Homework Set 1
"Galactic Dynamics" course at SJTU

Due Date: XXXXXXX

1. (15 points) [Slightly revised from BT08, Problem 1.4]

   An axisymmetric transparent galaxy has luminosity density that is constant on spheroids $R^2 + z^2/q^2$ having axis ratio q. A distant observer located on the symmetry axis of the galaxy sees an image with circular isophotes (iso-density contours) and central surface brightness I_n. A second distant observer, observing the galaxy from a line of sight that is inclined by an angle i to the symmetry axis, sees an image with elliptical isophotes with axis ratio $Q < 1$ and central surface brightness I_0.

   (a) What is the relation between q, Q, and i? *Hint: the answers are different for oblate ($q < 1$) and prolate ($q > 1$) galaxies.*

   (b) What is the relation between I_0, I_n, and Q? *Hint: 1. the answer depends on if the galaxy is oblate or prolate. 2. Projected surface brightness is the integration of luminosity density along the line of sight.*

   (c) Assuming that galaxies are oriented randomly, what fraction are seen from a line of sight that lies within 10° of the symmetry axis? From within 10° of the equatorial plane? In other words, what fractions of a large sample of randomly oriented axisymmetric galaxies are observed to have an inclination of $i \leq 10^\circ$ (nearly face-on) and $80^\circ \leq i \leq 90^\circ$ (nearly edge-on), respectively?

   (d) *Optional question.* (5 bonus points) In astronomy, we often need to generate a uniform distribution of stars (or points) on the surface of a sphere of radius R. If you are given a random number generator, describe how you can achieve this. This is related to question (c).