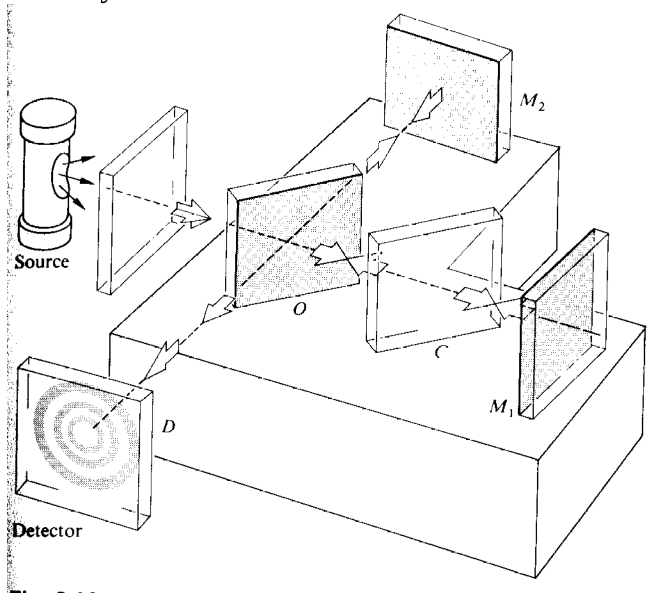
Lab 4 Comments
Michelson Interferometer (MI)

Alignment of the MI is the key!

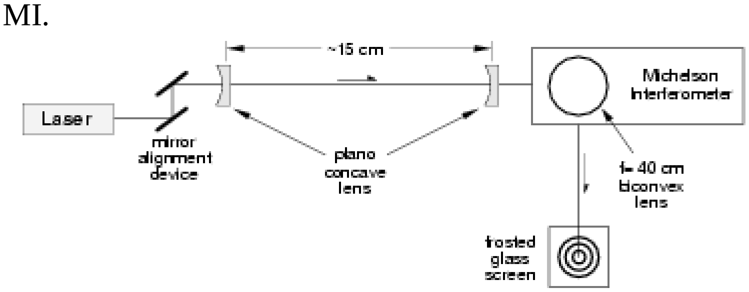


Start with the laser at a fixed height, the beam aligner at a fixed height, the front of the MI at a fixed height and level. (If the heights are messed up, have Tommy reset them.) Then adjust the mirror on the beam aligner to retroreflect. Use the two knobs on the back of the mirror, and adjust the beam height using the knob on the side of the unit. You must both retroreflect the beam and center the beam on the moveable mirror in the MI.

Be very careful with the knobs on the stationary mirror in the MI. Very small changes can send the interference pattern off the screen!

Be aware that there is a 40 cm converging lens on the output of the MI. Where will you find the sharpest image of the interference pattern?

Adjust the height and orientation of the concave lenses to expand and center the beam going into the MI.



When you remove the lenses, take the entire stand off, rather than just the lens.

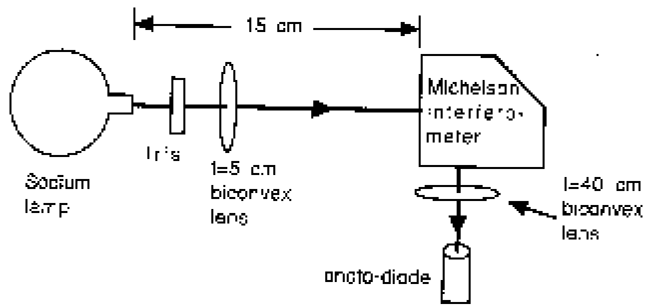
LoggerPro has an FFT option (under Insert → Additional Graphs → FFT Graph). This offers another way to find the fringe passage rate. Monitor the computer carefully while taking data, and don't hesitate to re-measure when you encounter a computer glitch.

Take at least 5000 data points at 50 Hz for the He-Ne laser to improve the quality of your FFT data.

When doing the Na doublet, keep the laser on and all of the laser optics in place. If you lose the alignment with the Na, you will be able to quickly recover it by simply removing the Na lamp and re-aligning the laser interference pattern.

