Exoplanet Name: _____

Prelab 9: The Radial Velocity and Transit Methods for Exoplanet Detection

Due Friday, November 9 at the start of class

Must be handed in on paper to the assignment inbox

Please write legibly or type your answers. Illegibile assignments will not be graded

1. *Remind yourself what the following terms mean by defining them in your own words. A picture may help as well.*
   (a) Semimajor Axis
   (b) Eccentricity
   (c) Doppler Effect (for light!)

Method 1: Radial Velocity

2. Based on what you learned in class, describe how planets are detected via the radial velocity method. It may help to draw a picture.

3. *Go to the following website to learn more about the RV Method.*
http://astro.unl.edu/naap/esp/animations/radialVelocitySimulator.html

With the simulator at that link, try altering each of the following properties of the star-planet system, one at a time. Watch what each does to the Radial Velocity curve at the upper right. In particular, watch the x and y-axis values of the graph (which will tell you the amplitude, or strength, of the signal and the period) and the shape of the curve. Describe the observable effect of changing each of the following parameters on the curve in words (do shape, amplitude or both change? in what way?), and draw and label an RV curve showing this effect (e.g. show a high mass curve in one color and a low mass curve in another).

Planet Properties:
- (a) Planet Mass
- (b) Planet Semimajor Axis
- (c) Planet Eccentricity

Star Properties:
- (d) Mass

4. Based on what you discovered in problem 3, what kinds of planets are astronomers most likely to find through the radial velocity method? Answer by circling or bolding a choice for each of the options below.

   Astronomers are most likely to find (low/high) mass planets in (close/far) orbits around (low/high) mass stars.

Method 2: Transits

5. *Go to the following website to learn more about the Transit method of planet detection: http://astro.unl.edu/naap/esp/animations/transitSimulator.html*

Using the simulator on the website, vary each of the following parameters and watch its effect on the light curve in the upper right. This time, watch the depth and length of the transit and describe in words how they vary when you change the parameters. Draw and label a light curve showing each effect (e.g. a light curve for a high mass planet in one color and low mass in another).

Planet Properties:
(a) Planet Mass
(b) Planet Radius
(c) Planet Semimajor Axis
(d) Planet Eccentricity
Star Properties:
(e) Star Mass

6. What does the information you gathered in question 5 tell you about what types of exoplanets are most easily detected via the transit method? Write a statement similar to the one you circled at the end of your radial velocity investigation.

7. Now try changing the inclination of the system (under "System Orientation and Phase"). What happens as you move the slider from right to left? Can you make the planet transit disappear? If so, over what range of inclinations is it visible and over what range is it invisible?

8. What does the result of your investigation for question 7 tell you about the geometry of transiting exoplanetary systems and the likelihood of our detecting planets via this method? What types of systems can we see transits in and which can't we?