Astronomy 128

Assignment 2, Thursday, Feb. 7

1. Read Chapter 5 of Elmegreen.
2. To enhance the content, read the following sections of Binney and Merrifield: all of 4.2 and 4.3 up to and including 4.3.2.
3. Do the following exercises from Chapter 5 of Elmegreen: 1, 2, 3, 5 and 6. 1, 2 and 3 can be done with many different applications. You can choose whichever you like, but if you want a short tutorial in GAIA (very nice graphical analysis program designed for astronomy), let me know. It's available on hven.
4. Show that the deVaucouleurs surface brightness in magnitudes per square arc-second is given by:
$$\mu = \mu_e + 8.328\left[\left(\frac{r}{r_e}\right)^{1/4} - 1\right]$$
What is μ_e in terms of Σ_e.
5. Verify the equation at the top of page 95 in Elmegreen.
6. Derive an equation for the average surface brightness out to radius r of a circular galaxy obyeing the deVaucouleurs $r^{1/4}$ law. What is the average surface brightness out to radius $r = r_e$?
7. Verify equation (4.14) (page 180) of Binney and Merrifield. One way to get around the logarithmic divergence is to impose a cut-off radius, r_c, such that
$$\begin{aligned} j(r) &= j_o\left(1 + (r/r_o)^2\right)^{-3/2},\ r \le r_c \\ j(r) &= 0,\ r > rc \end{aligned}$$
Show that the projected surface brightness is
$$\begin{aligned} I(x) &= \frac{2r_o j_o}{\sqrt{1+x_c^2}}\frac{\sqrt{x_c^2 - x^2}}{(1+x^2)},\ x \le x_c \\ I(x) &= 0,\ x > x_c \end{aligned}$$
where $x = R/r_o$ and $x_c = r_c/r_o$.
8. In Section 5.2, we see how the "boxiness" or "diskiness" of the isophotes are determined by A_4 and B_4. Binney and Merrifield state that the coefficients A_1, A_2, A_3 and all the B_n should be small. In order to see why, write a short program that prints the (r, θ) coordinates of an ellipse with the added harmonic terms (as defined in Binney and Merrifield). Try different values of the coefficients ($n = 1$ to 4), plot the results and argue why A_1, A_2, A_3 and all the B_n should be small.