Astronomy 405: Homework #12 (Galaxies & Stars)

You may find it helpful to consult a galactic astronomy text, such as Binney & Merrifield's *Galactic Astronomy*, to determine certain stellar values for this problem set.

1. Carroll & Ostlie, Problem 7.6:

From the light and velocity curves of an eclipsing, spectroscopic binary star system, it is determined that the orbital period is 6.31 years, and the maximum radial velocities of stars A and B are 5.4 km s⁻¹ and 22.4 km s⁻¹ respectively. Furthermore, the time period between first contact and minimum light $(t_b - t_a)$ is 0.58 d, the length of the primary minimum $(t_c - t_b)$ is 0.64 d, and the apparent bolometric magnitudes of maxim, primary minimum, and secondary minimum are 5.40 magnitudes, 9.20 magnitudes, and 5.44 magnitudes respectively. From this information, and assuming circular orbits, find the

- (a) Ratio of the stellar masses. (3 pts)
- (b) Sum of the masses (assume $i \simeq 90^{\circ}$). (3 pts)
- (c) Individual masses. (3 pts)
- (d) Individual radii. (5 pts)
- (e) Ratio of the effective temperatures of the two stars. (5 pts)
- 2. Use the Hertzsprung-Russell diagram and the stellar spectra within the lecture notes to answer the following questions.
 - (a) If a K-type star has a luminosity of $10^4 L_{\odot}$, what is its luminosity class? (3 pts)
 - (b) If a Main Sequence star is three times as hot as the Sun, estimate (roughly) its luminosity, spectral type, B-V colour, and radius. (5 pts)
 - (c) What key parameter determines the position of a white dwarf along the temperature sequence? (*Hint: consider the narrow range of progenitor star characteristics.*) (2 pts)
- 3. The center of the Milky Way is at (1950 epoch) $\alpha = 17^{h} 42^{m} 29.3^{s} \pm 0.15^{s}$, $\delta = -28^{d} 59' 18'' \pm 3''$. What are its Galactic coordinates? (3 pts)
- 4. Carroll & Ostlie, Problem 24.8: Prove that for $z \gg z_o$

$$L(R,z) \simeq 4L_o e^{-\frac{R}{h_R}} e^{\frac{-2z}{z_o}}$$

and so $z_o = 2z_{thin}$ is the effective scale height of the luminosity density function. (3 pts)

5. Carroll & Ostlie, Problem 27.9: Assuming that the Sculptor group of galaxies (see Carroll & Ostlie, pg. 1061) occupies a spherical volume of space, find the difference in magnitude between two identical objects located at the very front and back of the group. (6 pts)