Astronomy 321: Assignment #3

Notes:
1. There are 3 x 10^{18} cm per parsec.
2. 1 Mpc = 1 MegaParsec = 1,000,000 parsecs

1. Go to the url http://homework.uoregon.edu:8080/hubble/hubble.jnlp. This represents a measuring inteface to Hubble's original data. You are to use this simulation to measure angular diameters and redshifts (from real spectra) to derive your own relation between redshifts and angular diameters. You should find a noisy relation between angular diameter and redshift but the general sense will be that the smaller diameter galaxies have larger redshifts. This simulation will be demonstrated on tuesday in class. Select 20 galaxies from the drop down image list and make the requisite measurements. Turn in a data table and a graph of that data.

2. Using a simple conservation of energy argument involving the kinetic energy of a particle in comparison to the potential energy of the universe to show that the critical density of the Universe is

$$\rho_c = \frac{3H^2}{8\pi G}$$

3. For a point mass object, show that circular velocity of an orbit about that point mass declines as $R^{-1/2}$ (like it does in our solar system), where R is the distance between the orbiting object and the point mass.

4. For a value of $H_o = 100$ km/s per Mpc, numerically calculate what the critical density of the Universe is. Compare that density to the density of a typical galaxy which has a mass of 10^{12} solar masses and a radius of 20 kiloparsecs. For simplicity, assume the galaxy is spherical.

5. The sun is located at a distance of 8 kiloparsecs from the center of the Galaxy and has an orbital velocity of 220 km/s. Compute the orbital period of the sun around the galaxy as well as the mass of the galaxy enclosed within the orbit of the sun. Suppose we observe a star located at a distance of 80 kpc from the center of the galaxy and it too has an orbital velocity of 220 km/s. What is the orbital period of that star and what is the mass of the galaxy? Does these orbits obey Kepler's Laws?