

1. The core radius of NGC 1399 is $\sim 5''$ or 400 pc and has a central surface brightness of $14000 L_{\text{sun}}/\text{pc}^2$. Use Equation 3.46 and information from Figure 6.12 in SG to find the mass-to-light ratio in the core. Compared to M/L ratios for globular clusters in the Milky Way, which do not contain much dark matter (see Table 3.1 SG), does the core of this galaxy require significant amounts of dark matter?

2. a.) Derive the expression for enclosed mass as a function of radius for a thin, flat disk whose surface mass density decreases exponentially with radius.

b.) Assume a galaxy has a spherical mass distribution with the same enclosed mass versus radius relation as an exponential disk. At what radius (R_{max}) does the circular velocity achieve its maximum value?

c.) At what radius (R_{half}) does the circular velocity fall to half of its maximum value for the galaxy described in b)?

d.) Suppose that a spherical distribution of dark matter is added to this galaxy in such a way that the luminous matter contributes essentially all the mass inside R_{max} (so that the inner part of the rotation curve looks the same), but that the rotation curve is now flat for radii greater than R_{max} . What is the ratio of dark mass to luminous mass inside R_{half} ?

3. Suppose that most of the mass interior to the solar radius ($R_o=8.5$ kpc) in the Milky Way were in a spherical dark halo. If the rotation curve is flat, with $V=220$ km/s, what is the density of the dark halo in the solar neighborhood? How does this compare with the disk local density of $0.18 \pm 0.03 M_{\text{sun}}/\text{pc}^3$ estimated by analyzing the velocity dispersions and stellar density profile in the direction perpendicular to the galactic plane?

4. One form of the Tully-Fisher relationship is $M_H = 2 - 10 \log V_{\text{max}}$.

a.) Suppose an Sb galaxy has $i=60$ degrees, $m_H=14$ mag and V_{max} (uncorrected for i) = 200 km/s. Assume that m_H has been corrected for all extinction effects. What is the distance to the galaxy?

b.) Some have claimed that the TF relationship has an intrinsic scatter (1 sigma) of only 0.3 mag while others claim the scatter is as high as 0.7 mag. What are the distance uncertainties that correspond to these estimates of the scatter?