

**PHYS 480/581**  
**Cosmology**

Worksheet #2  
Wednesday 08/24/2022

**Question 1.**

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If the typical mass of a galaxy is about  $10^{12} M_{\odot}$ , what is the average density of the Universe today, in  $M_{\odot}/\text{Mpc}^3$ . How does that compare with the current density of the Universe,  $\rho_c \simeq 1.4 \times 10^{11} M_{\odot}/\text{Mpc}^3$ ?



**Question 2.**

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We would like to come up with a metric that would allow us to measure distances in our Universe. To be valid such metric must respect the cosmological principle, which implies an homogeneous and isotropic Universe. This puts strong constraints on the structure of the possible metric. Using spatial cartesian coordinates, the most general metric I can write down is

$$ds^2 = -f(t, x, y, z)dt^2 + g(t, x, y, z)dx^2 + h(t, x, y, z)dy^2 + l(t, x, y, z)dz^2. \quad (1)$$

- (a) What conditions does isotropy put on the functions  $f(t, x, y, z)$ ,  $g(t, x, y, z)$ ,  $h(t, x, y, z)$ , and  $l(t, x, y, z)$  ?
- (b) What conditions does homogeneity put on the functions  $f(t, x, y, z)$ ,  $g(t, x, y, z)$ ,  $h(t, x, y, z)$ , and  $l(t, x, y, z)$  ?