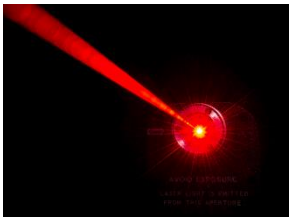
Name _____

Finding the Thickness of Hair

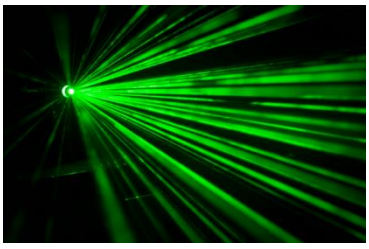
Purpose of the Experiment

The purpose of this experiment is to use diffraction to determine the thickness of a piece of hair.



Introduction

You can't use the same measurement devices for everything. Using a meterstick, ruler, or caliper wouldn't be helpful when determining the diameter of a fine wire, thin thread, or any other small object. Very small measurements can be determined by using diffraction and the interference pattern shown in Young's Double Slit experiment. Young's experiment was conducted by passing light through two narrow slits separated by a small distance and examining the resulting interference pattern. The resulting interference pattern can also be seen when light is allowed to travel around a narrow object, like a piece of hair. The same equation for the double slit experiment can also be applied to light traveling around a narrow object.



Safety

Never look directly into a laser beam. Never shine a laser in another person's eye.

Procedures

1. The best place to conduct this experiment is a dark room with no windows. If needed, move to a room with no windows.
2. Obtain a piece of hair (a piece of string also works). A student with longer hair can normally get a strand of hair by running their fingers through their hair.
3. Take a mounting slide and mount a single strand of hair across the center of the opening on the slide.
4. Determine the wavelength of the laser and record as λ. If the wavelength of the laser is not stated on the laser, use most laser points are red (630 nm-670 nm), green (520 nm and 532 nm) and violet (405 nm and 445 nm)

   https://phc.amedd.army.mil/PHC%20Resource%20Library/Laser%20Pointer%20FS_24-031-0617.pdf

5. Place the mounting slide in front of the laser. Then, tape a piece of computer paper on the wall. Measure the distance from the computer paper to the mount and record as L.
6. Turn off the room lights and turn on the laser. In order to get the laser to strike the piece of hair, slightly move the mount around until you see a diffraction pattern on the piece of paper.
7. Using a pencil, draw the bright spots on the paper taped to the wall.
8. Back in the classroom, measure the distance between the central maximum and the bright fringe, y. Add your measurements to the data table.
9. Use the measurements to calculate the thickness of the piece of hair, d.

   $dsin\theta = m\lambda$ where $sin\theta = \frac{y}{L}$

Data and Data Analysis

Wavelength of light source, λ: _____ Distance from mount to screen, L: _____

Order Number	y (distance from central maximum to center of bright fringe)	d (thickness of hair)
8		
7		
6		
5		
4		
3		
2		
1		
0		
1		
2		
3		
4		
5		
6		
7		
8		
Average of thickness of hair, d		

Sample Calculation Use this space to write one sample calculation for the thickness of the hair.