

## Homework # 2, due 17 Feb

1. Suppose the initial mass function is the Salpeter mass function with a low-mass cutoff of  $0.1 M_{\odot}$  and a high-mass cutoff of  $100M_{\odot}$ . Determine the normalization from the local disk column mass density (i.e., the number density integrated vertically through the Galactic plane in units  $\text{pc}^{-2}$ ). What is the average stellar mass? Where does the mass function reach a maximum? If  $L \propto M^{3.5}$  for all masses, what mass star has the average luminosity? From these results, what is the column density of stars in the solar neighborhood and what is the mean distance between stars?
2. Do problem 2.7 in the text.
3. Suppose the number density of stars normal to the Galactic plane varies as  $n(z) = n_0 \exp(-z/z_h)$ . Suppose you do a survey of stars in the direction of the North Galactic Pole complete to a magnitude  $m_v = 30$ . What value would you obtain for  $\mathcal{V}/\mathcal{V}_{max}$ ?
4. Do parts (a), (b) and (c) of problem 2.11. Without doing part (d), do you think the observable stars able in regions B and C would be more or less metal rich than what is actually in your model sky?
5. Consider hydrogen gas in the galactic plane. Assume the Sun is at a distance of  $R_0 = 8$  kpc from the Galactic center with the average Galactic rotational velocity at that distance of  $V_0 = 200$  km/s. Also assume that  $V(R)$  is constant. Suppose there are 2 uniform rings of gas in the Galactic plane, one at 4 kpc radius and the other at 12 kpc radius, with negligible height and width compared to their radii. Derive an expression for the radial velocity of these rings as a function of Galactic longitude  $\ell$ . Also derive an expression for the observed intensity of each ring as a function of  $\ell$ .