Astro 425 Cosmology: Problem Set 2

Due October 12th 2015

Please answer all questions using an ipython notebook

1. If we lived in a Olberian universe (a) calculate the distance at which any random line-of-sight will intersect the surface of a star (this is referred to as the point at which the optical depth of uniformly distributed stars is unity)

   Assume all the stars have the same luminosity as the Sun, the average number density of stars is 10^9 Mpc^{-3}, and the radius of the stars is $7x10^8$m.

2. When Edwin Hubble measured the expansion rate of the universe he derived a Hubble's constant of 500 km s^{-1} Mpc^{-1}. To get this value of H_o how incorrect were his estimates of the distances to Cepheid stars. How does his value of the universe change the age of the universe and would we need to live in an accelerating or decelerating universe in order to reconcile the Hubble time with the current age of the universe (13.7 Gyr). Remember to explain your answers.

3. Ryden problem 3.2

4. Using Python solve the following equation **numerically** and plot a(t) vs t. Note "$\cdot$" represents the time derivative,

$$\dot{a}^2 = H_0^2 a^{-3}$$

   where H_0 is the Hubble constant (H_0=70 km s^{-1} Mpc^{-1})

   Solve the integration algebraically and overlay the solution on your plot