DEPARTMENT OF PHYSICS AND ASTRONOMY

PHY305 Stellar Atmospheres

Problem Sheet No.1

Deadline: Monday 16th November 2015 - F10 (4pm)

1. α Pav (HD 193924, B2 IV) has a parallax of 17.8 milli-arcseconds, as measured from the Hipparcos satellite, and an angular diameter of 0.80 milli-arcseconds from interferometric observations.

   (a) If the integrated flux received at Earth from α Pav is $f_\oplus = 2.0656 \times 10^{-5}$ erg/cm^2/s, what is it's radius (in $R_\odot$), effective temperature (in K) and luminosity (in $L_\odot$)? [15]

   (b) The observed Johnson visual magnitude of α Pav is V=1.91 mag. What is its absolute visual magnitude, and hence calculate the bolometric correction (in magnitudes) for this star, using your result from (a). You may neglect interstellar reddening. [5]

2. During the late stages of evolution of the Sun, it will first expand to become a red giant ($\log g = 0.0$) and subsequently contract to a white dwarf ($\log g = 8$). Neglecting mass-loss, what will its radius be during these phases, in units of the current Solar radius $R_\odot$? Will the Earth be engulfed during the red giant phase? [10]

3. For a star, whose pure hydrogen photosphere has T=7,000K and P_e=50 dyn/cm^2, use the Saha and/or Boltzmann equations to:

   (a) Determine the ratio of the number of hydrogen atoms in the ground state to those in the initial states for the Balmer and Paschen continuum. [10]

   (b) Determine whether atomic hydrogen or the negative hydrogen ion provides the major continuum opacity source at $\lambda = 3500$Å? Would your answer be the same at $\lambda = 4000$Å? (Assume identical bound-free cross-sections for atomic hydrogen and H$^-$). [20]

   (c) Determine the fraction of ionized hydrogen. What is the gas pressure? [10]

4. An O star with T=35,000 K has an electron pressure of 1000 dyn/cm^2 and a pure *helium* atmosphere. Use the Saha equation to determine the dominant ionization stage of helium. Use charge neutrality to derive the gas pressure and so evaluate the ratio of electron to gas pressure. [30]