Astronomy 405: Homework #10 (Spectra)

1. **Carroll & Ostlie, Problem 9.25**:
   Derive Eq. (9.60) for the uncertainty in the wavelength of a spectral line due to Heisenberg's uncertainty principle. (5 pts)

$$\Delta\lambda \approx \frac{\lambda^2}{2\pi c}\left(\frac{1}{\Delta t_i} + \frac{1}{\Delta t_f}\right)$$

   where Δt_i is the lifetime of the electron in its initial state and Δt_f is the lifetime in its final state.

2. The absolute B magnitude of a K5 giant is 0.95.
   (a) What are the distinguishing features of the optical spectrum for this type of star? (5 pts)
   (b) Calculate the apparent magnitude for this star, at a distance of 20 A.U. from the Earth. Could it be seen with the naked eye? (3 pts)
   (c) Calculate the B-band flux density received by the Earth from this star, given that the zero-point B-band flux density is 4×10^{-20} ergs s^{-1} cm^{-2} Hz^{-1}. (5 pts)
   (d) How much total B-band flux would the Earth receive from this star, ignoring atmospheric effects, in ergs s^{-1}? (You may assume B-band extends from 3900Å to 4900Å.) (3 pts)

3. (a) You take a spectrum of the galaxy IC4198, which lies within 2 h^{-1} Mpc on the sky of the center of the Coma cluster, and find that the radial velocity is 8990 km s^{-1}. If the central velocity of the cluster is 6930 km s^{-1}, and the velocity dispersion of the cluster is 997 km s^{-1}, what is the probability that this galaxy is an actual member of the cluster? Express your answer both as a percentage and in units of σ, assuming a Gaussian distribution of velocities (i.e., $1\sigma = 997$ km s^{-1}). (5 pts)
   (b) What type of galaxy is IC4198? *This will require some online searching, at* http://ned.ipac.caltech.edu *or a similar site.* (3 pts)