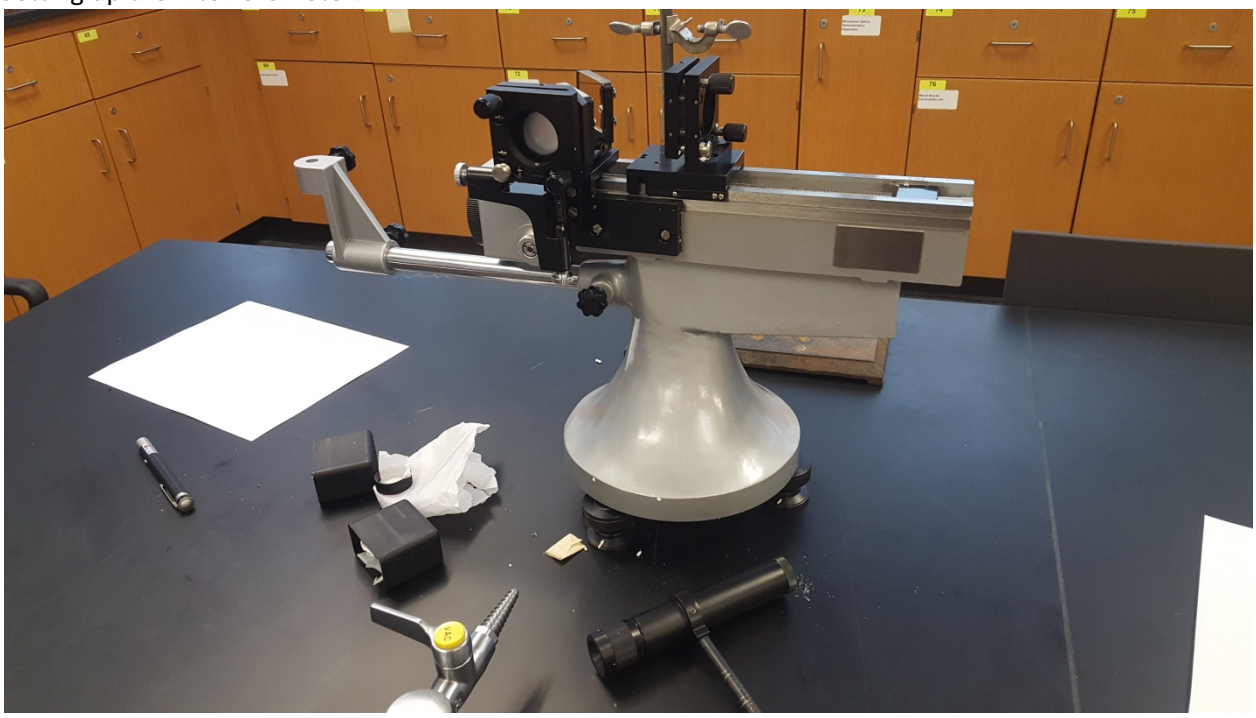
Michelson interferometer tutorial

1. Setting up the interferometer:



   a. Open the box
   b. On the top of the Styrofoam there should be 2 accessories: an accessory holder (gray metal with 2 holes and screws) and a telescope
   c. Pull out both of the accessories mentioned and set them on the table
   d. Remove the top layer of Styrofoam
   e. In the center there should be a large metal body to the interferometer in a plastic bag. This is very heavy (looks are deceiving) very carefully remove the body and set it on the bench top. Remove all packing material and set it aside. There is no replacement packaging so save all you take off and note what it goes to for when you clean up.
   f. Now you will need a flathead screwdriver. You can find one in the toolkit under the instructor desk sink. It is small and green.
   g. On the body, locate the metal panel on the side opposite the scale. Remove the 2 accessory screws and set them aside.
   h. Put on gloves (you are now handling optics which are VERY sensitive – you need to be incredibly careful not to damage them). Students must also wear gloves when handling the interferometer especially anything close to the beam splitters and mirrors.
   i. Remove from the box the accessory that has 2 small plastic boxes covering 2 parallel beam splitters and 1 mirror most likely wrapped in some form of lens paper. This attachment has 2 screw holes. This is the Michelson interferometer/stationary mirror accessory.
   j. Place the attachment on the body so that the outcroppings on the attachment rest on the ridge on the body and the screw holes line up with the accessory screw holes recently emptied.

