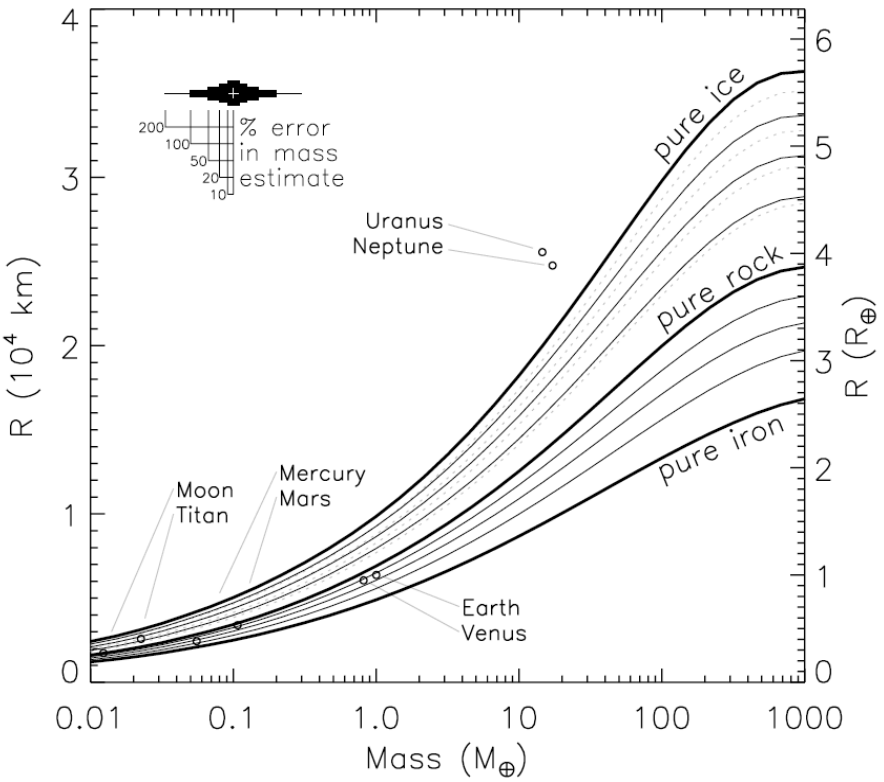
# Astro 118 – Physics of Planetary Systems
## Problem Set #5, Winter 2014
## Due in class on Monday, March 3, 2014

1) Show that Equation 6.12 in our book is true. Note that there is a typo: "*D*" should be "*d*." Also, I only got this to work if I assumed that $A_B = A_g$ (that the Bond albedo = geometric albedo) which is not necessarily a great assumption. Let me know if you get it to work without that…

2) In class we derived an expression for column density $N$ (molecules/cm$^2$), when looking directly up from a given location with a local number density of $n_0$ molecules/cm$^3$. $N = n_0 H$. What is the expression for the column density when looking towards the horizon, instead of looking up? You can assume a constant scale height $H$ (constant $T$, $g$, $\mu$) and that you are standing on a planet with radius $a$, and the local number density is again $n_0$ molecules/cm$^3$. The planet radius will appear in your answer. This is very relevant to transmission spectra of transiting planets, since light passes through a planet's atmosphere at this geometry.

3) Problem 6.2 from our book.

4) Calculate the expected increase in the global average temperature of the Earth at a full Moon (when we see the moon at full phase) compared to a new Moon (when we see no light from the moon). Neglect eclipses and orbital eccentricity. The radius of the Moon is 1700 km, the semi-major axis of the Moon's orbit is 384,000 km, and its geometric albedo in a very wide visible bandpass is 0.10. Earth's Bond albedo is 0.3.




5) Using this diagram and the Internet, estimate the composition (mass fractions of components, like iron, rock, water) of the transiting planets: 55 Cancri e, GJ 1214b, HD 97658b, Kepler-10b, Kepler-11b

*Be sure to write down the masses and radii that you use for each planet.* The three thin curves between each thick curve are for mixtures of 25/75, 50/50, and 75/25 by mass of the two components. So Earth is 2/3 rock, 1/3 iron, for example. Ignore the thin dotted curves. For reference, Uranus and Neptune have H/He atmospheres that are 15% of their mass. Don't go overboard with significant figures. This should be relatively quick.