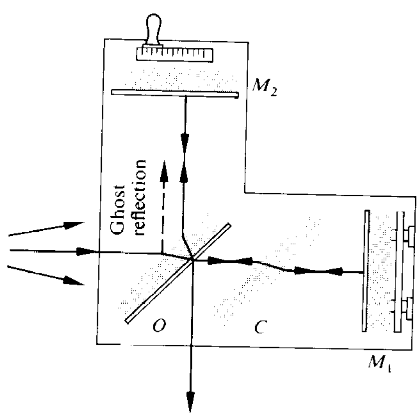
If you cannot find the Na interference pattern, rotate the movable mirror micrometer head a few turns, and you may be able to see it. The interference pattern is smeared out for certain path lengths due to destructive interference between the two lines in the Na doublet.

For the Na case, you may want to try a 10 cm lens instead of the 5 cm lens suggested in the lab manual.

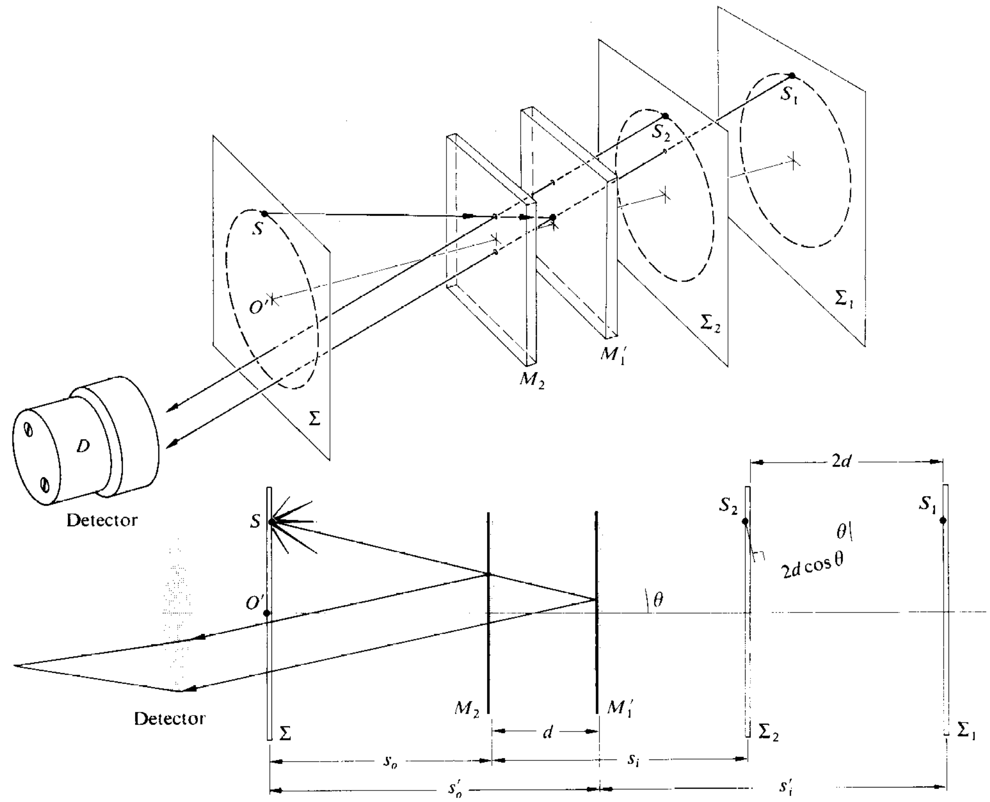


Note that the Na lamp has a limited longitudinal coherence length. Therefore, interference patterns are most easily seen when the two arms of the interferometer are of nearly equal length.

Be careful not to leave the motor running and drive the micrometer to its limit!



Extra spots appear from unwanted reflections



Destructive interference occurs when the path length difference is an integer number of wavelengths:

$$2d\cos(\theta_m) = m\lambda$$

where *m* is an integer. (It is not $\lambda/2$ because of an additional phase shift acquired in the interferometer by the two beams. There is a π phase difference between a wave that is externally reflected (O-M1) from the beam splitter compared to the one that is internally reflected (O-M2) on the same surface.) [Check out the Stokes relations: P[3], pages 184-185]

For the central fringe, $\theta_m = 0$, so

$$2d = m\lambda$$