Gas Spectroscopy
Lab #7

Objectives: In this lab, we will learn how to use a spectroscope, how to identify gas lamps by their spectral lines, and how to appreciate the wealth of information one can obtain from the spectrum of an object.

Category: Guided Investigation

Part 1: The Spectroscope

By looking at, and into the spectroscope try to discover how a spectroscope works. In particular, try to think about the following questions:

• What does the spectroscope do to the light?
• What are the different components of the spectroscope?
• What do the numbers inside the spectroscope correspond to?

Part 2: Exploration of different spectra

Using the spectroscope, try to look at different objects around you. Look at both, sources of light and “regular” objects, such as the wall. Make sure also to look at an incandescent light bulb. If it is clear, go outside and look at the Moon as well. Describe/draw what you see. Furthermore, try to answer the following questions as you go along.

• How many kinds, or types, of spectra did you observe? Consider the spectrum of the Sun as well.
• Did any objects have exactly the same spectrum? Why?
• What spectrum do you expect regular objects to have? Why?
• What kind of spectrum does the Moon have?
• Why does the Moon have the spectrum it has?
Part 3: Calibration

Every gaseous element produces a characteristic emission line spectrum when submitted to an electric current. The goal in the following two parts of the lab is to learn to match elements with their spectral signatures. In order to do that, you shall measure the wavelengths of their spectral lines and compare them to observed spectra of known elements. The scale inside the spectroscope gives you a rough idea of the wavelength. However, as always with optical instruments, things shift and distort over time. Thus, it might not be very accurate. In order to increase your accuracy, you shall first calibrate your spectroscope. To this end, simply look at fluorescent light through your spectroscope and compare your readings with the following list of lines:

<table>
<thead>
<tr>
<th>Color</th>
<th>Wavelength (Å)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Violet</td>
<td>4100</td>
</tr>
<tr>
<td>Violet-Blue</td>
<td>4375</td>
</tr>
<tr>
<td>Turquoise</td>
<td>4900</td>
</tr>
<tr>
<td>Green</td>
<td>5450</td>
</tr>
<tr>
<td>Orange</td>
<td>5900</td>
</tr>
<tr>
<td>Red</td>
<td>6100</td>
</tr>
</tbody>
</table>

- Is there a consistent shift between your measurements and the given wavelengths, or is there distortion?
- If you have a constant shift, how much is it?
- If you have distortion, in which direction is it? How much distortion is there? (Try to quantify it the best you can.)

Now that you calibrated your spectroscope, make sure to always use that same one to perform further measurements.

Part 4: Gas spectra

Your instructor has set up several gas tubes around the room. Your mission is to identify, for each gas tube, which element is inside. To help you, you will
be handed out spectra of various known gases that you should be able to match with your observations. Again, make sure to record all your observations, and defend your choice for a match.

Conclusions

• Did this lab help you attain the objectives mentioned above? If yes, how so? If no, why?

• Which parts of the lab were helpful to your understanding, and which ones were rather confusing? How so?