Astro 620 Homework 1 Due Thursday Sept 17 2015

1) Explain why the intensity or surface brightness of a galaxy (usually measured in magnitudes per square arcsec or watts per square centimeter or equivalent surface brightness unit is nearly independent of its distance (ignore cosmological effects).

2) What is meant by the fundamental plane of elliptical galaxies? What parameters are involved and how are they correlated. With reference to problem 1 state why the observers used surface brightness as one of the parameters.

3) The luminosity function of galaxies is described by the Schecter function (S&G eqs 1.24,1.25 or B&T 1.19,1.19)
a)What is L* -in numbers and in meaning?
b) $f(L)= (L/L^*)^{-a} \exp-(L/L^*)$; if a=1.25 show that half the light comes from galaxies with L>0.45L* (incomplete gamma function integral…) see MWB
c) What fraction of galaxies are brighter than L*, 0.1 L*; what fraction of the light comes from galaxies between 0.5-1.5 L*.

4) What is the Tully-Fisher relation and what does it imply physically? (see pg 54-55 and pg 271 and sec 11.3 in MBW) How does one use it to measure distance. Estimate the distance to a galaxy with velocity width 200km/sec and an apparent magnitude of 14.

5) Since we are into integrals today describe the free parameters in Sersic formula for the surface brightness of galaxies (B&T 1.17, MBW eq 2.22)- what do they mean and what are the 'common' values?
a) what has one to assume to fit this one dimensional formula?
b) derive eq 2.23 (the Sersic law in magnitudes) for n=1
c) Integrate the Sersic profile and determine the half light radius (that radius within which half the light is contained) for n=4. Explain how this is used in the fundamental plane.

6) Utilizing resources on the Web
Access NASA's Extragalactic Database (NED) and answer the following questions:
(a) What is the De Vaucouleurs' morphological type and mean optically determined (heliocentric) systemic velocity of the Circinus Galaxy in km sec^{-1}. What does the T type mean? What is its corresponding distance? Make sure to explain which distance you're using. This is one of the nearest AGN known.

(b) Print out the spectral energy distributions [i.e. log f_ν(in Jansky) as a function of log ν with error bars for Arp 220 and 3C 273. Comment on the differences- what do you think is the origin of the differences?
(c) Look at the SDSS spectrum NGC 4395, a well-studied low-luminosity AGN- what dominates the spectrum?
How many papers have been written on it?
(d) Use on the cosmology calculators to determine the age of the universe at redshift z = 7.7 and the corresponding scale in kpc per arcsecond. Make sure to write down the cosmological parameters that were used for these calculations.