

## Ph 444 Problem Set 3

Due: Thursday, September 25, 2008

1. Calculate the critical mass density and its uncertainty using the current best estimate of the Hubble constant,  $H_0 = 71.9 \pm 2.7 \text{ km s}^{-1} \text{ Mpc}^{-1}$ .
2. The Millennium Galaxy Catalog yields a local luminosity density in galaxies of

$$j = ((1.986 \pm 0.031) \times 10^8 L_{\odot} \text{ Mpc}^{-3}) \left( \frac{H_0}{100 \text{ km s}^{-1} \text{ Mpc}^{-1}} \right).$$

The dependence on  $H_0$  comes from the use of the Hubble law to calculate distances to galaxies. Calculate the average mass-to-light ratio ( $M/L$ ) in solar units for galaxies that would be required if galaxies produced the critical mass calculated in problem 1. Also find the uncertainty in this  $M/L$ . Compare your value with the value of  $M/L \simeq 2$  expected for a “normal” stellar population.

3. Ryden problem 4.4

4. Ryden problem 4.5 Hint: to calculate the pressure you can either start with Ryden equation (4.32) or use the expression for the pressure of a gas of non-interacting particles with number density  $n$ , momentum  $p$ , and speed  $v$ :  $P = npv/3$ .