

Homework 5: Due Tuesday Oct. 18

READING 1: <http://amazing-space.stsci.edu/resources/explorations/ghunter>

READING 2: <http://nedwww.ipac.caltech.edu/level5/Charlton/frames.html>

1. (9 points) Galaxy Evolution and Classification (Based on Reading 1)

Do the exercise in “Reading 1”. Answer the following questions.

- Give an example of the type of bias that your sample of galaxies could have when you pick by eye?
- As the sample size increases, how does the fraction of irregular galaxies in the sample change?
- What properties distinguish elliptical galaxies from spiral galaxies?
- What is an irregular galaxy?
- Do we see the same fraction of irregular galaxies in the Hubble Deep Field South as in the Hubble Deep Field North?
- What is the most common type of galaxy in the local universe and in the Hubble Deep Fields?

2. (8 points) Quasar Spectrum.

Sketch what the spectrum would look like for a quasar at redshift $z = 2.3$. By “sketch” I mean to draw an graph of flux vs. wavelength to show what the real observed spectrum would look like. Use some of the spectra you see in your notes as a guide. Calculate the observed wavelengths of all features in the spectrum mentioned here.

- Include the Ly α , MgII, and CIV emission lines of the quasar in your sketch (to scale), using the fact that the rest wavelengths of these lines are 1216 Angstroms, 2800 Angstroms, and 1550 Angstroms respectively.
- Draw the Ly α forest and point out a line in the forest produced by a redshift $z = 1.7$ galaxy. Label it by its observed wavelength.
- A damped Ly α system occurs at $z = 1.5$ along the line of sight toward this quasar. Such a system has very strong Lyman series lines. Calculate the observed wavelength of this system and sketch the Ly α (1216 Å) and Ly β (1026 Å) lines at their appropriate locations on your spectrum.
- Draw the Lyman limit break that corresponds to the $z = 1.5$ damped Ly α absorber. The rest frame wavelength for such a break is 912 Å.
- Draw the metal lines of MgII and CIV corresponding to the $z = 1.5$ damped Ly α absorber.

3. (3 points) Quasar Absorption Lines - Short Answer questions based on Reading 2

- Why are Lyman-alpha forest lines never observed in a quasar spectrum at wavelengths longer than the Lyman-alpha emission line of a quasar?
- How does the Ly α forest change over time and why does this change take place?
- Ionizing photons exist all through the Universe and were contributed by the sum total of all galaxies and quasars. If the number of these ionizing photons decreases with time, how will the relative abundance of CIV (triply ionized C) to CII (singly ionized C) in a galaxy halo change with time. Explain. (This is logical. Reason it out.)

4. (6 points) Essay question (1 – 2 page response) What is the most amazing thing that you have ever seen or heard about astronomy, cosmology, or the Universe? Why does it amaze you? How does studying astronomy impact the world? After all, tax dollars are spent on it. Does anything you know about astronomy and the origin of the Universe affect the way that you think about life? Are there other justifications for spending time and money on astronomy?

5. (4 points) Question to the professor. Write a question about something that you are still wondering about. This is required. I will try to answer your question on your graded homework.