k. Carefully hold it in place while you securely screw the Michelson Interferometer/Stationary mirror accessory to the body.
l. Now, go to the box and remove the movable mirror. It should be in a small rectangular hole to the bottom right. It should look like a black solid sheet of metal with 2 raised edges that each have a notch in them. ( I have seen some improperly put away with the mirror facing up but this endangers the mirror – keep this in mind when repacking the boxes)
m. When you pull it out it will have a single mirror on the other side that resembles the mirror on the accessory just attached.
n. On the body you will notice a spring type structure going down the center with a metal movable ridge attached perpendicular to the spring's length. On the mirror you just pulled out look on the underside you should see a small round outcropping on one of the walls. This is a button that secures the mirror in place. Line up the mirror's notches with the ridge on the body and start by attaching the button side of the mirror so that the button depresses against the side of the top of the body. The mirror should be facing the large black knob on the front of the interferometer. While the mirror is still at an angle with the button depressed, slowly lower the other (raised) side down into place it should go on smoothly and lightly click securely into place.
o. Remove all optic coverings and save them in the box.
p. In the box, look for a thin lollipop/magnifying glass shaped accessory wrapped in paper. This is the viewing screen. Remove it and place it on the desk.
q. On the lower portion of the body you will find a small black knob. Unscrew until you can extend the silver metal rod in the base out a bit on the side of the large black gnarled knob on the front.
r. Slide the accessory holder (removed from the box in the first steps) onto the bar so that the screw portion of its knob go into the groove on the accessory pole you just extended. The triangle on the accessory holder should be facing up with the 90 degree angle away from the body of the interferometer.
s. Screw both knobs securely into place to stabilize the pole and the accessory holder.
t. That is all the setup necessary for the interferometer for the students to be able to complete their lab.

2. Other equipment needed:
    a. For each group you will also need 1 ring stand, 1 standard ring stand clamp, 1 laser (found in the cabinet 1 up from the floor nearest the door - bottom shelf), 1 roll of masking tape, a few sheets of copy paper, and a large white board.
    b. Gloves also need to be available to all students.
    c. Each group needs AT LEAST 4 of the wave transparency films located in a box on top of the interferometers.
    d. Set all materials out on the desk for the students.
3. How to actually align the interferometer for analysis (students should be able to do this on their own given the instructions provided in their lab manual but it's good for you to know and be prepared):
    a. Turn off all of the lights and close all of the shades.

b. Using the clamp on the ring stand, align the laser pointed 90 degrees at the stationary mirror through the center of the beam splitter. You should see the laser point as close to the center of the stationary mirror as possible.
c. Now you will need to align the stationary mirror. Hold a piece of paper up behind laser. Slowly and carefully turn the small knobs on the back of the stationary mirror to move the most intense laser point (reflected laser beam) back into the laser. There will be quite a bit of scattering due to the laser quality, you need only move the most intense point which should be the only one moving as you turn the knobs. Do not look directly into the laser.
d. Next you need to align the movable mirror:
    i. Coarse Adjustment: Attach the viewing screen to the accessory holder with the matte side facing/parallel to the movable mirror. You should see two extra intense points/point patterns near the center of the screen. Carefully use the knobs on the rear of the movable mirror to combine these points/point patterns as accurately as possible. As you move the knobs you should see 1 move, move it to the matching pattern if there's quite a bit of confusing scattering.
    ii. Fine adjustment: Attach the telescope with the gnarled end furthest from the body of the interferometer. Adjust its position so that it is projecting the newly centered beam/pattern through the center of the telescope and is projected out. Set up the whiteboard on a chair or counter perpendicular to the laser beam. Where you see the pattern projected tape a piece of the matte copy paper. You can use the gnarled end of the telescope to make the pattern/projection larger. Once you think you have good size and resolution to adequately combine (this is a VERY sensitive alignment) recombine the two now magnified patterns as carefully and perfectly as possible. Once properly aligned you should see stripes form across the combined interference patterns (vertical or horizontal). You will be able to know it is properly aligned once those stripes (the interference pattern) appear to move when you slowly carefully turn the small silver knob on the side of the interferometer body (this moves the movable mirror finely).

4. Troubleshooting/Hints:
    a. The interferometers are sensitive to vibration. If the pattern seems to keep vibrating and misaligning, advise students to stand still and give the tables a wide berth.