Astrophysical Dynamics — HS 09-10
Exercises Class 4 (due Nov 11$^{\text{th}}$)

1

The mass distribution of an elliptical galaxy is well approximated by an isothermal sphere with velocity dispersion $\sigma = 250$ km/s, and its total mass is roughly the mass within 20 kpc.

a) Compute the mean radial velocity, the mean tangential velocity, and the circular velocity at large radii.

b) Compute its central density assuming that its central part can be described by a King profile, using the definition of King core radius as an approximate estimate of the half mass radius.

2

Consider again a singular isothermal sphere with isotropic velocity dispersion. The root mean square speed of its stars is $\sqrt{< v^2 >} = \sqrt{3}\sigma$. Let us now construct another isothermal sphere with the same density profile, but in which all stars are on randomly oriented circular orbit, so that now the r.m.s. speed is the circular velocity. These two systems have identical density distributions but different amounts of kinetic energy per star (show). How is this consistent with the virial theorem?