

Spectra I

•Materials

diffraction grating
helium lamp
oxygen lamp
hydrogen lamp
sodium lamp
mystery lamp

•Introduction

The figure below is an example of several spectra from each stellar **spectral class**. In each spectra, you can see not only what colors are emitted, but also dark lines, called **absorption lines**. The continuous spectrum is created by the hot glowing gas in the low-lying levels of the star's atmosphere. The absorption lines are created when this light flows outward through the upper layers of the star's atmosphere. Atoms in these upper layers absorb radiation at specific wavelengths, which depend on the specific kinds of atoms present. Scientists group stars with similar spectra into spectral classes. Above or below the diagram, label the following absorption lines:

- 1) $H\alpha$: red, strong in the mid spectral classes
- 2) He I: yellow, strong from O to K
- 3) $H\beta$: blue-green, strong from B5 to F5
- 4) Na I: yellow, strong in M
- 5) $H\gamma$: blue, strong in B and A stars.

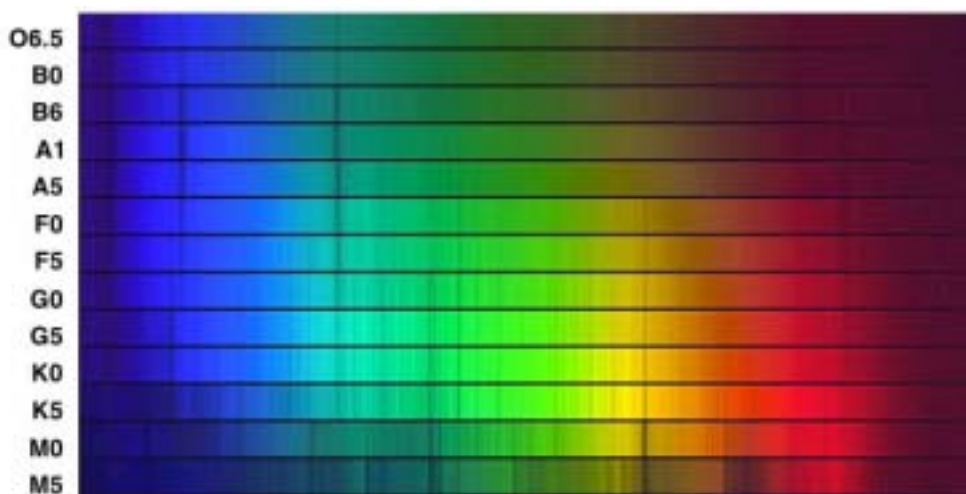
You may be wondering what the symbols α , β , and I refer to. $H\alpha$ is the symbol for hydrogen alpha, the Balmer alpha electron transition for hydrogen. Similarly for $H\beta$, only the Balmer beta transition. Refer to your text for more information on energy level transitions. I refers to the fact that helium in this case is not ionized. He II is helium that has lost one electron, Fe IX has lost eight electrons, and so on.

A gas made of a certain element has its own characteristic absorption lines. In this lab, you will look at spectra from several gases, making detailed observations of the lines. This will prepare you for the next lab, Spectra II, where you will actually analyze the spectra of some stars and identify their chemical makeup by observing their absorption lines.

•Procedure

1) Your lab instructor has several gas lamps, one with helium gas, one with hydrogen gas, one with oxygen gas, one with sodium gas, and a mystery lamp (you have to guess what's in it). You will be given a diffraction grating, which works like a prism, spreading out the wavelengths of light. As the instructor turns on each lamp, hold the diffraction grating to your eye so you see a spread of colors. There are only two orientations for the diffraction grating, one that you will be able to see the bands and one you won't. Ask your lab instructor if you cannot make out the bands. Write or draw your observations.

2) Although each lamp cannot be on for more than about 30 seconds, your instructor will turn on each lamp several times. Draw in the absorption lines you see in the appropriate boxes on the following page.



Copyright:
KPNO 0.9-m
telescope,
AURA, NOAO,
NSF

Hydrogen

blue

red

Helium

blue

red

Oxygen

blue

red

Sodium

blue

red

Mystery

blue

red

3) What is mystery lamp?

4) **Turn in your observations for credit.** Your instructor will return them to you for the Spectra II lab, where you will use them to help you identify the absorption lines of the stars you study.