MICHELSON Interferometer:
Measuring the Index of refraction of air

I. Background research: In your lab notebook leave space for an introduction that describes the Michelson Interferometer. You will need to spend some time in the library doing some research for this aspect of your notebook. Dr Johnson will be taking you to the library on Friday where you will have an opportunity to complete this part of your report. You will need at least one reference source that is NOT your textbook OR an internet source. You may use another Modern Physics text. Be sure to include references.

II. Measuring the Index of Refraction of Air

1. The Low-tech Michelson interferometer setups will be used for this experiment. Use a green mercury lamp to view a bulls-eye pattern in the fiberboard interferometer. This is best accomplished in the dark. Look backwards into the apparatus and adjust the screws at the back of the adjustable mirror until the two images of the light source overlap. Next, slowly adjust the screws to move the pattern about. Sketch in your notes the shape of the pattern, once you have gotten as close to the center of the bulls-eye as possible. Also sketch the adjustment knobs, and show what effect each one has on your bulls-eye. (This step is just to get you acquainted with the interferometer)

2. There are copper chambers that can be inserted into one arm of the interferometer. The air can be removed from the chamber using a vacuum pump. As air is slowly leaked back into the chamber, the fringes shift. Think about WHY this happens and make some notes about it.

3. To perform the experiment, attach the pump to the copper chamber, and place the chamber into one arm of the interferometer. Readjust the mirror until you observe the bulls-eye pattern. Use the pump with a pressure gauge on it to remove the air from the chamber to a pressure to 70kPa below atmospheric pressure. Very slowly allow the air back into the chamber using the valve on the pump. This will take some practice. Count the number of fringe shifts (bright to bright or dark to dark) in order to determine the index of refraction of the air in the tube. You will want to repeat this measurement several times to be sure of your result. Make sure that both you and your lab partner have an opportunity to count the fringes at least a three times. You are making two

measurements in each trial, the air pressure and the number of fringes. Be sure to make an estimate of your uncertainty in each type of quantity and record it and your reasoning in your lab notebook.

4. You can now calculate the change in the index of refraction using the principles behind the Michelson interferometer. You will first need to determine an equation that relates the index to the fringes. Next you will need to determine how the change in index is related to the number of fringes.

5. You should compare your result with an accepted value of the **change** in the index of refraction of air by using a reference source to find the accepted value of the index of refraction at atmospheric pressure and at 70kPa below normal atmospheric pressure. The National Institute of Standards and Technology has a calculator of the index of refraction of air that can be found at http://emtoolbox.nist.gov/Wavelength/Ciddor.asp