Lab 11
How Many Galaxies Are There in the Universe?

15.2 Exercise Section

15.2.1 Direct Measurement, Measurement Error

How many chairs do you think there are in your classroom? You have one minute!

How did you determine this?

How does your number compare with that of other groups? What does this say about the uncertainty in the results?

Now do an exact count of the number of chairs - you have three minutes. By comparing results from different groups, what is the uncertainty in the result?

15.2.2 Estimation

How many chairs do you think there are in the entire University? You might wish to consider the campus map shown in Figure 15.1.

How did you determine your number?

How accurate do you think your number is?

How might you estimate the uncertainty in your number?

15.2.3 How many galaxies are there in the Universe?

1. 1 arcminute = _____ degrees. (3 points)

2. Area of picture = _____ square degrees. (3 points)

3. Number of pictures to cover the whole sky: _____ (5 points)

4. Time to image the entire sky: _____ days. (4 points)

5. Time to image the entire sky: _____ years. (4 points)

6.
Region A1:
Region A2:
Region A3:
Region B1:
Region B2:
Region B3:
Region C1:
Region C2:
Region C3:

There are a total of _____ galaxies in Hubble Deep Field. (10 points)

7. Total number of galaxies in the whole sky: (7 points)

8. Discuss several reasons why your result may not be especially accurate. (8 points)

9. To make our estimate, we assumed that the 10 day exposure sees every single galaxy in this portion of the sky. With this in mind, how would the calculation you just conducted compare to the real number of galaxies in the Universe? Back up your answer with a short explanation. (8 points)

15.3 The Mass and Density of the Universe (Contained in Galaxies)

10. Average Mass of a Galaxy = _____ gm (2 points)

Mass of Universe = _____ gm (2 points)

11. Seconds in year = _____ s/yr

Age of Universe in seconds = _____ s.

Radius of Universe (in cm) = _____ cm. (3 points)

Volume of Universe = _____ cm^3

12. Average Density of the Universe = _____ gm/cm^3 (3 points)

13. Compare your answer for the average density of the Universe to the mass of a single hydrogen atom. Are they similar? What does this imply about the Universe, is it full of stuff, or mostly empty? (3 points)