Astronomy 128: Galaxies and Galactic Structure

Week 6, Thursday, February 23

Topic: Spiral Galaxies I

This week we'll move beyond the Milky Way and the Local Group galaxies, and take a look at spiral galaxies more generally. We'll look at their photometric characteristics and their distribution of gas, as well as dark matter (as revealed by rotation curves) and the Tully-Fisher relation. Finally, we'll look at the Hubble sequence for spirals a bit more. Next week, we'll tackle the issue of spiral structure and look at theories for how spiral arms form.

Break: Micah (?)

Reading:

Read Chapter 5 of Sparke & Gallagher, up through the end of Section 5.3. If you took Astro 121, Section 5.1.1 on CCDs should be review for you.

Problems:

1. Come to class with at least one *written* question on the reading.
2. We'll talk about the LMC Cepheid paper we put off from last week. Be sure to read over at least the abstract and introduction, and look at the figures.
3. SG 5.3.
4. SG 5.6.
5. SG 5.7.
6. SG 5.8.
7. Do Chris Mihos' galaxy rotation curve lab, found at http://burro.astr.cwru.edu/JavaLab/index.html. Choose "Applets" in the left panel, then choose "RotCurve". Start the applet, and then follow the instructions under the "Lab" link on the left. (Note that there are only three galaxies to fit, rather than the four listed there.)

(a) For each galaxy, record the three parameters of your best fit (halo central density, halo core radius, and disk mass-to-light ratio), as well as the chi-squared of your fit. Capture and print out an image of your best rotation curve.[1] Do this for both the "maximum disk" model and the best-fit model including a halo.

(b) Calculate the galaxy masses and mass-to-light ratios as described on the "Lab" page. Also separately calculate the mass in the dark halo you fit to the rotation curve, using the parameters from your fits; you can find the halo density profile under the "Applet Physics" tab. What fraction of the total mass is in the dark halo?

8. SG 5.10.

9. SG 5.11.

10. SG use NGC 7331 as their "poster child" spiral galaxy throughout this chapter, so let's do one more problem with it. Find the H-band flux of NGC 7331 (e.g., using the NASA Extragalactic Database, or NED), and use it along with the H-band Tully-Fisher relation given by SG to find the distance to NGC 7331. How does this distance compare with the distance given in NED?

11. Investigating the Hubble sequence for yourself: Find high-resolution, color images of three galaxies, one each of types S0 or Sa, Sb or Sc, and Sd or Sm. Using SG's Table 5.1 as a guide, comment on how the differences in galaxy types manifest themselves in your images. Also find rotation curves for your galaxies and compare them, again referring to the classification criteria in the table. One way to get started tracking down a rotation curve is to use NED to find papers that refer to a particular galaxy, and then to search for the word "rotation" in the title.

[1]The applet itself won't let you do this, but most operating systems have a way to do a screen capture. Under OS X, you can do this by pressing Command-Shift-4, and then dragging a box around the area you want to capture. When you release the mouse, the image will be saved as a PDF file on the Desktop. Under Linux, type "import curve.png" in an xterm, and then drag a box around the area you want, which will then be saved as image curve.png (or whatever filename you typed) when you release the mouse.