

The Fringe of Optics

Purpose

To construct the mathematical relation describing interference patterns

Apparatus

computer

PhET simulation: "Wave Interference" (available at <http://phet.colorado.edu>)

Note: it's helpful if there is a means to magnify/zoom the image on the screen. If there is, write the key combination here:

Discussion

The modern study of light began in the late 1600s and early 1700s with Isaac Newton in England and Christiaan Huygens in the Netherlands. Newton theorized that light consisted of particles. Huygens theorized that light consisted of waves. In 1801, Thomas Young offered convincing evidence for the wave model of light when he demonstrated that light could produce an interference pattern.

Because light wave interference produces bands of light and dark, the results are often referred to as *fringe* patterns. The pattern produced depends on the characteristics of the light and the arrangement used to produce it. The "Wave Interference" simulation allows us to manipulate the light and interference arrangement. By observing the consequences of these manipulations, we can put together the mathematical expression that relates the various variables to one another.

Procedure**INITIAL SETUP**

Step 1: When the simulation opens, maximize the window so that it occupies as much screen area as possible. Then click the tab labeled "Light". Use the button at the bottom of the simulation window to pause the animation.

Step 2: In the main (animation) section of the simulation window, activate the screen. Then activate the intensity graph. Then maximize the wave animation by clicking the green box with the "+" symbol.

Step 3: In the control panel section of the simulation window, activate the two-slit barrier. Set the slit width to 525 nm (the second tick mark past zero on the slider). Set the barrier distance to 2590 nm (fourth tick—midpoint on the slider). Set the slit separation to 1750 nm (the midpoint on the slider).

Step 4: Play the animation (un-pause the simulation).

Step 5: In the light source controls (lower left side of the window), change the color to yellow-green (set the selector to the boundary between yellow and green). Watch for several seconds as the light passes through the slits to form a fringe pattern on the screen.

Step 6: In Part A, we want to observe changes in the fringe pattern. The pattern may narrow or widen. That is, the peaks (maxima) and valleys (minima) may get closer together or farther apart. As a means for comparison, place a marker on the graph as follows (and as shown in Figure 1):

- In the control panel section, click "Measuring Tape." Drag the tail end up so the tape is vertical.
- Move the tape base so that its red crosshairs mark the minimum immediately below the central maximum on the vertical scale of the intensity graph. (If zoom/magnification is possible, do so now.)
- Move the end of the tape so that it marks the minimum directly above the central maximum.

Fringe Of Optics Tech Lab Answer Document

K Morrison



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