UNIVERSITY OF ALABAMA
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PH 495/ECE 493 LeClair & Kung Spring 2011

Laboratory - Spectral Composition of Light

1 Objectives

The objective of this lab is to understand that the light we see (or can't see) is most often the result of a combination of multiple 'colors' with various intensities, and gain knowledge of how this is done experimentally.

2 Equipment

You will need the following equipment:

- hydrogen, helium, mercury vapor discharge lamps
- incandescent light bulb (or flashlight)
- LEDs (red, green)
- red helium neon or diode laser
- green helium neon laser
- handheld spectrometer
- grating spectrometer
- Ocean Optics USB-controlled spectrometer, coupled to an optical fiber and a computer

3 Measurements of various light sources

Do not use the handheld or grating spectrometers to measure the lasers.

3.1 Use the handheld spectrometer to visually observe the spectral composition of all the arc lamps available. Record whether the spectrum is discrete or continuous. If discrete, record the line colors that you can see.

3.2 Repeat 3.1 for sunlight and the incandescent light bulb.

3.3 Repeat 3.1 for several LEDs available (red, green, blue, violet/ultraviolet).

3.5 Using the grating spectrometer, measure the discrete spectra more carefully to determine the emission wavelengths. Do this for at least 2 LEDs and 2 vapor lamps.

3.5 ***Time permitting:*** Using the Ocean optics spectrometer, point the optical fiber to each of the sources in 3.1, 3.2 and 3.3. Adjust the gains (integration time) accordingly to obtain an unsaturated spectrum and record it. NB: since we have only one such spectrometer, you will need to take turns with other groups. It is OK to collaborate with another group on this measurement.

3.6 In the report, compare/explain the spectral composition of the light sources obtained in 3.4 and 3.5 with those observed in 3.1, 3.2 and 3.3.

4 Laser Measurements

Do not use the handheld or grating spectrometers to measure the lasers. Really.

NB: since we have only one Ocean Optics spectrometer available, you will need to take turns with other groups. It is OK to collaborate with another group on this measurement.

4.1 It is not possible to shine a laser into the optical fiber because the intensity of the focused laser light would overwhelm the spectrometer even at very short integration time. However, you may be able to do so using the following procedure.

4.2 Shine a laser onto a white sheet of paper. Then point the optical fiber toward the same location on the sheet of paper.

4.3 Adjust the gains (integration time) accordingly to obtain an unsaturated spectrum and record it. *If this does not work, try using nearly-crossed polarizers or a Wratten neutral density filter to attenuate the laser.*

4.4 Repeat with the other two lasers available.

4.5 In the report, compare the spectral composition of the laser sources obtained in 4.3 and 4.4.

4.6 Compare the spectral composition of the laser source with that of an LED, and that of an incandescent light bulb.