PHYS133 – Lab 8

Galaxy Zoo

Goals:
- Observe and classify different types of galaxies.
- Discover moving objects in the sky using images taken at different times.
- Practice using the Celestial coordinate system (Right Ascension and Declination).
- Use the coordinate location of reference stars to interpolate the coordinates of an unknown object.
- Use the parallax to determine the distance of an asteroid, using the same technique astronomers use to measure the distance of stars.

What You Turn In:
- The Data sheets at the end of the lab manual.
- Print outs from the program Astrometry of Asteroids.
- Answers to the questions in this manual.

Background Reading:
The www.galaxyzoo.org website, background section of this manual and chapter 16 (especially 16.1) of your textbook.

Equipment provided by the lab:
- Computer with Internet Connection
- Equipment provided by the student:
  - Pen
  - Calculator
Background:
Go to www.galaxyzoo.org. Scroll down to just below the galaxy picture to the heading “History of Galaxy Zoo.” Go to the bottom of the paragraph and click the “MORE” link:

Read the linked article, “The Story So Far.” You will see how the work of volunteer citizen-scientists on previous generations of Galaxy Zoo helped astronomers make genuinely new discoveries. Please take your galaxy classification seriously and do your best work. You do not want a useful galaxy image to be excluded from a scientific research project because you are being careless.

If you use a program that modifies the color scheme of your monitor based on the time of day (such as f.lux), you will need to turn it off while you are working with Galaxy Zoo.

Procedure
1. Return to the Galaxy Zoo main page. On the upper right-hand side, click the “Sign Up” button;

Create your account and agree to the privacy policy. After you sign up, you should be redirected to the main website, but you will no longer see the black bar at the top of the screen that has the “Login” and “Sign up” buttons. If the black bar is still there, enter your username and password and click “Login.”

2. Click the green “Begin Classifying” button. You will land on the galaxy classification screen, which under the menu-bar has an image on the left and the first classification question on the right:
Read the pop-up help page and look at the example pictures carefully. After you understand the differences between smooth galaxies, galaxies with features and/or disks, and stars or other artifacts, click one of the three buttons on the lower-right of your screen to answer your classification question.

The green arrow on the screenshot above points to a button that will invert the color scale: black will become white and vice versa. If you are not sure if the galaxy has features, try the invert button. Sometimes features that are ambiguous in one color map stand out very well in another color map.

3. After you classify the galaxy as smooth, features/disk, or star/artifact, you will be asked a series of further questions that depend on the type of galaxy you chose. The “Examples” button will be there at each step, ready to help you answer each question. Please take your time with your first galaxy. Some features are hard to see—for example, spiral arms and bars can be very faint. You will speed up as you get more familiar with the different types of galaxies and features. At any time, if you feel you have made a mistake, you can click the “Restart” button to start over on your current galaxy.

4. Once you become more comfortable with galaxy classification, you can begin to gather data. Now you will need the “Favorite” button:

To make your dataset, simply keep on classifying. Each time you work on a galaxy whose classification you are comfortable with, hit the “Favorite” button. If the image is hard to classify, extremely faint, or is not a galaxy at all (star or artifact),
do not hit the “Favorite” button. Your dataset is complete once you have put at least 12 galaxies on your favorites list.

5. Now click the “Profile” button at the top of your screen:

You should see thumbnails of the galaxies you have recently classified:

Click on “Favourites” to load your data set. Take a screenshot of your 12 galaxies and hand it in with your lab report.

6. (Note: you can do this step outside of lab meeting. Simply log in to Galaxy Zoo from any computer and load your profile to see your list of favorites.) Now you are going to make a graph similar to the one below:
Bluer galaxies indicate active star formation. When this process is over, the galaxies become much redder (why?).

7. One by one, click on the thumbnail image of each galaxy in your data set. You will see an information screen that looks like this:

For each galaxy, (1) write down the absolute magnitude, and (2) decide whether the galaxy is red, blue, or neither. A galaxy that looks orange-ish or yellow-ish should be labeled red. You may have an easier time deciding on the color when you’re comparing the thumbnail images of all galaxies in your data set.
On a piece of graph paper, neatly (with a ruler) make an x-axis labeled “Absolute Magnitude” and a y-axis labeled “Color.” In astronomy, color is a technical term for the logarithm of a ratio of brightnesses at two different wavelengths. For example, a red galaxy would be much brighter at long wavelengths than at short wavelengths. However, Galaxy Zoo does not tell you the mathematical color of your galaxy, which is why you are choosing colors by eye. Simply draw a dotted horizontal line that divides your y-axis in half. You will place red galaxies above the line and blue galaxies below the line, similar to what you see in Fig. 76.15.

Put numbers on your x-axis. Most galaxies have absolute magnitudes between negative 15 and negative 22; yours will probably fall in a similar range. Choose your x-axis scale so that your faintest galaxy is at the leftmost edge of the axis and your brightest galaxy is at the rightmost edge of the axis. This means you have to number your axis backwards, from highest to lowest. In astronomy, the lowest magnitude (-22 in my dataset) corresponds to the brightest galaxy.

Finally, clearly mark the position of each galaxy at the correct absolute magnitude and color (red or blue) in your graph. If you had a galaxy that appeared neither red nor blue, place it on the horizontal line that divides your y-axis in half.

Neatness counts very much for this lab. If the axes on your graph aren’t straight, if your labels aren’t legible, or if your data points are sloppily drawn, you will not earn full credit.

8. Assess how much your graph resembles the figure on the previous page. Are the brightest galaxies in your dataset blue or red? Are they spiral, elliptical, or a mix of both? Do you have any galaxies in the “green valley” (neither red nor blue, plotted exactly halfway up your y-axis)?

9. Why galaxies in the green valley so rare? Did galaxies in the green valley have their last mergers recently, or very long ago?

10. Galaxy Zoo doesn’t report the mass of your galaxies. In fact, it’s hard to calculate accurate galaxy masses. Your comparison of graph you made for question 6 with the book’s color-magnitude figure is based on the assumption that the brightest galaxies have the most mass. Explain why that assumption might be wrong.

MAKE SURE YOU ATTACH ALL DATA SHEETS AND GRAPHS