## Ay 124 - Homework \#3

Posted on Monday, Feb. 23 - Due by 5 pm on Friday, Feb. 27 (directly to the TA)

Problem 1 [75 points, to be awarded as the TA thinks is appropriate]
Assume that surface brightness of galaxies is given by the Sersic formula,

$$
I(r)=I_{0} \exp \left\{-b_{n}\left[\left(r / r_{e}\right)^{1 / n}\right]\right\}
$$

a. Derive the values of $b_{n}$ for $n=1,2,3,4,5$, so that $r_{e}$ represents the radius enclosing $1 / 2$ of the total light.
b. Derive the values of the total light enclosed by these profiles for $n=1,2,3,4,5$, expressed in the units of $I_{0} r_{e}^{2}$. Are there values of $n$ for which this formula diverges?
Assume a circular symmetry, and feel free to do numerical integrations as needed.

Problem 2 [25 points]
Without looking at your notes, handouts, etc.,
a. What is the Fundamental Plane of elliptical galaxies? [5 points]
b. Use the Virial Theorem to derive it (or an analogous relation), as well as the Tully-Fisher relation, and state clearly your assumptions. [10 points]
c. What physical conditions must be satisfied in order to reproduce the observed slopes and the small scatter of these relations? [10 points]

