PHY152H1S – Practical 9: Double-Slit Interference

Don't forget:

- List the NAMES of all participants on the first page of each day's write-up. Note if any participants arrived late or left early.
- Put the DATE (including year!) at the top of every page in your notebook.
- NUMBER the pages in your notebook, in case you need to refer back to previous work.

Today's Textbook Reference to review before lab:
"University Physics with Modern Physics" 1st Edition by W. Bauer and G.D. Westfall ©2011
Chapter 34 Wave Optics, Section 34.3 "Double-Slit Interference"
Pg. 1101-1104, in particular equation 34.8 on bright fringe locations.

In 1801 Thomas Young was able to make a measurement of the wavelength of light using a double-slit experiment. Today you will try to reproduce this experiment using laser-light, which is monochromatic.

In two-slit interference, light falls on an opaque screen with two closely spaced, narrow slits. As Huygen's principle tells us, each slit acts as a new source of light. Since the slits are illuminated by the same wave front, these sources are in phase. Where the wave fronts from the two sources overlap, an interference pattern is formed. As shown in Figure 1, d is the centre-to-centre slit spacing, L is the distance between the slits and the viewing screen, and Δy is the distance between adjacent bright fringes seen on the viewing screen.

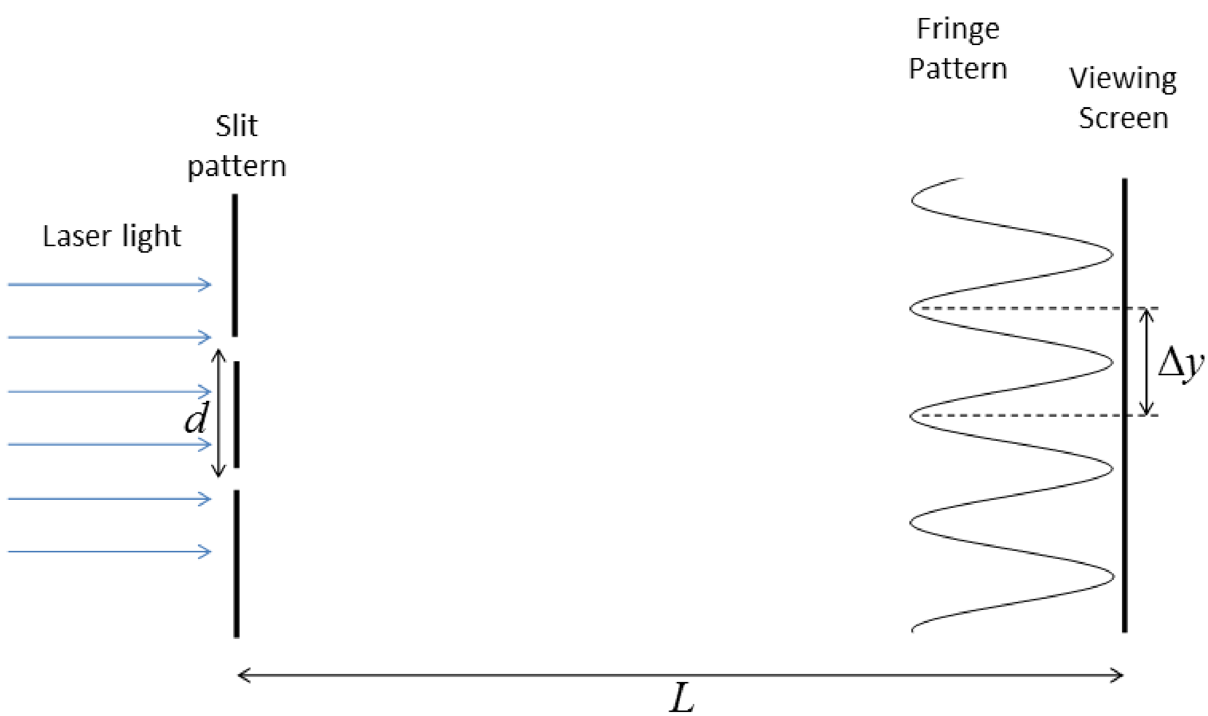


Figure 1. Schematic for a Young's double-slit experiment.

