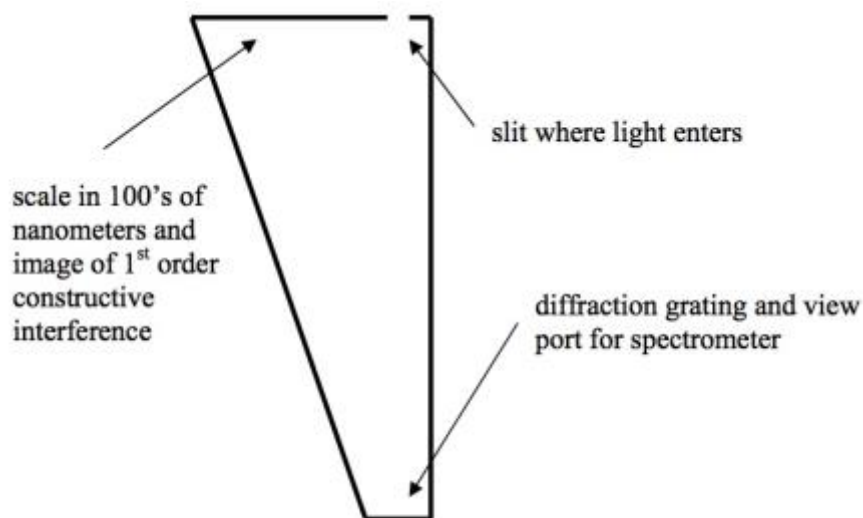


The Spectroscopy of Stars

In this activity you will use a hand held spectroscope to investigate a number of known and unknown light sources. A spectroscope is an instrument that helps to observe the spectrum of light (the specific wavelengths present). This spectroscope works in the visible region of the electromagnetic spectrum but scientists have comparable instruments to investigate the ultraviolet and infrared portions of light as well. Based on the spectrum you observe you will try to identify the types of elements present in different light sources.

Spectroscope

Today we will be using commercial spectroscopes that can be purchased for about \$10. The spectroscopes are based on a diffraction grating, a series of thinly spaced slits that are about 1 micrometer apart. When light passes through each slit it spreads out. The light spreading out from adjacent slits interferes and adds either constructively or destructively. The location where the light adds constructively will depend on the wavelength, therefore the diffraction grating is a dispersive element like a prism. The spectroscopes we will be using today have a scale in units of 100 nanometers, allowing us to quantitatively measure the wavelength of the colors of light observed.

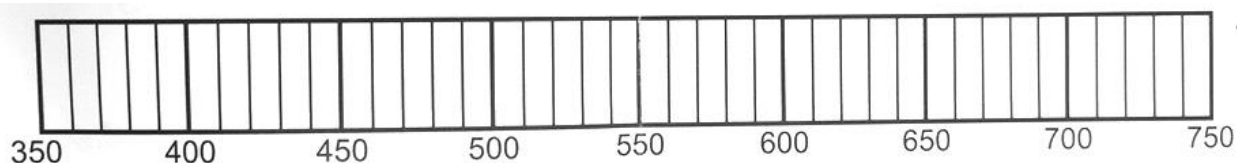


White incandescent light

Looking through the view port of your spectrometer, point the slit directly at an uncovered light bulb. You should observe the spectrum on the left, directly above the scale. A dimmer image will also be visible on the right of the scale. This is caused by diffraction of light through the transparent scale and should be disregarded.

1) Record in words what you observe.

2) Make a sketch of your observations. What colors do you see? Do you see equal amounts of all the colors?



Fluorescent Lights

Point your spectroscope at one of the overhead fluorescent lights in the room. Common fluorescent light contain a gas in the tube but there is a phosphor coating in the tube that glows to create light that is more white in color.

1) Record in words what you observe. Compare to your observations of the incandescent white light source.

2) Explain why the fluorescent lights look white to the naked eye.

3) Which element can you confirm is present in the fluorescent lights? Use the spectra on the last page and justify your answer.

Emission Lamps

We will look at a few emission spectra for different elements. Each contains a glowing gas of a single element. (For each lamp make the following observations.)

Krypton

1) Color when viewed with the naked eye?

2) Compare your observations with the Kr emission spectrum below. Are they the same?

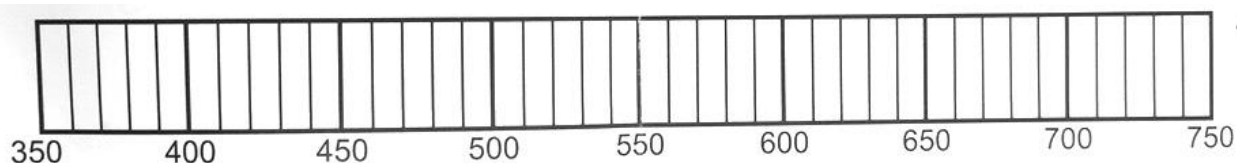


3) Explain why you see the color listed in (1) when you look at the lamp without the spectroscope.

Unknown #1

1) Color when viewed with the naked eye?

2) Make a sketch of your observations.



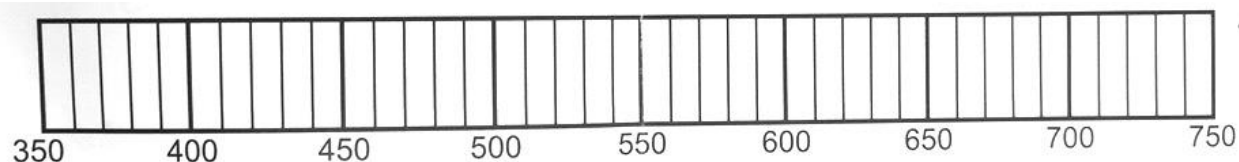
3) Compare the observed spectrum to the spectra on the last page and identify the element.

4) Explain why you see the color listed in (1) when you look at the lamp without the spectroscope.

Unknown #2

1) Color when viewed with the naked eye?

2) Make a sketch of your observations.



3) Compare the observed spectrum to the spectra on the last page and identify the element.

4) Explain why you see the color listed in (1) when you look at the lamp without the spectroscope.

The Sky

NEVER POINT YOUR SPECTROSCOPE DIRECTLY AT THE SUN. YOU MAY DAMAGE YOUR EYES.

Begin by closely reviewing the spectra of an incandescent lamp. Go outside and point your spectroscope at the empty blue sky. You may find it helpful to stand in the shade and point your spectroscope at the brightly illuminated side of a white building.

1) Carefully look at the spectrum of the Sun and record your observations. You may observe several dark vertical lines overlaid on the continuous thermal spectrum. It is very difficult to see and you may not be able to observe them.

2) If the spectrum of the Sun shows a continuous band and with distinct dark lines, what does this represent?

Emission spectra for common gases (the color of each lamp with the naked eye is also indicated).

Hydrogen (H)



red color

Helium (He)



gold color

Neon (Ne)



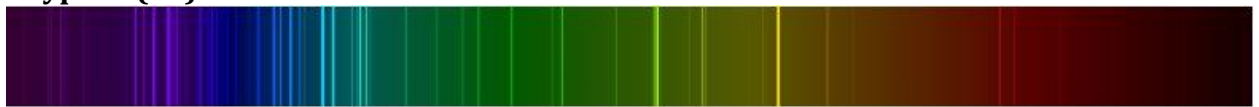
red color

Argon (Ar)



purple color

Krypton (Kr)



white color

Xenon (Xe)



blue color

Mercury (Hg)



blue color