Assignment 3

Due the night before class: Monday, February 4 by 8:30 pm

You are reading two things for Tuesday's class - the last two pages of Ryden & Peterson's Ch. 12 on the properties of known exoplanet systems and the Beatty et al. paper on the discovery of the exoplanet KELT-2Ab.

I can't emphasize enough that you can learn many things from the paper even though you inevitably will not understand everything in it even after reading it a couple of times. Tuesday's class will *not* be the last time we discuss the paper. And once we have a relatively good understanding of most of the main points in this paper, you will be well-equipped to read other papers on exoplanets. I will post more annotations of the paper later today (and will send you an email when I do so).

To prepare for Tuesday's class, I'd like you to take another careful look at the first two figures in the Beatty et al. paper and answer the following questions:

1. Explain in roughly one long paragraph what Fig. 1 is showing. Ignore the lowest, bisector, panel. Describe what is being measured with each data point in the main panel, what is plotted on each axis, what the red line is, and what the middle panel shows (you can deduce it from the top panel; there's no new information in the middle panel). Do you think the fit is good (i.e. are the data well-described by the model)? Why? Explain how the planet's mass is determined from this plot.

2. What is being plotted in Fig. 2 and what can we learn from it? Again, no more than one long paragraph.

For both questions, imagine you are writing for a chemistry major or someone like that who is comfortable with numbers and the idea of an experiment that sets out to show that something is or isn't true. But assume you have to explain the *meaning* of the quantities plotted on the axes, for example, not just regurgitate the raw information in the labels.

Strive to make your written answers flow in a coherent narrative, rather than being a list of bullet points.

3. Post one (or more) question(s) about the paper (big picture or small scale, your choice) on the news forum I've set up on the Astro 94 Moodle page.

Please email me your responses to 1 and 2 and post for 3 by 8:30 pm on Monday night.

We'll discuss these figures in class, and discuss what can be determined about an exoplanet from these sort of data. One issue we'll touch on is the role of orbital inclination angle (that pesky "sin *i*" term in the radial velocity version of Kepler's

third law we saw in the Ryden & Peterson reading from last week). We'll also summarize a few of the key results from the last decade of exoplanet discovery (the Ryden & Peterson two-pages of reading for this week). I'll also show you some stellar spectra so you can see how the Doppler shift (radial velocity) measurements themselves are made.

Other topics I'm hoping to have the time to touch on include:

- Why are those transit light curves not flat bottomed?
- What is up with the *phases* of exoplanets and what could we learn from those systems where starlight reflected off the exoplanet is detectable in the observed light curves?
- It's convenient to scale star masses and radii to those of the Sun. How do we know those properties of the Sun?

But I'm also intending to have much more student discussion (and a little in-class problem solving) than in our first two class meetings.

This will, I hope, give you all an opportunity to ask questions about the material you've been reading and thinking about.