You have a blue box called an "Introductory Optics Kit" from PASCO. It has 21 kinds of items in it, but you only need 4, as shown in Figure 2 and Figure 3:

- Magnetic Optics Bench
- Component Holders (x 2)
- Diffraction Plate
- Viewing Screen

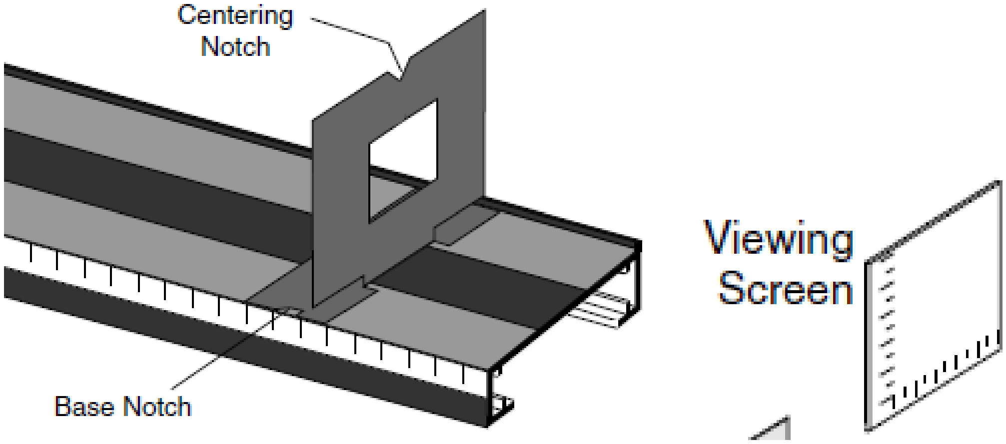
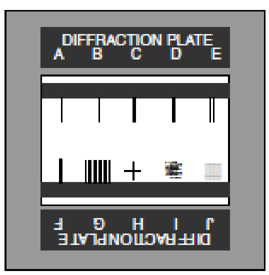


Figure 2. Here is one Component Holder sitting on the Magnetic Optics Bench. Also shown is a viewing screen, which attaches magnetically to the Component Holder.



Pattern	No. Slits	Slit Width (mm)	Slit Spacing center-to-center (mm)
A	1	0.04	
B	1	0.08	
C	1	0.16	
D	2	0.04	0.125
E	2	0.04	0.250
F	2	0.08	0.250
G	10	0.06	0.250
H	2 (crossed)	0.04	
I	225 Random Circular Apertures (.06 mm dia.)		
J	15 x 15 Array of Circular Apertures (.06 mm dia.)		

Figure 3. Here is the Diffraction Plate with a list of slit widths and spacings.

In addition you need a red and blue laser, which come in a separate plastic briefcase, and can be placed on the Magnetic Optics Bench.

In two-slit interference, light falls on an opaque screen with two closely spaced, narrow slits. Lasers are a good source of very bright, monochromatic, coherent plane waves. If the laser beam evenly illuminates both slits, you should be able to see the pattern diffusely reflected on a viewing screen. The positions of the bright fringes are given by Equation 34.8 in your text, where m is any integer. The fringe spacing, between adjacent fringes, is:

$$\Delta y = \frac{L}{d}\lambda$$

Use the red and blue lasers and the double slit pattern D to form fringe patterns on the viewing screen. Count the number of fringes in some known distance to obtain a measurement of Δy. Measure L, and use d = 0.125 mm to determine λ for each laser. Repeat the experiment with slit patterns E and F, both of which have a = 0.250 mm. Not all measurements may be possible; report in your lab book which pattern and choice of L work best for each laser.

This Student Guide was written by Jason Harlow, Dept. of Physics, Univ. of Toronto in the Winter of 2014.

Last revision: March 17, 2014 by Jason J.B. Harlow.