Astronomy 205 - Homework #1

Due – October 19, 2006

Work on these problems independently.

Question 1

In class, we calculated the radial velocity of the Sun in a solar system consisting of only the Sun and Jupiter. Calculate radial velocity (in m s\(^{-1}\)) of the Sun in a solar system consisting of only the Sun and the Earth. How does this velocity compare to that of the Sun-Jupiter system?

Question 2

In a recent Nature article, Sahu and his collaborators present the detection of several candidate extrasolar planets. What technique was used for these observations, and what is the advantage of the field observed for the observations? What are the biases in the technique (i.e., is the technique biased towards, for example, finding Earth mass planets far from their host star?)?

Question 3

In class, we derived the following expression,

\[
\frac{dA}{dt} = \frac{1}{2}rvT
\]  

(1)

as a way of proving Kepler’s 2nd Law. Using this expression, and the equations for pericenter and apocenter, derive equations for the tangential velocities at pericenter and apocenter. These equations should be expressed in terms of eccentricity, period, and semi-major axis distance. (Hint: as a first step, rewrite the equation (1) in terms of the area of an ellipse and the orbital period.) Input the values for Mercury’s orbit to calculate its velocity at perihelion and aphelion.

Question 4

Calculate the amount of solar radiation absorbed by Venus (in W m\(^{-2}\)). For this calculation, you should take into account the Bond albedo of Venus. Do the same calculation for the Earth. Which planet absorbs more radiation per m\(^2\)? Now calculate the temperature (in K) Venus would have if (a) it rotated rapidly and (b) if its rotation period was equal to its orbital period. For this problem, ignore the Greenhouse effect.