

Spectra Lab

In this lab you will investigate emission, continuous and absorption spectra through the study of gas emission tubes.

How an emission tube works:

An emission tube passes an electric current through a tube of pure elemental gas, exciting electrons inside the atoms of that gas to higher energy states. Those electrons emit light of very specific wavelengths (colors) as they cascade down to lower energy levels. Every element has a unique emission spectrum, which corresponds to the energy levels available to electrons in that element. Astronomers use spectra as a tool to study the temperature and composition of objects in the universe.

Note: It is very important that you not touch the power supply or the emission tube at any point during this lab!

Materials:

Emission Tube Power Supply
Hydrogen, Helium and Neon emission tubes
Bug light
Regular incandescent light bulb
Diffraction Grating
Solar Spectrum Chart
Colored Pencils

Observation 1: Hydrogen

Have your instructor insert the Hydrogen emission tube into the power supply. Turn off the lights and hold a diffraction grating up to your eye. Look slightly to the side of the emission tube and you should see a series of bright lines of different colors. Draw what you see below with colored pencils. Pay close attention to the colors, spacing and brightness of each line. You should draw brighter lines thicker and try to accurately represent their spacings. Use the whole width of the paper and don't cluster your lines together.

If each of these colors represents one possible transition of an atom from one energy level to another, what do you think the brightness of the lines indicates?

Observation 2: HELIUM

Have your instructor insert the Helium emission tube into the power supply. Again, sketch what you see below.

How is this spectrum different from hydrogen?

Observation 3: NEON

Have your instructor insert the Neon emission tube into the power supply. Again, sketch what you see below.

What color of light is the most abundant in the Neon spectrum?

What color does it appear to be to your eye?

Are they related to each other? How and/or why?

Look back at the other two emission tubes. What colors do they appear from a distance?

Given your observation, do you think that all "neon lights" actually contain neon in them? Why or why not?

Observation 4: ELEMENT X

Have your instructor insert the Element X emission tube into the power supply. Again, sketch what you see below.

Once you're finished, see your instructor for a set of comparison spectra. What element is this? How can you tell?

Observation 5: Bug light versus regular incandescent light bulb.

First observe the spectrum of a regular incandescent light bulb then that of a "bug light". Sketch both below.

Incandescent light bulb:

Bug light:

How are they different?

Bug lights claim to keep bugs away from them. Given your observation of the two spectra, which range of the spectrum do you think bugs see in? Explain your answer. Hint: what color are bug zappers, which lure bugs in with their light and then zap them?

Observation 6: GE Reveal Bulb

First observe the spectrum of a regular display case light bulb (it has a long slender filament) then that of a GE reveal bulb. Sketch both below.

Display Case Bulb:

GE Reveal Bulb:

How are their spectra different?

How are their colors different (without the diffraction grating)?

Based on your knowledge of the spectra, explain WHY the colors are different.

Observation 7: The Solar Spectrum

Study the solar spectrum you have been given and the accompanying information. What kind of features do you see? Describe them in words or through a labeled drawing below.

According to the information you were given, what do the dark lines represent? What causes them and what do they reveal about the composition of the sun?