AY230 – Homework Set #3

Due November 4, 2008

(1) HII Temperature: Because the recombination coefficient to bound levels of hydrogen $\sigma_n^{rec}(v)$ decreases with increasing electron velocity v, the electrons that are the most likely to recombine have energies less than $3kT/2$. Let the mean energy of electrons that recombine to all bound levels of hydrogen be

$$\bar{E} = f\frac{3}{2}kT = \frac{\sum_{n=1}^{\infty} < \sigma_n v \frac{1}{2}mv^2 >_{max}}{\sum_{n=1}^{\infty} < \sigma_n v >_{max}} \tag{1}$$

Evaluate $f(T)$ for temperatures of $T = 5000, 10000, 15000$, and $20000\,\mathrm{K}$ (an approximate solution is encouraged).

(2) Diagnosing the properties of star-forming galaxy: On the website, you will find a gzipped ASCII spectrum listing the wavelengths (Å) and flux values (units are $10^{-15}\mathrm{erg\,s^{-1}\,cm^{-2}\AA^{-1}}$) of a galaxy. Assume that the galaxy is 450 Mpc away (ignore redshift in the following).

(a) Produce a nice plot of the spectrum identifying all emission lines

(b) Measure the fluxes for these lines. Tabulate.

(c) Estimate the extinction in this galaxy

(d) Estimate the temperature of the HII regions in this galaxy

(e) Estimate the density of the HII regions in this galaxy

(f) Use several methods to estimate the metallicity of this galaxy

(g) Estimate the SFR of the galaxy