HOMEWORK #16 (due start of class February 24)

LEARNING GOALS for this assignment:
1. To practice the radial velocity method of detecting exoplanets, using an authentic example.

TO RECEIVE FULL CREDIT:
1. Staple multiple pages and identify yourself by Star Name (worth 5 points!).
2. You must **show how** you derived your answer by writing all the logical steps that led you to it. Follow the format of the "Homework Example" on our Web site.
3. All sentence responses must be typewritten and in complete sentences. You may handwrite any arithmetic. Use good English grammar.
4. **If you work more than three hours on this assignment, you should stop, record your work here, and contact Dr. McCarthy or Mr. Hammer (our Teaching Assistant) for help.**

Part I. Reading

At the SDSS Web site below, read the *Spectral Types* project linked below. Do not do any of the questions (red) or exercises (green); instead, just try to understand the main concepts.

http://skyserver.sdss.org/dr16/en/proj/advanced/spectraltypes/spectraltypeshome.aspx

Part II. The Exoplanet of 47 Ursae Majoris

In 1992, an exoplanet was detected orbiting the star 47 UMa, via the radial velocity technique. The data is shown graphically below. The star has the following properties: 1.48 L_{Sun}, 1.08 M_{Sun}. The following questions are based on assigned reading in our textbook (Section 12.3). You may assume circular orbits.

a. Draw a schematic diagram (looking down perpendicular to this solar system) showing the positions of the planet and the star relative to the center of mass when the velocity of the star is measured to be +50 m/s, 0 m/s, and -50 m/s. Indicate direction to observer. [NOTE: By definition, negative velocity indicates an object is coming towards the observer, i.e., a "blue-shift."]

b. Assuming the period of the orbit from the curve below is 2.95 years, calculate the planet's semi-major axis (in AU).

c. Estimate the minimum mass of the planet (in Jupiter masses).

d. What "solar flux" does this planet receive (quote as ratio to flux Earth receives from the Sun)? Based on the calculated equilibrium temperature, would you expect liquid water to be on the surface of a possible moon of this planet?