a. Cover the screen with a sheet of graph paper.

b. Dial up one of the fixed slits that shows at least two orders of minima. Record its width (d). [Note: this distance may be referred to as "a" on the single slit accessory.]

c. Sketch the pattern. Label the central maximum, first-order minima, and second-order minima.

d. Record the distance to the first- **and** second-order minima. (Hint: the total distance between the two first-order minima—divided by two—is the first-order minima distance.)

e. Show calculations in each cell of the table. Use the interference equation to calculate the predicted minima angle. Use geometry to calculate the actual minima angle.

	Minima Angle as Predicted	**Minima Angle as Measured**	**Percent ERROR**
First Order			
Second Order			

f. What sources of error are involved in this measurement?