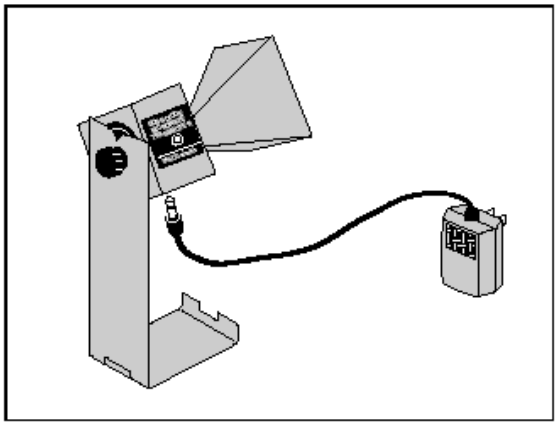
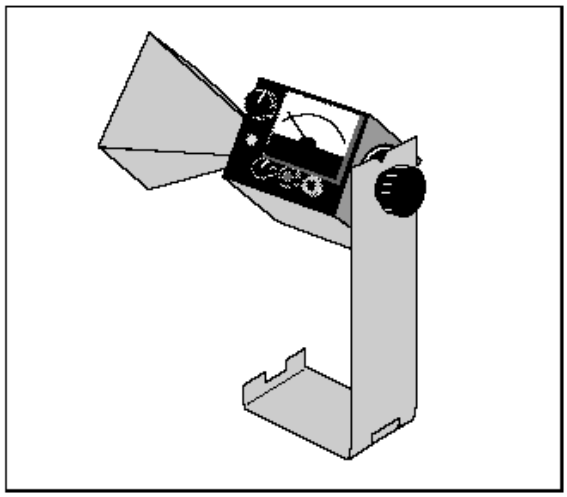
EXPERIMENT 17
INTERFERENCE USING MICROWAVES

I. THEORY Refer to your lab manual for the theory.

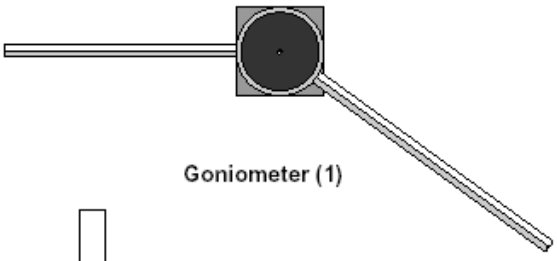
The following figures identify the equipment to be used.



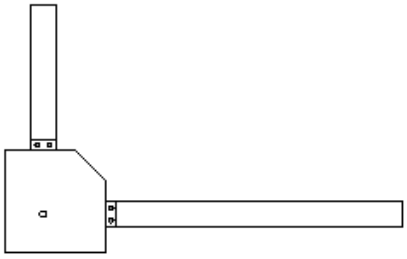
Microwave Transmitter with Power Supply



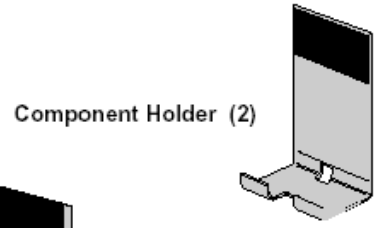
Microwave Receiver



Goniometer (1)

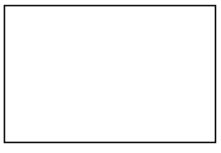


Fixed Arm Assembly (1)



Component Holder (2)

Rotating Component Holder (1)

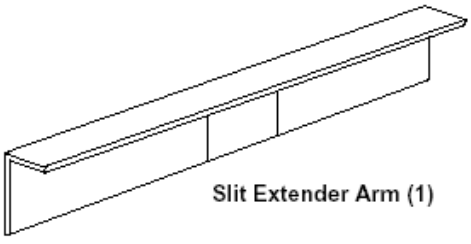


Metal Reflector (2)

Narrow Slit Spacer (1)

Partial Reflector (2)

Wide Slit Spacer (1)



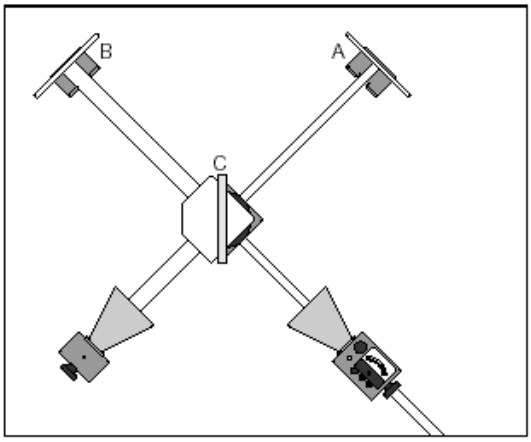
Slit Extender Arm (1)

