ASTR 8060
Homework 2

Learning goals: practice applying the angular size-distance and redshift computations; become familiar with standard astronomical bandpasses; practice converting astronomical fluxes to various systems of measurement in common use; summarize the operation of a CCD.

1. You are observing the Hβ emission line in a binary supermassive black hole candidate with a radial velocity of 5,000 km s^{-1}. For what cosmological redshifts will this line fall in the J,H,K windows?

2. If a galaxy is 1 Mpc away and has a diameter of 30 kpc, how large is it in the sky?

3. You are observing on a 8 m diameter optical telescope with an f/3 prime focus or an f/12 Nasmyth focus. The typical seeing is 0.5 arcsec FWHM at this site. What physical size in microns should your CCD pixels have in order to Nyquist sample a star image at Prime focus? At Nasmyth? What is your resulting field of view in each case if the ccd has 2048^2 pix.

4. A star has a B magnitude of B= 9.5. Convert this to erg s^{-1} cm^{-2} Angstrom^{-1}, photons s^{-1} cm^{-2} Angstrom^{-1} and Jy. Write out each step of the conversion in detail, showing units, rather than simply adopting the handy conversions I have in the class notes.

5. A star has an AB magnitude of 20 at 5500 Å. Convert this into standard Johnson V magnitude and into photons s^{-1} cm^{-2} Angstrom^{-1}.

6. An astronomical source A has surface brightness of 1 MJy per steradian at 5500 Angstroms. Convert this into erg s^{-1} cm^{-2} Hz^{-1} arcsec^{-2}, into erg s^{-1} cm^{-2} Angstrom^{-1} arcsec^{-2} into mag arcsec^{-2}, and into photons s^{-1} cm^{-2} Angstrom^{-1} arcsec^{-2}.

7. Write a 1 page description (use a figure or two if it helps, but these are included in the page limit) of how a CCD works as if you were educating a classmate. Be sure to include the fundamental physics of the detection process, and the process by which the CCD is read out.