AST s309L (summer 2012)

Homework Assignment 1

Due: Wed., July, 18th (in class)

Q1: describe the scientific method and explain why astrology is not a science.

Q2: research (and then describe) the differences in internal composition between Jupiter and Earth.

Q3: use the equation for the radial velocity signal (lecture 2, slide #7) to compute the signal $\mathbf{V_{obs}}$ for 3-5 different values of the mass of the central star $\mathbf{m_s}$ for a planet with the same mass $\mathbf{m_p}$ and same orbital period **P** (you can select the values for these two parameters). We also assume the fortunate case that $\boldsymbol{i} = 90^o$.
Units: **P** in years, $\mathbf{m_p}$ in Jupiter masses, $\mathbf{m_s}$ in solar masses => $\mathbf{V_{obs}}$ will be in m/s.
Find out how the radial velocity signal of your planet changes with changing mass of the central star. HINT: create a graph (even by hand) where you plot $\mathbf{V_{obs}}$ vs. $\mathbf{m_s}$.

Q4: use the equation for the astrometric signal (lecture 4, slide #10, second equation) of an exoplanet, to compute the signal **Θ** for 3-5 different values of the distance **D** to the star.
Units: **M** in solar masses, **m** in Jupiter masses, **a** in astronomical units (AU), **D** in parsec => **Θ** will be in arcseconds.
Use a planet with **m** = 1 Jupiter mass at **a**=5 AU around a star with **M** = 1 solar mass. Find out how the astrometric signal changes with changing distance to the star. Again, a graph will be helpful.

Q5: (answer will not be evaluated): what is the single most interesting (for you) topic or question that you hope to learn about in this course?

Q6: (BONUS): transform the equation from Q3 so that the parameter $\mathbf{m_p \sin i}$ is on the left hand side of the formula and all other parameters are on the right hand side.
Assume that you just built a spectrograph with an awesome radial velocity precision of 1.0 m/s! Let's further assume that your radial velocity signal detection limit is equal to this precision. What minimum mass for an exoplanet will you be able to detect with your new instrument around a star with the mass of the Sun and with a period of 1 year? If possible, give this mass in units of Earth masses!