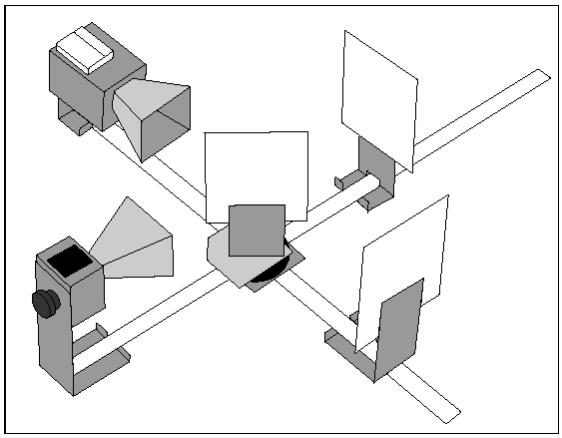
II. LABORATORY PROCEDURE

Overall Notes:
Make sure you are using the same polarization for the receiver and detector throughout the lab. Set both to 0° (vertical polarization).

If you have trouble setting the intensity reading to a specified value, seek assistances from your instructor.

1. Set up the Michelson Interferometer shown below using metal reflectors at A and B and a partial reflector at C. Plug the transmitter in and turn the INTENSITY selection switch on the receiver to "10X".





2. Move reflector A toward the partial reflector and observer the increase and decrease in the receiver signal. If you do not see this, adjust the INTENSITY and VARIABLE SENSITIVITY dials until you do. Also try adjusting the partial reflector as stated in the next step.

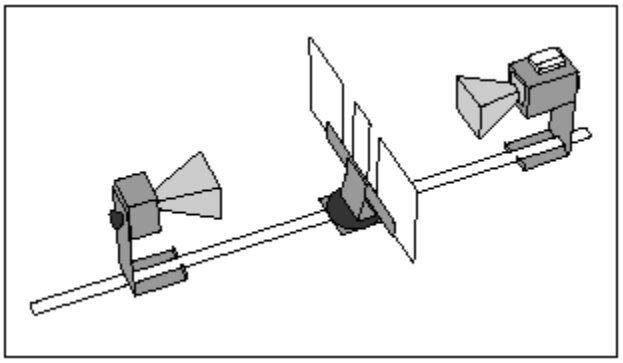
3. With reflector A at a position that produces a maximum in intensity (meter reading) at the receiver, slowly rotate the partial reflector (C) to a position that gives a maximum in intensity at the receiver. This should orient the partial reflector at 45° to the metal reflectors. Adjust the position of reflector A to make sure it is still at a position which gives maximum intensity at the receiver. Adjust the INTENSITY and VARIABLE SENSITIVITY dials until you get a meter reading of about 0.7. Record the position of reflector A.

4. Slowly move reflector A away from the partial reflector past at least 10 intensity minima and to an intensity maxima. Record the number of minima traversed and the position of reflector A.

5. Disassemble the Michelson Interferometer. Place the transmitter on the 0° arm of the goniometer and the receiver on the movable arm of the goniometer at 180°.

6. You will need to construct the double slit from the two metal reflectors, the narrow slit spacer and the slit extender arm. Attach the two metal reflectors and the narrow slit spacer to the magnetic strip on the slit extender arm as shown below. Use the meter-stick caliper jaw to set the width of both slits. Use the dimension of the caliper jaw that gives a slit spacing between 2 and 3 cm. Place the metal plates so that the slit spacer is as close

to the center of the extender arm as possible. Attach the extender arm to the rotating component holder and place the holder on the goniometer.



7. Move the transmitter slightly toward or away from the double slit to maximize the intensity at the detector. Repeat this procedure for the receiver. Record the position of the receiver. Slowly rotate the receiver arm from 120° to 240° to locate the global maximum. Place the receiver at this maximum. Set the INTENSITY to "10X" and adjust the VARIABLE SENSITIVITY dial until you get a meter reading of about 1.00 or as large as possible. After this setting, **do not move** the VARIABLE SENSITIVITY dial until you have completed all measurements with the narrow slit spacer. Record the angle. The angle is expected to be 180°, but will be off if the double slit is not perfectly centered and perfectly symmetric. Record the intensity as 10 times the scale reading.
8. Record the angular position and intensity of each relative minimum and relative maximum between 120° and 240°. Record the angular position as the position of the receiver arm minus 180°.
9. Repeat steps 6-8 using the wide slit spacer.
10. Use the vernier caliper to measure the width of the meter-stick caliper jaw. Record this value as the slit width for both the single and double-slit. Also measure the width of the narrow slit spacer.

III. CALCULATIONS AND ANALYSIS

Using the data from the Michelson Interferometer, determine the wavelength of the microwaves.

For the double slit using the narrow slit spacer and the double slit using the wide slit spacer:

- Determine the angles between 0° and 90° for which the theoretical intensity is **zero**. Show in detail how the angles were found. List the angles in a table along with the corresponding experimental angles. How do the theoretical angles compare to the experimental?
- Determine the angles between 0° and 90° for which the theoretical intensity is a **relative maximum**. Show in detail how the angles were found. List the angles in a table along with the corresponding experimental angles. How do the theoretical angles compare to the experimental?