

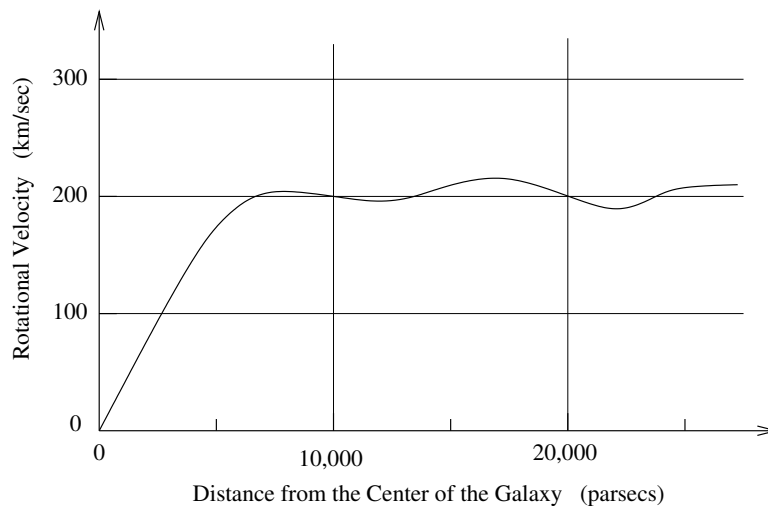
Astronomy 301 – Fall 2019

Homework 10

Due Date: Wednesday, November 13, 2019, 9:00 AM

We encourage you to work together on the homework but you are not allowed to copy from each other. You must write out the answers in your own words.

1. Describe the appearance of typical elliptical galaxies on photographs. What is the range of masses for elliptical galaxies? The range of luminosities? The range of sizes?
2. Describe the motions of stars in elliptical galaxies. How do the motions of the individual stars affect the shapes of the absorption lines in the spectrum of the entire galaxy? How does the mass of an elliptical galaxy affect the speed of the stars. How, then, do we measure the masses of elliptical galaxies?
3. Here is a typical rotation curve for a spiral galaxy. What is the orbital velocity of the gas and stars in the galaxy at a distance of 10,000 pc from the galactic center? At a distance of 20,000 pc? Calculate the length of time it takes material at 10,000 pc to travel in a circle around the center of the galaxy (this is the orbital period of the material). Convert the distance from the center of the galaxy from parsecs to Astronomical Units and convert the orbital period to years. You can check that your answers are reasonable by comparing your results to the results calculated for the Milky Way during lecture. Do the same for 20,000 pc from the center. (Think before calculating the 20,000 pc case. The answer is trivial once you know the answer for 10,000 pc.)



Two more questions on the next page!

4. Using Newton's modification of Kepler's third law and the orbital periods and radii you calculated for the previous question, calculate the mass of the galaxy determined from stars and gas in orbit around the center of the galaxy at distances of 10,000 pc and 20,000 pc from the center of the galaxy. Why are the two masses different? Suppose a photograph of the galaxy shows that nearly all the galaxy's light is emitted at radii less than 10,000 pc (in other words, the galaxy looks like it is about 10,000 pc in radius). What is the source of the extra mass?
5. Rich clusters of galaxies have few spiral galaxies. What happened to the spirals? What is the source of the strong, diffuse X-ray emission from rich clusters?