

## INTERFERENCE AND DIFFRACTION

**Objectives:** • To investigate multiple-slit interference and diffraction

### Apparatus:

laser (a source of monochromatic, coherent light), glass slide with assorted slit patterns, magnifying glass, labjack, retort stand with clamp, tape measure, two meter ruler, 30cm ruler

### Part I: Qualitative Observations

- a) Use the laser to illuminate each of the **single slits** in column A. If you don't get a "clean" pattern for a particular slit, try moving the laser slightly. Sometimes a slit may have a small defect somewhere along its length. Make a sketch of each single slit diffraction pattern, one beneath the other and properly aligned with each other. From your sketches it should be clear how the pattern is affected by the slit width.
- b) Column E contains a single slit and four double slits. All of the slits in column E have the same *width*, but the distance between the double slits varies. Make a sketch of the patterns seen on the wall by the single slit and each double slit. Sketch the patterns one beneath the other. Your sketches should make it clear how the double slit patterns are similar to and different from the single slit pattern, and how the double slit pattern is affected by the spacing of the slits.
- c) Column D contains single, double, triple, quadruple and decuple (10) 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 patterns.

### Part II: Young's Double Slit Experiment

- a) Choose your favorite double slit and make the measurements needed to determine the wavelength of the laser light. Use the traveling microscope to determine the slit spacing. Calculate the wavelength of the laser. Estimate the uncertainty of each of your measurements and determine the resulting uncertainty in the wavelength. (Think about dominant error!)
- b) Would it be possible to get the pattern you see if light were made out of particles as Newton believed?

### Part III: Measuring spacing

Your instructor will 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.