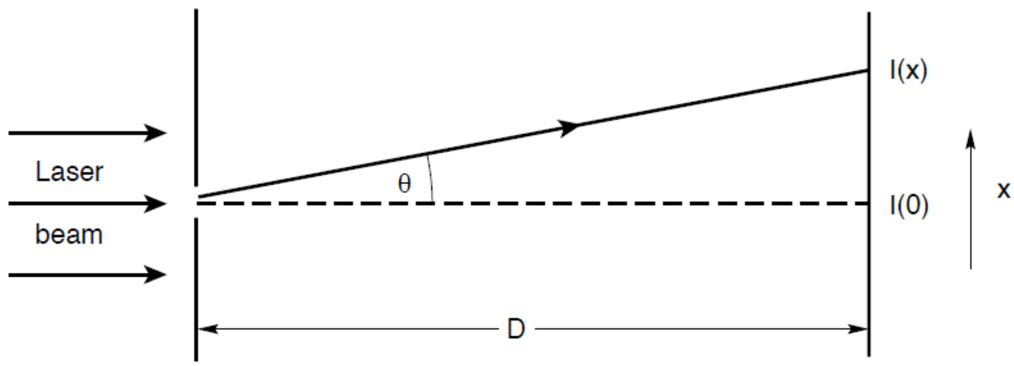
Lab 5: Diffraction

Introduction
We will look at the wave nature of light in a set of experiments where diffraction and interference patterns are produced when laser light is incident on various obstacles.

Background - see Pedrotti^3, Chapter 11



The general arrangement that will produce a diffraction pattern is illustrated schematically in the figure above. At a distance D from the obstacle, the intensity of the diffracted light will be measured as a function of the x coordinate. The diffraction patterns are relatively simple in the far field limit, where $a^2 / D\lambda << 1$, where a is the characteristic dimension of the obstacle (such as the width of a slit) and λ is the wavelength of light. This is the Fraunhofer diffraction limit, and the diffraction patterns are simply Fourier transforms of the diffracting object.

Experiment
In the following experiments, you will scan the diffraction patterns with a linearly driven photodiode and record the data with the computer.

1. Measure the diffraction patterns from single and multiple slits. In the far field limit, you should be able to extract the slit parameters by analysis of your diffraction patterns. Compare your results with a measurement of the slit widths with the microscope.

2. Using Babinet's principle (which relates the diffraction pattern of a mask to its complement), measure the diameter of a human hair (your own if you have one to spare!).

3. Using a razor blade (BE CAREFUL! Do not cut yourself!), cut a slit in aluminum foil and measure the diffraction pattern. From it, deduce the slit width. Compare to the width from microscopy. Repeat with two closely-spaced slits you cut into the foil.

4. Using the razor blade, measure the diffraction pattern from an edge, and compare it to the expected pattern.