Stellar Spectra

ASTR250

April 3, 2018

Goals

1. Recognize features in stellar spectra and correlate these with the surface temperature
2. Understand how the spectra of giants and dwarfs can be distinguished, even if the surface temperature is the same

Question 1 Read the main sequence stellar data from `StellarDataMainSequence.xls` into `python` arrays. Recall how this was done with `pandas` from ICE. Also use the functions `Luminosity`, `Radius` and `Temperature` from the notebook, which give a parameterized version of the main sequence. (It is not perfect!) Make the following plots for the main sequence:

1. The "theoretician's" main sequence, temperature (increasing to the left) versus luminosity. A log-log scatter plot will probably work best for the data from the spreadsheet. Put the version from the python functions on the plot as well.
2. The "observer's" main sequence, $B - V$ color versus M_V (bolometric luminosity determined from V band). A log-log scatter plot will probably work best for the data from the spreadsheet.
3. Luminosity as a function of stellar mass. Use both the spreadsheet data and python functions.
4. Radius as a function of stellar mass. Use both the spreadsheet data and python functions.
5. Temperature as a function of stellar mass. Use both the spreadsheet data and python functions.

Question 2 Use the the `StellarData.xls` to calculate the surface gravity of stars of type B8V, A0V, A2V, A8V, F5V, G0V, K0V, K4V, M0V, M4V, M7V and M1Iab, and download stellar spectra that are representative of these stars' surface temperatures and surface gravity from the Phoenix database

http://phoenix.astro.physik.uni-goettingen.de/?page_id=15

The surface gravity g is defined in the same way as one usually defines the gravitational acceleration at Earth's surface

$$g = \frac{GM}{R^2} \tag{1}$$

where we usually express g as $\log_{10}\left(\frac{g}{1 \text{ cm s}^2}\right)$. Plot these spectra over the range 400 to 900 nm in a series of plots so that you can compare features between the spectra.

Question 3 Label the transitions of hydrogen from $n > 2 \rightarrow 2$ on the spectra above. You will need to remind yourself how to calculate these. For plotting, `plt.axvline` is helpful. Make plots of a zoom of all the spectra (on top of each other) near 656.6 nm. Which spectral type has the narrowest line there? Which has the broadest?