ASTROPHYSICS

Homework Set 5
March 12, 2010

1. From observing sunspots, it is determined that the period of rotation near the solar equator is 25 days. Use this information to determine the Doppler shift, Δλ/λ, of the spectra lines coming from the east and west limbs of the Sun. That is, determine the fractional shift in wavelength of light from the limbs of the Sun relative to light from the center of the solar disk.

2. A particular star has an apparent visual magnitude of 1.0 and a parallax of 0.0083".
   (a) Determine the distance to the star in parsecs.
   (b) Determine the distance modulus.
   (c) Determine the star’s absolute visual magnitude.
   (d) Suppose that the star has a bolometric correction of BC = −1.4. Determine the star’s absolute bolometric magnitude.
   (e) Determine the star’s luminosity in solar units.
   (f) From the star’s measured spectrum, it is determined that its effective surface temperature is 3150 K. Determine the star’s radius in solar units.

3. A certain globular star cluster has a total of 10^4 stars; 100 of them have \( M = 0.0 \), and the rest have \( M = +5.0 \). Determine the integrated visual magnitude of the cluster.

4. The apparent magnitude of a planet can be written as
   \[ m = -2.5 \log \ell_p + K, \]
   where \( K \) is a constant and \( \ell_p \) is the flux from the planet: \( \ell_p \propto \Phi/d^2 \). Here \( d \) is the distance of the planet from Earth and \( \Phi \) is a phase factor that depends on the amount of projected daylight area visible from Earth. At superior conjunction, when Venus is at its greatest distance from Earth, Venus is in the “Full Moon” phase with \( \Phi = 1.0 \). The average observed
apparent magnitude of Venus at superior conjunction is $-3.5$. Estimate the apparent magnitude of Venus at its greatest angular elongation from the Sun, when it is in the “Half Moon” phase with $\Phi = 0.5$. 