Basic Skills for the Optics Laboraotory

1) **Align a laser beam through two apertures.**

Often you will need a beam going from point A to point B, both of which are determined by other constraints. This is non trivial because your adjustments are angular and not located at point A or point B, thus not orthogonal. For this you will use the red He-Ne laser. Strongly attenuate the output so that it is less than one milliwatt.

a. Mount two apertures (irises) and set them to the same height, but a height that is not the same as that of the laser beam. Place them ~1 m apart and bolt them down.

b. You need 4 degrees of freedom (because you need to get vertical and horizontal position right at both apertures). The easiest way to do this is to bounce the beam off of two mirrors. Each bounce gives you two degrees of freedom (two knobs on the mirror mount!).

c. Align the beam through both apertures. You will have to iterate, i.e. get the beam going through the first aperture, it will miss the second. Then if you align it to the second it will miss the first. If you use the right algorithm, iterating back and forth will converge to alignment though both.

2) **Align a lens to the beam.**

To get best focusing, you should go exactly through the enter of a lens and the lens should be exactly perpendicular to the beam. Choose a lens that will give you a waist of 25-50 μm.

a. Place and bolt down and iris so that the iris is centered on the beam. Check this by opening and closing the iris and looking at the laser light on a card downstream. Tape a piece of white paper with a small hole to the iris.

b. Choose the approximate location for the lens. Place a card in the beam downstream by approximately twice the focal length of the lens. Mark/note the center of the beam by closing down the iris to it's minimum.

c. Place the lens in the beam and close down the iris. Adjust the horizontal and vertical positions until the beam is centered at the same place as before.

d. Look for the back reflection from the lens on the white paper taped to the iris. Is the reflection going back through the center of the iris? This indicates that the beam is hitting the lens normal to the lens surface. By adjusting the lens tip/tilt and x/y and looking at the 4 conditions (deviation of the beam on the card in x/y and back reflection on the iris in x/y) iterate to match all conditions simultaneously.