ASTRO 381: HOMEWORK 3

Assigned on Wed Apr 25. Due by Th May 10, 5 pm.

GD refers to the class textbook "Galactic Dynamics" by J. Binney & S. Tremaine (1987; Princeton University Press). The number of points for each question is indicated in brackets.

1. GD, problem 3-12 [**15 pts**]

2. On the class website (http://www.as.utexas.edu/∼sj/a381c-sp07/) you will find a text file "vrot.txt" showing the rotation curve (radius R in kpc, rotation velocity V in km/s) of a weakly barred spiral galaxy, which is at a distance of 20 Mpc.

a) Assume for simplicity that V is equal to the circular speed V_c (i.e, do not correct for non-circular streaming motions and interpolation errors). Derive and plot the angular frequency Ω (defined as V_c/R), the epicyclic frequency κ, (Ω - $\kappa/4$), and (Ω - $\kappa/2$) as a function of radius R. [**20 pts**].

b) Structural decomposition of a near-infrared image of this galaxy shows that it hosts a weak bar at a radius of 35 arcseconds. Bars are expected to end between the 4:1 ultraharmonic resonance (UHR) and the corotation resonance (CR) due to the presence of chaotic orbits near the CR. Estimate lower and upper limits on the bar pattern speed Ω_p in km per second per kpc. [**5 pts**].

c) *HST* images of this galaxy shows a nuclear ring of intense star formation. Explain the possible origin of such a ring. Estimate the radii between which you would expect it to lie, assuming that the bar pattern speed is equal to the lower limit you calculated in (b). [**10 + 5 pts**].

3. GD, problem 7-3 [**15 pts**]

4. GD, problem 7-7 [**15 pts**]

5. GD, problem 7-8 [**15 pts**]