Stellar Spectra. You are an astronomer! *Estimating Stellar Surface Temperatures, Chemical Compositions, and Motion from Spectra of Stars*

Write your answers on this page. Due by the BEGINNING of class Monday 7/7/2008. You may hand it in early anytime in class. Late = zero credit. See helpful HINTS on course webpage.

You already know that as the temperature of an object emitting a thermal (continuous) spectrum increases, the wavelength corresponding to the intensity peak of the spectrum gets shorter ("bluer"). You also know that Wien’s law is the equation that relates the temperature and the wavelength where a thermal spectrum peaks ($\lambda_{\text{peak}}$, or $\lambda_{\text{max}}$, same thing):

$$\lambda_{\text{peak}} = \frac{2900 \text{ K} \cdot \text{micrometers}}{T}$$

(where 1 micrometer is equal to $10^{-6}$ meters)

(Note: Here Wien’s law is expressed in different units than we used in class (meters) or in your textbook (nanometers). It’s the same law! Some books just prefer to express it this way. They just used a conversion factor to change the units from meters to micrometers. Both ways are correct.)

Using the equation: For example, if the temperature of the object is 6000 K, then peak intensity of the spectrum is located at a wavelength of $2900 \text{ K micrometers} / 6000 \text{ K} = 0.4833 \text{ micrometers}$. (Visual: on the middle, dashed spectrum below, the location of $\lambda_{\text{peak}}$ is marked with the downward arrow.)

1. Calculate the peak wavelengths for two objects of $T = 5000 \text{ K}$ and $T = 7000 \text{ K}$:
2. On the next page you will find real spectra taken from six different stars and plotted on the same graph for ease of comparison.

(a) Which of the three basic types of spectra do you see in these stellar data? (There are more than one)

(b) Calculate the temperature of the stars labeled A7IV and G8IV using the spectra and the equation from page 1. HINT: Estimate the continuous spectrum for each star as demonstrated in class by drawing a “best fit” curve through the spectrum.

3. Chemical composition. Now you will determine the chemical composition of the surfaces (photospheres) of the stars. Use our on-line laboratory spectra of different gases; we call these “comparison spectra”: http://www.radiochemistry.org/periodictable/gas_spectra/index.html (this site is also linked from our course web site on the “Homework” page).

(a) Which of the three basic types of spectra do you see in the COMPARISON spectra? (There are more than one.)

(b) Use the comparison spectra to determine which chemical element is present in the star, A7IV, and write the name of the element below:

(c) Which of the other stars also contains that element? Do the others stars contain other elements? Very briefly, explain how you can tell.
NOTE: The shaded region indicates the extent of the visible spectrum, which is also the extent of the comparison spectra.
Here is a real spectrum of the star Sirius (Alpha Canis Majoris), followed by a hypothetical star, Bob.

4. **Motion.** Star Bob (lower spectrum) is identical to Sirius in luminosity, surface temperature, composition, and distance from Earth. Assume no dust between us and either star.

(a) In which direction (relative to Earth) is star Bob’s motion? *How can you tell?*

(b) Sketch what star Bob’s spectrum would look like if Bob’s motion had the **same speed** but in the **opposite direction**. (Draw it directly on one of the above graphs.)