Astronomy 312 - Fragile
Homework 6 (assigned 2/25/16; due 3/17/16)

(3) 1. For a temperature of 7.3×10^5 K, make a graph of the Planck function, plotting $\log_{10} \nu B_\nu(T)$ vs. $\log_{10} \nu$ for $\log_{10} \nu$ between 15.5 and 17.5. How does the behavior of your graph compare with that of Fig. 28.14 for the continuous spectrum of the quasar 3C 273?

(3) 2. Verify that the relativistic redshift formula given in class guarantees that the recession velocity v always remains less that the speed of light. You are welcome to either prove it mathematically or you can simply demonstrate it by choosing a few (say 7) sample values of z between 0 and 3 and reporting both the classical and relativistic recession velocities expected at those redshifts.

3. The radio galaxy Cygnus A has an observed radio flux density of 2.18×10^{-27} J cm^{-2} s^{-1} Hz^{-1} at a frequency of 10^3 MHz. The observed redshift of the galaxy is $z = \Delta\lambda/\lambda_0 = 0.170$.

(2) (a) For the radiation observed at 10^3 MHz, what was its rest frame frequency in Cygnus A?

(2) (b) What is the radio luminosity per frequency band (J s^{-1} Hz^{-1}) at 10^3 MHz if the distance to Cygnus A is $d = 240$ Mpc?

(1) (c) To find the total radio luminosity of Cygnus A, we must multiply the result of part (b) by the bandwidth $\Delta\nu$ of our detector. Assume $\Delta\nu = 10^4$ Hz and compute the energy radiated per second at radio frequencies.

(3) (d) What would be the minimum mass of hydrogen that would need to be converted into helium each second in order to provide such a luminosity from fusion?

(2) (e) If Cygnus A continues to radiate at the current rate for 10^8 years, how many solar masses of hydrogen would be converted to helium? Does this seem reasonable if Cygnus A were a stellar source?