INTERFERENCE AND DIFFRACTION

Objectives: • To investigate multiple-slit interference and diffraction

Apparatus:
laser (a source of monochromatic, coherent light), single/double slit wheels, pasco optics bench

Part I: Qualitative Observations

a) Use the laser to illuminate each of the **single slits** on the single slit wheel. If you don't get a "clean" pattern for a particular slit, turn the horizontal and vertical adjust knobs to adjust the laser slightly. Make a sketch of each single slit diffraction pattern and label each with the slit width. Place the sketches one beneath the other, properly aligned with each other for clarity. From your sketches it should be clear how the pattern is affected by the slit width.

b) The multiple slit wheel contains a single slit and double slit comparison opening labeled with:  . These slits all have the same slit width. Make a sketch of the patterns seen on the screen by the single slit and the double slit. Sketch the patterns one beneath the other. Your sketches should make it clear how the double slit pattern is similar to and different from the single slit pattern,

c) Now flip to the  double slit comparison opening. These slits have the same width but have different slit separations. Make a sketch of the patterns seen on the screen by each double slit. Your sketches should make it clear how the double slit pattern is affected by the spacing of the slits.

d) Now flip to the "multiple slits" section which contains single, double, triple, quadruple and sextuple (5) slit patterns. All of the slits have the same width and the distance between the slits of the multi-slit patterns is constant. Make sketches of each of the patterns produced on the screen. Use the phasor method from class and the problem set to explain the main features of the patterns.

Part II: Young's Double Slit Experiment

a) Choose a double slit and make the measurements needed to determine the wavelength of the laser light. Your choice of slit can make this measurement more or less precise, so choose a double slit that maximizes the precision. Calculate the wavelength of the laser. Estimate the uncertainty of each of your measurements and determine the resulting uncertainty in the wavelength. Assume the slit width has a negligible uncertainty. Think about dominant error before making this calculation!

b) Would it be possible to get the pattern you see if light were made strictly out of particles as Newton believed?

Part III: Measuring spacing

Your instructor will now give you a new double slit slide.

a) Devise and carry out an experiment to determine the slit width and slit spacing with uncertainty in each. Clearly describe your work.
b) Measure the width and spacing of your slide, using the traveling microscope. Estimate the uncertainty.
c) Compare your results – do the results agree within uncertainty? If yes, celebrate appropriately! If not, look for the source of the discrepancy.