Homework 1, due Friday September 28  
Astronomical Ideas, Haverford College  
Fall 2012, Professor Willman

To receive full credit on homework, you must show all work and answer the questions completely. The graders and I need to be able to tell what question you are answering and how/why you’re doing what you’re doing. Think about the answers that you find and what they mean.

1. a. Look up the diameter of a helium atom and its nucleus on the internet. Quote your source.  
b. Create a scale model of an atom. Using 8 inches for the diameter of an atom’s nucleus (like ~8 inches was the diameter of the Sun in our scaled Solar System model), what is the corresponding scaled-size of an entire atom? If our scaled atom is centered on Founder’s Green, where might the edge of our scaled atom lie?  
c. What fraction of an atom’s volume is occupied by its nucleus?

2. Astronomers estimate that the universe is 13.7 billion years old. To help put this age in context, we will make a scaled model of the Universe’s age: 1 year in the scaled model = 13.7 billion years. If right now is the stroke of midnight on Dec 31, at what time in the year:

   a) Was the first telescope made? (1609)  
   b) Did the first Homo sapiens evolve? (~200,000 years ago, from wikipedia article on humans)  
   c) Did the Sun form? (4.6 billion years ago)

Show your work.

3. Had Kepler lived on one of a group of planets orbiting a star three times as massive as our Sun, would he have deduced the same empirical laws? Briefly explain. [From the book 21st Century Astronomy by Hester et al.]

4. During the latter half of the 19th century, a few astronomers thought there might be a planet circling the Sun inside Mercury’s orbit. They even gave it a name: Vulcan. We now know that Vulcan does not exist. If a planet with an orbital radius a fourth the size of Mercury’s actually existed, what would be its orbital period relative to Mercury’s? [From the book 21st Century Astronomy by Hester et al.]